

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Mercedes-Benz USA, LLC,
Petitioner,

v.

Yechezkal Evan Spero,
Patent Owner.

Case [To be assigned]
Patent 10,894,503

**PETITION FOR *INTER PARTES* REVIEW OF
CLAIMS 1-36 OF U.S. PATENT NO. 10,894,503
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. §42.100 *et seq.***

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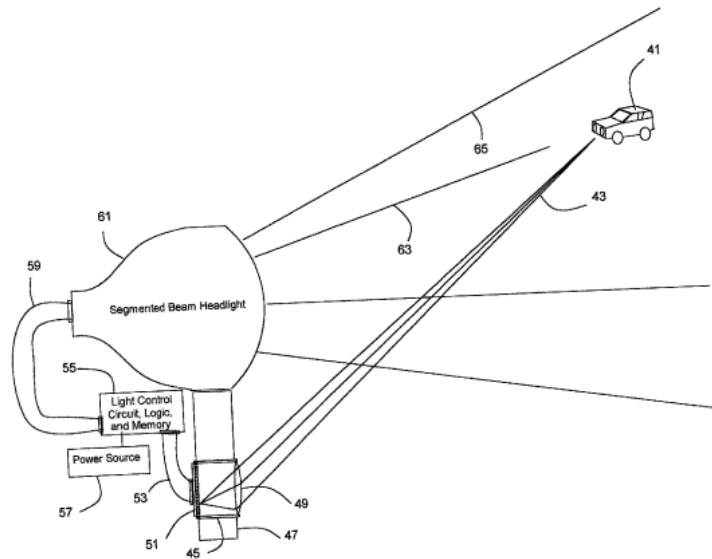
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I. INTRODUCTION

Petitioner Mercedes-Benz USA, LLC challenges Claims 1-36 of US10,894,503 (“**’503**”) (EX1001). The ’503 claims a vehicle headlight system that includes (1) a plurality of light clusters or light sources in a headlight (*e.g.*, LEDs), (2) sensors to collect data, and (3) a processor and control circuitry to control the light clusters or sources based on sensor data. The ’503 recites that its sensors can obtain information about the field-of-view in front of the vehicle—for example, detect other vehicles—and that its processor and control circuitry can then use this to reduce the illumination in portions of the field-of-view (*e.g.*, those LEDs pointing at the oncoming vehicle) while keeping LEDs in other areas (*e.g.*, in portions with no other vehicles) at full illumination.

But this was not new at the time of the ’503. Automated headlight systems, enabling selective illumination of lighting elements in response to sensor data, were well known before this. For example, the primary reference herein, US2003/0137849 (“**Alden**”) (EX1005), discloses a near-identical headlight system in which a controller can control individual lighting elements (*e.g.*, LEDs) based on sensor data:



This enables the Alden system to, for example, reduce light in certain areas where there is a detected vehicle (63) while switching other areas where there is no vehicle (65) to full illumination. Alden was not considered during prosecution of the '503, and alone and in combination with certain other prior art, renders Claims 1-36 of the '503 invalid.

II. MANDATORY NOTICES

A. Real Parties-in-Interest

The real parties-in-interest are Petitioner Mercedes-Benz USA, LLC; Mercedes-Benz Group AG; Mercedes-Benz AG; and Mercedes-Benz Intellectual Property GmbH & Co. KG.

B. Related Matters

An entity separate from the Patent Owner reflected in USPTO records, Torchlight Technologies, LLC (“**Torchlight**”), asserted the '503 in two lawsuits in

the District of Delaware on June 7, 2022:

- Case No. 1:21-CV-751 against Petitioner Mercedes-Benz USA, LLC, Daimler AG,¹ Volkswagen Group of America, Inc., Audi AG, Audi of America, LLC, Porsche AG, and Porsche North America, Inc.
- Case No. 1:22-CV-752 against General Motors LLC, General Motors Co., and General Motors Holdings, LLC.

These cases are in their infancy. Many defendants were only just served; responses to the operative complaint have not been filed; and no discovery has been exchanged. Further, the cases have been indefinitely stayed pending resolution of whether the complaint should be dismissed due to lack of standing and failure to join necessary parties.

The '503 is also the subject of IPR2023-00197 (challenging Claims 20-25, 59-64), IPR2023-00328 (challenging Claims 26-36, 65-70), and IPR2023-00335 (challenging Claims 1-19, 37-58), filed by Volkswagen Group of America, Inc. (“**Volkswagen**”). These IPRs are pending, and are awaiting decisions on institution.

Petitioner is also filing contemporaneously herewith a petition for *inter partes* review of Claims 37-70 of the '503.

C. Counsel and Service Information

¹ Daimler AG became Mercedes-Benz Group AG on February 1, 2022.

Lead counsel is Celine Crowson (Reg. No. 40,357). Backup counsel are Joe Raffetto (Reg. No. 66,218), Scott Hughes (Reg. No. 68,385), and Ryan Stephenson (Reg. No. 76,608). Service information is as follows:

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III. NOTICE OF FEES PAID

Fees are submitted herewith. If additional fees are due during the proceeding, the undersigned authorizes the Office to charge them to Deposit Account No. 50-1349.

IV. CERTIFICATION OF GROUNDS FOR STANDING

Petitioner certifies that the '503 is available for *inter partes* review, and that it is not barred or estopped from requesting this review.

V. PRECISE RELIEF REQUESTED

The relief requested is cancellation of the challenged claims, as follows:

Ground	References	Claims ²	Basis
1	Alden	1 -4, 7, 10-17, 19, 20 , 21-23, 25, 26 , 27, 30-36	102 / 103
2	Alden/Harbers	5, 28-29	103
3	Alden/Bergkvist	6	103
4	Alden/Beam	8, 18, 24	103
5	Alden/Kobayashi	9	103

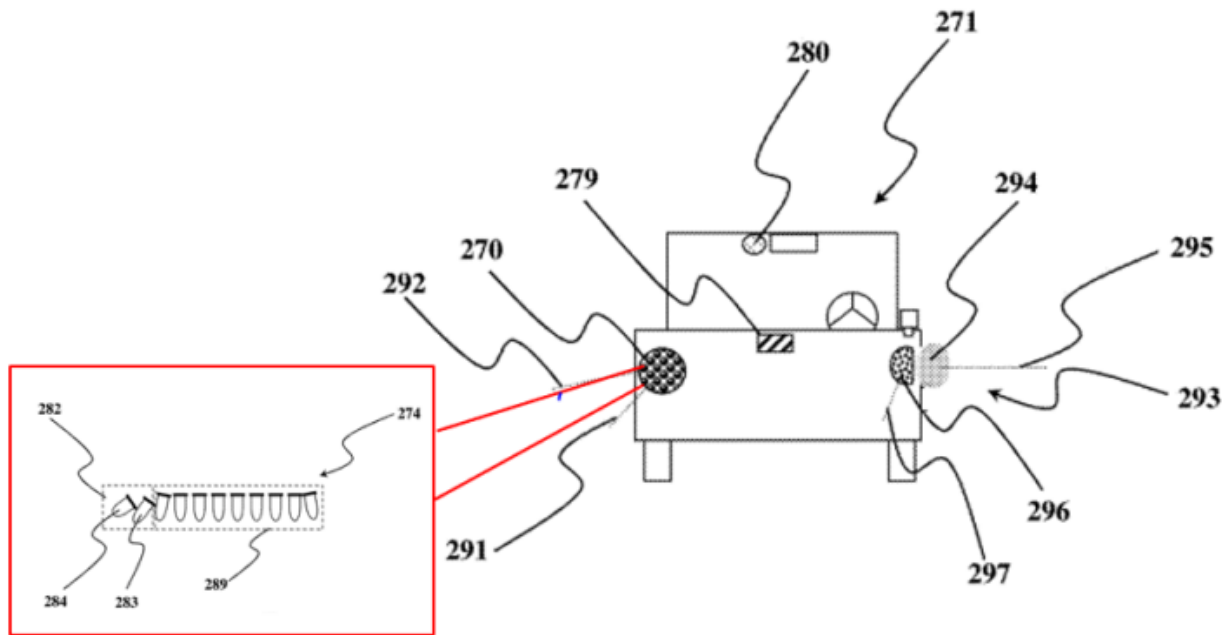
VI. OVERVIEW OF THE '503

A. Subject Matter of the '503

The '503 argues that in the “prior art,” lighting fixtures were often single, large lights that were “generic” and “universal.” ('503, 5:39-49, 11:4-8, 11:50-51.) These lights were allegedly not tailored to individual applications, produced light in more places than needed, and required reflectors and refractors to re-direct light. (*Id.*) The '503 claims it came up with a new approach: a “Digital Lighting Fixture” that can “provide the ‘correct’ lighting solution for the situation at hand.” (*Id.*, 11:11-16.) The '503 purports to accomplish this through “controllability offered by breaking the total light output up into discrete (‘digital’) specifically aimable and dimmable elements which can be addressed by control electronics.” (*Id.*, 11:60-67.)

² Independent claims in bold.

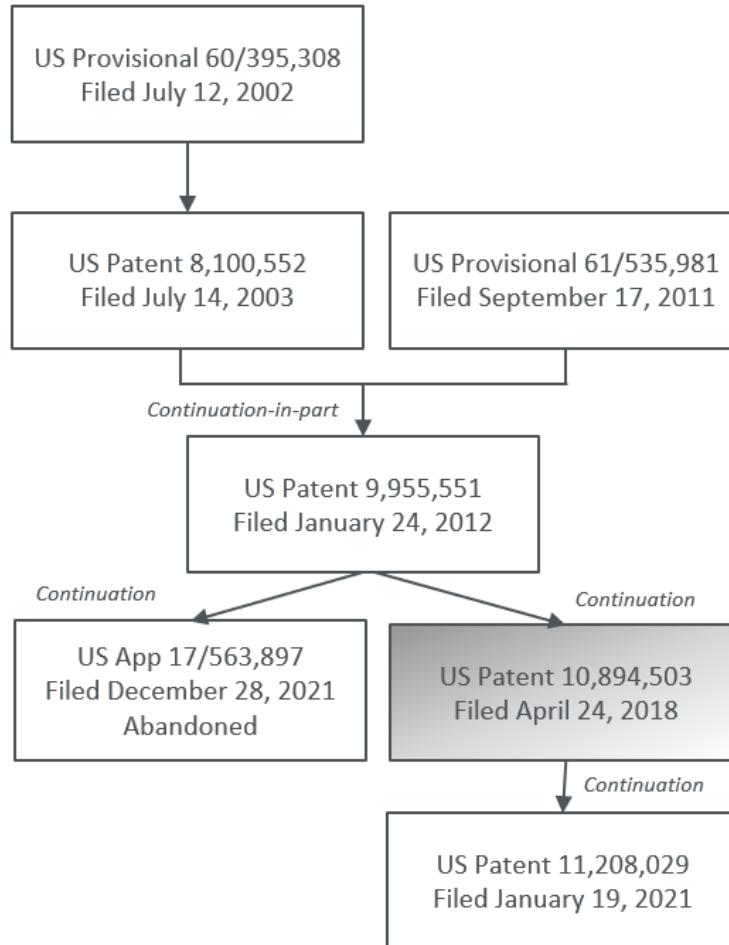
While the '503 gives various example applications, its claims are directed to the alleged invention as used in a vehicle “headlight system.” (*Id.*, Claims 1, 20, 26; *see also* Abstract.) The claims recite how light clusters or sources (*e.g.*, LEDs) can be included in a vehicle headlamp:



(*Id.*, Fig. 15 (annotated).) “Sensors” obtain relevant situational data, including detecting things like headlights of oncoming vehicles. (*See, e.g., id.*, Claim 1, 50:40-52:57; 53:17-55:47.) A “processor” can then determine, based on this, how to adjust the output from the individual lights (or LEDs), so that, for example, areas where other vehicles are present have lower illumination than areas that do not. (*See, e.g., id.*)

B. Prosecution History of the '503

The '503 was filed on April 24, 2018, and issued on January 19, 2021. It is part of the following family:



The Examiner issued one prior art rejection during prosecution, rejecting certain claims based on US2013/0258688 (“**Kalapodas**”). (EX1002, '503 File History, Non-Final Rejection mailed Nov. 9, 2018.) Patent Owner argued that Kalapodas was not prior art, since the alleged priority dates of the '503 are before

September 17, 2011,³ and in response the Examiner withdrew the prior art rejection. (*Id.*, Final Rejection mailed Feb. 12, 2020.) Additional office action was issued, but no further prior art rejections were made. (*Id.*, Final Rejection mailed Oct. 30, 2020.) Ultimately, a Notice of Allowance issued in November 2020. (*Id.*, Notice of Allowance and Fees Due mailed Nov. 18, 2020.)

VII. CLAIM CONSTRUCTION AND POSITA DEFINITION

A. Claim Construction

Claims in an *inter partes* review “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). Unless indicated otherwise, all claim terms herein are given such ordinary and customary meaning.

B. Definition of a Person of Ordinary Skill in the Art

A person of ordinary skill in the art (“**POSITA**”) in the field of the ’503 would have had an undergraduate degree in mechanical engineering, electrical

³ Petitioner does not concede that the ’503’s claims are entitled to a priority date of September 11, 2017, or earlier, but does not address the same because all references herein are prior art under the earliest possible priority date of July 12, 2002.

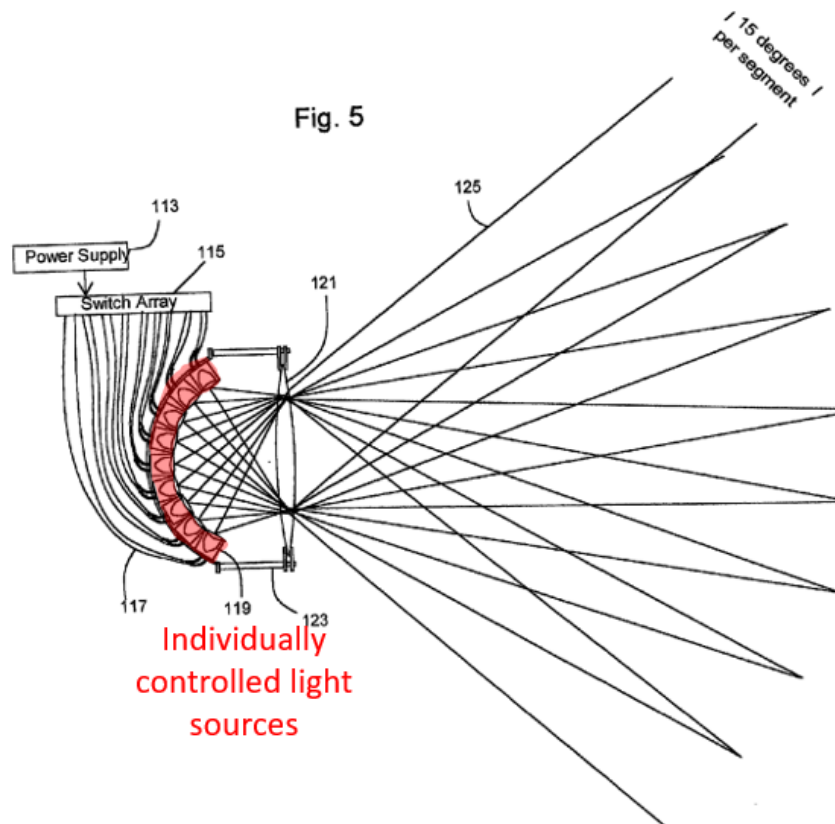
engineering, automotive engineering, optical engineering, applied physics, computer science, or similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting control systems. (Papanikolopoulos Decl., ¶33.)⁴ The more education one has, the less experience needed to attain an ordinary level of skill. (*Id.*) Similarly, more experience in the field may serve as a substitute for formal education. (*Id.*)

VIII. ANALYSIS OF GROUNDS FOR UNPATENTABILITY

Alden is US2003/0137849. Alden was filed on January 22, 2002, and published July 24, 2003. Alden is prior art under at least pre-AIA § 102(e) because it was filed before the filing date, and any potential priority date, of the '503.

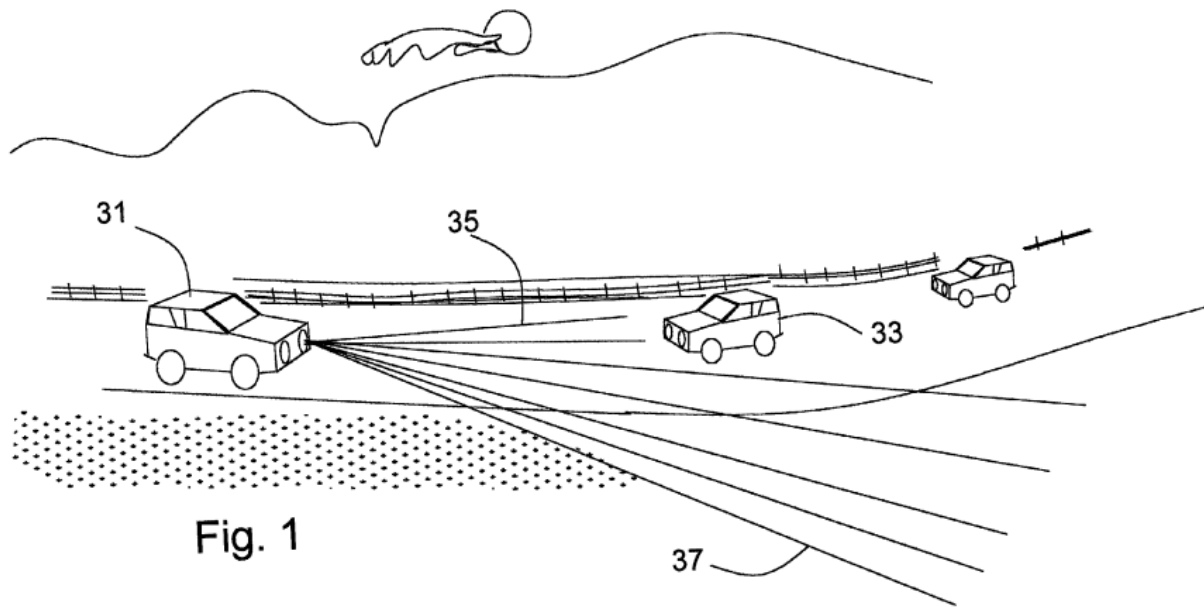
In Alden, individual lighting elements (119) such as LEDs are positioned in a curved manner inside of a headlight:

⁴ Dr. Nikolaos Papanikolopoulos is an expert in intelligent transportation systems, among other things. His Declaration is included as EX1003.



(Alden, Fig. 5, [0029].) Alongside this, the Alden system includes (a) a “sensor unit” to detect objects along the road and (b) a “light control circuit” with a “CPU” to adjust the individual LEDs based on sensor data. (*Id.*, Figs. 2-3, [0026]-[0027].)

Alden teaches that, with its individually-controllable LEDs, a vehicle can “emit[] a low beam illumination 35 in a first headlight distribution sector while concurrently emitting a high beam, illumination 37 in a second headlight distribution sector,” with “[t]he low beam illumination being emitted in response to the detection of an oncoming vehicle 33” to reduce “glare”:



(*Id.*, Fig. 1, [0004], [0025].) Alden’s system can also be used to “concentrate light” to “look around corners,” “look up a hill,” and “look down a hill,” all “in response to road conditions.” (*Id.*, Figs. 11-13, [0036]-[0038].)

A. Ground 1 – Alden Anticipates and Renders Obvious Claims 1-4, 7, 10-17, 19-23, 25-27, and 30-36

1. Independent Claim 1

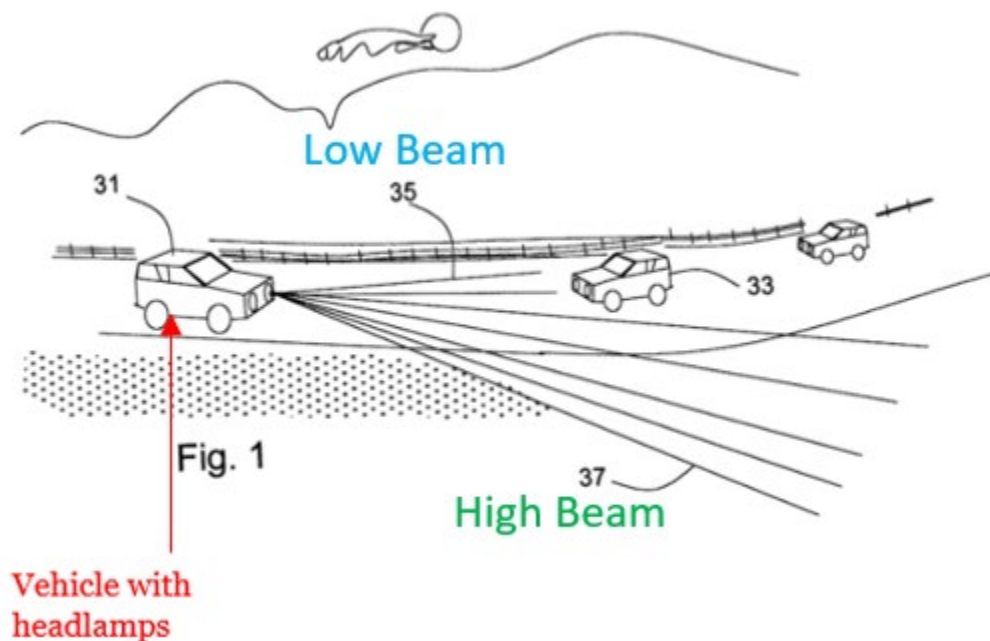
Alden anticipates and renders obvious Claim 1. (Papanikolopoulos Decl., ¶¶50-70.)

1[Pre]: A vehicle headlight system comprising:

Alden discloses Claim 1[Pre] to the extent limiting. (*Id.*, ¶51.) Alden’s system is “for automatically *controlling the distribution of a headlight* in response to environmental conditions.” (*Id.*, [0006]; *see also* Abstract.)⁵ In Alden, a “first

⁵ All emphasis added unless otherwise noted.

vehicle 31” includes an “automatic segmented illumination” headlight system, allowing the vehicle to emit different light illuminations in different areas in its field-of-view, such as emitting “a low beam illumination 35 in a first headlight distribution sector while concurrently emitting a high beam, illumination 37 in a second headlight distribution sector”:

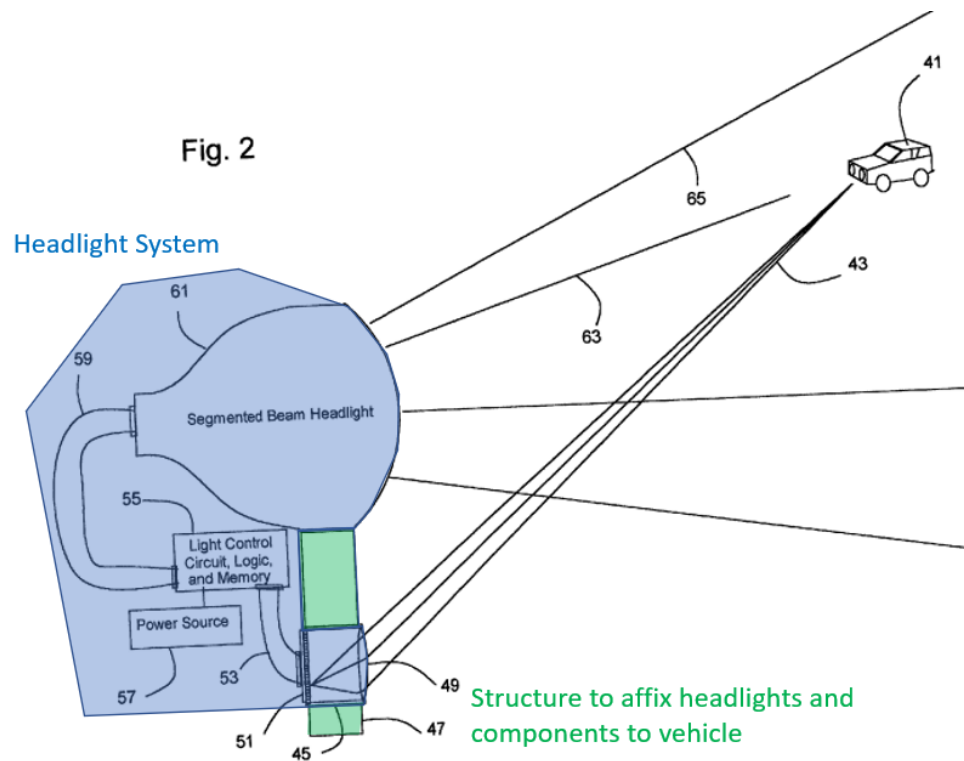


(*Id.*, [0025], Fig. 1 (annotated); *see also* [0026], [0029].)

1[A]: one or more headlamps and a vehicle structure, arranged for affixing components of the system to the vehicle;

Alden discloses Claim 1[A]. (Papanikolopoulos Decl., ¶¶52-53.) Alden’s system is for “one or more headlamps,” *i.e.*, headlights, on a vehicle. (Alden, Figs. 1-2, Fig. 11, [0025].) It includes numerous components to affix to the vehicle,

including “segmented beam headlight” (61), “sensor unit” (45), and “light control circuit, logic, and memory” (55):

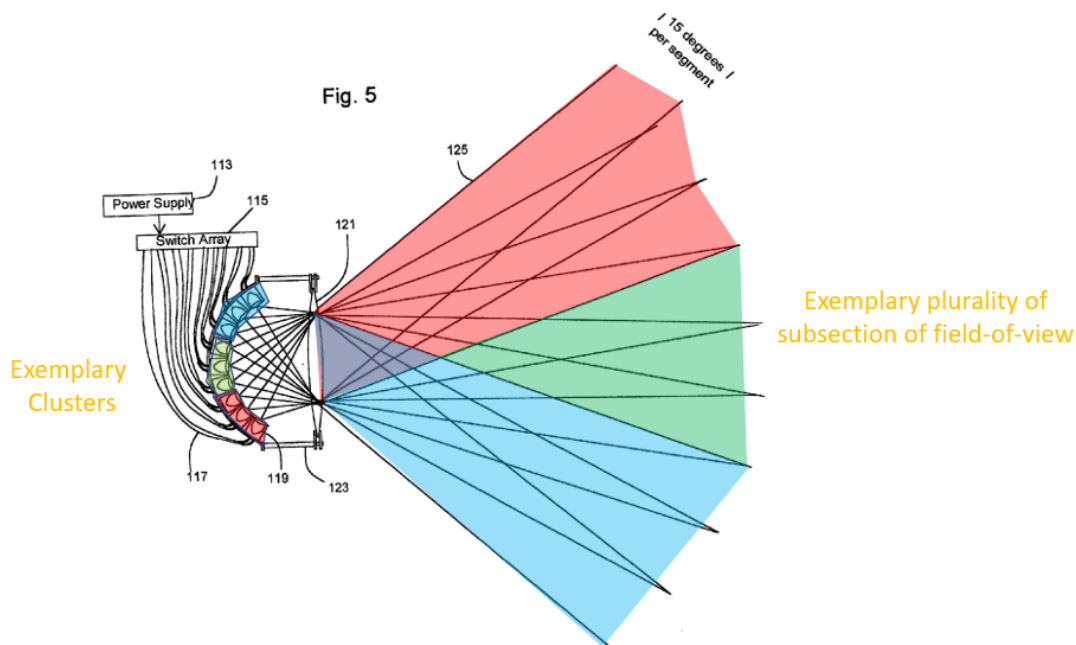


(*Id.*, [0026], Fig. 2 (annotated).) Alden explains these are “mounted on an equipped automobile 47 (47 being a part of the automobile—the [full] automobile is not shown).” (*Id.*, [0026].)

1[B]: *a plurality of light clusters, arranged in each of the one or more of the one or more headlamps, the headlamps capable of projecting light so as to illuminate a plurality of sub-sections of a field-of-view with different illumination characteristics, . . . wherein the light clusters operate to create a headlight beam;*

Alden discloses Claim 1[B]. (Papanikolopoulos Decl., ¶¶54-56.) First, “light clusters” can comprise “one or more light emitting sources,” such as one or more LED(s). (*See, e.g.*, ’503, Claim 2; Papanikolopoulos Decl., ¶54.) Alden’s system

includes a “plurality of light clusters” to create a headlight beam, as it includes a plurality of lighting elements (*e.g.*, LEDs) arranged in the headlamps to project light. (Alden, [0027], Fig. 5.) Further, these lighting elements are “on a curve along the focal point of a headlight lens 121,” with different groups projecting light into different areas in front of the vehicle, *e.g.*, left, center, right:

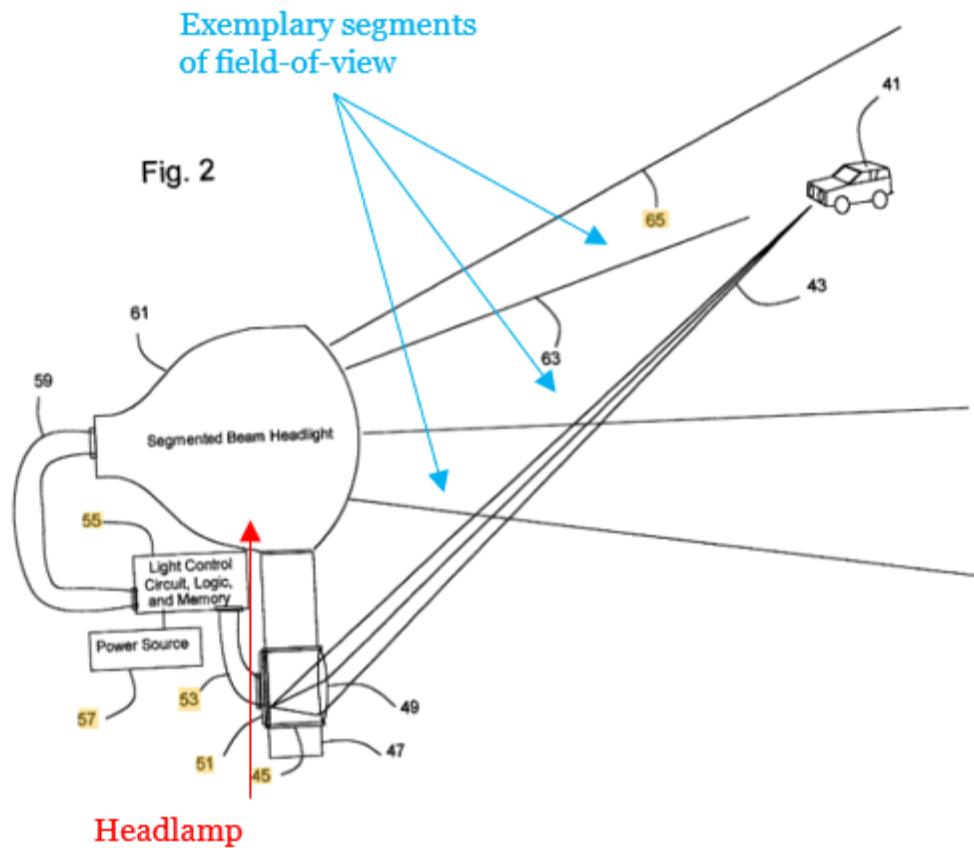


(*Id.*, Fig. 5 (annotated.)) These lighting elements can also be individually controlled, and thereby arranged in additional groupings, to project different illuminations in different areas in front of the vehicle, such as dimmed, low beam light in the area of an oncoming vehicle and high beam light in other areas. (*Id.*, [0026]-[0029].)

Second, Alden’s headlamps project light into different areas in front of the vehicle (“a plurality of sub-sections of a field-of-view”) with “different

illumination characteristics.” (Papanikolopoulos Decl., ¶55.) Again, lighting elements are individually-controllable on a curve along the headlight lens, “such that the light from each lighting element goes into *a specified portion (or portions) of a headlight distribution area.*” (Alden, [0025], [0029], Fig. 5.) As shown in Figure 5 above, this results in a first group of LEDs in blue illuminating the area to the left of the vehicle, a second group of LEDs in green illuminating a second area in the front of the vehicle, and a third group of LEDs in red illuminating a third area to the right of the vehicle. (Papanikolopoulos Decl., ¶55.)

Further, if an oncoming vehicle is detected, thereby requiring different illumination characteristics (*e.g.*, lower light) in that particular area (“sub-section”), Alden will produce “a high beam in a *first sector 65* [where there is no other vehicle] while concurrently producing a low beam in a *second respective sector 63* (or dim beam) where the 41 [other vehicle] is sensed”:



(Alden, Fig. 2 (annotated), [0026]; *see also* [0027]-[0028] (noting that “[s]ignals are sent to each of the headlight control circuit zones that need to be dimmed to restrict the amount of current to the corresponding headlight zones such that they are dimmed in a dimming process 109” and that “zones which are not dimmed remain on high beam”), Figs. 11-13, [0036]-[0038] (describing changing the projection of light in areas in front of vehicle based on road conditions such as corners and hills).)

1[C]: the subsections determined in response to sensor data,

Alden discloses Claim 1[C]. (Papanikolopoulos Decl., ¶¶57-58.) The illumination requirements for Alden’s “headlight distribution sectors” (e.g., “subsections” of the field-of-view) are determined in response to sensor data. (Alden, [0025]-[0027].) Alden’s headlight system “emits a low beam illumination 35 in a first headlight distribution sector while concurrently emitting a high beam illumination 37 in a second headlight distribution sector. The low beam illumination in 35 being emitted *in response to* the detection of an oncoming vehicle...” (*Id.*, [0025]; *see also* [0026]-[0029].)

Alden’s system includes a “left sensor 51a and a right sensor 51b” that detect light from headlights of another vehicle at multiple positions 43a-d:

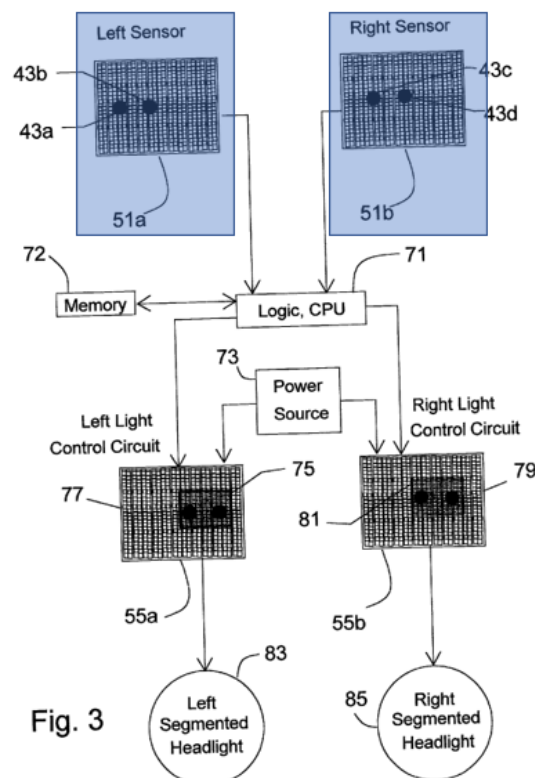
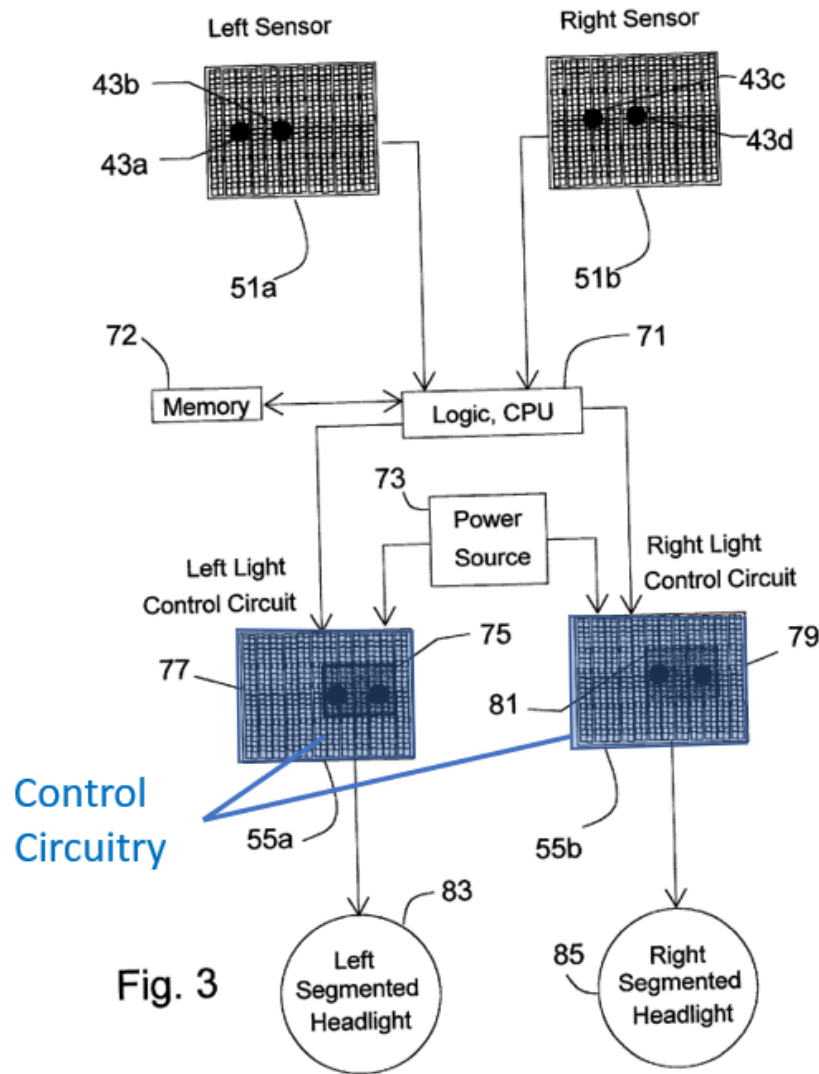


Fig. 3

(*Id.*, Fig. 3 (annotated), [0027]-[0028]; *see also* [0026], Fig. 2 (depicting sensor unit 45 with detector array 51).) This sensor data is used to “determine the intensity of light that will be produced by the 61 [vehicle] in the corresponding headlight sectors ... Note that a left shaded circuit area 75 indicates the areas of a segmented headlight control switch array switches which will cause portions of the left headlight to be dim while a non-shaded left circuit area 77 represents the portions of the segmented headlight which will be on high beam.” (*Id.*, [0027].)

1[D]: *electronic control circuitry configured to independently operate the light clusters*;

Alden discloses Claim 1[D]. (Papanikolopoulos Decl., ¶¶59-61.) Alden’s system includes a “left light *control circuit*” (55a) and a “right light *control circuit*” (55b):



(Alden, Fig. 3 (annotated).)

These circuits include “segmented headlight control switch array switches,” which provide power to the light elements in the headlights, causing certain “portions” of the headlight to “dim” and others to switch to “high beam.” (*Id.*, [0027].) In particular, based on sensor data, the control circuitry “controls the power flow” to the headlights to independently control the lighting elements. (*Id.*, [0026]-[0027]; *see also* [0006], [0008], Fig. 4, [0028].) For example, where data

from sensors 51a, 51b indicates the presence of another vehicle 41, the control circuitry “controls the power flow” so the headlight “distributes high beams throughout its distribution areas except in a box in the direction of the 41.” (*Id.*, [0027].)

The switch array control circuitry is further illustrated in Figure 5, where the lighting elements are “individually controlled” by a “switch array,” with each switch being “controlled by the CPU and logic previously described. For example the power to 119 is controlled by the CPU which dictates its respective switch characteristics at 115 such that the power from a power supply 113 carried via segment wire 117 is controlled in response to the sensed environmental conditions.” (*Id.*, [0029], Fig. 5.)

1[E]: one or more sensors configured to obtain and provide the sensor data predefined as pertinent to illumination requirements for the field-of-view; and

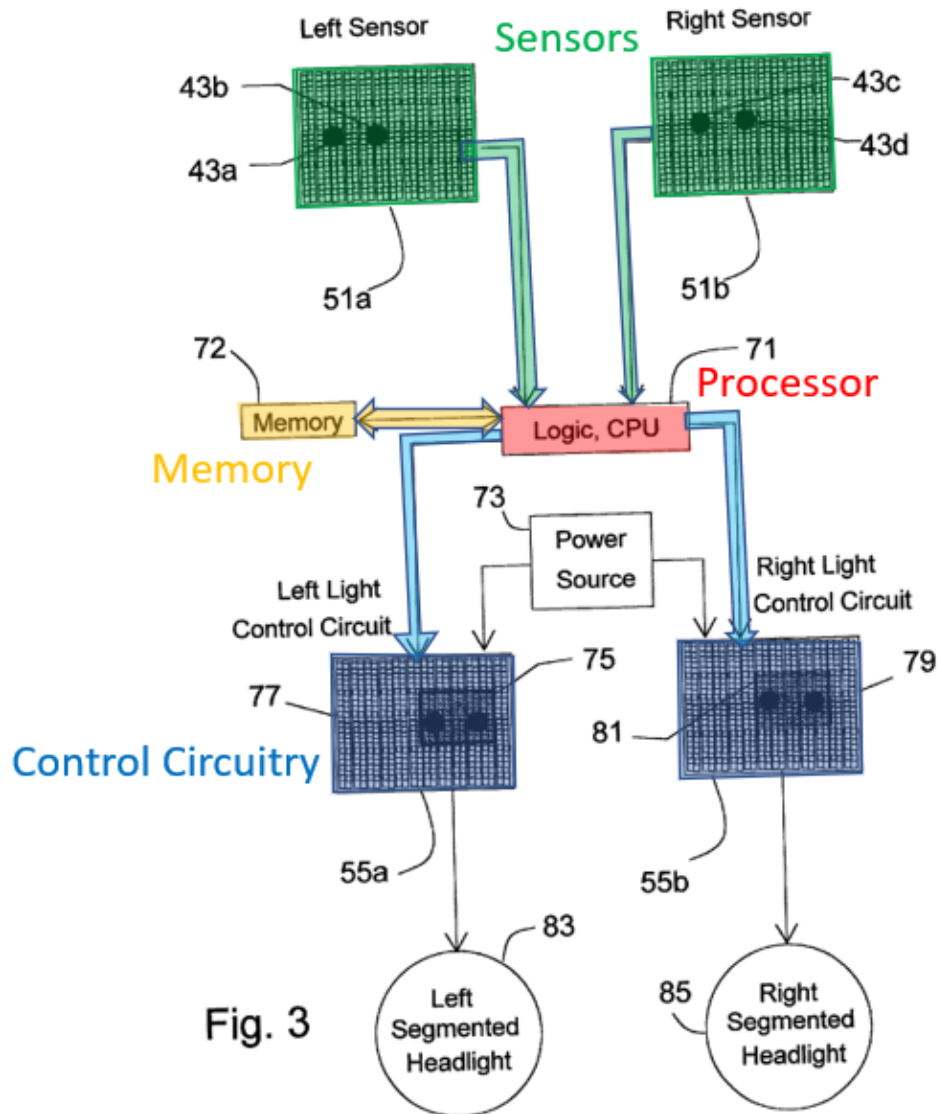
Alden discloses Claim 1[E]. (Papanikolopoulos Decl., ¶62.) As discussed, Alden discloses a “left sensor” and a “right sensor” that obtain and provide sensor data. *See supra* Claim 1[C]. The sensor data in Alden is “predefined as pertinent to illumination requirements for the field-of-view” because it relates to the detection of oncoming vehicles and potential adjustment of light in response thereto.

(Papanikolopoulos Decl., ¶62.) Specifically, the sensor data comprises detection of “illuminated spot[s]” “fall[ing] upon a photon detector array which otherwise doesn’t receive significant light.” (Alden, [0027]; *see also* [0026], Fig. 2.) The

logic of Alden's system interprets this data as headlights of an oncoming vehicle, and Alden's CPU logic flow selects portions of the headlight to dim based on this sensor data. (*Id.*, [0026]-[0028]; *see also* Figs. 2-4.)

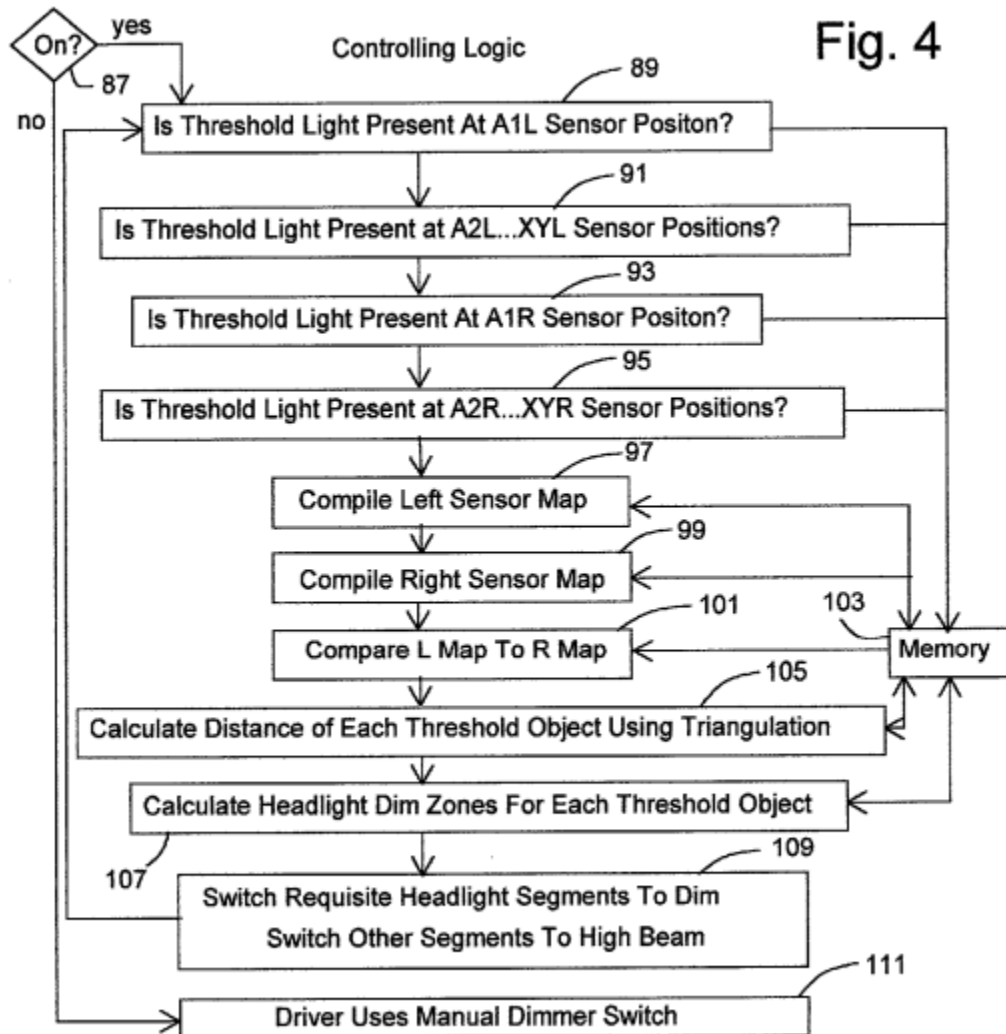
1[F]: [1] a logical controller including a processor, the processor in communication with a memory storing one or more algorithms, with the sensors, and with the control circuitry, [2] wherein the processor is configured to process the one or more algorithms and the sensor data to determine an illumination for at least two of the sub-sections, [3] that reduces illumination to reduce glare in at least a first of the at least two subsections and adapt the light emitted from one or more of the light-clusters so as to create the headlight beam that provides the determined illumination.

Alden discloses Claim 1[F]. (Papanikolopoulos Decl., ¶¶63-70.) First, Alden discloses a “logical controller including a processor” in communication with “memory,” “sensors,” and “control circuitry”:



(Alden, Fig. 3 (annotated), [0027].) As shown in Figure 3, left and right sensors 51a-51b are connected to CPU 71 comprising logic. (*Id.*, [0027].) The CPU is connected to memory 72, and “[i]nformation from the [memory] 72 and [CPU] 71 is sent to control the power flow from a power source 73 via a left light control circuit 55a and a right light control circuit 55b.” (*Id.*)

Second, Alden discloses that the processor (logic CPU 71) is configured to “process algorithms” and sensor data to determine an illumination for at least two sub-sections of the field-of-view:



(*Id.*, Fig. 4; *see also* Fig. 3, [0026]-[0028].) As shown in Figure 4, the logic process used by the CPU can include: processing sensor data (steps 89, 91, 93, 95); compiling sensor maps (steps 97, 99); determining the “distance and intensity of

each object sensed in a calculating process 101”; and calculating distances to objects using a “triangulation process 105.” (*Id.*, Fig. 4, [0028]; *see also* Fig. 3, [0026]-[0027].)

The distance data is then used to “determine the intensity of light that will be produced by the 61 [headlight] in the corresponding headlight sectors,” as shown in step 107, and signals are then sent to the control circuits to switch some zones to dim and others to high beam, as shown in step 109. (*Id.*, Fig. 4, [0027]-[0028]; *see also* Fig. 3, [0026]-[0027].) Thus, Alden determines illumination for “at least two-subsections”—that is, zones where an oncoming vehicle is present that need to be dimmed (first subsection) and zones where there is no other vehicle that should be high beam (second subsection). (*Id.*)

Alden further explains that this is a real-time process that is continuously repeated. (*Id.*, [0028] (stating that the “process then begins again so as to be responsive to changing environmental conditions *in real time*.”).) Thus, if environmental conditions, including the location of other vehicles, change, the determined light distribution pattern for headlights will also change. (Papanikolopoulos Decl., ¶66.) For example, Alden explains that if threshold light is detected at certain sensor positions such that another vehicle is present, a determination is made that the intensity of light for the headlight sectors corresponding to those sensor positions should be switched to dim, or low beam.

(*Id.*, Fig. 4, [0027]-[0028]; *see also* Fig. 3; Papanikolopoulos Decl., ¶66.) If, when the process is repeated, the position of the other vehicle changes so threshold light is no longer detected at those same sensor positions, then the system makes a determination to switch the corresponding sectors from low beam to high beam. (*Id.*) In sum, as part of the real-time process, Alden is continuously determining whether each sector should be dimmed low beam or high beam. (Papanikolopoulos Decl., ¶66.)⁶

Third, Alden discloses that its headlamps provide beams with the determined illumination levels and that its uses different illuminations levels in different sectors to reduce glare where another vehicle is present (*i.e.*, “a first of the at least two subsections”). (Papanikolopoulos Decl., ¶68.) Alden describes that “[t]he location of objects is used to calculate which zones of each headlight need to be dimmed in a calculate headlight dim zones process 107. Signals are sent to each of

⁶ In addition, Alden mentions that the headlights can be operated to produce not only low and high beam light, but also “a range of intensities between the high beam and the low beam state.” (Alden, [0061].) Where Alden wants a sector of the headlight beam to be low or high, a determination is made to power the lighting elements for those sectors to produce low or high beam intensity light, as opposed to light at an intensity in the range between low and high. (Papanikolopoulos Decl., ¶67.)

the headlight control circuit zones that need to be dimmed to restrict the amount of current to the corresponding headlight zones such that they are dimmed in a dimming process 109. Zones which are not dimmed remain on high beam. Thus the light sent to the sensed vehicle location is dimmer than the light sent to all other areas of the headlight distribution area.” (*Id.*, [0028], Fig. 4; *see also* [0026]-[0027], [0029], Fig. 5.)

Alden discloses that this reduces glare: “the driver of 41 [*i.e.*, the oncoming vehicle] has minimum glare while the driver of 47 [*i.e.*, the vehicle implementing the Alden system] has maximum light.” (*Id.*; *see also* Abstract, [0005].) That is, based on the sensor data, a headlight beam is generated that is dimmer in a first subsection where another vehicle is sensed, to reduce glare to the driver of that vehicle, while other subsections where no other vehicles are sensed are switched to high beam. (Papanikolopoulos Decl., ¶¶69-70.)

2. Independent Claim 20

Alden anticipates and renders obvious Claim 20. (Papanikolopoulos Decl., ¶¶71-78.)

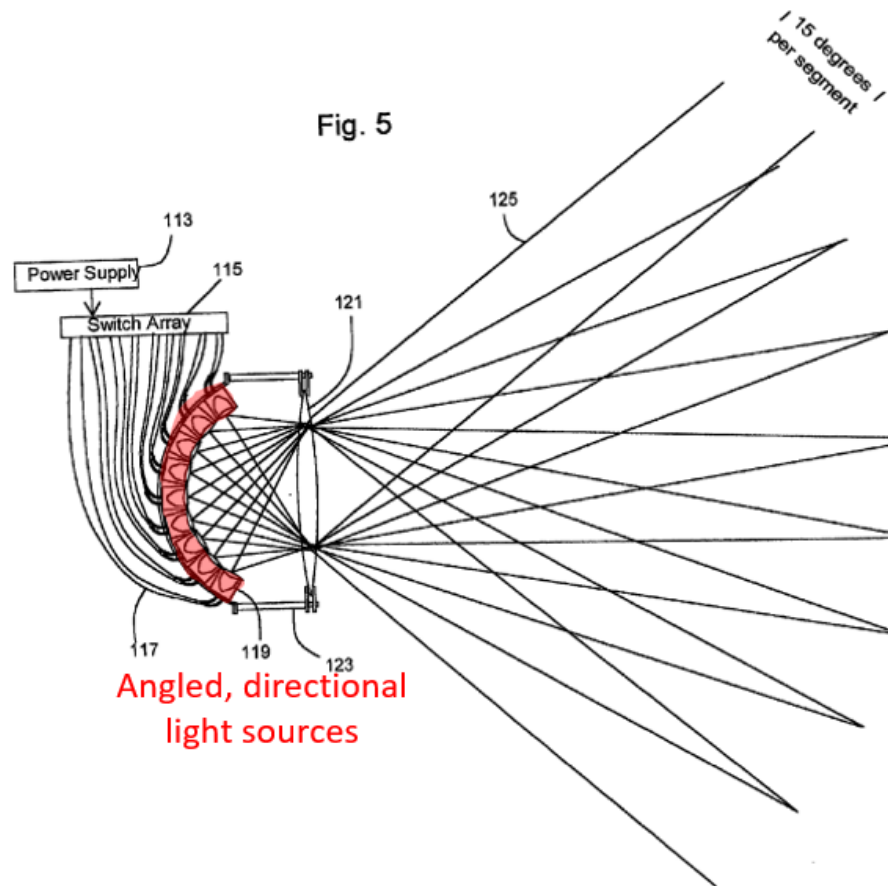
20[Pre]: *A vehicle headlight system comprising:*

Alden discloses Claim 20[Pre] to the extent limiting. *See supra* Claim 1[Pre].

20[A]: [1] *one or more headlamps affixed to a vehicle*, [2] *each headlamp including at least three directional light sources aimed at different angles*

relative to the vehicle, [3] the light sources configured to have one or more controllable light characteristics,

Alden discloses Claim 20[A]. (Papanikolopoulos Decl., ¶¶73-74.) First, Alden discloses “one or more headlamps affixed to a vehicle.” *See supra* Claim 1[A]. Second, Alden’s headlamps each have “at least three directional light sources aimed at different angles relative to the vehicle,” as they include an “array” of lighting elements “on a curve along the focal point of a headlight lens 121, such that the light from each lighting element goes into a specified portion (or portions) of the headlight distribution area”:



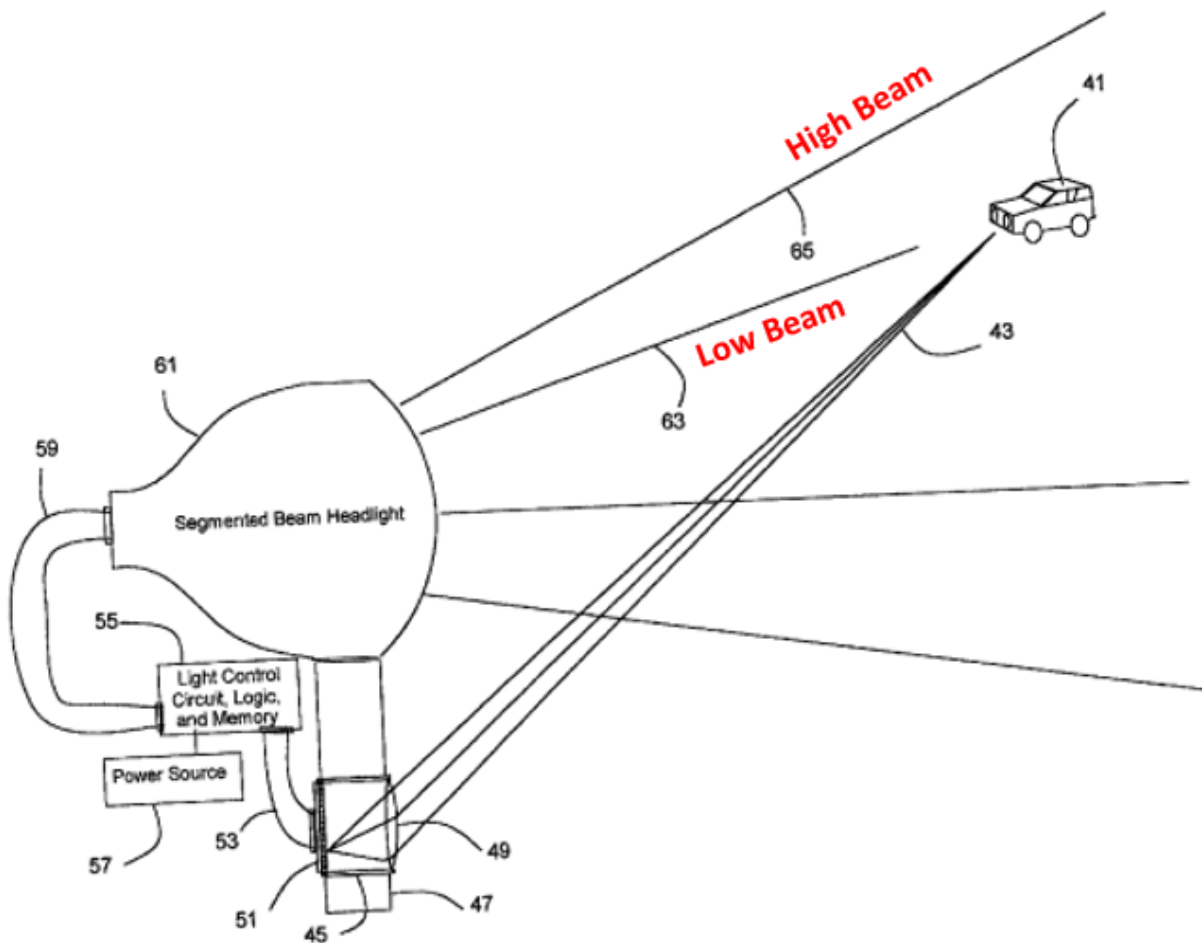
(Alden, Fig. 5 (annotated), [0029].) As shown, each lighting element is directed at a different angle relative to the front of the vehicle, based on its position along the curve. (Papanikolopoulos Decl., ¶73.)

Third, Alden discloses that its lighting elements have “one or more controllable light characteristics,” as its lighting elements are “independently controllable as to intensity and direction.” (Alden, [0008]; *see also* Abstract, [0026]-[0029], Figs. 2-4.) To adjust intensity, for example, the power to each individual lighting element is CPU-controlled, such that “the light sent to the area of 41 [an oncoming vehicle] is dimmed using a headlight with segmented lighting means.” (*Id.*, [0029]; *see also* [0026]-[0028].) *See also supra* Claim 1[D].

20[B]: wherein a first light source of the more than one light sources at a first angle is less visually disturbing to traffic than a second light source of the more than one light sources aimed at a second angle, different from the first angle;

Alden discloses Claim 20[B]. (Papanikolopoulos Decl., ¶75.) Alden’s lighting elements (“light sources”) are situated and aimed at different angles, based on their location along the curve. *See supra* Claim 20[A]. This results in “light from each lighting element [going] into a specified portion (or portions) of the headlight distribution area.” (Alden, [0029], Fig. 5; *see also* Abstract, [0026]-[0028].) Any lighting element angled away from an oncoming vehicle (*e.g.*, towards the side of the road) would be “less visually disturbing” than an element angled such that it directs light at the oncoming vehicle. (*Id.*, [0029], Fig. 5; *see*

also Papanikolopoulos Decl., ¶75.) As Alden discloses, its angled lighting elements can produce “a high beam in a first sector 65 while concurrently producing a low beam in a second respective sector 63 (or dim beam) where the 41 [oncoming vehicle] is sensed,” such that the “the *driver of 41* has *minimum glare* [e.g., less visual disturbance] while the *driver of 47* has *maximum light*”:



(Alden, Fig. 2 (annotated), [0025]-[0029].)

20[C]: control circuitry configured to adjust the at least one light characteristic of at least one of the directional light sources;

Alden discloses Claim 20[C]. (Papanikolopoulos Decl., ¶76.) Alden's system includes "a light control circuit" having a "left light control circuit" (55a) and a "right light control circuit" (55b). *See supra* Claim 1[D]. Alden discloses that this control circuitry is configured "to adjust at least one light characteristic" of the light sources. *Id.*; *see also supra* Claim 20[A]. For example, with respect to light intensity, each circuit "controls which segments of a segmented beam headlight 61 are on low and which are on high by controlling the power flow to each respective sector from a power source 57." (Alden, [0026]-[0027], Figs. 2-4.) The control circuits can include "switch arrays," with lighting elements 119 being "individually controlled" by a corresponding switch in the array, such that the element emits dimmed or high beam light. (*Id.*, [0029], Fig. 5; *see also* Abstract, [0026]-[0027].)

20[D]: one or more sensors configured to sense information defined as pertinent to determining illumination output from the one or more headlamps and communicating the sensed information to a processor as sensor data;

Alden discloses Claim 20[D]. (Papanikolopoulos Decl., ¶77.) Alden discloses sensors that receive light that may be indicative of an oncoming vehicle and thus used by the CPU to adjust the illumination of the headlamps. *See supra* Claim 1[E]. This information is communicated to a processor, CPU 71, as sensor data, so that the CPU can determine whether to adjust the light being output by the headlamps. *See supra* Claim 1[F].

20[E]: [1] the processor, in communication with at least the sensors and the control circuitry, configured to: [2] process the sensor data to determine, within a field-of-view, at least a first subsection including a detected vehicle and at least a second subsection not including the detected vehicle, [3] determine optimal use of the differently aimed directional light sources to maximize vehicle operator visibility in at least the second subsection, while minimizing a disturbing effect, resulting from the illumination output, on the vision of other traffic in at least the first subsection, and [4] direct the control circuitry to adjust the directional light sources to achieve the determined optimal use.

Alden discloses Claim 20[E]. (Papanikolopoulos Decl., ¶78.)

First, Alden discloses a processor “in communication with” sensors and control circuitry. *See supra* Claim 1[F].

Second, Alden’s processor uses “sensor data” to determine which subsections in the field-of-view include “a detected vehicle” and which do not. *See supra* Claim 1[E]-1[F].

Third, Alden’s processor determines operation of the lighting elements to produce “a high beam in a first sector 65 [no other vehicles] while concurrently producing a low beam in a second respective sector 63 (or dim beam) where the 41 [other vehicle] is sensed ... Thus the driver of 47 can see everything illuminated to the maximum except the area where 41 is. Meanwhile, the driver of 41 sees only a dim or low beam light from 47. ***Thus the light for both drivers is concurrently optimized*** by segmented the light distribution into independently controlled sectors.” (Alden, [0026], [0027] (noting CPU 71 determines the light to be produced so the headlight “distributes high beams throughout its distribution areas

except in a box in the direction of the 41 [other vehicle]. Thus the driver of 41 has minimum glare while the driver of 47 has maximum light.”.) *See also supra* Claim 1[F].

Fourth, Alden’s processor “direct[s] the control circuitry” to adjust the lighting elements to “reduce glare” for other vehicles while “maximizing” illumination in areas with no other vehicles. *See supra* Claims 1[D], 1[F].

3. Independent Claim 26

Alden anticipates and renders obvious Claim 26. (Papanikolopoulos Decl., ¶¶79-86.)

26[Pre]: A method for generating a headlight beam in an adaptive headlight system that provides illumination to at least a portion of a field-of-view, comprising:

Alden discloses Claim 26[Pre]. (Papanikolopoulos Decl., ¶80.) Alden discloses “automatic segmented illumination” headlights on a vehicle that provide “low beam illumination” and “high beam illumination” in different sectors in a vehicle’s field-of-view. (Alden, Abstract, [0025]-[0029], Figs. 2, 4-5, 11.) *See also supra* Claims 1[Pre], 1[B].

26[A]: utilizing one or more sensors of a vehicle including the adaptive headlight system to obtain and provide data predefined as relevant to a determination of illumination requirements for the field-of-view, the data including data indicative of at least one of one or more other vehicles or a pedestrian;

Alden discloses Claim 26[A]. (Papanikolopoulos Decl., ¶¶81-82.) Alden’s system uses sensors to obtain and provide “data predefined as relevant to a

determination of illumination requirements for the field-of-view.” *See supra* Claim 1[E]. Alden discloses that this data is “indicative of at least one or more other vehicles or a pedestrian.” *See supra* Claim 1[F]. As explained above, the sensed data indicates the presence of an “oncoming vehicle” or “any other vehicle.” (Alden, [0025]; *see also id.*, Figs. 2-4, [0026]-[0027] (describing that the sensor data “detects the two headlights of” an oncoming vehicle and is used to sense other vehicles), [0028]-[0029].)

26[B]: determining illumination requirements for the field-of-view based on the data sensed by the sensors, including determining illumination for at least a first subsection of the field-of-view including the other vehicle or pedestrian, as indicated by the sensor data, and for at least a second subsection of the field-of-view not including the other vehicle or pedestrian;

Alden discloses Claim 26[B]. (Papanikolopoulos Decl., ¶83.) Alden discloses determining illumination requirements for a field-of-view based on data from sensors, including determining illumination for a portion of the headlight distribution area where another vehicle is detected (“first subsection”) and a second portion where no other vehicles are detected (“second subsection”). *See supra* Claims 1[F], 20[E].

26[C]: determining a control strategy for controlling one or more directional light clusters in a headlight assembly to create an output headlight beam meeting the determined illumination requirements, the headlight beam spatial light distribution shaped to provide high beam illumination for a driver of the vehicle,

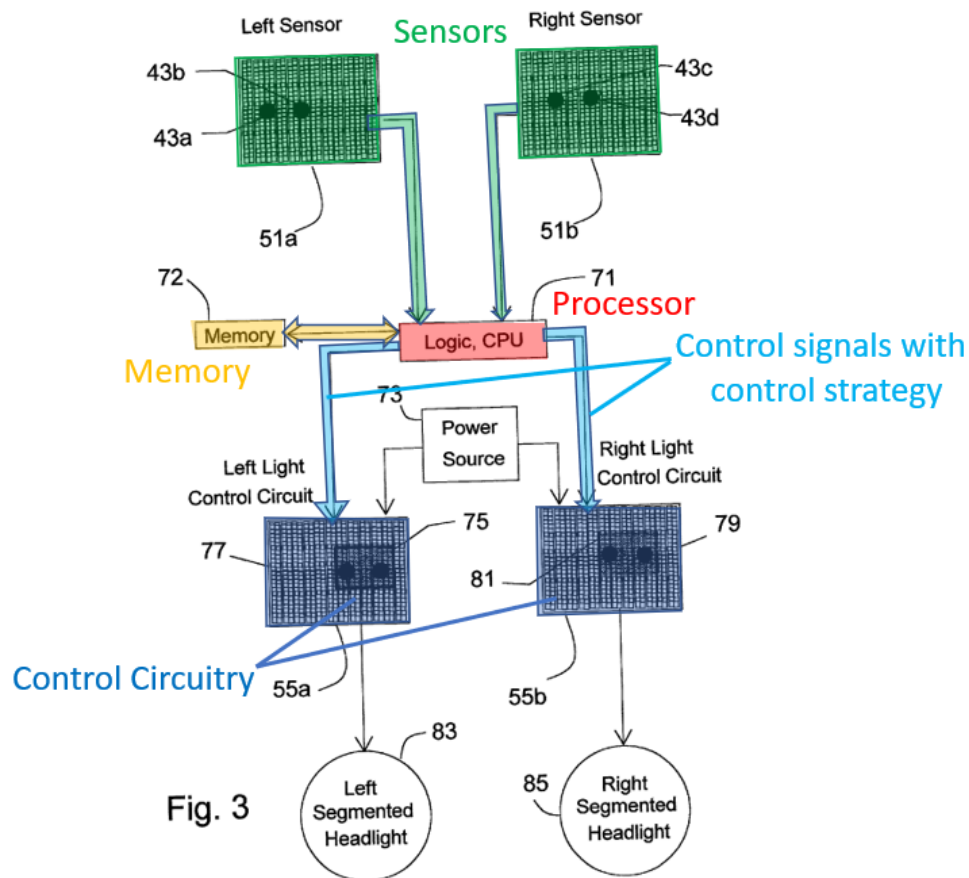
in at least the second subsection, while mitigating glaring light illuminating at least the first subsection including detected other vehicles or pedestrians;

Alden discloses Claim 26[C]. (Papanikolopoulos Decl., ¶84.) As discussed, Alden discloses a logic CPU that determines the “control strategy” for controlling the lighting elements of its system—*i.e.*, the processing steps for determining whether each portion of the headlight distribution area should be dimmed or on high beam. *See supra* Claims 1[F], 20[E]. Alden’s logic CPU processor sets the control strategy for the lighting elements so as to create light output in a “headlight distribution area,” such that portions including a detected vehicle (“first subsection”) are dimmed to reduce glare for the driver of the other vehicle, while portions with no detected vehicles (“second subsection”) are illuminated in high beam. *Id.* Alden further discloses that the controlled lighting elements are “directional lighting clusters,” as the lighting elements 119 are situated on a curve so as to direct light into specific portions of the headlight distribution area. *See supra* Claims 1[B], 20[A].

26[D]: sending control signals implementing the control strategy to an electronic control circuitry configured to operate the light-clusters; and

Alden discloses Claim 26[D]. (Papanikolopoulos Decl., ¶85.) *See supra* Claim 1[D], 1[F]; *see also* Claim 20[E]. As explained, CPU 71 sends control signals implementing the control strategy to a “left light ***control circuit***” (55a) and

a “right light *control circuit*” (55b) that operate the lighting elements in the left and right segmented headlights:

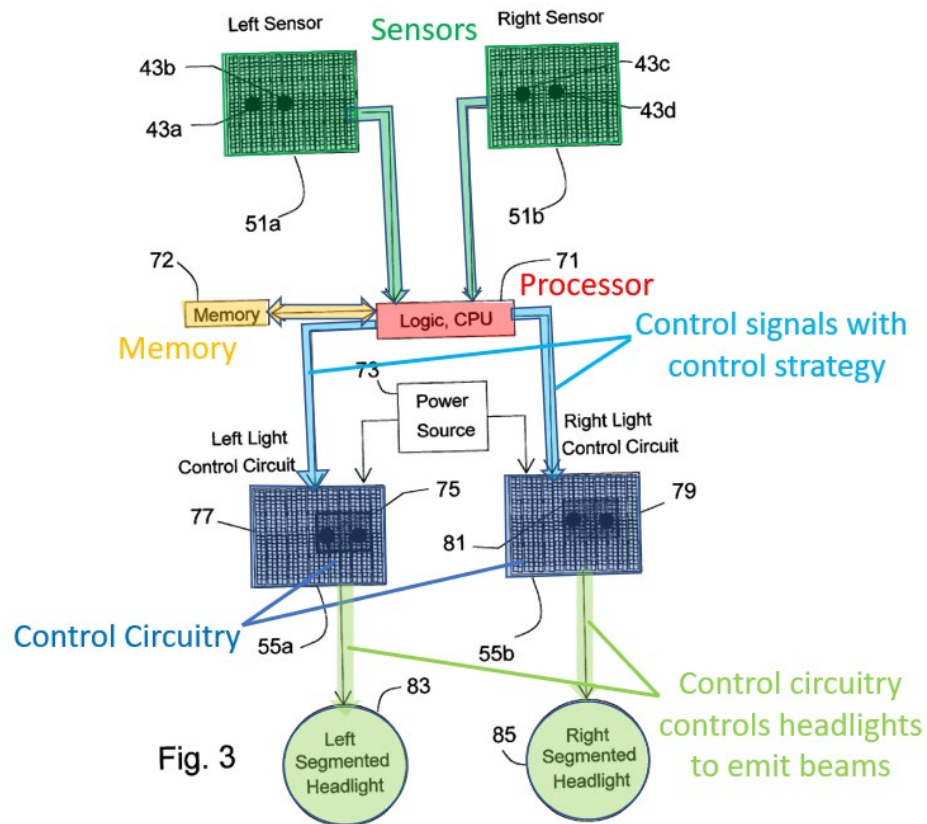


(Alden, Fig. 3 (annotated).)

26[E]: *controlling the light clusters via the electronic control circuitry to collectively emit the headlight beam meeting the determined illumination requirements.*

Alden discloses Claim 26[E]. (Papanikolopoulos Decl., ¶86.) As explained, the left and right control circuits control the lighting elements in the segmented left and right headlights, respectively, to emit a headlight beam with the determined

illumination characteristics for the different portions of the headlight distribution area. *See supra* Claims 1[D], 1[F]; *see also* Claims 20[C], 20[E].



(Alden, Fig. 3 (annotated); *see also* Figs. 1-2, 5, 11-13.)

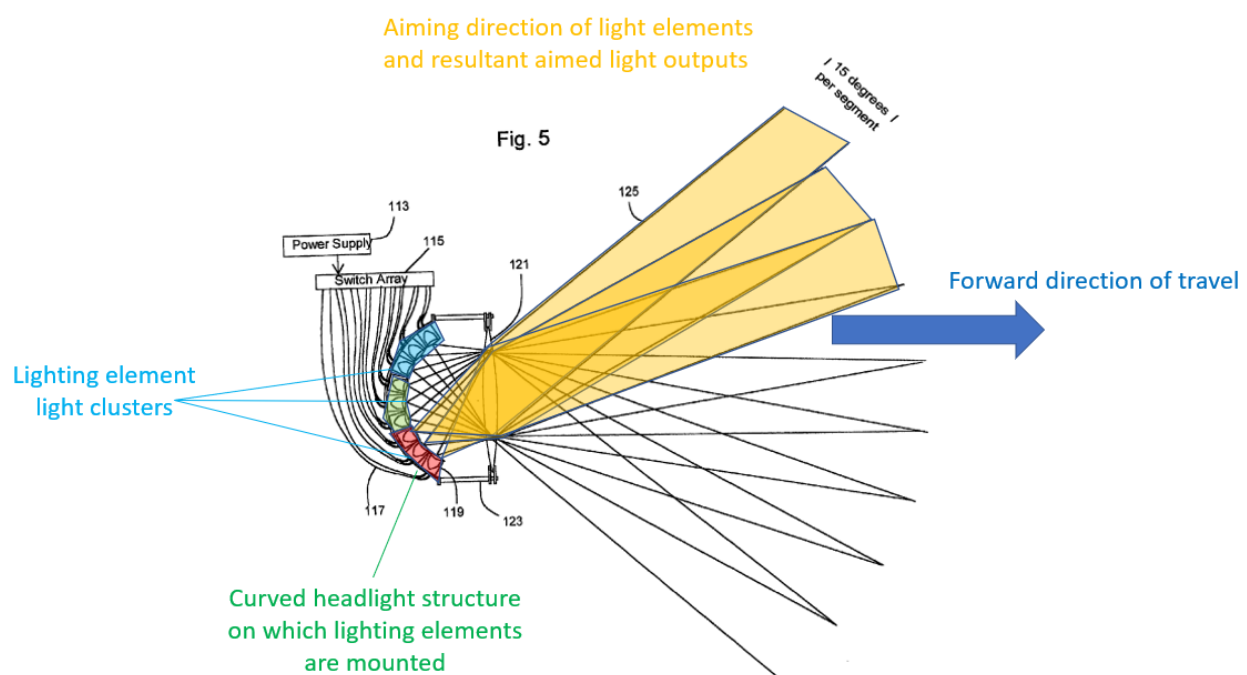
4. Dependent Claim 2

Alden anticipates and renders obvious Claim 2. (Papanikolopoulos Dec., ¶¶87-98.)

2[A]: *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;

Alden discloses Claim 2[A]. (Papanikolopoulos Decl., ¶¶88-89.) Alden discloses that the light elements 119 forming the “light clusters” are in a “segmented headlight 123” structure that includes a curved portion on which the light elements are mounted:



(Alden, [0029], Fig. 5 (annotated).) As shown, the positioning of the light elements on a curve in the headlight causes each to emit light at a different angle, such that light from each element (or group of elements) is aimed into particular segments ahead of the vehicle. (*Id.*, [0029] (disclosing that “lighting elements are on a curve along the focal point of a headlight lens 121 such that the light from each lighting

element goes into a specified portion (or portions) of the headlight distribution area” ahead of the vehicle).)

2[B]: 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

Alden discloses Claim 2[B]. (Papanikolopoulos Dec., ¶¶90-92.) In Alden each “light cluster” has one or more light emitting sources, *e.g.*, individual or groups of lighting elements 119. (Alden, Fig. 5, [0029].) *See also supra* Claim 2[A]. Alden further discloses that light elements 119 have a “variable light-source characteristic” dependent on power. (Alden, Abstract, [0026]-[0029].) For example, the intensity of each light element is alterable, as it can be either a “high” or “low” beam, depending on the power supplied. (*Id.*)

The power to each element is controlled by “electronic control circuitry,” namely “left light control circuit 55a” and “right light control circuit 55b.” (*Id.*, [0026]-[0027], Figs. 2-4.) These circuits include switch arrays for respective left and right headlights that “control[] which segments ... are on low and which are on high by controlling the power flow to each respective sector from a power source 57.” (*Id.*) For example, “the power to 119 is controlled by the CPU which dictates its respective switch characteristics at 115 such that the power from a power supply 113 carried via segment wire 117 is controlled in response to the sensed environmental conditions ... Thus the light sent to the area of 41 (where another

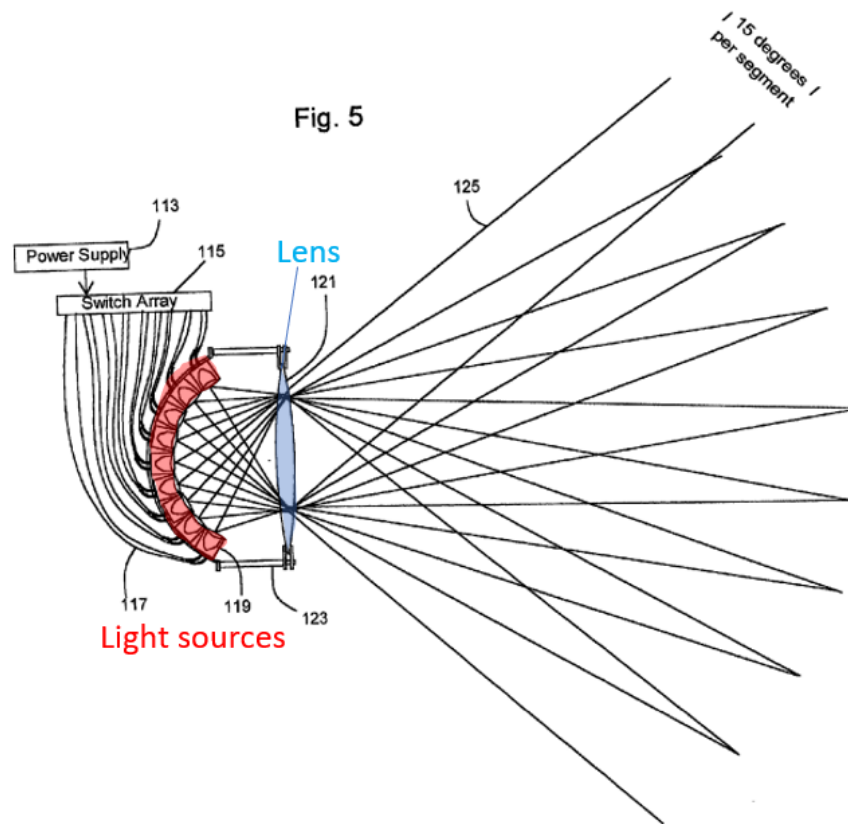
vehicle is sensed) is dimmed using a headlight with segmented lighting means.”

(*Id.*, [0029].)

2[C]: 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;

Alden discloses Claim 2[C]. (Papanikolopoulos Decl., ¶¶93-97.) The ’503 discloses that “light modifying elements” can include “lenses” and “refractors,” each of which “controls” light by directing it to specific areas. (’503, Claims 3-4; Papanikolopoulos Decl., ¶93.) The ’503 further discloses that “light-source characteristics” can include things like intensity and direction. (*Id.*, Claim 2[D]; Papanikolopoulos Decl., ¶93.)

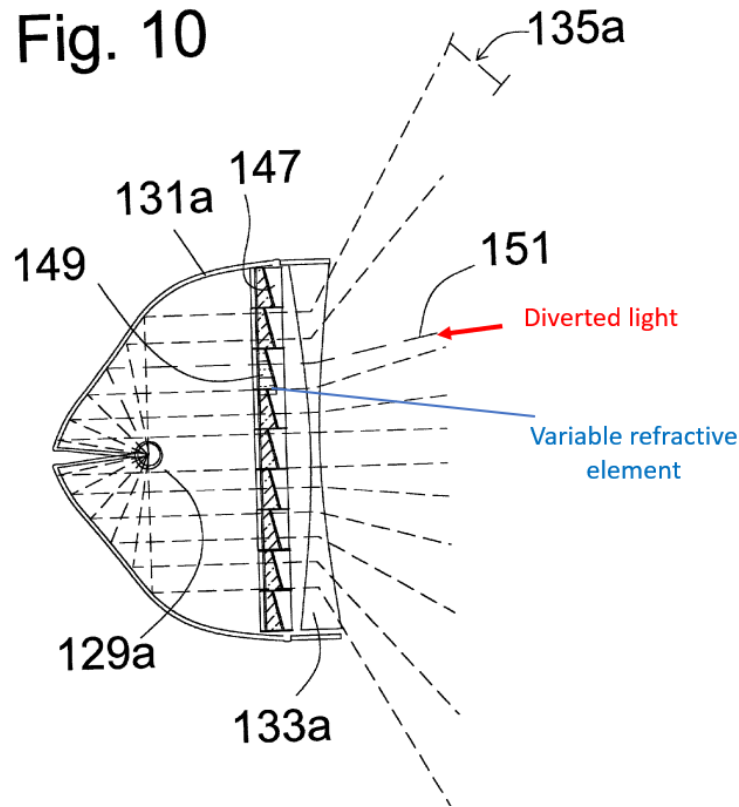
Alden discloses this, as it uses a “lens 121” in the path of light emitted from lighting elements 119, which causes “the light from each lighting element [to go] into a specified portion (or portions) of the headlight distribution area”:



(Alden, [0029], Fig. 5 (annotated).) This lens controls a “characteristic” of the light, as it focuses the light from each lighting element into particular portions of the light distribution area. (*Id.*, [0029]; Papanikolopoulos Decl., ¶94.) Thus, Alden discloses Claim 2[C] for this reason alone.

In addition, Alden’s system can include other “light modifying elements,” including a “variable refractive element” in the form of a liquid crystal. (Alden, [0033]-[0035], [0061], Figs. 8-10.) This refractor “enables light from an individual headlight distribution sector to be redirected in response to sensed environmental

conditions when used in conjunction with the elements and processes previously discussed herein.” (*Id.*)



(*Id.*, Fig. 10 (annotated).)

The liquid crystal has a first refractive state when a circuit is open, such that light passes straight through, without bending. (*Id.*, Fig. 8, [0033].) The liquid crystal then has a second refractive state when the circuit is closed, causing the “light to bend due to refraction after passing through.” (*Id.*, Fig. 9, [0033].) By selectively closing the circuit, light for a particular sector can be “bent” to redirect the light to a different area. (Papanikolopoulos Decl., ¶¶95-96.)

Alden discloses that its use of refractive elements to “bend” light can be included in its headlight system, such as that of Figure 5, and a POSITA would have readily understood how to implement the variable refractive elements in such system. (*Id.*, ¶97.) In fact, Alden expressly discloses that “[o]ne or more methods employed herein ***may be used in combination*** to vary illumination ***in a segmented system.***” (Alden, [0061].) Thus, this would be the use of a known optical element (liquid crystal) in a system having different light distribution sectors that Alden describes the liquid crystal as acting upon. (Papanikolopoulos Decl., ¶97.) Moreover, a POSITA would have had a reasonable expectation of success, as the refractor would perform its same function of allowing light to pass straight through when a circuit is open and bending light when the circuit is closed. (*Id.*) And a POSITA would have been motivated to add this refractor, such as to the system in Figure 5, so as to provide an additional means of modifying the direction or intensity of individual lighting sectors, including bending the light output in certain desired portions, allowing more variable control of lighting of subsections of a headlight beam. (*Id.*) For example, as disclosed in Alden, the inclusion of variable refractor elements in the path of different beam segments allows for greater control of the light, including allowing a user to “divert” light from one section to become low beam light in areas where a vehicle is sensed. (Alden, [0035].) In addition, including the refractor would allow for more controlled bending or directing of

certain light segments into road curves, as shown in Figure 11. (*Id.*, Fig. 11; *see also* Figs. 14-15, [0039]-[0040].)

2[D]: 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.

Alden discloses Claim 2[D]. (Papanikolopoulos Decl., ¶98.) The curved surface on which Alden's light elements 119 are mounted ("the structure"), combined with the control of the light elements and the lens 121 ("light modifying element"), result in light being emitted with particular characteristics, including intensity, direction, beam spread, and spatial light distribution. (Alden, [0026]-[0029], Fig. 5.) Alden explains that with its lighting elements being "on a curve along the focal point of a headlight lens 121," the "light from each lighting element goes into a specified portion (or portions) [*i.e.*, direction] of the headlight distribution area." (*Id.*, [0029].) Alden adds that the control of the lighting elements by control circuitry causes different intensities of light in different portions of the headlight distribution area. (Alden, [0026]-[0029], Fig. 5.) Moreover, the inclusion of refractive liquid crystal elements, as disclosed in Alden, further alters the direction, beam spread, and spatial light distribution. (*Id.*, [0033]-[0035].)

5. Dependent 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.

Lens 121 (“light modifying element”) in Alden’s lighting system is a “static light modifier,” as it focuses light from the different elements into “a specified portion (or portions) of the headlight distribution area.” (Alden, [0029], Fig. 5.) Alden anticipates Claim 3 for this reason alone. (Papanikolopoulos Decl., ¶100.)

Additionally, Alden anticipates and renders obvious Claim 3 based on its “variable refractive element.” (*Id.*, ¶101.) This “*variable refractive* element” is a “variable light modifier” with refractors. (*Id.*) Further, Alden discloses that its variable refractive element includes “variable light modifier control circuitry,”⁷ as it includes a circuit configured to be “open” or “closed” to control the direction and distribution of light passing through the elements. (Alden, [0033]-[0035].) Opening or closing the circuitry for the liquid crystal element alters the variable refractive

⁷ The claim recites (1) a “static light modifier” ***or*** (2) a “variable light modifier” together with “variable light modifier circuitry.” Thus, the claim language “*variable light modifier* circuitry” is only limiting with respect to the optional “variable light modifier.” (Papanikolopoulos Decl., ¶99.)

liquid crystal, causing the light to either pass straight through or be “bent” and redistributed to a different portion of the headlight distribution area. (*Id.*; Papanikolopoulos Decl., ¶101.) *See also supra* Claim 2[C].

6. Dependent 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.

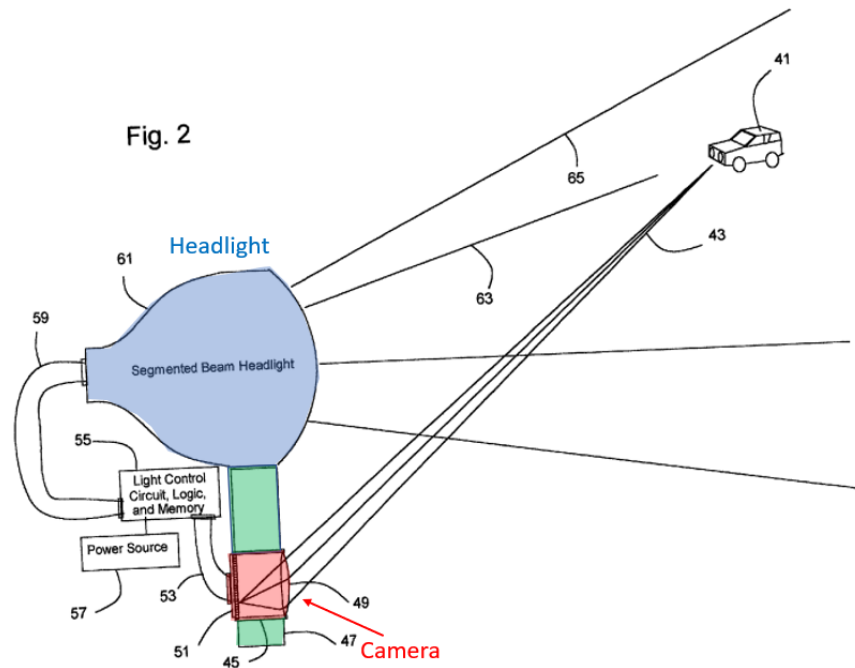
Alden anticipates and renders obvious Claim 4. (Papanikolopoulos Decl., ¶102.) Alden discloses that its “light modifying element” can be “lens 121.” (Alden, [0029].) *See also supra* Claim 2[C]. Such a lens is also a common type of “optical device.” (Papanikolopoulos Decl., ¶102.) Alden further discloses that other optical devices, such as its variable refractive element, can be used as a light modifying element. *See supra* Claim 2[C]. (Papanikolopoulos Decl., ¶102.)

7. Dependent Claim 7

The headlight system of claim 1, [a] 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 [b] wherein the logical controller upon receiving data, indicating a position of the lights, from the camera-sensor, [c] 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 [d] responsively adapt the headlight beam to decrease at least one vision-disturbing characteristic to the oncoming vehicle driver.

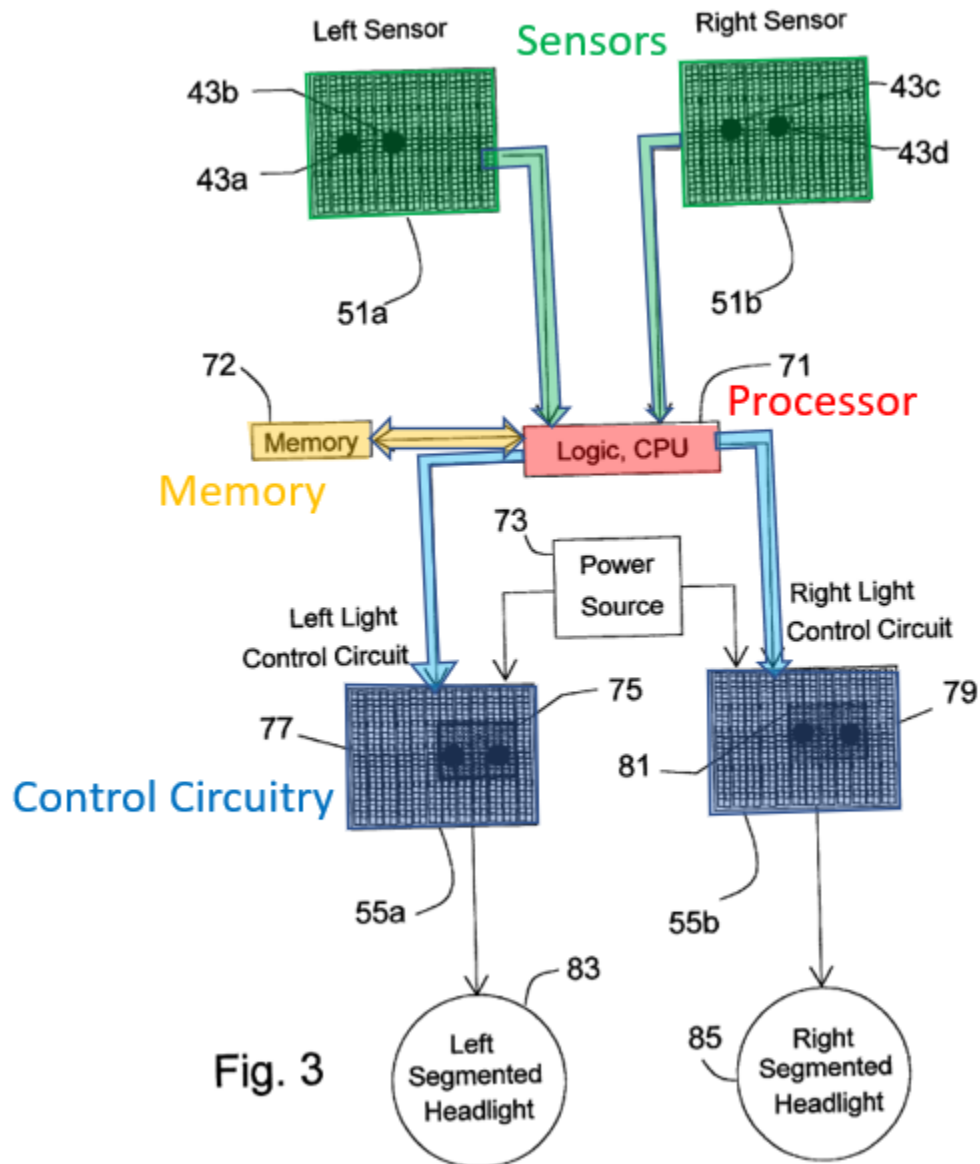
Alden anticipates and renders obvious Claim 7. (Papanikolopoulos Decl., ¶¶103-107.)

First, Alden’s “sensors” include a lens 49 that directs light to photodiode arrays or CCD detectors 51 (*i.e.*, “camera-sensors”), which image lights of oncoming vehicles having drivers whose vision could be disturbed by the glare of the headlight:



(Alden, Fig. 2 (annotated), [0026]-[0027], Fig. 3.) *See also supra* Claim 1[E]-1[F].

Second, Alden discloses that its CPU (“logical controller”) receives data from these camera sensors containing “illuminated spots” 43a-43d indicating the position of the oncoming vehicle:



(Alden, Fig. 3 (annotated); *see also* [0026], [0027] (“The 51a detects the two headlights of 41 at a first illuminated spot 43a and a second illuminated spot 43 b respectively ... Meanwhile, 51b also detects the two headlights of 41 as a first spot 43c and a second spot 43d respectively.”).) *See also supra* Claims 1[E]-1[F].

Third, Alden discloses that its CPU implements algorithms (such as shown in Figure 4) to determine a position of the oncoming vehicle, as compared to the

vehicle having the headlight system, using “triangulation” and compiling “sensor maps, based on the positions of the “illuminated spots” from the camera sensor data. (*Id.*, [0027]-[0028], Figs. 3-4.) *See also supra* Claim 1[C], 1[F].

Finally, Alden discloses that its CPU adapts the headlight beam by “controlling the power flow” to the different segments of the headlights, such that high beams are distributed throughout the distribution area except in the direction of the other vehicle, which receives dimmed beams instead. (Alden, [0026], [0027] (“Information from the 72 and 71 is sent to the control the power flow from a power source via a left light control circuit 55a and a right power control 55b ... The 55a controls the power flow from 73 to a left segmented headlight 83 which distributes high beams throughout its distribution areas except in a box in the direction of the 41. Similarly, the 55b controls the power flow from 73 to a right segmented headlight 83 which distributes high beams throughout its distribution areas except in a box in the direction of the 41. Thus the driver of 41 has minimum glare while the driver of 47 has maximum light.”), [0028]-[0029].) *See also supra* Claim 1[D], 1[F].

8. Dependent 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.

Alden anticipates and renders obvious Claim 10 for the reasons discussed above. *See supra* Claims 1[C], 1[E]. For example, Alden discloses that its sensors

detect the headlights of an “oncoming vehicle.” (Alden [0025]; *see also* [0026]-[0027], Figs. 1-3; Papanikolopoulos Decl., ¶108.)

9. Dependent Claim 11

The headlight system of claim 1, further including a computer vision 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/processor is further configured to modify the headlight beam to change illumination of the identified entity.

Alden anticipates and renders obvious Claim 11. (Papanikolopoulos Decl., ¶109.) Alden’s headlight system includes a “computer vision processing unit” with its logic CPU 71 and control circuitry 55. (Alden, [0027], Fig. 3; *see also* Figs. 11-13.) The logic CPU 71 and control circuitry 55 receive data from photodiode or CCD detector arrays 51, and use this data with algorithms (such as shown in Figure 4) to identify vehicles in the light distribution area in front of a vehicle. (*Id.*, [0027]-[0028], Figs. 3-4.) Alden further discloses that the logic CPU 71 and control circuitry 55 are configured to modify the output of the segmented headlight beam such that any detected vehicles in the light distribution area are illuminated with dimmed beams. (*Id.*, [0027]-[0028]; *see also* [0025]-[0026], [0029].) *See also supra* Claim 7.

10. Dependent 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.

Alden anticipates and renders obvious Claim 12. (Papanikolopoulos Decl., ¶110.) As discussed above, Alden discloses that a headlight beam is created that provides the driver of the vehicle with high visibility in portions of the distribution area where no other vehicles are detected (“second subsection”), while mitigating glaring illumination projected to reach the eyes of another driver by having dimmed, low beams in portions of the distribution area where the other vehicle was detected (“first subsection”). *See supra* Claims 1[E]-1[F]. (*See also* Alden, [0027] (“The 55a controls the power flow from 73 to a left segmented headlight 83 which distributes high beams throughout its distribution areas except in a box in the direction of the 41 [other vehicle]. Similarly, the 55b controls the power flow from 73 to a right segmented headlight 83 which distributes high beams throughout its distribution areas except in a box in the direction of the 41. Thus the driver of 41 has minimum glare while the driver of 47 has maximum light.”), [0025]-[0026], [0028]-[0029].)

11. Dependent 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.

Alden anticipate and renders obvious Claim 13. (Papanikolopoulos Decl., ¶111.) As discussed above, Alden’s system detects light from oncoming vehicles. *See supra* Claims 1[C], 1[F]. The headlight beam of Alden is modified to reduce glare to the oncoming vehicle, while maintaining high-beam illumination in other portions of the light distribution area. (*See, e.g.*, Alden, [0027].) Because the high-beam illumination is maintained in the other portions of the light distribution area, the range of this high-beam illumination is not diminished. (Papanikolopoulos Decl., ¶111.)

12. Dependent 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.

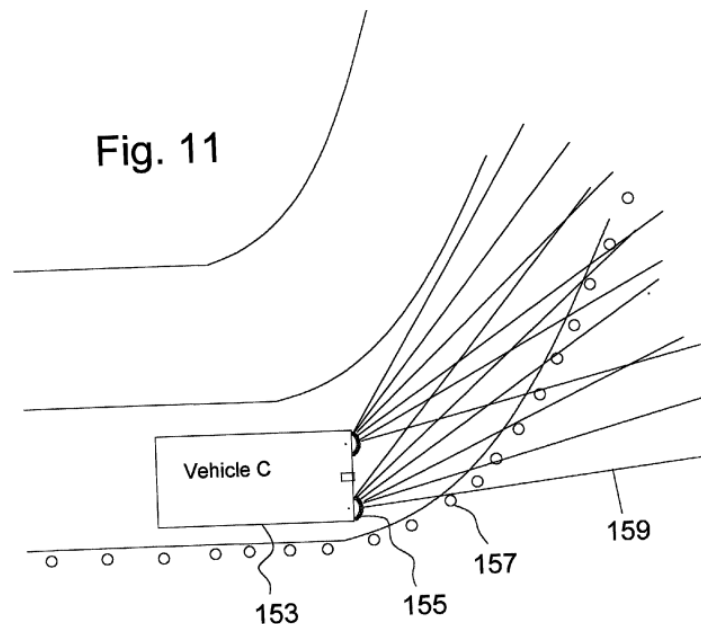
Alden anticipates and renders obvious Claim 14. (Papanikolopoulos Decl., ¶112.) Alden discloses that its sensors include a camera (lens and photodiode array or CCD) that detects electromagnetic radiation (photons) of visible light from other vehicles. (Alden, [0026]-[0027].) Specifically, Alden discloses a “sensor unit 45” including a “lens 49” and “detector array 51” that may be a photodiode array or CCD, sensing information regarding “emitted light 43” from other vehicles. (*Id.*, [0026].) *See also supra* Claim 1[E]. Alden additionally notes that “[m]any light

detector (wherein electromagnetic radiation is converted to an electric signal) techniques can be used herein as sensors, for example, photodiode, CCD etc.” (*Id.*, [0061].)

13. Dependent Claims 15, 21, 32-33

15 / 21: The system of claim [1 / 20], wherein the [logical controller / processor] 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 / to direct the control circuitry to adjust the directional light sources] in a direction of the road curvature.

Alden anticipates and renders obvious Claims 15 and 21. (Papanikolopoulos Decl., ¶¶113-114.) Alden discloses that “the present invention,” namely its segmented headlight system, can be used to “concentrate light to look around corners in response to road conditions”:



(Alden, [0036], Fig. 11.) As shown, Alden discloses that a vehicle with the “segmented sensing elements and segmented light distribution elements described herein” can “sense[] that the road turns by receiving light from reflectors such as a reflector 157.” (*Id.*, [0036].) Alden’s “sensing elements” include left and right sensors to detect such light and a CPU to process this data and instruct the control circuitry and LEDs accordingly. (Alden, Figs. 3-5, [0027]-[0029].) This data is, in particular, used by the CPU and control circuitry to adjust the LEDs “responding headlights 155” (such as, for example, those shown in Figure 5 pointed in the direction of the reflectors) so that they “direct light into the corner to maximize the driver’s ability to see there.” (*Id.*, [0036], [0026]-[0029]; Papanikolopoulos Decl., ¶113.) *See also supra* Claim 1[D], 1[F]. By directing light into the corner, or curve of the road, to maximize the driver’s ability to see there, the system is increasing illumination in the direction of the curve. (Papanikolopoulos Decl., ¶113.)

Additionally, Alden discloses that its system can include a “rotation sensor” in the steering wheel that can further detect when a vehicle is planning to turn. (Alden, [0039]-[0040], Figs. 14-15.) As the steering wheel “rotates ‘x’ degrees,” the system calculates the new planned direction of the vehicle and “changes the direction of the headlight output 197 a corresponding ‘f(x)’ degrees.” (*Id.*) Thus, when a driver turns her steering wheel before moving, in anticipation of an

upcoming turn, Alden’s system “increases illumination illuminating the turn.”

(Papanikolopoulos Decl., ¶114.)

32 / 33: The method of claim [26 / 32], wherein the determining illumination requirements further includes determining illumination for an upcoming [curve / turn] indicated by the sensor data, wherein the determining the control strategy further comprises determining the control strategy for controlling the directional light clusters to create an output headlight beam that illuminates around the [curve / turn].

Alden anticipates and renders obvious Claims 32-33. (Papanikolopoulos Decl., ¶115.) *See supra* Claims 15, 21. Again, Alden discloses that its sensors “sense[] that the road turns by receiving light from reflectors such as a reflector 157,” and that “directing of light can be achieved with the segmented sensing elements and segmented light distribution elements described herein.” (Alden, [0036].) As discussed above, this includes determining a control strategy for the lighting elements, such that high intensity light is directed to segments intended to illuminate the turn. (*Id.*, [0027]-[0029], [0036]; *see also* [0039]-[0040] (discussing controlling direction of the headlight beam based on senses steering wheel angle.) *See also supra* Claims 1[F], 26[B]-[C].

14. Dependent Claims 16-17, 22-23, 34-36

16 / 17: The system of claim [15 / 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.

Alden anticipates and renders obvious Claims 16-17. (Papanikolopoulos Decl., ¶¶116-117.) *See supra* Claims 15, 21. As discussed, Alden's system can sense when a road curves in front of a vehicle, such that the vehicle must turn, based on sensor data detecting reflectors 157 along the road. (Alden, [0036], Fig. 11.) Alden further discloses increasing the illumination illuminating the turn, directing light "into the corner to maximize the driver's ability to see there." (*Id.*)

Additionally, Alden discloses that its system can include a "rotation sensor" in the steering wheel that can further detect when a vehicle is planning to turn. (Alden, [0039]-[0040], Figs. 14-15.) As the steering wheel "rotates 'x' degrees," the system calculates the new planned direction of the vehicle and "changes the direction of the headlight output 197 a corresponding 'f(x)' degrees." (*Id.*) Thus, when a driver turns her steering wheel before moving, in anticipation of an upcoming turn, Alden's system "increases illumination illuminating the turn." (Papanikolopoulos Decl., ¶117.)

22 / 23: The system of claim [21 / 20], wherein the processor is further configured to determine at least a planned upcoming turn, indicated by the sensor data, and to direct the control circuitry to increase illumination illuminating the turn.

Alden anticipates and renders obvious Claims 22-23. *See supra* Claims 16-17. (*See also* Papanikolopoulos Decl., ¶118.)

34 / 36: The method of claim [32 / 26], wherein the determining illumination further includes determining illumination the increases illumination of an upcoming turn indicated by the sensor data, wherein the determining the control instructions further comprises determining the control instructions for controlling one or more of the directional light sources to achieve illumination of the turn.

35: The method of claim 26, wherein the determining illumination requirements further includes determining illumination for an upcoming turn indicated by the sensor data, wherein the determining the control strategy further comprises determining the control strategy for controlling the directional light clusters to create an output headlight beam that illuminates the turn.

Alden anticipates and renders obvious Claim 34-36. *See supra* Claims 16-17, 22-23. (See also Papanikolopoulos Decl., ¶119.)

15. Dependent Claims 19, 25

19 / 25: The system of claim [1 / 20], wherein at least one of the one or more headlamps further includes at least one of reflectors, refractors, or lenses usable to alter emitted light from at least one of the light [clusters / sources].

Alden anticipates and renders obvious Claims 19 and 25. *See supra* Claim 2[C] (Alden using lenses and refractors to alter light). (See also Papanikolopoulos Decl., ¶120.)

16. Dependent Claim 27

The method of claim 26, wherein the determining illumination requirements further comprises: determining the illumination requirements based on headlight modes comprising one or more of parking lights, low beam, high beam, cornering lights, load leveling adjustment, integral turn signal indicators,

inputtable alternate beam pattern selection, and specified preferential headlight illumination color of the driver.

Alden anticipates and renders obvious Claim 27. (Papanikolopoulos Decl., ¶121.) Alden discloses determining the headlight illumination requirements based on headlight modes comprising “low beam” and “high beam.” *See supra* Claims 1[B], 1[F]. Alden further discloses determining the headlight illumination requirements based on headlight modes comprising “cornering lights.” *See supra* Claims 15, 21.

17. Dependent Claim 30

The method of claim 26, wherein the control strategy dynamically adapts the headlight beam based on real-time changes to the data sensed by the sensors indicating a change to at least one of beings, objects and preceding vehicles ahead of the first vehicle.

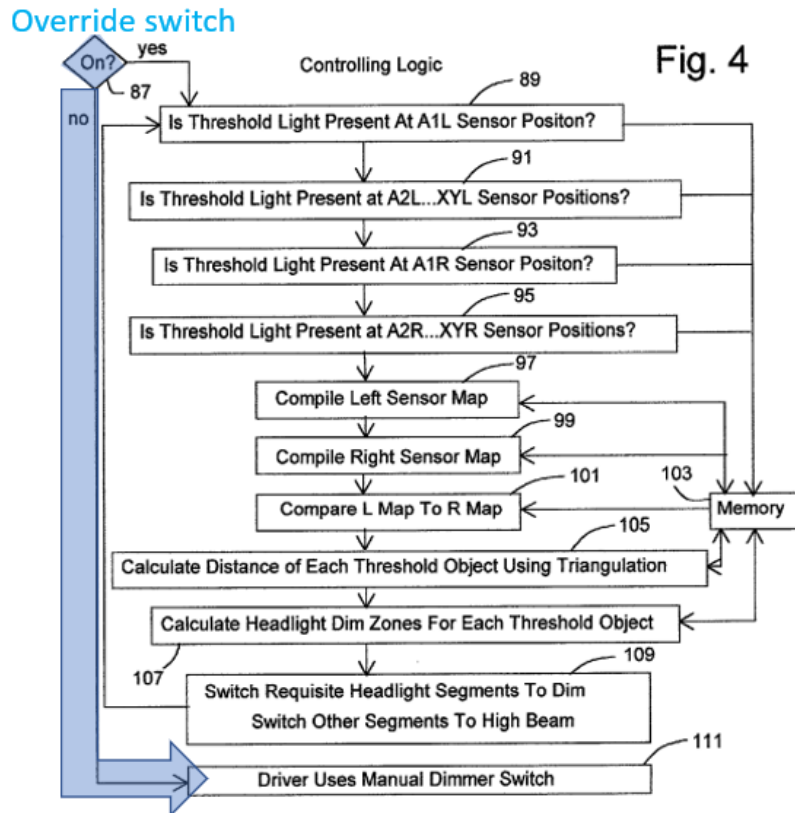
Alden anticipates and renders obvious Claim 30. (Papanikolopoulos Decl., ¶¶122-123.) Alden’s sensors detect data indicating the presence of at least another vehicle and driver, which information is then used to determine a control strategy for the output of the headlight beam. *See supra* Claims 26[A], 26[E]. Alden further discloses that, after the process determines the light intensity for each lighting element (*e.g.*, whether it is emitting dimmer low beam light or high beam light), the “process then begins again so as to be ***responsive to changing*** environmental conditions in ***real time***.” (Alden, [0028].) Thus, where the position or presence of “beings” and “objects” (detected other vehicles and their drivers) changes, Alden

dynamically adapts the headlight beam in real-time based on the changing positions or presence of other vehicles. (Papanikolopoulos Decl., ¶123.) *See also supra* Claim 8.

18. Dependent Claim 31

The method of claim 26, further comprising receiving input to an override switch and, responsive to the input, adjusting automatic operation of the headlight system to reflect operator instruction as indicated by the input to the override switch or by further input to a different vehicle input other than the override switch.

Alden anticipates and renders obvious Claim 31. (Papanikolopoulos Decl., ¶124.) In Alden, “a user controlled switch 87 gives the user the ability to select whether the system is in auto mode (on) or manual mode (off). If the system is off, the user controls the headlights via a manual dimmer switch 111.” (Alden, [0028].)



(*Id.*, Fig. 4 (annotated).)

That is, when the user turns the switch 87 to off, overriding the operation of the automatic headlight mode, the system changes its operation to change manual mode, where the driver uses a manual dimmer switch. (*Id.*, [0028], Fig. 4.) When the switch 87 is on, lights are controlled via the automated process discussed in detail above. *See supra* Claim 26.

This is identical to how the '503 describes its “override switch.” (*See, e.g.*, '503, 52:23-26 (“Input data to the controller would first and foremost be in the control of the driver and would consist of an overriding manual selector switch. Otherwise headlamp control is automatic.”); Papanikolopoulos Decl., ¶124.)

**B. Ground 2 – Alden in view of Harbers Renders Obvious
Dependent Claims 5 and 28-29**

WO2001/001038A1 (EX1006) (“**Harbers**”) published on January 4, 2001, and is prior art under at least § 102(b). Harbers, like Alden, is directed to vehicle headlamp systems to selectively control illumination of different areas in front of a vehicle to maximize driver visibility. (Harbers, Abstract, 5:14-7:19). Similar to Alden, Harbers discloses vehicle headlights made up of a plurality of controllable LEDs, which include color LEDs that can be controlled to generate different colors (“spectral characteristics”) and spatial distributions of light in response to sensed conditions. (*Id.*, 2, Figs. 1B-4B, Claims 1, 9; *see also* Papanikolopoulos Decl., ¶¶125-126.)

1. Dependent Claim 5

The headlight system of claim 1, wherein at least one of the light-clusters includes: [a] 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, [b] 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.

Alden in view of Harbers renders Claim 5 obvious. (Papanikolopoulos Decl., ¶¶127-131.) Alden’s light clusters can include a plurality of **LEDs**. (Alden, Fig. 5, [0029].) *See supra* Claim 1[B]. Alden further discloses that each LED has power distribution characteristics, and that control circuitry is configured to alter these

characteristics (e.g., overall light-cluster power distribution) to illuminate different portions of the headlight distribution area with different light intensities. (Alden, [0029].) *See also supra* Claim 1[B], 1[D], 1[F]. Alden does not explicitly disclose, however, that the “spectral” power of its LEDs can be controlled to illuminate the headlight distribution area with different colors—that is, while Alden specifically mentions that its system can use “white LEDs” and “*alternate lighting mechanisms*,” it does not expressly say that these “alternate lighting mechanisms” include *colored* LEDs. (Alden, [0029].)

Harbers, in the same field as Alden, similarly discloses vehicles with headlamps having a plurality of controllable LEDs. (Harbers, 2:1-32, Figs. 1B-2.) Each headlamp has light sources 4, 5 that emit beams “subdivided into four beam segments 6, 6’, 6’’, 6’’’, 7, 7’, 7’’, 7’’’.” (*Id.*, 6:28-7:19, Fig. 1B.) The light sources producing the beams may comprise “a plurality of light-emitting-diodes (LEDs),” such as “an array of 8x3 LEDs.” (*Id.*, 8:10-20.) This LED array may include red, green, blue, and yellow LEDs, which can be controlled such that different beam segments have different “spectral characteristics,” *i.e.*, colors. (*Id.*, 8:21-10:20, Figs. 1B, 2, 3A-4B.)

Harbers explains that controlling the spectral characteristics of each beam segment can improve visibility. (*Id.*) For example, “to improve the visibility of the surroundings of the vehicle 1, a substantially different spectral characteristic of the

light beam is brought about between the on-axis parts [*e.g.*, in front of the driver] and the off-axis parts [*e.g.*, to the side of the driver] of the light beam. In particular, in the off-axis beam segment 6', 7' of the light beam, the spectral characteristic of the light is adapted to a light intensity which is relatively low ... This can be achieved by providing the *first beam segment 6; 7 and the third and fourth beam segments 6'', 6''' ; 7'', 7''' with a spectral characteristic which is rich in white or yellow-orange light and by providing the second beam segment 6', 7' with a spectral characteristic which is rich in blue-green light.* By thus rendering the spectral characteristic of the light beam generated by the light source dependent upon the position in the light beam, objects situated outside the center of the light beam are better observed.” (*Id.*, 9:28-10:5; *see also* 2:33-3:10, 4:33-5:26, 6:1-7, 9:1-27, 5:21-26.)

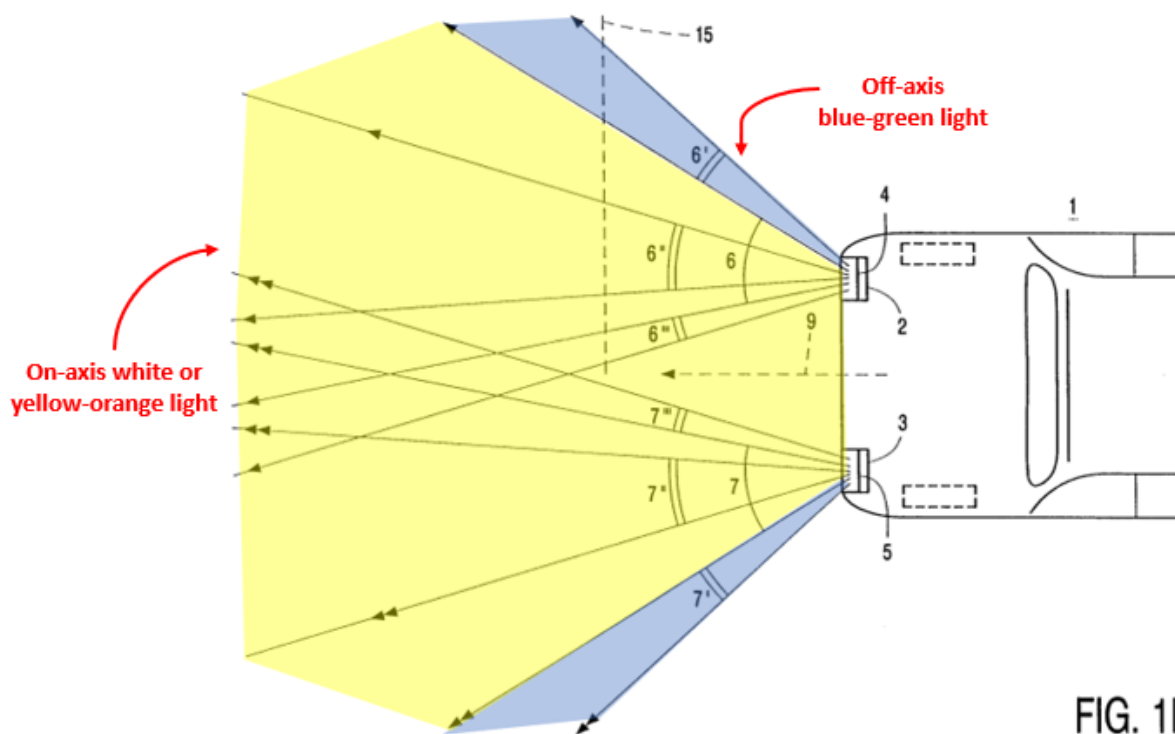


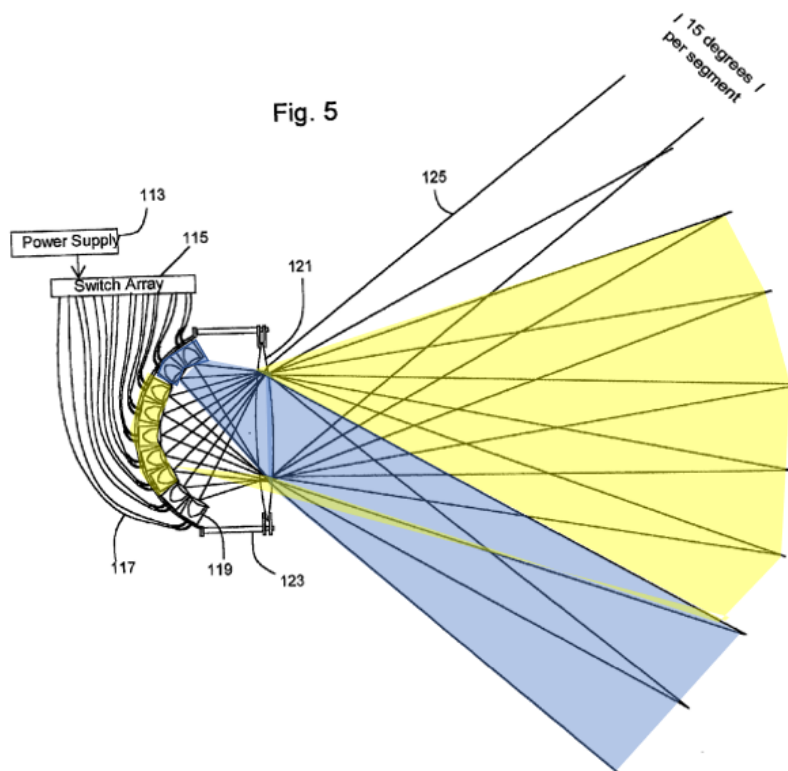
FIG. 1B

(*Id.*, Fig. 1B (annotated).)

It would have been obvious to apply the teachings of Harbers and use color LEDs in the system of Alden, selectively controlling such LEDs to create beam segments with different spectral intensities (or colors) in different portions of the headlight distribution area. (Papanikolopoulos Decl., ¶130.) Both Alden and Harbers are directed to headlamp systems that include LED arrays configured to direct beams of light having different characteristics into different areas in front of the vehicle. (*See, e.g.*, Alden, Figs. 2, 5; Harbers, Figs. 1B, 2.) Moreover, both disclose control circuitry to adjust the power distribution of individual LEDs to change output characteristics of the light. (Papanikolopoulos Decl., ¶130.)

Therefore, using color LEDs as described in Harbers in the LED array and control system in Alden would have merely been the implementation of a known device (color LED arrays) for its intended purpose in a similar system already designed for use with “white LEDs” and “alternate lighting mechanisms.” (*Id.*)

Moreover, the color LEDs from Harbers would perform their same function if implemented in the system of Alden, and the system of Alden would likewise perform its same function of adjusting illumination of different portions of a headlight distribution area. (*Id.*, ¶131.) However, Alden would now provide the ability to control not just intensity and direction of light from the LEDs, but also color as well (that is, an additional “lighting characteristic”). (*Id.*) A POSITA would have been motivated to include color LEDs in the system of Alden so that, for example and as taught by Harbers, off-axis and on-axis beam segments have different spectral characteristics so that objects “situated outside the center of the light beam are better observed.” (Harbers, 9:28-10:5; *see also* 2:33-3:10, 4:33-5:26, 6:1-7, 9:1-27, 5:21-26.) Indeed, this could be easily achieved by including particular color LEDs, as taught by Harbers, at particular locations along the curve in Alden’s Figure 5 headlight to produce “blue” light in portions of the beam that are off-axis and directed toward the side of the road, while including yellow light in the main, on-axis portions of the headlight distribution area:



(Alden, Fig. 5 (annotated).)

2. Dependent Claim 28

The method of claim 26, wherein the illumination requirements accommodate peripheral night vision of the driver, by defining bluish headlamp illumination along a side of a road, while defining yellow tinted illumination along the road.

Alden in view of Harbers renders Claim 28 obvious. (Papanikolopoulos Decl., ¶¶132-133.) Harbers discloses providing different segments of illumination to improve the driver's view of the road and vehicle surroundings. (Harbers, 2:1-32, Figs. 1B-2.) Harbers adds that factors including whether it is "day or night" can impact driver vision and should be taken into account when forming different light distribution beams in areas ahead of the vehicle. (Harbers, 2:1-33.) Harbers further

discloses that the driver's "off-axis" viewing, or peripheral vision, of "objects situated at or near the edge of the field of vision of driver," such as the shoulder of the road or objects on the edge of the road, can be enhanced by providing blue color beams along the side of road and yellow color beams along the road itself. (*Id.*, 2:33-3:10, 4:33-5:26, 6:1-7.) In particular, Harbers discloses that by providing "yellow" light in the on-axis beam segments illuminating along the road, along with "blue-green" light in off-axis beam segments, "objects situated outside the center of the beam are better observed." (*Id.*, 9:28-10:5; *see also* 2:33-3:10, 4:33-5:26, 6:1-7, 9:1-27, 5:21-26.)

As discussed above, it would have been obvious to apply these teachings to Alden's system to include color LEDs and produce blue light in off-axis areas along the side of the road and yellower light in the center portion of the headlight distribution area. *See supra* Claim 5. (Papanikolopoulos Decl., ¶133.) For example, a POSITA would have been motivated to use color LEDs and produce blue and yellow beam segments to improve driver vision in all areas, including along the side of the road. (Harbers, 10:6-14.) Such would ensure that, as taught by Harbers, objects along the road can be better observed (*i.e.*, "accommodat[ing] peripheral night vision of the driver"). (Papanikolopoulos Decl., ¶133.) Moreover, such use of color LEDs would have been the simple substitution of one known element (color LEDs) for another (generically-recited LEDs) in a similar system, which system

would now have the ability to control an additional lighting characteristic to further improve driver visibility. (*Id.*)

3. Dependent Claim 29

The method of claim 26, wherein the illumination requirements accommodate sensed fog or snow environmental conditions by defining a shift of at least a portion of the headlight beam towards yellow.

Alden in view of Harbers renders Claim 29 obvious. (Papanikolopoulos Decl., ¶¶134-135.) Harbers discloses altering its lighting based on fog and snow: “Under unfavorable weather conditions, in particular fog and snow, when visibility is reduced by backscattering caused by fog or snow particles, both the ***configuration and the spectral composition*** of the light beams generated by the light source 4, 5 ***can be adapted*** by activating different combinations of LEDs and by changing the output levels of the various LEDs. As a result of these adaptations, the spatial and/or spectral distribution of the light is changed. ***An example of such an adaptation*** is shown in Fig. 4A, wherein a relatively ***wide beam 16*** is obtained which is ***substantially composed of yellow light***. The absence of the blue component in the visible light causes the effect of backscattering to be substantially reduced.” (Harbers, 10:6-14.)

It would have been obvious to apply these teachings to Alden, and thereby use colored LEDs and adjust the color of those LEDs in areas in the field-of-view, for the reasons discussed above. *See supra* Claim 5. For example, applying these

teachings would enable Alden to produce yellower light in the area in front of the driver when rain or snow are sensed, as taught by Harbers. (Papanikolopoulos Decl., ¶135.) A POSITA would have been motivated to change this portion of the light distribution to yellower light in order to increase visibility and avoid backscatter under these conditions. (Harbers, 10:6-14.)

C. Ground 3 – Alden in view of Bergkvist Renders Obvious 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.

Alden in view of US4970628 (EX1007) (“**Bergkvist**”) renders Claim 6 obvious. (Papanikolopoulos Decl., ¶¶136-137.) Bergkvist issued on November 13, 1990, and is prior art under at least § 102(b). Bergkvist discloses a vehicle having a headlamp beam with different lobes, including a “full beam lobe” and a “dipped lobe.” (Bergkvist, Abstract, 2:7-23, 2:40-60, 3:66-4:44.) Bergkvist further discloses that when a “dipped” beam is used to reduce glare (or “dazzle”) to oncoming vehicles, there may not be sufficient illumination of roadside objects like signs. (*Id.*, 1:5-38.) To ensure sufficient illumination, Bergkvist discloses a headlight that produces both visible light ***and ultraviolet (UV) light***, so that roadside objects (such as signs) “glow” when illuminated with UV. (*Id.*, Abstract, 2:7-23, 2:40-60, 3:66-4:44.) Bergkvist discloses that by including a UV light source in the headlight, the driver will “observe” objects like road signs and

pedestrians “despite said objects being located in an area not irradiated by visible light.” (*Id.*, 4:4-44.)

It would have been obvious to apply Bergkvist’s teachings to include a UV light source in Alden’s system, so as to better illuminate roadside objects, like road signs in areas where there is little or no visible light projected, without causing glare to other drivers or pedestrians. (Papanikolopoulos Decl., ¶137.) Including such a UV light source would have been well within the skill of a POSITA, as it would merely add a known element for its intended purpose in a headlight that is already made up of a plurality of light sources and that can already use a variety of “lighting mechanisms.” (*Id.*) Moreover, a POSITA would have been motivated to include at least one UV light source in the array of Alden in order to have light outside the visible range, such that it is not distracting to other drivers or pedestrians but can still illuminate reflective materials such as road signs or markings. (*Id.*)

D. Ground 4 – Alden in view of Beam Renders Obvious Claims 8, 18, and 24

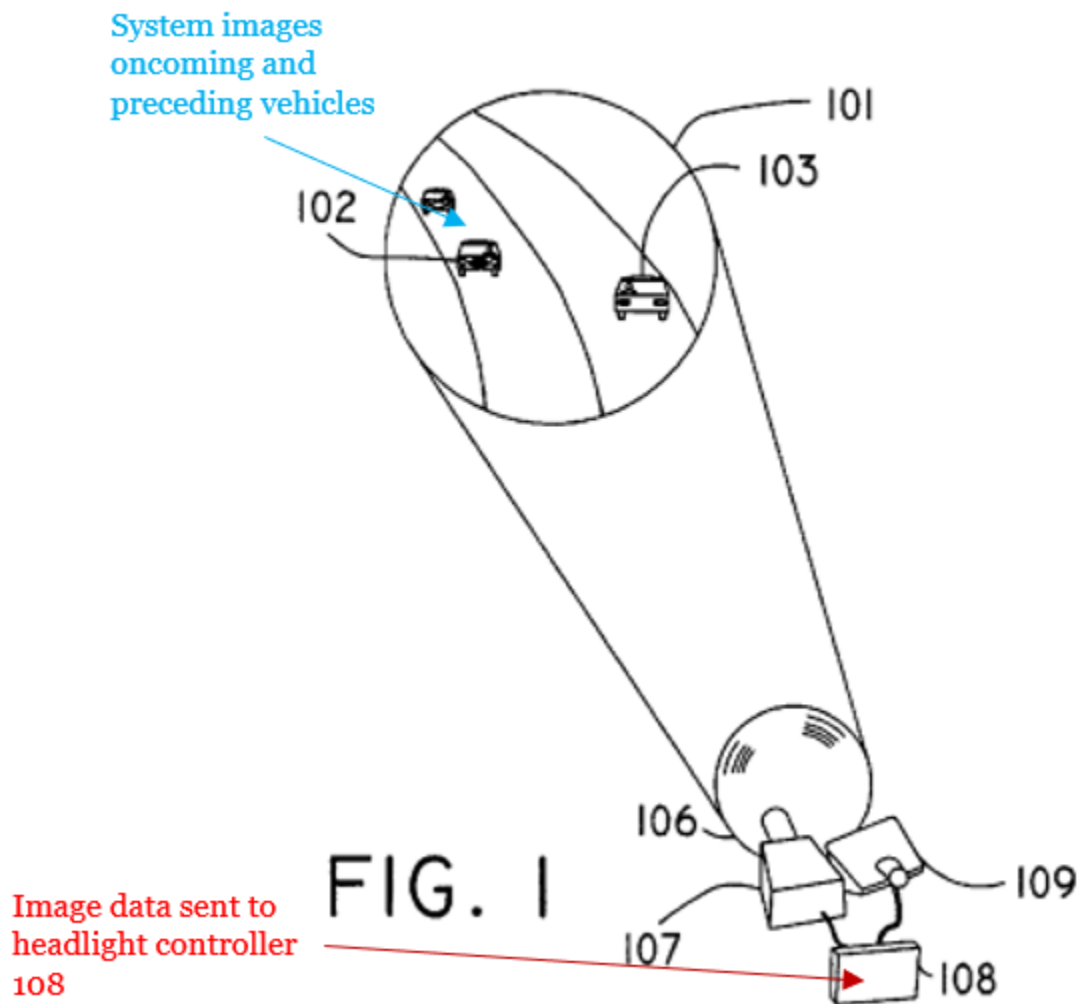
1. Dependent Claim 8

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.

Alden in view of US6144158 (EX1008) (“**Beam**”) renders Claim 8 obvious. (Papanikolopoulos Decl., ¶¶138-144.) Beam issued on November 7, 2000, and is prior art under at least § 102(b). Dependent Claim 8 is nearly identical to dependent Claim 7, but says that instead of detecting an oncoming vehicle, the system detects a “preceding vehicle” and adjusts the beam to decrease at least one “vision-disturbing characteristic” (*e.g.*, glare) to the driver of that vehicle. (*Id.*, ¶138.) Alden discloses the elements of Claim 8 for the same reasons as Claim 7, except only expressly mentions detecting lights of an “oncoming vehicle” and reducing glare for the driver of that vehicle. *See supra* Claim 7.

Like Alden, Beam discloses a system controlling headlight output patterns in particular areas to eliminate “the blinding of a driver in an oncoming vehicle, while continuing to provide intense forward illumination.” (Beam, Abstract, 1:5-19.) Beam describes a vehicle headlamp system that uses a “sensor 107” to detect light from other vehicles. (Beam, 4:9-59, 5:3-16, Claims 1-6, Figs. 1-2, 4.) The sensor data is used by controller 108 to adjust the output of a plurality of individually-controlled light sources, or “microbeams,” making up the headlight beam, in order to attenuate beams directed to detected vehicles. (*Id.*)



(*Id.*, Fig.1 (annotated).)

Beam recognizes that headlights can cause glare, or “dazzle,” that impacts not only drivers of oncoming vehicles, but also drivers of preceding vehicles “when reflected by a rear-view mirror.” (*Id.*, 4:9-25, 4:45-59, 6:61-7:8.) Thus, Beam discloses that lights from both the headlights of oncoming vehicles and the tail lights of preceding vehicles can be detected, and the output of the headlight controlled to darken light directed to the areas of the sensed oncoming and

preceding vehicles. (*Id.*, 4:9-25, 4:45-59, 5:61-6:8, 6:61-7:8.) For example, Beam discloses a system that “automatically sens[es] the presence and location of headlights *and taillights* ahead of the car on which it is mounted,” and then controls “the light output” of an overall headlight beam so that “the area of the beam that would dazzle the driver will be darkened, while maintaining full intensity elsewhere.” (*Id.*, 2:54-65.)

It would have been obvious to a POSITA to modify Alden to detect headlights of oncoming vehicles and taillights of preceding vehicles, and to dim headlight beam output directed to areas of both oncoming and preceding vehicles as taught by Beam. (Papanikolopoulos Decl., ¶142.) Both Alden and Beam are directed to controlling headlight beams to reduce glare for other drivers by dimming the headlights in areas occupied by detected vehicles. (*Id.*) And both accomplish this by detecting lights from other vehicles using a sensor, determining the locations of other vehicles based on the detected lights, and controlling the output of an array of light sources so that beams directed to the other vehicles are dimmed. (*Id.*)

Thus, modifying Alden to dim headlight beams directed to a portion of the area where preceding vehicles are present would have merely required the continued use of Alden’s existing system and components for their intended purpose. (*Id.*, ¶143.) A POSITA would have recognized that taillights can be

detected in the same way the Alden system detects the headlights of oncoming vehicles—by using the left and right sensors (51a, 51b) to detect light and determine another vehicle is present at the location of the sensed light when it is “above a threshold intensity or distance.” (Alden, [0027]-[0028].) That is, modifying Alden to reduce glare for oncoming vehicles, as well as preceding vehicles, would require no additional equipment or changes in processing. (Papanikolopoulos Decl., ¶143.)

Moreover, a POSITA would have a reasonable expectation of success, as the system of Alden would continue to perform the same function, using the same components, and would produce the same result, namely, using the sensors in concert with headlamps to increase illumination for a driver while reducing glare for drivers of other vehicles nearby. (*Id.*, ¶144.) And a POSITA would have been motivated to check for preceding vehicles in addition to oncoming vehicles, as taught by Beam, as the purpose of Alden is to control the headlights so that the driver’s vision is maximized with high beams in areas with no other vehicles, while “all areas with other drivers present receive low beams so as to minimize the glare for to betterment of other drivers.” (Alden, Abstract; Papanikolopoulos Decl., ¶144.)

2. Dependent Claims 18, 24

18 / 24: *The system of claim [1 / 20], wherein at least one light source provided to at least one headlamp includes a laser diode.*

Alden in view of Beam renders Claims 18 and 24 obvious.

(Papanikolopoulos Decl., ¶¶145-147.) As explained, Beam, like Alden, discloses a system controlling headlight output patterns in particular areas to eliminate “the blinding of a driver in an oncoming vehicle, while continuing to provide intense forward illumination,” which system can include sensors and a plurality of individually-controlled light sources. *See supra* Claim 8. Beam further discloses that its light sources can include LEDs or an array of lasers (*i.e.*, “laser diodes”). (Beam, Claims 4-5; Papanikolopoulos Decl., ¶146.) Thus, Beam recognizes that LEDs and lasers, which are emitted from laser diodes, are alternative known “lighting mechanisms” that can be used in an array to generate a controllable headlight beam. (*Id.*, ¶146.)

It would have been obvious to a POSITA to modify Alden to include laser diodes as the light sources. (*Id.*, ¶147.) As taught by Beam, laser diodes and LEDs were known alternative components, each capable of being individually controllable light sources that can be used in arrays for headlight beams. (*Id.*) Thus, using laser diodes instead of LEDs as the light sources in Alden would have simply been the replacement of one known component for another. (*Id.*) Alden expressly contemplates this, teaching that its lighting elements can be “white LED”

or an “*alternate lighting mechanism*.” (Alden, [0029].) Moreover, a POSITA would have a reasonable expectation of success in using laser diodes instead of LEDs, as the system of Alden would continue to work the same if laser diodes were used. (Papanikolopoulos Decl., ¶147.) For example, the system would continue to sense the lights from other vehicles and adjust light outputs in different portions of the headlight distribution area in response, by controlling individual lighting elements as disclosed in Alden. (*Id.*, ¶147.)

E. Ground 5 – Alden in view of Kobayashi Renders Obvious Claim 9

The headlight system of claim 1, wherein the one or more sensors includes a GPS sensor.

Alden in view of US6,049,749 (EX1009) (“**Kobayashi**”) renders Claim 9 obvious. (Papanikolopoulos Decl., ¶¶148-151.) Kobayashi issued on April 11, 2000, and is prior art under § 102(b). Kobayashi is titled “Lighting device for a vehicle” and, like Alden, is directed to vehicle headlamp systems including detection of positioning along a road. (Kobayashi, Abstract, 1:5-8.) Kobayashi discloses that a “GPS navigation device 29 sends information about the road profile and the present vehicle position to ECU 10.” (*Id.*, 17:39-40, Fig. 12; *see also* Fig. 1, 2:28-50.) Kobayashi further discloses that “when the vehicle advances along a scheduled course, irradiation control of the lamp is conducted in accordance with the course concerned.” (*Id.*, Fig. 10, 15:6-28, 17:41-67; *see also* Fig. 9, 11:34-14:52, Fig. 1, 3:9-5:28, Fig. 12, 17:3-67.)

It would have been obvious to a POSITA to apply the teachings of Kobayashi and include a GPS sensor in the system of Alden. (Papanikolopoulos Decl., ¶149.) Both are directed to the same function and perform the same result—Alden discloses directing light based on detecting an oncoming road turn or curve (Alden, [0036], [0039]-[0040]), and Kobayashi similarly discloses controlling headlights based on the upcoming direction of the vehicle. (Kobayashi, 18:1-14.) Further, a POSITA would have been motivated to applying the teachings of Kobayashi to Alden. (Papanikolopoulos Decl., ¶149.) Alden details how a headlight system can use sensors to sense light from reflectors located along a curve in a road, to detect road curvature, and adjust the headlights in view of this. (Alden, [0036], Figs. 11.) Additionally, Alden discloses that a steering wheel sensor can be used to determine the direction the vehicle is traveling and adjust light accordingly. (*Id.*, [0039]-[0040], Figs. 14-15.) Kobayashi makes clear that this same detection of road curvature can be performed with a GPS with the same result. (Kobayashi, 17:39-40.)

A POSITA would have thus been motivated to combine Alden's techniques with Kobayashi's teaching of using GPS to maximize successful detection of road curvature in different environments. (Papanikolopoulos Decl., ¶150.) Alden already recognizes that different techniques, such as light reflector along a road curve and steering wheel sensors, can be used to sense road curvature and turns

and the direction the vehicle is going to travel. (Alden, [0036], [0039]-[0040].) Thus, a POSITA would have been motivated to include additional, known techniques for sensing road curvature, such as Kobayashi's teachings of GPS. (Papanikolopoulos Decl., ¶150.) A POSITA would have understood that using GPS gives the same information with even better prediction and lead time on upcoming curves and turns ahead of a vehicle as Alden's method of using sensed roadside reflectors. (*Id.*)

Moreover, it would have been obvious to modify Alden to include the use of GPS as taught by Kobayashi, so that the system could work in areas where, for example, reflectors are not included along every road curve or such reflectors would not be reliably detected by the vehicle's light sensors. (*Id.*, ¶150.) Installing such road reflectors along all roads would be expensive, and it could be impractical in some areas, like urban environments, where there may not be a place for such reflectors to be installed such that they could be recognized. (*Id.*) However, as taught by Kobayashi, using GPS information received within the vehicle itself allows the system to determine upcoming curves and turns and adjust the light accordingly, without requiring any additional infrastructure external to the vehicle. (*Id.*) A POSITA would understand that the systems are complementary, as both Alden and Kobayashi disclose sensor data fed to a controller, which then controls lighting. (*Id.*)

A POSITA would have had a reasonable expectation of success of including a GPS in the system of Alden, as Alden’s system discloses the use of a CPU to process sensor and control vehicle lighting accordingly. (*Id.*, ¶151.) A POSITA would have thus expected that Alden’s CPU could synthesize multiple sources of information, such as data regarding both roadside light reflectors and oncoming vehicles. (Alden, [0025]-[0026], [0036], [0039]-[0040].) It would have thus been obvious to include the GPS sensor feeding information regarding road profile from Kobayashi into the system of Alden to further control lighting around road curvatures. (Papanikolopoulos Decl., ¶151.)

IX. TRIAL SHOULD BE INSTITUTED

A. *Fintiv* Factors

The Board should institute review because Petitioner has been diligent in filing its Petitions and the circumstances surrounding the parallel district court cases do not warrant discretionary denial under § 314(a). *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 11-21 (Dec. 1, 2020) (precedential) (citing *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar 20, 2020) (precedential)). These cases are in the early stages: there is no case schedule; fact discovery has not taken place; no *Markman* or substantive proceedings have taken place; and no trial date is set. Further, the cases have been indefinitely stayed ***by agreement of the parties*** pending investigation into whether the plaintiff,

Torchlight Technologies, has standing. *See, e.g., Torchlight Techs., LLC v. Daimler AG, et al.*, No. 1:22-CV-751, D.I. 124-125 (Apr. 19, 2023 and Apr. 20, 2023, respectively). Given the foregoing, it is speculative that any court will address the distinct invalidity challenges raised in this Petition.

B. 35 U.S.C. § 325(d)

The Board should decline to exercise discretion under § 325(d).

First, Claims 1-36 are each subject to only one other IPR challenge. Those challenges were brought by an entity unrelated to and that competes with Petitioner: Volkswagen. Torchlight Technologies has accused different products of Petitioner and Volkswagen of infringement, such that there are distinct issues in the (alleged) infringement proceedings between Petitioner and Volkswagen. *Id.*, D.I. 97 at ¶¶ 49-57 (accusing Mercedes' 84 LED multi-row headlamp system), 74-82 (accusing Audi's Matrix system). It is also speculative to assume, at the institution deadline of this Petition, that Volkswagen's IPR challenges against the '503 will ultimately reach a Final Written Decision. Over a quarter of all IPRs settle before Final Written Decision. *See* EX1010 at 9.

Second, significantly, the prior art asserted herein, including Alden in particular, was never considered by the Examiner, let alone applied in a rejection. Further, none of the other pending IPR proceedings against the '503 include Alden or the combinations of Alden with other references as presented herein. *See Oticon*

Med. AB v. Cochlear Ltd., IPR2019-00975, Paper 15 at 20 (Oct. 16, 2019) (precedential) (noting “[t]here is new, noncumulative prior art asserted in the Petition”). Petitioner’s grounds thus present art that is not the same or substantially the same as art previously considered by the Office. *Advanced Bionics v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 7-9 (Feb. 13, 2020).⁸

X. CONCLUSION

Petitioner respectfully requests that a Trial be instituted. Claims 1-36 of the ’503 should be cancelled as anticipated and obvious over the prior art.

⁸ Should Patent Owner raise a *Fintiv* or § 325(d) challenge to the Petition, Petitioner intends to respond to any counter-arguments Patent Owner may raise.

Dated: June 6, 2023

Respectfully submitted,

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Table of Exhibits

Exhibit No.	Description
1001	U.S. Patent No. 10,894,503 (“ ’503 ”)
1002	File History for the ’503 Patent
1003	Declaration of Dr. Nikolaos Papanikolopoulos
1004	Curriculum Vitae of Dr. Nikolaos Papanikolopoulos
1005	U.S. Patent Application Publication No. 2003/0137849 (“ Alden ”)
1006	WIPO Patent Publication No. 2001/001038A1 (“ Harbers ”)
1007	U.S. Patent No. 4,970,628 to Bergkvist (“ Bergkvist ”)
1008	U.S. Patent No. 6,144,158 to Beam (“ Beam ”)
1009	U.S. Patent No. 6,049,749 to Kobayashi (“ Kobayashi ”)
1010	PTAB Trial Statistics April 2023 IPR, PGR

Certificate of Word Count

I certify that, in accordance with 37 C.F.R. § 42.24(d), the word count for the foregoing Petition totals 13,959. This is less than the permitted total under 37 C.F.R. 42.24(a)(1)(i).

/s/ Celine J. Crowson

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Certificate of Service

The undersigned certifies that, in accordance with 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, the foregoing Petition for Inter Partes Review, and Exhibits 1001 through 1010 were served on June 6, 2023, by Overnight Courier at the following address of record and addresses known to Petitioner as likely to effect service and the address of record for the '503 patent:

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