

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 11,208,029

**PETITION FOR *INTER PARTES* REVIEW OF
CLAIMS 1-33 OF U.S. PATENT NO. 11,208,029
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. §42.100 *et seq.***

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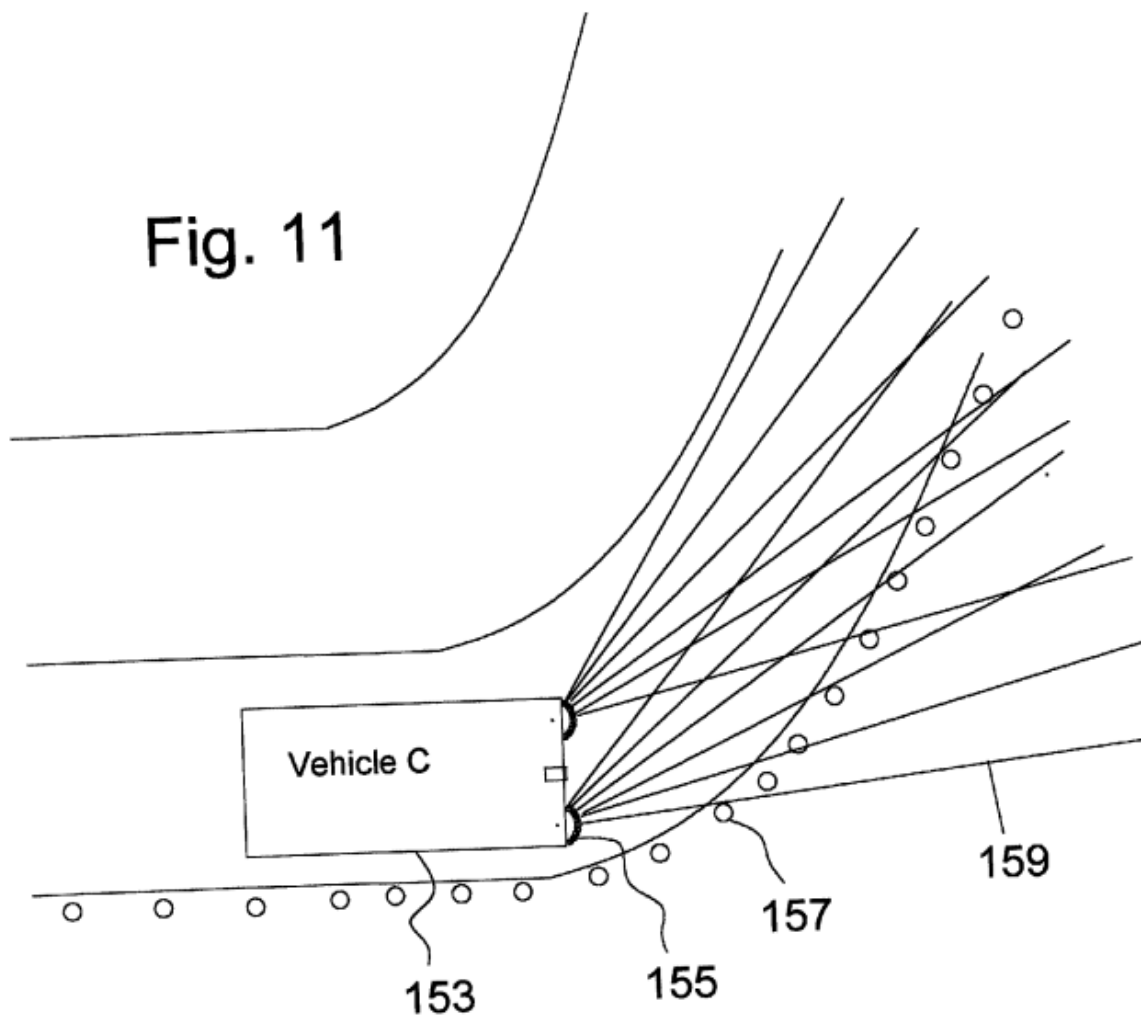
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I. INTRODUCTION

Petitioner Mercedes-Benz USA, LLC challenges Claims 1-33 of US11,208,029 (“**’029**”) (EX1001). The ’029 claims a headlight system for a vehicle that includes (1) headlamps comprising a plurality of LED light sources, (2) a processor and control circuitry that receives map data indicating an upcoming road curvature, (3) determining a change in lighting to increase light in the direction of a curve, and (4) causing LEDs to provide the change in lighting. The road curvature may be obtained from map data, and the processor and control circuitry can then use this data to change the intensity, color, or spatial distribution to increase light in the direction of the curve.

But this was not new at the time of the ’029. Automated headlight systems, enabling selective illumination of lighting elements in response to sensor data, were well known before this. For example, US2003/0137849 (“**Alden**”) (EX1005), discloses a headlight system in which a controller can control lighting elements (*e.g.*, LEDs) based on sensor data regarding a road curvature:



(Alden, Fig. 11.) This enables light from the vehicle's headlamps to increase lighting in the direction of a road curvature. (*Id.*)

Likewise, the use of GPS navigation systems that include map data to detect road curvature was well-known. For example, US6,049,749 (“**Kobayashi**”) (EX1006) discloses relying on map data to control a vehicle's headlights based on the predicted direction of the vehicle. (*See, e.g., Kobayashi, 17:39-61.*) As

discussed herein, the claims of the '029 are obvious over Alden in view of Kobayashi.

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 '029 in two lawsuits in the District of Delaware on June 7, 2022:

- Case No. 1:22-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 (including “Daimler AG”); responses to the operative complaint have not been filed; and no discovery has been exchanged. Further, the cases have been

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

indefinitely stayed pending resolution of whether the complaint should be dismissed due to lack of standing and failure to join necessary parties.

The '029 is also the subject of IPR2022-01500 (challenging Claims 1, 2, 10-13, and 23-24), filed by Unified Patents, LLC, and IPR2022-01586 (challenging Claims 1-33), filed by Volkswagen Group of America, Inc. (“**Volkswagen**”).

These IPRs have been instituted and are awaiting trial.

C. Counsel and Service Information

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 '029 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 in view of Kobayashi	1-8, 10-11, 12-19, 21-22, 23-30, 32-33	103
2	Alden in view of Kobayashi (alone or alternatively in view of Beam)	9, 20, 31	103

VI. OVERVIEW OF THE '029

A. Subject Matter of the '029

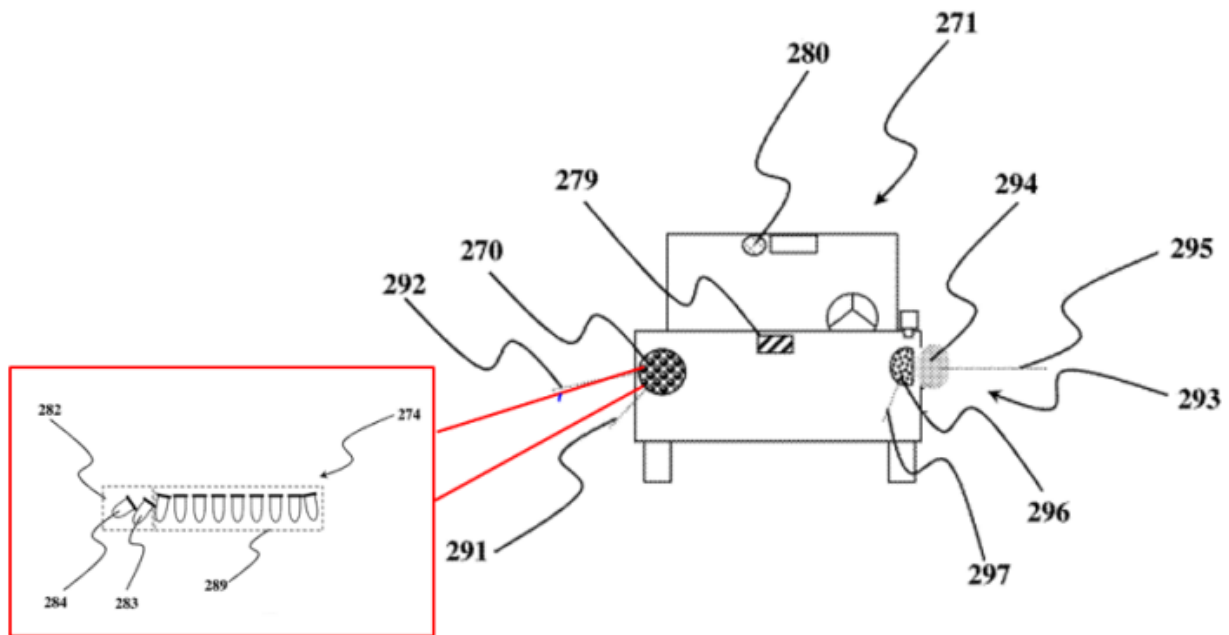
The '029 argues that in the “prior art,” lighting fixtures were often single, large lights that were and “universal.” ('029, 5:35-59.) These lights were allegedly not tailored to individual applications, were “inexact and wasteful,” produced light in more places than needed, and required reflectors and refractors to re-direct light. (*Id.*) The '029 claims it came up with a new approach called a “Digital Lighting Fixture” that can “provide the ‘correct’ lighting solution for the situation at hand.” (*Id.*, 10:63-11:14.) The '029 purports to accomplish this through “controllability offered by breaking the total light output up into discrete (‘digital’) specifically

² Independent claims in bold.

aimable and dimmable elements which can be addressed by control electronics.”

(*Id.*, 11:56-65.)

While the '029 gives various example applications, its claims are directed to the alleged invention as used in “headlamps” in a “motor vehicle.” (*Id.*, Claims 1, 12, 23; *see also* Abstract.) The claims recite how light clusters or sources (*e.g.*, LEDs) can be included in a headlamp on a vehicle:

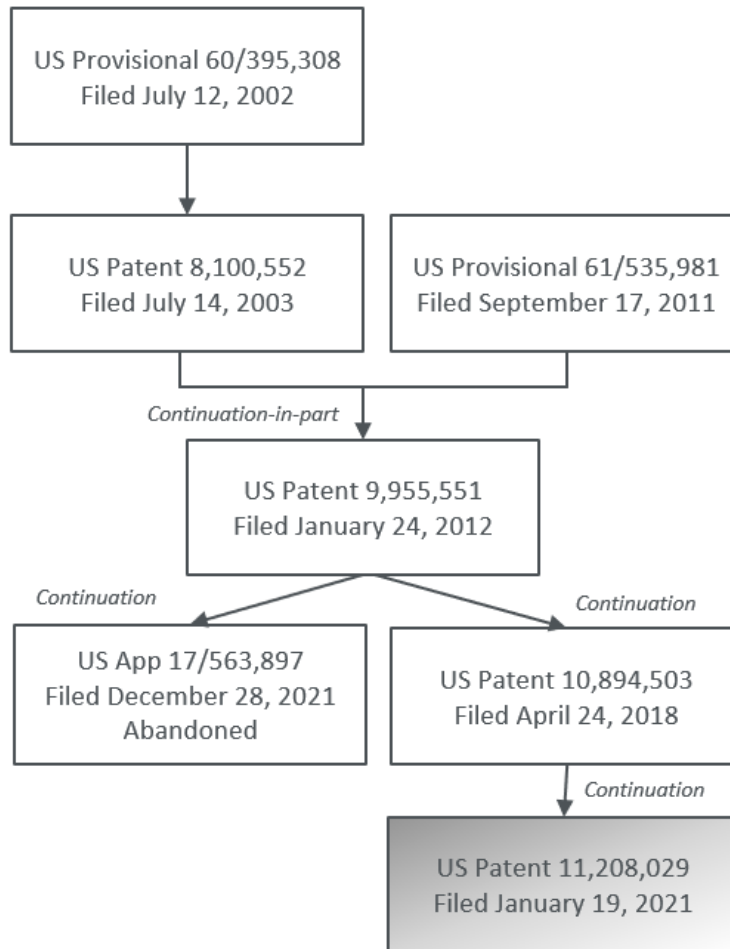


(*Id.*, Fig. 15 (annotated).) “Sensors” obtain relevant situational data, including detecting things like an approaching road curvature. (*See, e.g., id.*, Claim 1, Abstract.) A “processor” can then determine, based on this, how to adjust the output from the individual lights to increase light in the direction of the curvature.

(*See, e.g., id.*)

B. Prosecution History of the '029

The '029 was filed on January 19, 2021 and issued on December 28, 2021. It is part of the following family:



The Examiner issued one prior art rejection during prosecution, rejecting certain claims based on US2010/0286896 (“**Yamada**”) in view of US2012/0001547 (“**Nishitani**”). (EX1002.) Patent Owner argued that Yamada and Nishitani were not prior art, since the alleged priority dates of the '029 are before

October 12, 2005,³ and in response the Examiner withdrew the prior art rejection and allowed the claims. (*Id.*)

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

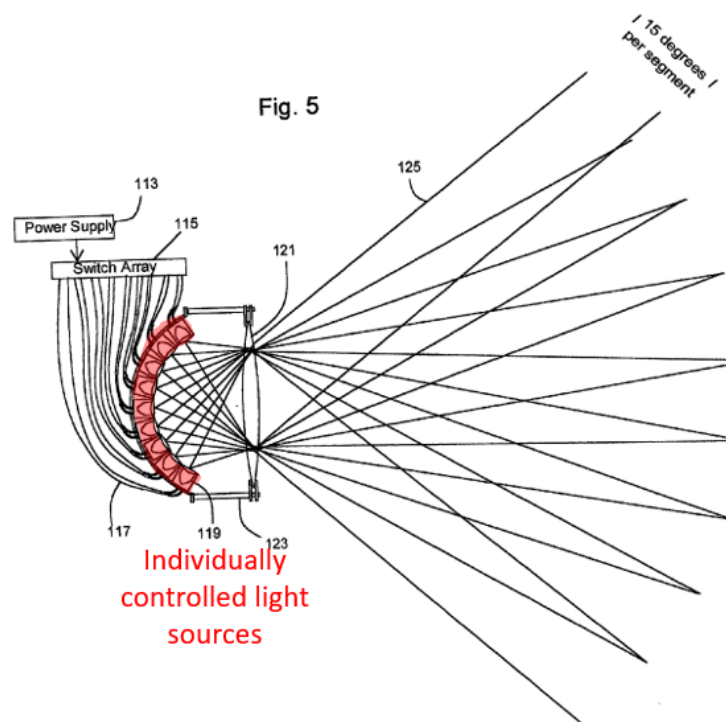
A person of ordinary skill in the art (“**POSITA**”) in the field of the ’029 would have had an undergraduate degree in mechanical engineering, electrical engineering, automotive engineering, optical engineering, applied physics, computer science, or similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting

³ Petitioner does not concede that the ’029’s claims are entitled to a priority date of October 12, 2005, or earlier, but does not address the same in this Petition because all references herein are prior art under the earliest possible priority of July 12, 2002.

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

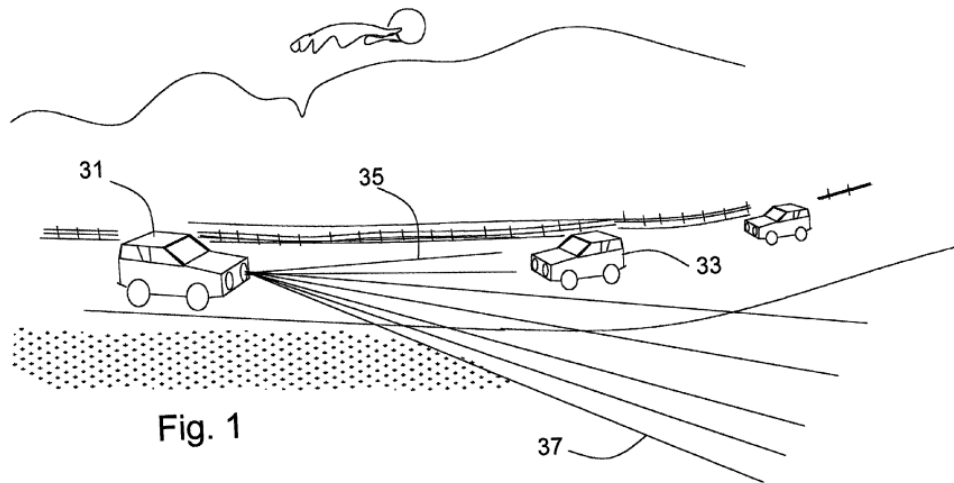
Alden was filed January 22, 2002, and published July 24, 2003. Alden is prior art under at least pre-AIA § 102(e) because it was filed before the filing date, and any potential priority date, of the '029. In Alden, individual lighting elements (119) such as LEDs are positioned in a curved manner inside of a headlight:



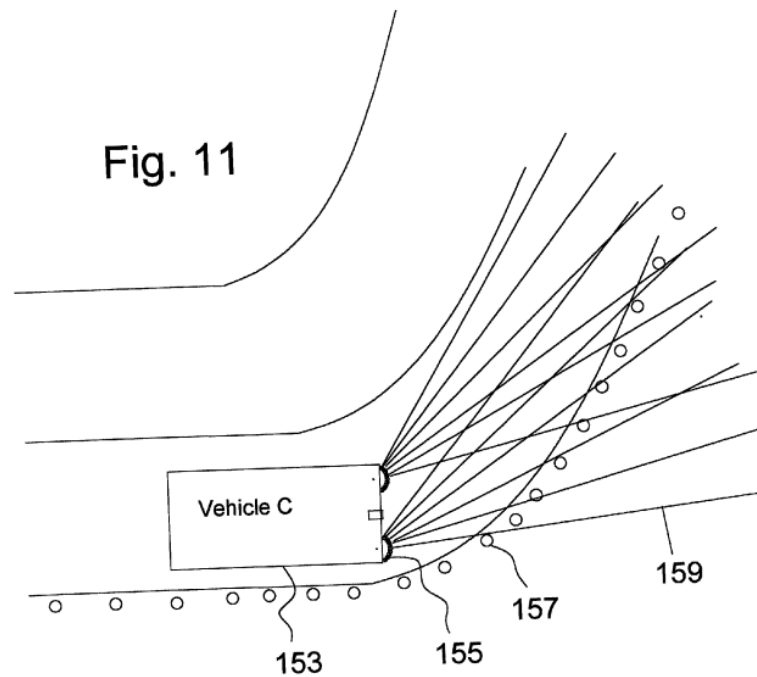
⁴ Dr. Nikolaos Papanikolopoulos is an expert in intelligent transportation systems, among other things. His Declaration is included as EX1003.

(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 using its individually-controllable LEDs, its “segmented light distribution system” can provide “illumination to independently controlled segments each operable within a range of intensities between the high beam and low beam state.” (*Id.*, [0061].) For example, 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 highlight distribution sector,” with “[t]he low beam illumination being emitted in response to the detection of an oncoming vehicle 33” to reduce “glare”:

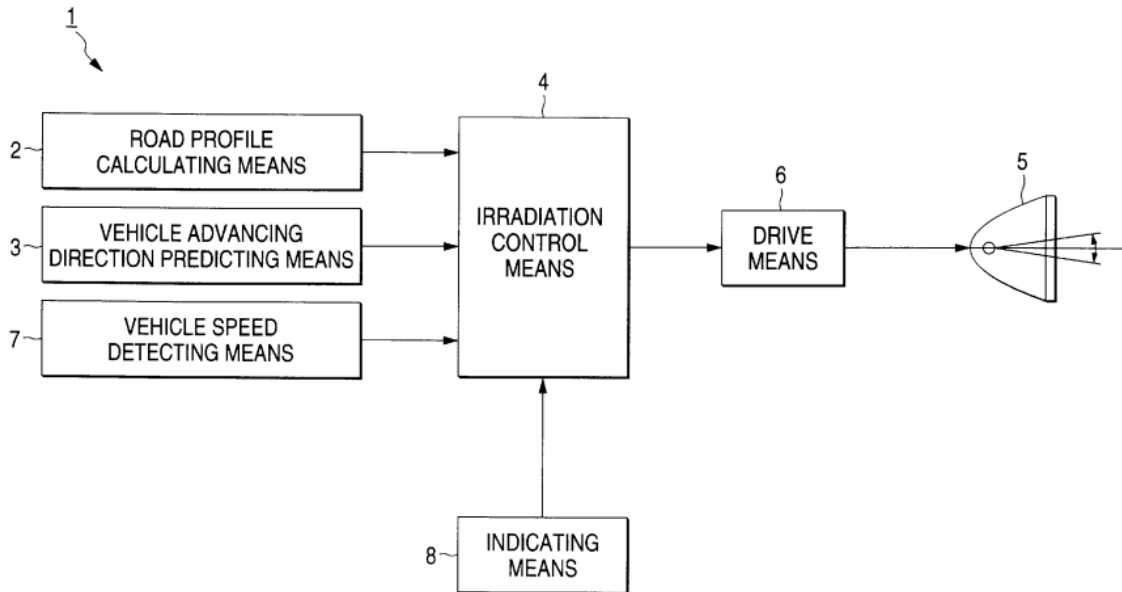


(*Id.*, Fig. 1, [0004], [0025].) Similarly, Alden’s segmented headlights can be used to “concentrate light” to “look around corners,” “look up a hill,” and “look down a hill,” all “in response to road conditions.”



(*Id.*, Figs. 11-13, [0036]-[0038].)

Kobayashi issued April 11, 2000, and is prior art under § 102(b). Kobayashi is titled “Lighting device for a vehicle” and is directed to adaptive vehicle headlamp systems. (Kobayashi, Abstract, 1:5-8.) Similar to Alden, Kobayashi’s headlamp system includes various inputs, a controller, and a headlamp:



(Kobayashi, Fig. 1, 3:9-5:28; *see also* Fig. 12, 17:3-67.) Kobayashi’s controller (“irradiation control means 4”) receives “road map information” from “road profile calculating means 2,” along with other sensor data, and use these inputs to automatically adjust the illumination of headlamp 5. (*Id.*; *see also* 2:4-39.)

A. Ground 1 – Alden In View of Kobayashi Renders Obvious Claims 1-8, 10-19, 21-30, and 32-33

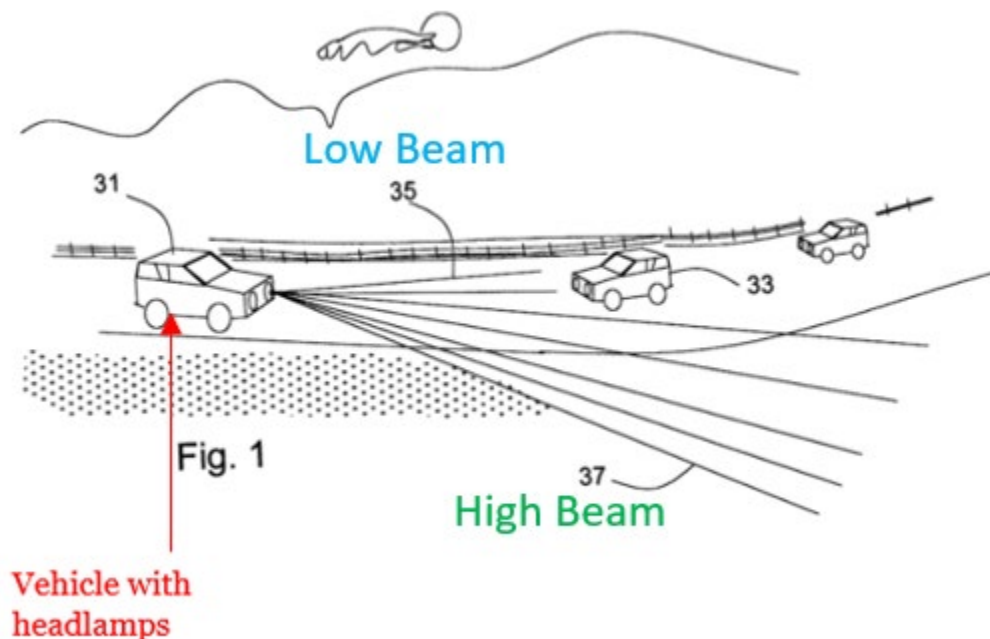
1. Independent Claim 1

Alden in view of Kobayashi renders obvious Claim 1. (Papanikolopoulos Decl., ¶¶54-77.)

1[Pre]: A system, for a motor vehicle, comprising:

Alden discloses Claim 1[Pre] to the extent limiting. (*Id.*, ¶55.) 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 vehicle 31” includes an “automatic segmented illumination” headlight system, allowing the vehicle to emit different light illuminations in different sectors of its “headlight distribution area,” *e.g.*, areas in the field-of-view of the equipped vehicle. For example, the system enables an equipped vehicle to 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”:



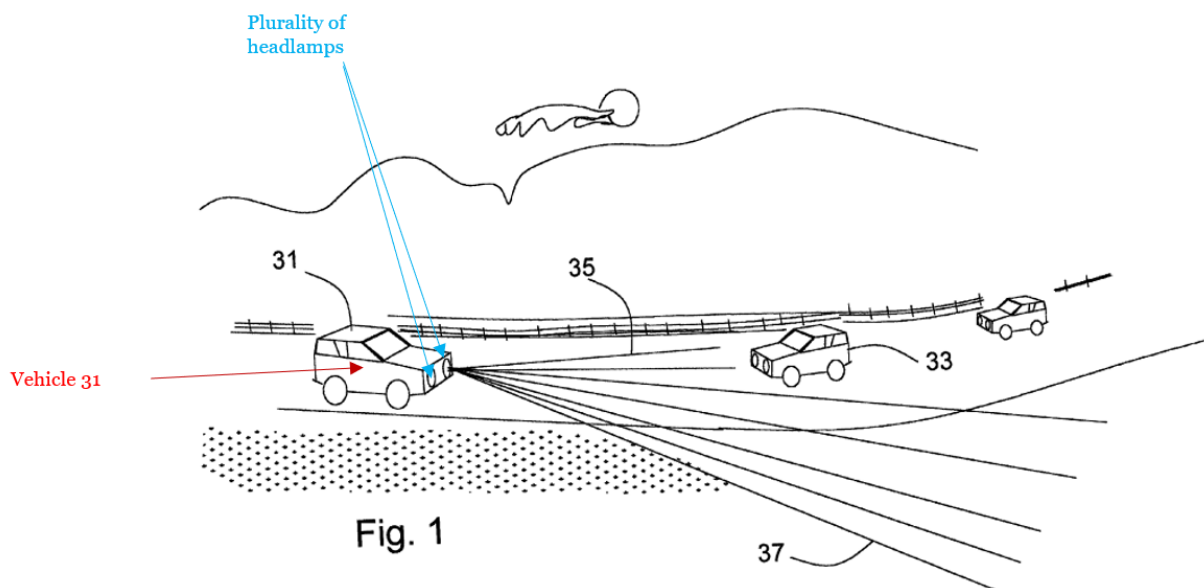
(*Id.*, [0025], Fig. 1 (annotated); *see also* [0026]-[0029].) Similarly, the system can be used to “concentrate light” in sectors to “look around corners,” “look up a hill,”

⁵ All emphasis added unless otherwise noted.

and “look down a hill,” all “in response to road conditions.” (*Id.*, Figs. 11-13, [0036]-[0038].)

1[A]: *a plurality of headlamps, each comprising a plurality of LED light sources;*

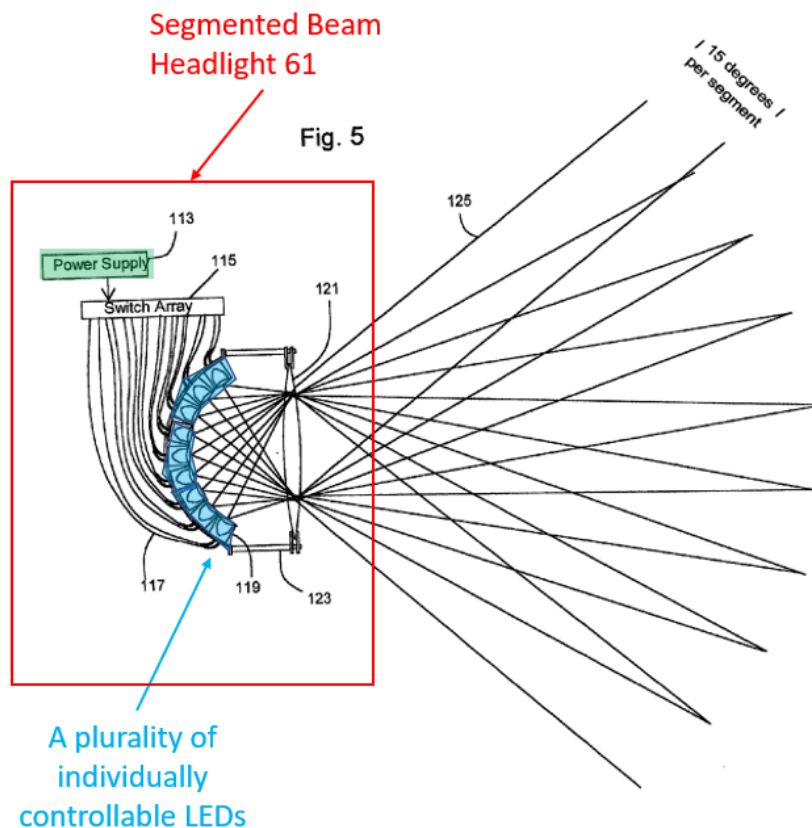
Alden discloses Claim 1[A]. (Papanikolopoulos Decl., ¶¶56-58.) First, Alden discloses a vehicle with a “plurality of headlamps”:



(Alden, Fig. 1 (annotated), [0025], [0027]-[0028]; *see also* Fig. 11, [0036].) As shown, the vehicle includes both left and right “segmented beam headlights.” (*Id.*, [0025]-[0026]; *see also* Figs. 2, 11.) Alden discloses that the “left headlight” and “right headlight” are controlled to emit different light in different sectors of the headlight distribution area, so that, for example, drivers of other vehicles have “minimum glare while the driver of [the equipped vehicle] has maximum light.” (*Id.*, [0027].) Alden’s segmented headlamps can similarly be controlled to

“concentrate light” in sectors to look around corners and up and down hills. (*Id.*, Figs. 11, [0054] (disclosing that “directing of light” around corner can be achieved with “the segmented elements described herein”); *see also* Figs. 12-13, [0037]-[0038].)

Moreover, each segmented headlight can include an array of individual lighting elements (“plurality of LED light sources”), with each lighting element being a “white LED (or alternate lighting mechanism)”:



(*Id.*, Fig. 5 (annotated), [0029].) As shown, these LEDs 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.” (*Id.*)

Alden discloses that each LED is “independently controllable as to intensity and/or direction.” (Alden, [0008]; *see also* Abstract, [0026]-[0029], Figs. 2-4.) To adjust intensity, the power to each element is CPU-controlled, such that, for example, “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], [0061].) To adjust direction, optical elements, such as lens 121 or variable refractive elements, are used. (*Id.*, [0029], Fig. 5, [0033]-[0035], Figs. 8-10.)

1[B]: one or more processors; and a memory storing instructions that, when executed by one or more of the one or more processors, enable the one or more processors to:

Alden discloses Claim 1[B]. (Papanikolopoulos Decl., ¶¶59-63.) First, Alden discloses a “processor” in communication with “memory,” which together detect objects and determine whether to adjust lighting elements:

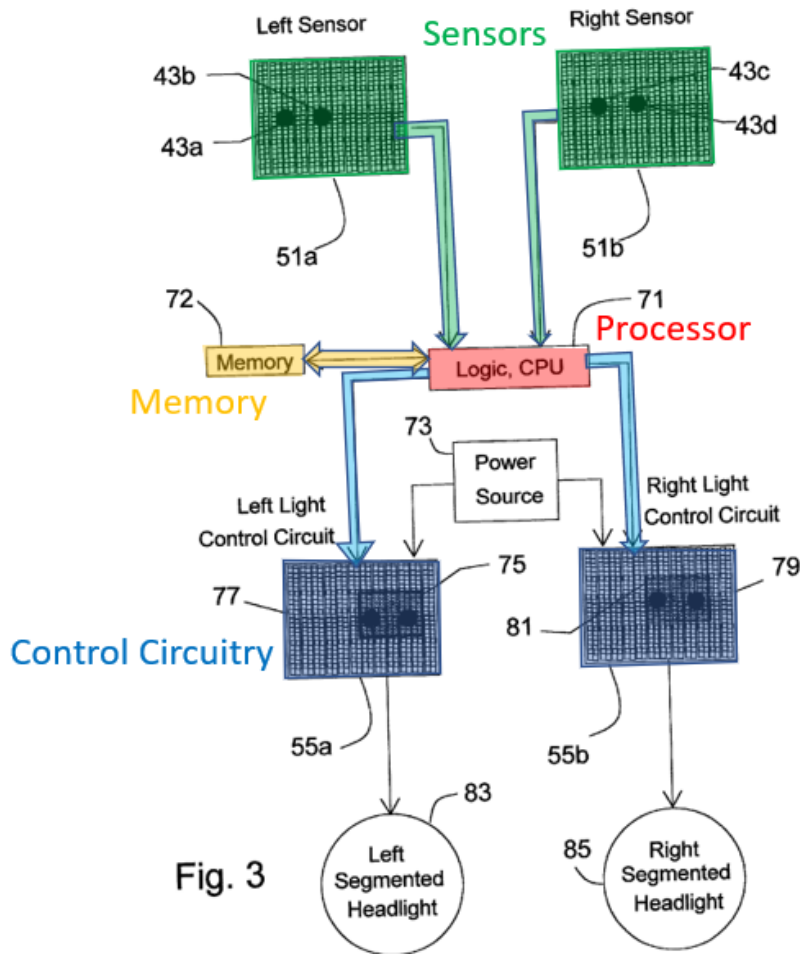
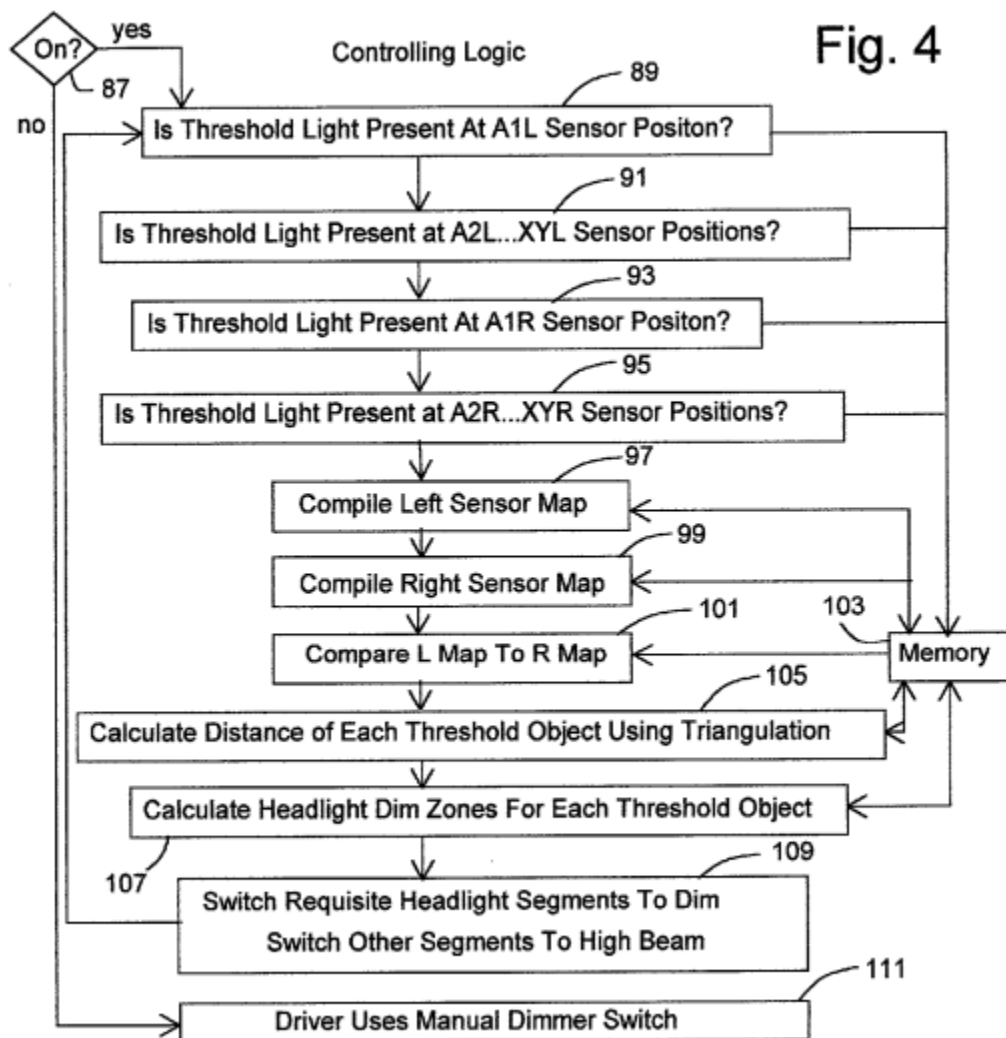


Fig. 3

(Alden, Fig. 3 (annotated), [0027]-[0028] (describing logic used and data being “stored in a memory 72”); *see also* Fig. 2, [0026].) As shown, left and right sensors 51a-51b are connected to CPU 71 comprising logic. (*Id.*, [0027].) CPU 71 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 its processor (logic CPU 71) is configured to execute “instructions” (*i.e.*, logic) stored in memory. (*Id.*, [0027]-[0029], Fig. 4.)

For example, Figure 4 of Alden discloses exemplary “controlling logic” that would be stored in the memory that CPU 71 can execute to process sensor data and control each LED within the headlights:



(*Id.*, [0028], Fig. 4; Papanikolopoulos Decl., ¶60.) As shown, 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].) For example, if the system of Alden detects light from roadside “reflectors” indicating a curve, then it can determine the distance to those reflectors. (*Id.*, Fig. 11, [0054]; Papanikolopoulos Decl., ¶60.)

CPU 71 uses the distance data to “determine the intensity of light that will be produced by the 61 [headlight] in the corresponding headlight sectors,” which, as shown in step 107, may include dimming light in certain sectors if the detected object is an oncoming vehicle. (Alden, Fig. 4, [0028].) CPU 71 then sends signals to the control circuits to switch sectors different illuminations, as shown in step 109. (Alden, Fig. 4, [0027]-[0028]; *see also* Fig. 3, [0029] (“Each lighting element being independently controlled by a corresponding switch in an array of switches 115. Each switch is controlled by the CPU and logic previously described.”), Figs. 11-13, [0036]-[0038] (describing using “segmented” headlights to change light in areas in front of vehicle based on road conditions such as corners and hills).)

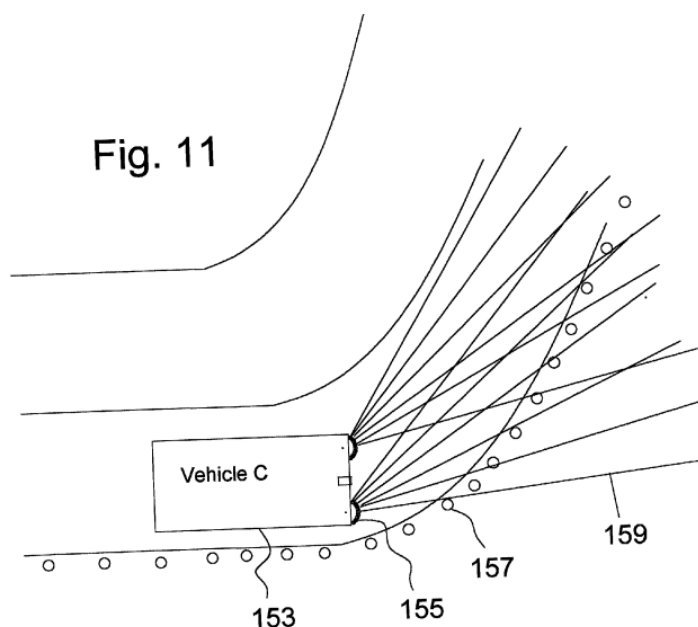
Alden further explains that this is a real-time, automatic process that is continuously repeated. (*Id.*, [0028] (stating that the “process then begins again so as to be responsive to changing environmental conditions *in real time*.”), Fig. 4.) Thus, if “environmental conditions” such as the areas around the vehicle change,

the determined light distribution pattern for the headlights will also change.

(Papanikolopoulos Decl., ¶¶62-63.)

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

Alden in view of Kobayashi discloses Claim 1[C]. (Papanikolopoulos Decl., ¶¶64-70.) Alden discloses that “the present invention,” namely its segmented headlights, can be used to “concentrate light to look around corners in response to road conditions”:



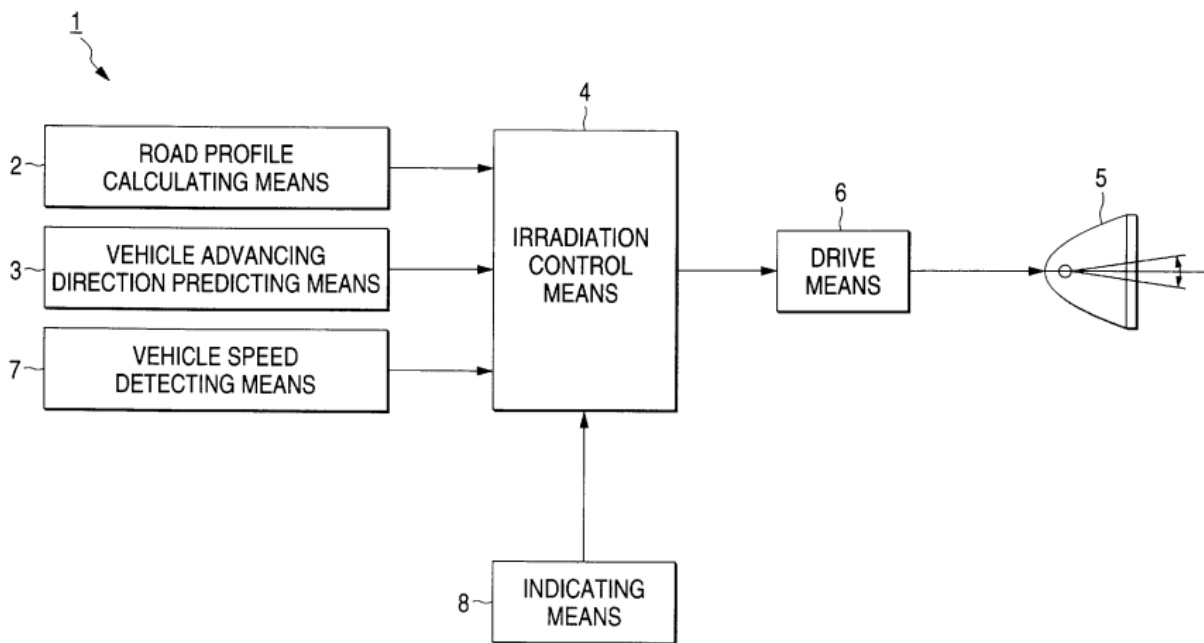
(Alden, [0036], Fig. 11.) As shown, Alden discloses that a vehicle with the “segmented sensing elements and segmented light distribution elements described herein” can “sense[] that the road turns by *receiving light from reflectors such as a reflector 157.*” (*Id.*, [0036].) That is, Alden can identify an upcoming road curve by receiving and detecting light from reflectors (“first data”) positioned along the

curve. (*Id.*) Alden’s “segmented 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]; Papanikolopoulos Decl., ¶¶64-65.) This data is, in particular, used by CPU 71 and control circuitry 55a-55b to adjust the LEDs in the “responding headlights 155” (such as, for example, those LEDs shown in Figure 5 that would be 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., ¶¶64-65.)

Alden discloses that its system can use additional sensors to detect road curvature. For example, Alden’s system also includes a “rotation sensor” in the steering wheel that can further detect when a vehicle is approaching an upcoming turn (*i.e.*, the rotation sensor provides “first data” regarding the angle of the steering wheel). (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 curve where the vehicle will have to turn, Alden’s CPU receives data indicating the amount the wheel was turned and adapts the light output, so that it “increases illumination illuminating the turn.” (Papanikolopoulos Decl., ¶67.)

Kobayashi, in the same field as Alden, discloses performing similar control of headlight systems to illuminate road curves based on road map data.

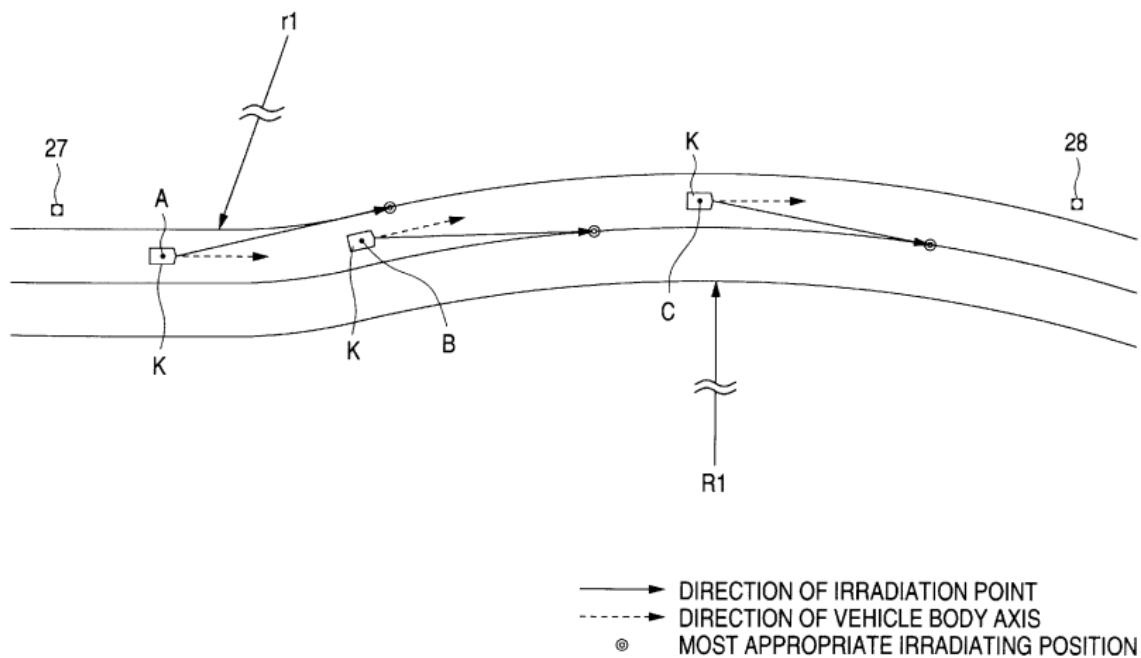
(Papanikolopoulos Decl., ¶68.) Similar to Alden, Kobayashi's headlamp system includes various inputs, a controller, and a headlamp:



(Kobayashi, Fig. 1, 3:9-5:28; *see also* Fig. 12, 17:3-67.) Specifically, Kobayashi discloses that its controller (“irradiation control means 4”) receives “road map information” from “road profile calculating means 2,” along with other sensor data, and use these inputs to automatically adjust the illumination of headlamp 5. (*Id.*; *see also* 2:4-39.) The “road profile calculating means” can also be included as part of a GPS sensor that outputs “map information.” (*Id.*, Fig. 12, 17:3-61, 2:28-50.) Kobayashi further discloses that as a vehicle moves along the road, the “irradiation

control means 4” can “conduct[] irradiation control of the lighting device in accordance with the road profile.” (*Id.*, 4:5-13.) As a result, “when the vehicle turns to left, the left shoulder is irradiated,” and “[w]hen the vehicle turns to right, the right shoulder is irradiated”:

FIG. 10



(*Id.*, Fig. 10, 15:6-28, 17:41-67; *see also* Fig. 9, 11:34-14:52.) Stated differently, “when the vehicle advances along a scheduled course, irradiation control of the lamp is conducted *in accordance with the course concerned.*” (*Id.*, 17:39-61.)

It would have been obvious to a POSITA to apply these teachings to Alden to additionally use map data to identify road curvature when adapting the LEDs of

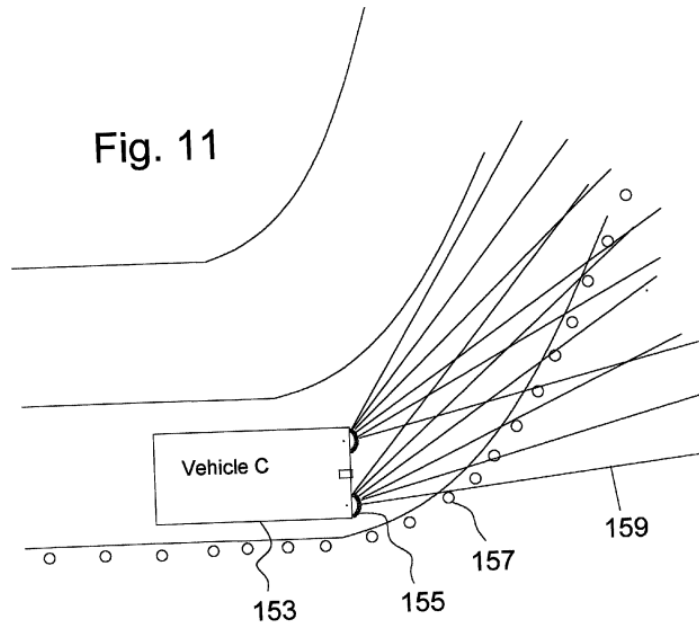
Alden to “direct light into the corner.” (Alden, [0036]; Papanikolopoulos Decl., ¶69.) Both Alden and Kobayashi are directed to vehicle headlamp systems that focus on controlled vehicle lighting systems based on multiple data streams. Moreover, both can re-direct light based on detecting an upcoming road curve, and both can use data from various sensors to do so. (*Id.*) Further, Alden already discloses that road curvature can be detected and light correspondingly adjusted using numerous means, including roadside reflectors and steering wheel sensors, and Kobayashi simply discloses an additional known means to detect road curvature: road map data. (*Id.*) A POSITA would have thus understood the systems to be complementary, as both disclose sensor data fed to a controller, which then controls lighting. (*Id.*) And a POSITA would have had a reasonable expectation of success, as Alden’s controller can already synthesize multiple sources of information (*e.g.*, roadside reflectors, steering sensors, oncoming vehicles) and the map data of Kobayashi could be similarly synthesized. (*Id.*)

Further, a POSITA would have been motivated to apply the teachings of Kobayashi to Alden. (*Id.*, ¶70.) Alden details how an LED lighting system can be configured to alter a light beam based on detection of road curvature using various approaches, including light sensors and reflectors and steering wheel sensors. (Alden, Fig. 11, [0036], Fig. 14, [0039].) Kobayashi makes clear that map data can be included as an additional approach in controlling direction of vehicle headlights.

(Kobayashi, Fig. 1, 2:4-50, 3:9-50, Fig. 12, 17:3-47, Fig. 10, 15:6-28, Fig. 9, 11:34-14:52.) A POSITA would have thus been motivated to combine the techniques of detecting a road curvature to maximize successful detection in different environments. (Papanikolopoulos Decl., ¶¶70.) For example, where a road lacks the reflectors contemplated in Alden, relying on map data may be preferred; installing 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.*) And in environments where map data may be less reliable, light sensors or steering wheel sensors may be preferred. (*Id.*)

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

Alden discloses Claim 1[D]. (Papanikolopoulos Decl., ¶¶71-72.) Alden’s system, including the processor executing stored instructions (“controlling logic”), “determine[s] a light change” that adapts a light pattern of the headlamps in “intensity” and “spatial distribution” to increase light in the direction of upcoming road curvature. *See supra* Claims 1[B]-1[C]. In particular, Alden’s system, including CPU 71, accommodates road curvature ahead of an equipped vehicle by adapting the light pattern to “concentrate light to look around corners in response to road conditions”:



(Alden, [0036], Fig. 11.) Alden discloses that this “directing of light can be achieved with the segmented elements described herein.” (*Id.*, [0054].) Alden thus “direct[s] light” by adapting the pattern of light from the lightings elements in its “segmented” headlights—such as, for example, the LEDs shown in the “segmented headlight of Figure 5—to “direct light into the corner to maximize the driver’s ability to see there.” (*Id.*, [0036], [0026]-[0029], Fig. 11; *see also* [0039]-[0040] (discussing controlling direction of light based on sensed steering wheel angle).)

That is, based on data indicating that the road ahead curves, Alden’s system determines the change in the “intensity” and “spatial distribution” of light from the headlights that is required to “shape” the light, so that it is concentrated (or directed) into the curve, thereby increasing the amount of light in the area of the curve. (*Id.*; Papanikolopoulos Decl., ¶71.) For example, as can be seen in Figure 11

above, Alden's systems adapts the shape of the light pattern from the headlights to shift light to the left, in the direction of the curve, so that the curve is illuminated with greater intensity and distribution of light. (*Id.*)

In addition, Alden in view of Kobayashi discloses Claim 1[D]. (Papanikolopoulos Decl., ¶72.) Kobayashi similarly includes a controller that determines a changed shaping of light when map data indicates an upcoming curve or change in road shape. *See supra* Claim 1[C]. For example, where map data indicates that a road curves left and then right, Kobayashi's controller can use this to concentrate or direct light in advance of the curves to the left and then to the right. *Id.* Again, it would have been obvious to modify Alden in view of Kobayashi to determine the required changed shaping of light to accommodate upcoming road turns based on "map data." *Id.* (Papanikolopoulos Decl., ¶72.) Alden would continue to perform the same determination of changed light patterns to accommodate upcoming curves or changes in road shape, only now it would make the determination based on received map data indicating the road curve. (*Id.*)

1[E]: [1] control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and [2] prior to the motor vehicle reaching the road curvature.

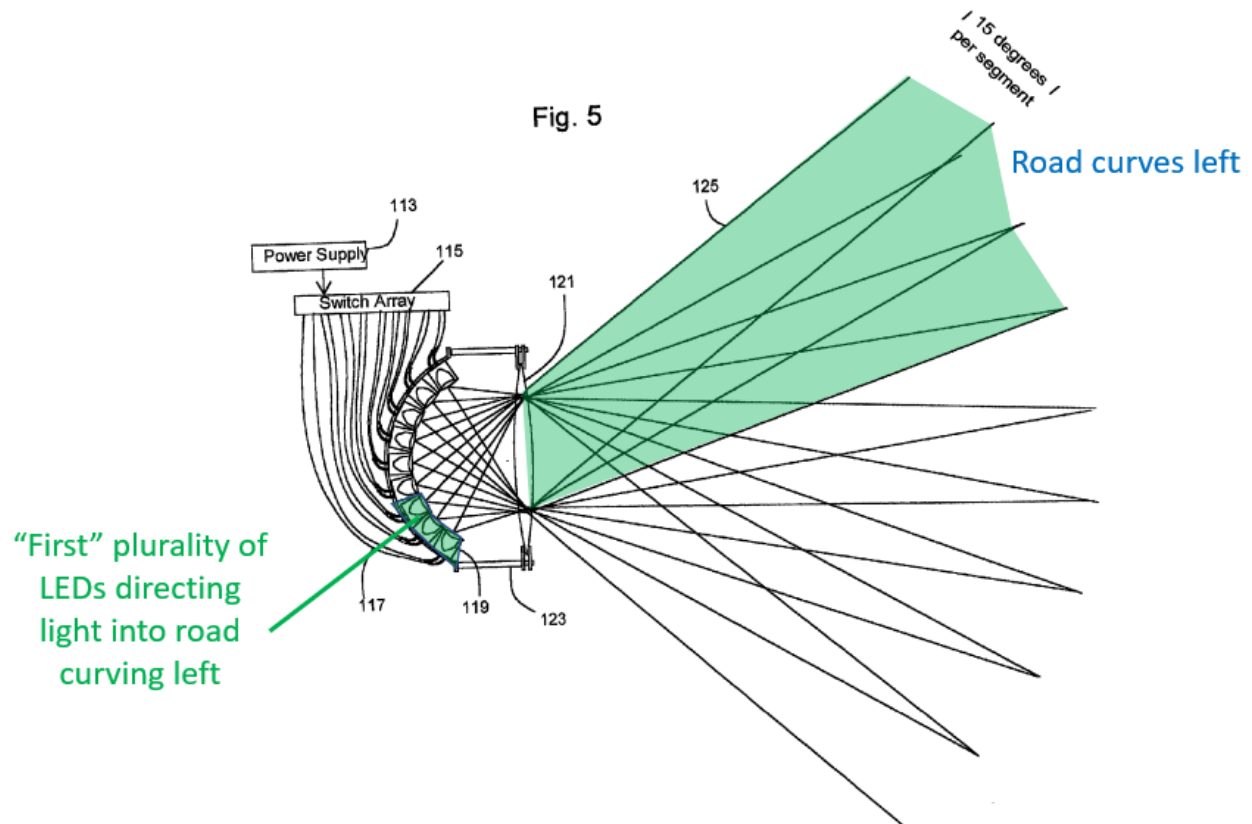
Alden discloses Claim 1[E]. (Papanikolopoulos Decl., ¶¶73-77.) First, as explained, CPU 71 processes sensor data and determines a changed "light pattern" to be produced in the headlight distribution area—such as to "direct light" into a

curve or to direct high beam light in sectors where there is no oncoming vehicle and low beam light where there is. *See supra* Claims 1[B]-1[C]. CPU 71 then controls a “first plurality” of LEDs in this array, such as those LEDs that direct light into sectors including the detected road curve, to produce the “light pattern” and concentrate light into the area of the curve “to look around corners.” (Alden, Fig. 11, [0029], [0036]; *see also* [0026]-[0028], [0033]-[0040], [0061].)

As discussed, Alden discloses that the CPU processes data indicating there is a curve in the road and instructs control circuitry including a switch array to power the LEDs accordingly. (Alden, Figs. 3-5, [0027]-[0029], Fig. 11, [0036].) In particular, CPU 71 and control circuitry 55a-55b can adjust the LEDs in the “responding headlights 155”—such as, for example, those LEDs shown in Figure 5 that emit light into sectors containing the road curve—so that they produce the changed light pattern to “direct light into the corner to maximize the driver’s ability to see there.” (*Id.*, [0036], [0026]-[0029]; Papanikolopoulos Decl., ¶74.) By directing light into the corner, or curve of the road, to maximize the driver’s ability to see, the system is increasing illumination in the direction of the curve. (Papanikolopoulos Decl., ¶74.)

When one is driving an equipped vehicle, the controlled “first plurality” of LEDs would be those LEDs that are directing light to sectors in the area where the road curves. (*Id.*, ¶75.) This can be seen with reference to Figure 5, for example,

where the controlled “first plurality” of LEDs could be those shaded in green, following the curve of a road as it turns left:



(Alden, Fig. 5 (annotated), [0029].) As shown, the three LEDs at the bottom of the array direct light into sectors at the left-hand side of the headlight distribution area and are thus controlled to produce the illumination pattern that “concentrates” light into the curve. (Papanikolopoulos Decl., ¶75.)

Second, this control and directing of light occurs “prior to the motor vehicle reaching the road curvature.” (*Id.*, ¶76.) Specifically, Alden discloses that an upcoming turn can be detected using sensor data detecting light from reflectors along the side of the road, or from rotation sensors in the steering wheel (*e.g.*,

before someone accelerates into a turn). (Alden, Fig. 11, [0036]-[0040], Fig. 1, Fig. 4.) This sensing would occur before the road curves; for example, the reflectors along the road would be ahead of a vehicle, and the system would “concentrate” light once it detects light from such reflectors. (*Id.*; Papanikolopoulos Decl., ¶76.) And once this detection of road curvature ahead is made, Alden discloses “concentrat[ing]” light accordingly before reaching the curve. (*Id.*)

In addition, Alden in view of Kobayashi discloses Claim 1[E]. (Papanikolopoulos Decl., ¶77.) Kobayashi similarly includes a controller that controls a headlamp to provide changed shaping of light before a vehicle reaches a curve, when map data indicates an upcoming curve or change in road shape. *See supra* Claim 1[C]. For example, where map data indicates that a road curves left and then right, Kobayashi’s controller can use this to concentrate or direct light in advance of the curves to the left and then to the right. *Id.* Again, it would have been obvious to modify Alden in view of Kobayashi to control the light sources to implement the changed shaping of light to accommodate upcoming road turns based on “map data.” (Papanikolopoulos Decl., ¶77.) Alden would continue to perform the same control of LEDs to shape the light pattern to direct light into the curve, only now it would do so based on received map data indicating the road curve. (*Id.*)

2. Independent Claim 12

Alden in view of Kobayashi renders obvious Claim 12. (Papanikolopoulos Decl., ¶¶78-82.)

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

Alden discloses Claim 12[Pre] to the extent limiting. (*Id.*, ¶79.) Alden discloses a system for a motor vehicle that includes headlamps. *See supra* Claim 1[Pre]. Alden’s system includes a “storage medium” along with “instructions” that can be executed by a “processor” to control the headlamps; in particular, Alden discloses a processor, CPU 71, coupled to memory and control circuitry, and further discloses “controlling logic” that enables the processor to execute a method of operating the headlamps of a motor vehicle. *See supra* Claims 1[B], 1[E]. Finally, Alden’s system includes multiple headlamps that each comprise a plurality of LED light sources. *See supra* Claim 1[A].

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

Alden in view of Kobayashi discloses Claim 12[A]. (Papanikolopoulos Decl., ¶80.) *See supra* Claim 1[C].

12[B]: *determine a light change, the change adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light*

in a direction of the road curvature ahead of the motor vehicle and shaping light based at least in part on the road curvature; and

Alden, alone or in view of Kobayashi, discloses Claim 12[B].

(Papanikolopoulos Decl., ¶81.) *See supra* Claim 1[D].

12[C]: control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and prior to the motor vehicle reaching the road curvature.

Alden, alone or in view of Kobayashi, discloses Claim 12[C].

(Papanikolopoulos Decl., ¶82.) *See supra* Claim 1[E] (likewise reciting “control at least a first plurality of the LED light sources to provide light based at least in part on the determined light change and prior to the motor vehicle reaching the road curvature”).

3. Independent Claim 23

Alden in view of Kobayashi renders obvious Claim 23. (Papanikolopoulos Decl., ¶¶83-87.)

23[Pre]: A computer-implemented method for adapting light from headlamps of a motor vehicle to accommodate road shape changes, the headlamps including a plurality of LED light sources, comprising:

Alden discloses Claim 23[Pre] to the extent limiting. (*Id.*, ¶84.) Alden discloses a computer-implemented method for adapting light emitted from the headlamps of a motor vehicle. *See supra* Claims 1[Pre], 1[B]. As discussed, Alden’s system includes a processor, along with memory and control circuitry, that enables the processor to execute “instructions” or logic for adapting light from the

motor vehicle's headlamps to accommodate road shape changes, such as curves in the road. *See supra* Claims 1[B], 1[E]. Alden further discloses that the headlamps each include a plurality of LED light sources. *See supra* Claim 1[A].

23[A]: *determining an upcoming shape change of a road, ahead of the motor vehicle, based on first data, including map data, indicating the shape change;*

Alden in view of Kobayashi discloses Claim 23[A]. (Papanikolopoulos Decl., ¶85.) *See supra* Claim 1[C].

23[B]: *determining a light output, the output adapting a light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction associated with the shape change ahead of the motor vehicle and shaping light based on the shape change; and*

Alden, alone or in view of Kobayashi, discloses Claim 23[B].
(Papanikolopoulos Decl., ¶86.) *See supra* Claim 1[D].

23[C]: *prior to reaching the road shape change, causing at least a first plurality of the LED light sources to provide light based at least in part on the determined light output.*

Alden, alone or in view of Kobayashi, Claim 23[C]. (Papanikolopoulos Decl., ¶87.) *See supra* Claim 1[E].

4. Dependent Claims 2, 13, 24

2/13/24: *The [system / storage medium / method] of claim [1/12/23], wherein the determination of the light change includes selection of the first plurality of the LED light sources.*

Alden in view of Kobayashi renders obvious Claims 2, 13, and 24.
(Papanikolopoulos Decl., ¶¶88-90.) These claims are substantially similar to Claim

1[E], which recites controlling “a first plurality of the LED light sources to provide light based at least in part on the determined light change.” As discussed, in Alden the determination of the light change includes a selection of the “first plurality” of LEDs in the array that will produce the changed light pattern, which selected plurality of LEDs are controlled to produce such pattern. *See supra* Claim 1[E]; *see also* Claim 1[D].

Again, Alden discloses that the “directing of light” around corners can be “achieved with the segmented sensing elements and segmented light distribution elements described herein.” (Alden, [0036], Fig. 11.) Alden also discloses that the LEDs in these segmented 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.” (Alden, [0029], Fig. 5.) In determining changes to the light pattern output from the headlights, Alden considers which LEDs direct light into different sectors of the headlight distribution area, including around a curve in the road. (*Id.*, [0006], [0008], [0028]-[0029], [0036], Figs. 5, 11.) Moreover, in response to sensed changes in environmental conditions, such as a change in the curve or shape of the road, Alden’s logic CPU 71 determines the intensity level of the lighting elements, such as the LEDs in Figure 5, to appropriately illuminate different zones of the headlight distribution area. (*Id.*, [0028].) This process is done in real-time, such

that LEDs are continuously selected in determining light changes. (*Id.*; Papanikolopoulos Decl., ¶¶88-90.) *See also supra* Claims 1[D]-1[E].

5. Dependent Claims 3, 14, 25

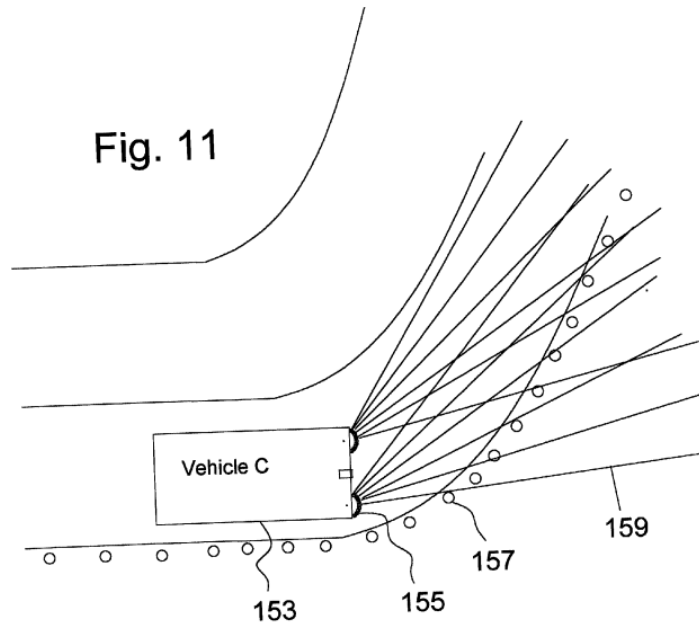
3/14: *[The system of claim 1 / storage medium of claim 12], wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to reshape light based on the road curvature as the motor vehicle travels at least to or through the road curvature.*

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

Alden in view of Kobayashi renders obvious Claims 3, 14, and 25.

(Papanikolopoulos Decl., ¶¶91-94.)

Alden discloses that the CPU in its segmented headlight system “reshapes” the light from the headlights, as the vehicle travels to or through curves or changes in road shape, so that the light is “concentrated” or “directed” into road curves ahead of the vehicle:



(Alden, [0036], [0039]-[0040], Figs. 11, 13-14.) *See supra* Claims 1[D]-1[E].

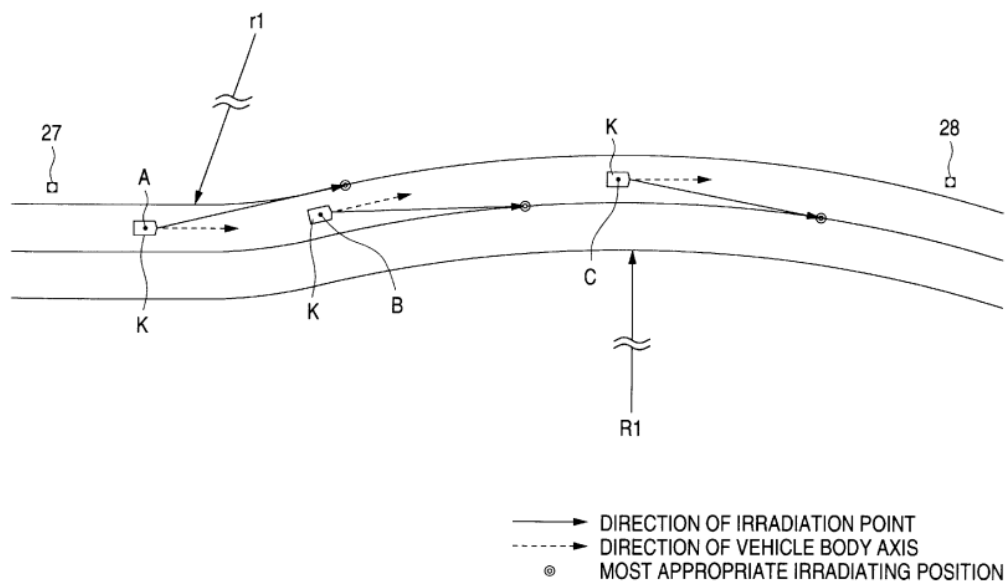
Alden continuously determines the illumination requirements of each LED in the array “so as to be responsive to changing environmental conditions in real time.”

(Alden, [0028].) Thus, as the motor vehicle travels along the road, and the environmental conditions around the vehicle change, including the curve or shape of the road in front of the vehicle, Alden’s system would continuously determine new illumination requirements for each LED in the array to reshape the headlight emission pattern. (*Id.*; Papanikolopoulos Dec., ¶91.)

In addition, Alden in view of Kobayashi discloses Claims 3, 14, and 25. (*Id.*, ¶92.) Kobayashi, like Alden, discloses continuously adjusting (“reshaping”) light as a vehicle proceeds along a road using map data. (Kobayashi, Abstract.) Kobayashi discloses that its controller (“irradiation control means 4”) receives

“road map information” from “road profile calculating means 2,” along with other sensor data, and uses these inputs to automatically adjust the illumination of headlamp 5. (*Id.*; *see also* 2:4-39, Fig. 12, 17:3-61, 2:28-50.) Kobayashi further discloses that as a vehicle moves along the road, the “irradiation control means 4” can “conduct[] irradiation control of the lighting device in accordance with the road profile.” (*Id.*, 4:5-13.) As a result, “when the vehicle turns to left, the left shoulder is irradiated,” and “[w]hen the vehicle turns to right, the right shoulder is irradiated”:

FIG. 10



(*Id.*, Fig. 10, 15:6-28, 17:41-67; *see also* Fig. 9, 11:34-14:52.) In particular, as shown above, Kobayashi plans and controls illumination—shaping and re-shaping light in the direction ahead of and through curves to improve safety. (*Id.*, 14:53-

15:28.) For example, when vehicle K turns right (point C), the right shoulder is illuminated, adapting the light pattern in intensity and spatial distribution and reshaping light relative to the previous curve, based in part on road curvature from map data. (*Id.*, 14:53-15:28.)

It would have been obvious to a POSITA to implement in Alden's system the continuous control disclosed in Kobayashi of reshaping the headlight beam pattern as the vehicle travels along the road using map data. (Papanikolopoulos Dec., ¶¶93-94.) Both Alden and Kobayashi disclose similar systems and disclose controlling headlights to continuously reshape light output in response to sensor data and changing environmental conditions. (*Id.*) A POSITA would have been motivated to combine the controller of Alden with the teachings of Kobayashi to allow real-time, iterative, reshaping of light as the vehicle travels along a changing road. (*Id.*) Further, a POSITA would have had a reasonable expectation of success, as the controllers in Alden and Kobayashi are complementary, and modifying Alden's controller to continuously reshape the light based on map data indicating changes in the shape of the upcoming road would have been nothing more than a routine use of a known technique from Kobayashi to improve Alden's similar lighting system to achieve its purpose of "directing light" into upcoming road curves. (*Id.*) *See also supra* Claim 1[C] (discussing additional rationales for applying Kobayashi's teachings to Alden's system).

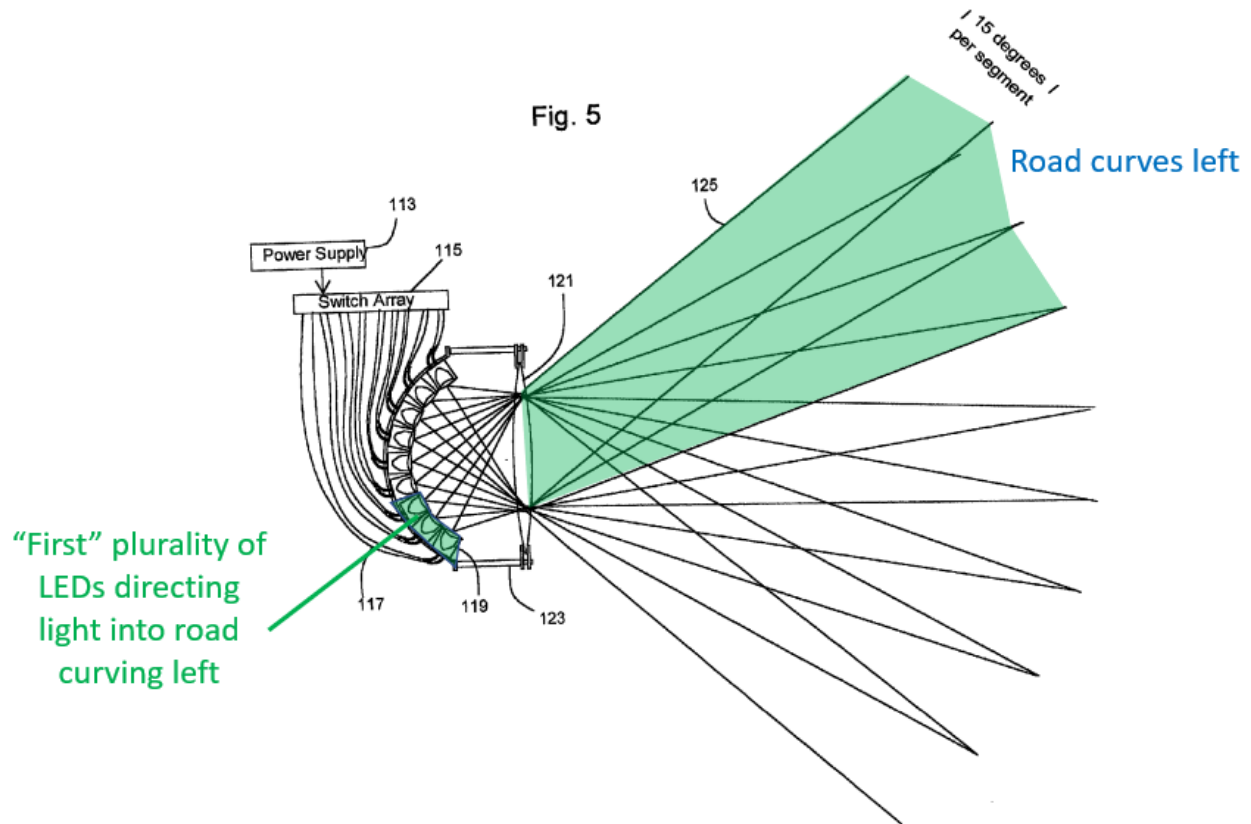
6. Dependent Claims 4, 15, 26

4/15/26: The [system / storage medium/method] of claim [3/14/25], wherein the reshaping [of] light further includes [control to / controlling] at least one of the first plurality of LED light sources, or a second plurality of LED light sources, including at least one LED light source different from the LED light sources of the first plurality of LED light sources, to provide reshaped light.

Alden in view of Kobayashi renders obvious Claims 4, 15, and 26.

(Papanikolopoulos Dec., ¶¶95-97.) Alden, alone and in view of Kobayashi, discloses a controller implementing a real-time, continuous process to “reshape” and change the output of the headlights as the environmental conditions around the vehicle change (such as when the vehicle is traveling along a road). *See supra* Claims 3/14/25.

As explained, this real-time process continuously determines new illumination requirements for each LED in the array to reshape the headlight emission pattern. *Id.* (Papanikolopoulos Dec., ¶96.) Thus, as the process continues in “real-time” different “pluralities” of LEDs will be selected and adjusted. (*Id.*) For example, where data received by the controller indicates that the road curves to the left, Alden selects and controls a “first plurality” of LEDs that direct light into the sectors of the headlight distribution area including the left-hand road curve:

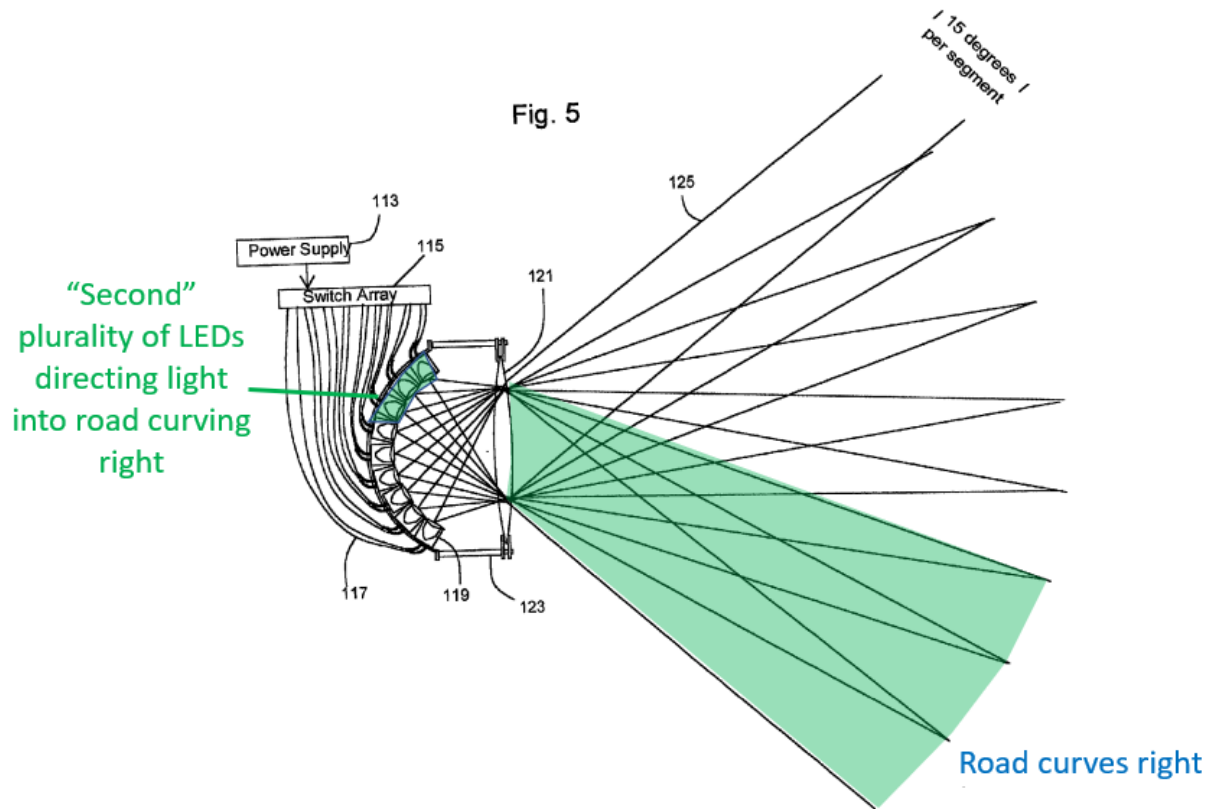


(Alden, Fig. 5 (annotated), [0029]; *see also* [0027]-[0028], [0033]-[0040], Fig. 11.)

See also supra Claims 2/13/24. If the road continues to curve left, Alden’s real-time process can continuously control the output of the same first plurality of LEDs to emit reshaped light that continues to be directed into the left-hand curve.

(Papanikolopoulos Dec., ¶96.)

If, however, the shape of the upcoming road changes, such that it then turns to the right, Alden’s controller would determine that a different, “second plurality” of LEDs are aimed such that they direct light into the sectors containing the right-hand turn:



(*Id.*, Fig. 5 (annotated), [0028]-[0029], [0036], *see also* [0039]-[0040].) This “second plurality” of LEDs, such as the three LEDs shown in green above, would be controlled to provide the reshaped light output in the sectors including the right-hand curve. (*Id.*; Papanikolopoulos Dec., ¶97.) Alden’s system will thus select a second, different set of LEDs to provide the shaped light output, as the equipped vehicle proceeds along a road where the curve changes from left to right. (Papanikolopoulos Dec., ¶97.)

7. Dependent Claims 5, 16, 27

5/16: *The [system of claim 1 / storage medium of claim 12] wherein the increase of light in the direction of the road curvature includes at least an increase of light*

emitted at a level below high-beam light and directed in the direction of the road curvature.

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

Alden in view of Kobayashi renders obvious Claims 5, 16, and 27.

(Papanikolopoulos Decl., ¶¶98-100.) As discussed, Alden discloses increasing light in the direction of a road curvature or road shape change. *See supra* Claims 1[D]-1[E]. Alden further discloses that the LEDs are “each operable within a range of intensities between the high beam and low beam state.” (Alden, [0061].) Thus, from the perspective of a POSITA, Alden discloses that the LEDs can be operated not only at low beam intensity or high beam intensity, but at a plurality of other intensities (such as a “medium” intensity) in between, as a vehicle approaches a curve. (*Id.*; Papanikolopoulos Decl., ¶98.)

Further, this would have been obvious to a POSITA in view of Alden. (Papanikolopoulos Decl., ¶¶99-100.) For example, a POSITA would have understood that when approaching a road curvature, an obstacle such as an oncoming vehicle may be present or approaching. (Alden, [0005]-[0006], [0025], [0060]-[0061].) A POSITA would have further understood from Alden that when approaching a road curvature, illumination of light at a level in the “operable [] range of intensities” less than high-beam light can be used. (*Id.*; Papanikolopoulos

Decl., ¶99.) Controlling the LEDs directed to sectors including the road curvature to emit increased light below high-beam light, such as a “medium” intensity light, would allow the driver to sufficiently see the road curvature, while not blinding potential oncoming vehicles that are not yet visible. (Papanikolopoulos Decl., ¶100.) Alden makes clear that it is concerned with reducing glare to oncoming vehicles, and thus, a POSITA, viewing Alden, would be cognizant of glare reduction when illuminating a road curve, to minimize the risk of blinding another driver that could be coming around the curve. (Alden, [0005]-[0006], [0026]-[0029]); Papanikolopoulos Decl., ¶100.) It would also have been well within the skill of a POSITA to use Alden’s teaching of using intensities less than “high beam light” when illuminating a curve, as Alden already teaches using such intensities to illuminate areas with segmented headlights. (Papanikolopoulos Decl., ¶100.)

8. Dependent Claims 6, 17, 28

Alden in view of Kobayashi renders obvious Claim 6, 17, and 28.

(Papanikolopoulos Decl., ¶¶101-108.)

6[Pre]/17[Pre]: *The [system / storage medium] of claim [1/12], wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:*

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

Alden in view of Kobayashi renders obvious claims 6[Pre]/17[Pre]/28[Pre].

(Papanikolopoulos Decl., ¶102.) *See supra* Claims 1[Pre]/12[Pre]/23[Pre].

6[A]/17[A]/28[A]: determine a second light [change / output], the second [change / output] adapting the light pattern of the headlamps in at least one of color, intensity or spatial distribution to increase light in a direction [of / associated with] a second [road curvature / shape change] ahead of the motor vehicle, determined based on at least one of the first data or second data including at least second map data, and the second [change / output] shaping light based at least in part on the second [road curvature / shape change]; and

Alden in view of Kobayashi renders obvious Claims 6[A]/17[A]/28[A].

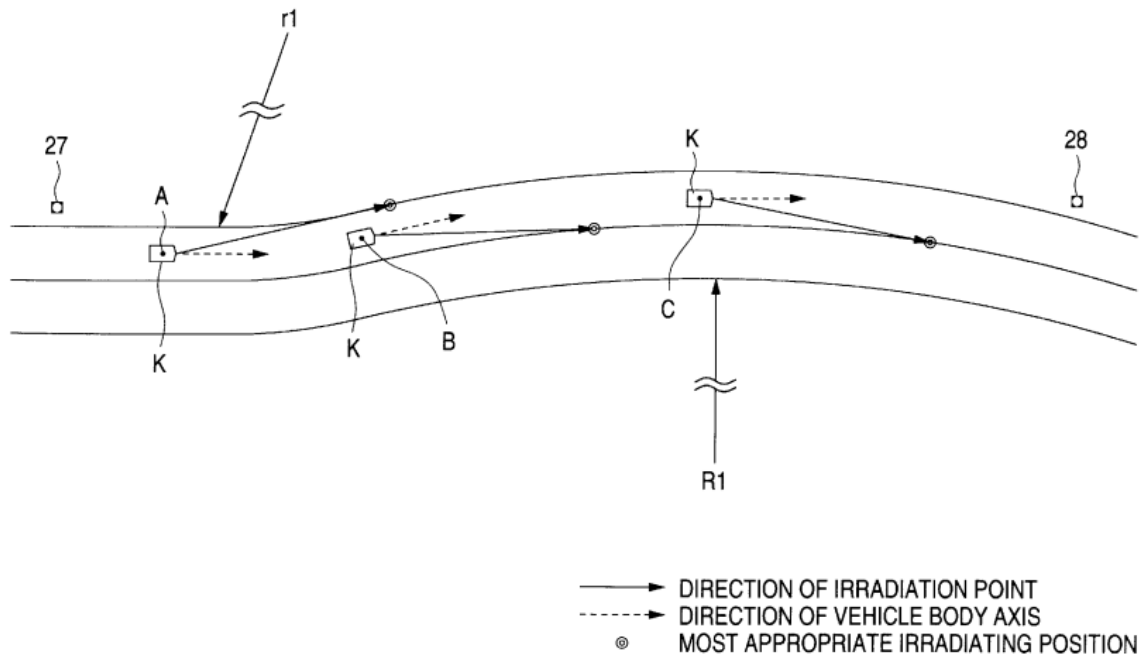
(Papanikolopoulos Decl., ¶¶103-106.)

As discussed, Alden discloses an iterative process that repeats in real-time, continuously determining the light output for each LED in the array. *See supra* Claims 4/15/26. This process would include, for example, determining a second light change (or output) that adapts the light pattern in intensity and spatial distribution to increase illumination in the direction of a new, different curve or shape change of the road ahead of the vehicle, as indicated by second, subsequent data from light sensors detecting roadside reflectors or a steering wheel angle sensor. *See supra* Claims 4/15/26, 1[D]. (*See also* Alden, [0028]-[0029], [0033]-[0040].)

In addition, and as also discussed above, Kobayashi discloses determining adapted light pattern outputs to reshape light as a vehicle proceeds along multiple road curvatures based on received road map information (“map data”). *See supra* Claims 3/14/25, 1[C]. (*See also* Kobayashi, Fig. 10, Fig. 1, 3:9-5:28, 17:3-67, Figs. 6, 12.) Kobayashi discloses that detection of road curves or changes in road shape,

such as around a bend in a road or at a branch in the road where a vehicle could take multiple paths, are indicated by “road profile calculating means” based on “road map information.” (*Id.*, 2:9-50, 3:9-5:286.) Initial “road map information” about a portion of the road the vehicle is traveling (“first map data”) may include information regarding multiple upcoming curves along the road. (*Id.*, 3:9-5:28, 14:53-15:28, Fig. 10.) In this situation, Kobayashi’s system determines a first light change adapting the light pattern to increase light in a direction of the first turn (following position A in Figure 10 below), and then a subsequent second change adapting the lighting pattern to increase light in a direction of the second turn (following position B in Figure 10 below):

FIG. 10



(Kobayashi, Fig. 10.) That is, the light changes for the road curves are determined based on the initial road map information (“first map data”), and the adapted light pattern is based on the first and second road curves. (Papanikolopoulos Decl., ¶104.)

Moreover, as the vehicle moves along a road, the road profile calculating means continuously checks road map information to determine an expected advancing direction of the vehicle along the road, and the system can also get new “road profile information” from beacons along the side of the road or from a GPS

navigation system. (*Id.*, 3:9-5:28, 14:53-15:28, 17:3-67, Figs. 10, 12.) Thus, as the vehicle moves along the road, the system can check new road map information associated with the new position and travel direction of the vehicle (“second map data”). (*Id.*) For example, in Kobayashi if the vehicle is determined to no longer be traveling in an expected direction based on the road profile, other sensor data can be used to control the irradiation control means to reshape the headlight beams. (*Id.*, 3:9-5:28.) If, at a later time when the vehicle is at a subsequent position, it is determined that the “road profile calculating means” using the new road map information (“second map data”) accurately predicts the advancing direction of the vehicle, then the “irradiation control means” will again control the headlight distribution in accordance with a road profile corresponding to the second map data. (*Id.*) This includes adapting the light pattern from the headlights to change in intensity and spatial distribution to increase light in directions associated with curves or road shape changes indicated by the second map data. (*Id.*)

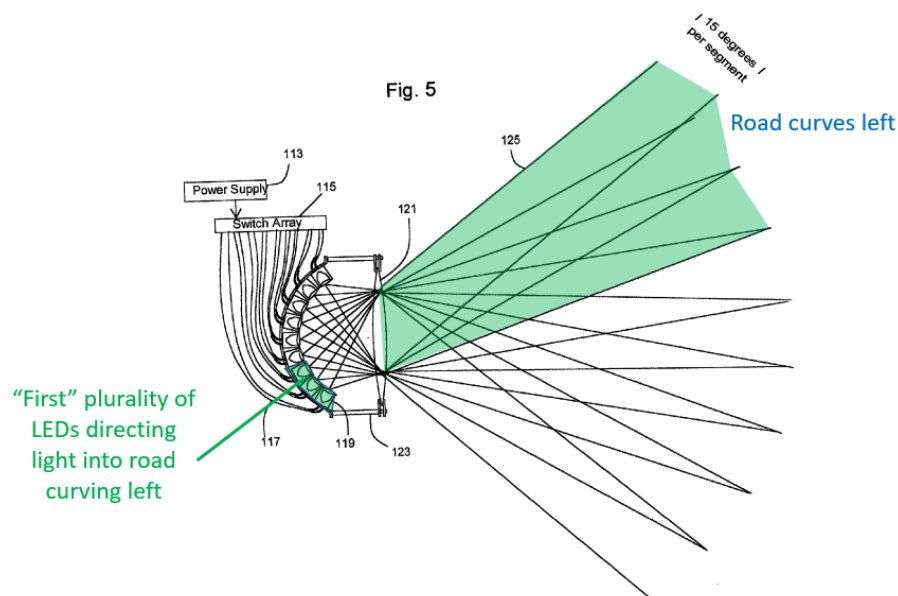
It would have been obvious to modify Alden in view of Kobayashi, so as to determine the required changed shaping of light to accommodate upcoming road turns based on first or second map data, for the same reasons as discussed above. *See supra* Claims 3/14/25 (discussing rationale for using map data of Kobayashi to reshape light around curves in Alden’s system). (Papanikolopoulos Decl., ¶106.) As discussed, Alden would continue to perform the same determination of changed

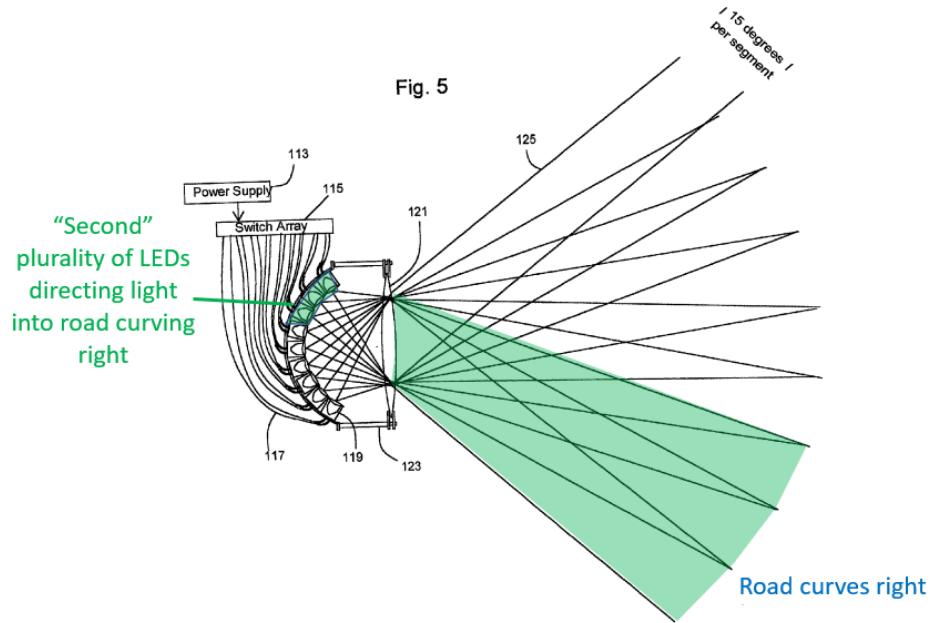
light patterns to accommodate multiple upcoming curves or changes in road shape, only now it would make the determination based on received map data indicating the road curves. *See supra* Claims 3/14/25.

6[B]/17[B]/28[B]: control[ling] at least a second plurality of the LED light sources, having at least one LED light source different from the first plurality of LED light sources, to provide light based at least in part on the determined second light [change / output] and prior to the motor vehicle reaching the second [road curvature / shape change].

Alden in view of Kobayashi renders obvious Claims 6[B]/17[B]/28[B].

(Papanikolopoulos Decl., ¶¶107-108.) As discussed, Alden discloses that when the received data indicates the upcoming road changes curve direction or shape, such as going from a first left-hand curve to a second right-hand curve, Alden's system controls a second plurality of LEDs, with at least one LED being different from the first plurality of LEDs, to provide light based on the determine second light change (or output) prior to the vehicle reaching the second curve:





(Alden, Fig. 5 (annotated), [0029]; *see also* [0027]-[0028], [0033]-[0040].) *See supra* Claims 4/15/26. As can be seen in the above example, when the Alden system illuminates a left-hand turn, it uses LEDs at the bottom of the array, and when it illuminates a right-hand turn, it uses LEDs at the top of the array. (Papanikolopoulos Decl., ¶107.) Thus, the LEDs of the “first plurality” and “second plurality” are different.

Further, it would have been obvious to modify Alden in view of Kobayashi, so as to control the light sources to implement the changed shaping of light to accommodate upcoming road turns based on map data, for the reasons discussed above. *See supra* Claims 6[A]/17[A]/28[A], 3/14/25. (Papanikolopoulos Decl., ¶108.) As discussed, Alden would continue to perform the same control of LEDs to reshape the light patterns to direct light into the curves, only now it would do so

based on received map data indicating the road curves. *See supra* Claims 6[A]/17[A]/28[A], 3/14/25.

9. Dependent Claims 7, 18, 29

Alden in view of Kobayashi renders obvious Claims 7, 18, and 29.

(Papanikolopoulos Decl., ¶¶109-112.)

7[Pre]/18[Pre]/29[Pre]: The [system / storage medium / method] of claim [1 / 12 / 23], wherein the increase of light in the direction [of / associated with] the [road curvature / shape change] includes at least one of expansion of the light pattern in the direction [of / associated with] the [road curvature / shape change] or an increase to intensity of light directed in the direction [of / associated with] the [road curvature / shape change]; and

Alden in view of Kobayashi renders obvious Claims 7[Pre]/18[Pre]/29[Pre] to the extent limiting. (Papanikolopoulos Decl., ¶110.) These claim elements generally recite that light is increased in the direction of the road curve by either expanding the light in the area of the curve or changing the intensity of light into the direction of the curve. As discussed, Alden discloses that the increase of light in the direction of the road curvature (or shape change) includes expansion of the light pattern in that direction and increasing intensity of light directed in the direction of the curve (or shape change), as Alden controls LEDs to “concentrate” or “direct light” into the curve to “maximize the driver’s ability to see there.” *See supra* Claims 1[D]-1[E]. (Alden, [0036], Fig. 11; *see also* [0037]-[0040], Figs. 12-15.)

7[A]/18[A]: wherein the determination of the light change includes determination of light changes to individual LEDs of the first plurality of LED light sources,

29[A]: wherein the determining the light output includes determining output for individual LEDs of the first plurality of LED light sources,

Alden in view of Kobayashi renders obvious Claims 7[A]/18[A]/29[A].

(Papanikolopoulos Decl., ¶111.) As discussed, Alden discloses that the LEDs are “individually controllable” and direct light to specific sectors of the headlight distribution area, and that the light output for each individual LED in the array is determined to produce the overall headlight pattern. *See supra* Claims 1[D]-1[E]; *see also supra* Claims 1[A], 4/15/26.

7[B]/18[B]: at least one of the changes including at least one of: [1] a variation to at least one of intensity or color of individual LEDs of the first plurality of LED light sources, or [2] providing light directed in the direction of the road curvature from an LED not providing light directed in the direction of the road curvature prior to the change.

29[B]: the output including providing light directed in the direction associated with the shape change from an LED not providing light directed in the direction associated with the shape change prior to the change.

Alden in view of Kobayashi renders obvious Claims 7[B]/18[B]/29[B].

(Papanikolopoulos Decl., ¶112.) These claim elements generally recite that the light provided in the direction of a road curve comes from an LED that was not previously providing light in that direction. (*Id.*) This can be seen in Figure 11 of Alden, where the light from the LEDs would be focused more directly ahead of the vehicle prior to the curve, before it is then “directed into the curve” (as indicated

by the slanting of the light beams to the left in the figure) when the curve is detected. (Alden, Fig. 11, [0036].) Further, as discussed, Alden in view of Kobayashi discloses a controller that allows for iterative, continuous “reshaping” of the light output as a vehicle proceeds along a route. *See supra* Claims 4/15/26. As a vehicle travels along a road, and for example goes from a left-hand curve to a right-hand curve, this would include selecting a second set of LEDs to “concentrate” light into the right-hand curve that were not previously focusing light into the curve. (*Id.*; Papanikolopoulos Decl., ¶112.)

10. Dependent Claims 8, 19, 30

Alden in view of Kobayashi renders obvious Claims 8, 19, and 30. (Papanikolopoulos Decl., ¶¶113-126.) These claims generally introduce the concept of the system, in addition to using map data to illuminate road curvature or shape changes, also detecting other vehicles and controlling the light output from LEDs directed towards such vehicles to reduce glare. Alden specifically discloses a system that performs both of these function—its system detects other vehicles and controls LEDs to direct dimmed, low beam light into areas where those other vehicles are located, *and* it teaches sensing upcoming road curves and directing light into the curves to “maximize the driver’s ability to see there.” (*See, e.g.*, Alden, Figs. 1, 2, 11, [0025]-[0026], [0036], [0061].) Thus, a POSITA would have understood that Alden’s system could use map data to control lights based on

upcoming road curves as taught by Kobayashi, while continuing to sense other vehicles and control the lights to reduce glare to those vehicles as taught by Alden and further discussed below. (Papanikolopoulos Decl., ¶113.)

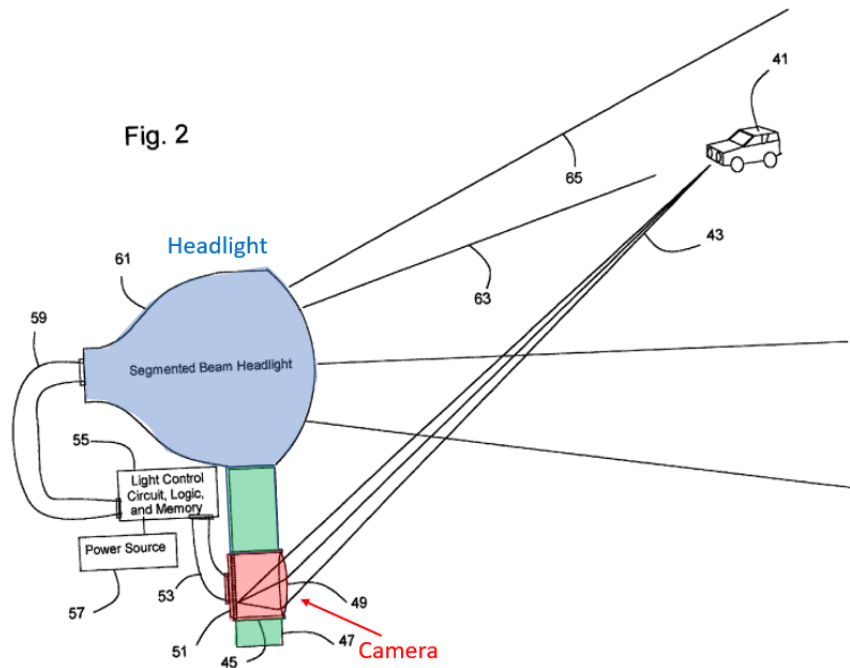
8[Pre]: *The system of claim 1, further comprising one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle; wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:*

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

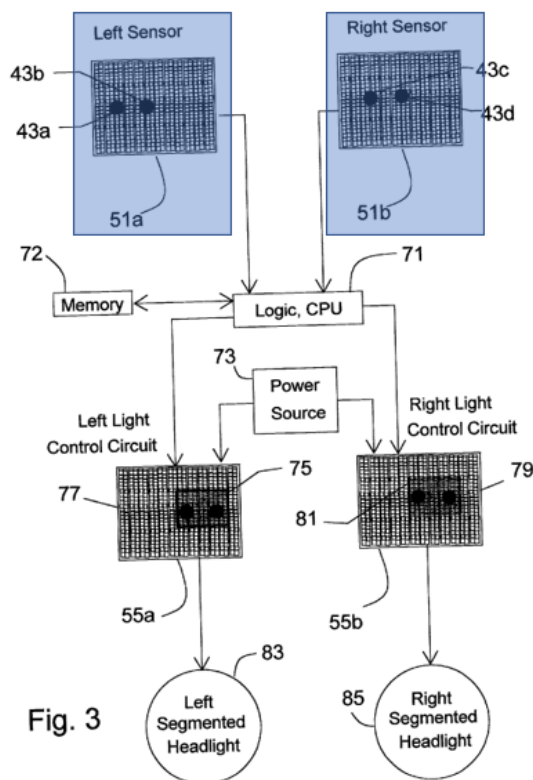
30[Pre]: *The method of claim 23, further comprising:*

Alden in view of Kobayashi renders obvious Claim 8[Pre]/19[Pre]/30[Pre] to the extent limiting. (Papanikolopoulos Decl., ¶¶114-116.) The only new element here is in Claim 8[Pre]: “one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle.” (*Id.*) Alden discloses one or more “sensors” including “cameras” that are positioned on a motor vehicle equipped with its system to capture image data indicating other vehicles ahead. (Alden, [0026]-[0028], Figs. 2-3.)

Specifically, each segmented headlight includes a “sensor unit 45” (“camera”) mounted on “vehicle 47” that can detect the presence of other vehicles such as “oncoming vehicles” within the headlight distribution area:



(Alden, [0025]-[0026], Fig. 2 (annotated), Fig., 3.) Each “sensor unit 45” can include a primary *lens* 49 and a *detector array* 51, and that the detector array can be a photodiode array or CCD (*i.e.*, camera sensors) that detects photon intensity (*i.e.*, light) and “convert[s] photons to electrons.” (*Id.*) The converted electrons “corresponding to the position and intensity of light” are sent “into a light control circuit 55 including logic and memory 55. 55 is further described in FIG. 3.” (*Id.*, [0026]-[0027].) (Alden, Fig. 2 (annotated), [0026]-[0027], Fig. 3.) Alden further discloses that its system includes a “left sensor 51a and a right sensor 51b” (“camera-sensors”) that detect light from headlights of another vehicle at multiple positions 43a-d:



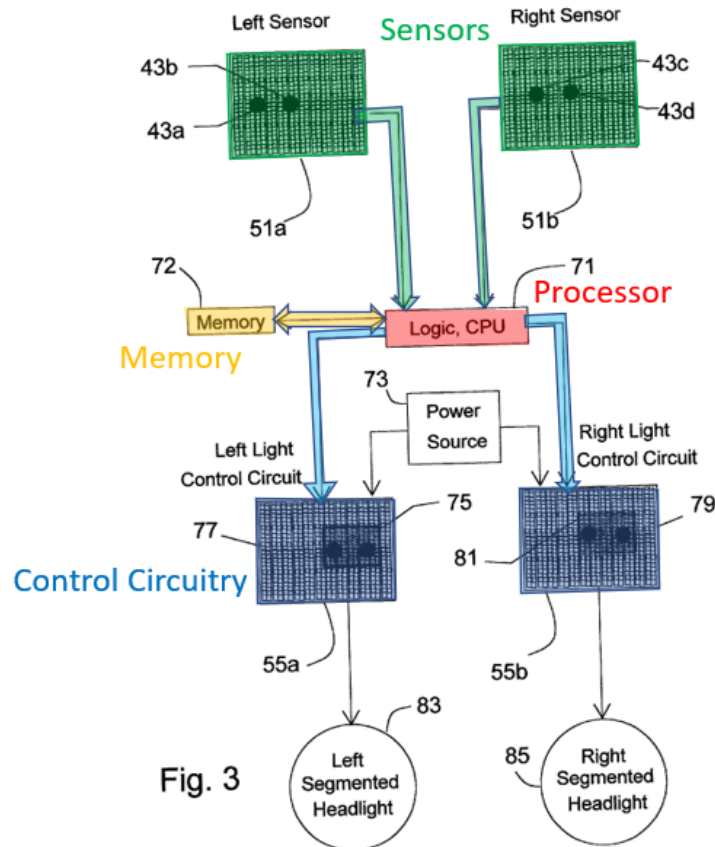
(*Id.*, Fig. 3 (annotated), [0027]-[0028]; *see also* [0026], Fig. 2 (depicting sensor unit 45 with detector array 51).)

8[A]/19[A]/30[A]: *[determine / determining] a position associated with at least one other vehicle based at least in part on second data [indicating the at least one other vehicle and] captured by the at least one of the one or more cameras; and*

Alden in view of Kobayashi renders obvious Claims 8[A]/19[A]/30[A].

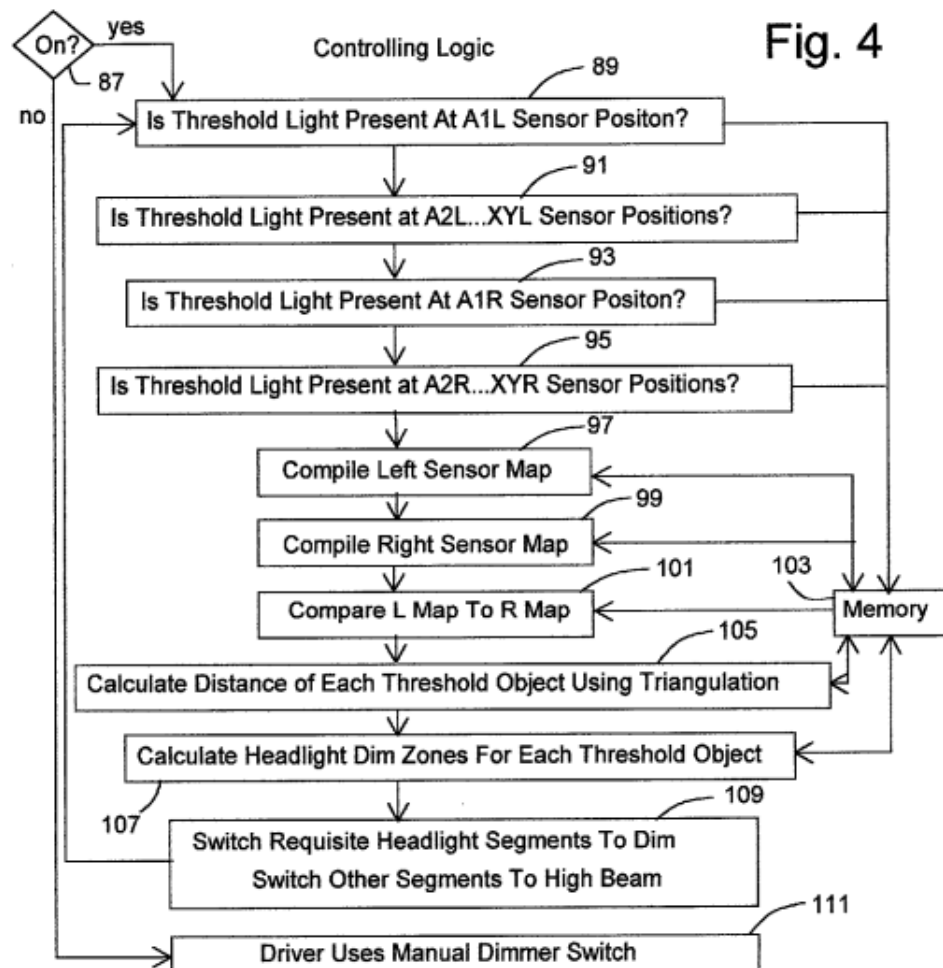
(Papanikolopoulos Decl., ¶¶117-123.) Claims 8[A]/19[A]/30[A] recite that the position associated with the other vehicle is determined based at least in part on data captured by one or more cameras and/or that indicates another vehicle. As discussed, Alden discloses one or more cameras positioned to capture image data (“second data”) indicating at least one other vehicle ahead of the motor vehicle.

See *supra* Claim 8[Pre]. Additionally, Alden discloses that its logic CPU 71 (“processor”) receives data from the camera sensors:



(Alden, Fig. 3 (annotated), [0027]; *see also* [0026].) As shown in Figure 3, camera sensors 51a-51b are connected to CPU 71, which receives information from the camera sensors regarding sensed light. (*Id.*, [0027].) In particular, each sensor “detects the two headlights of 41 [other vehicle]” at first and second illuminated spots, and “[e]lectrons corresponding to the position and intensity of light are categorized by a logic and CPU 71 and stored in a memory 72” as a “map of sensed light.” (*Id.*)

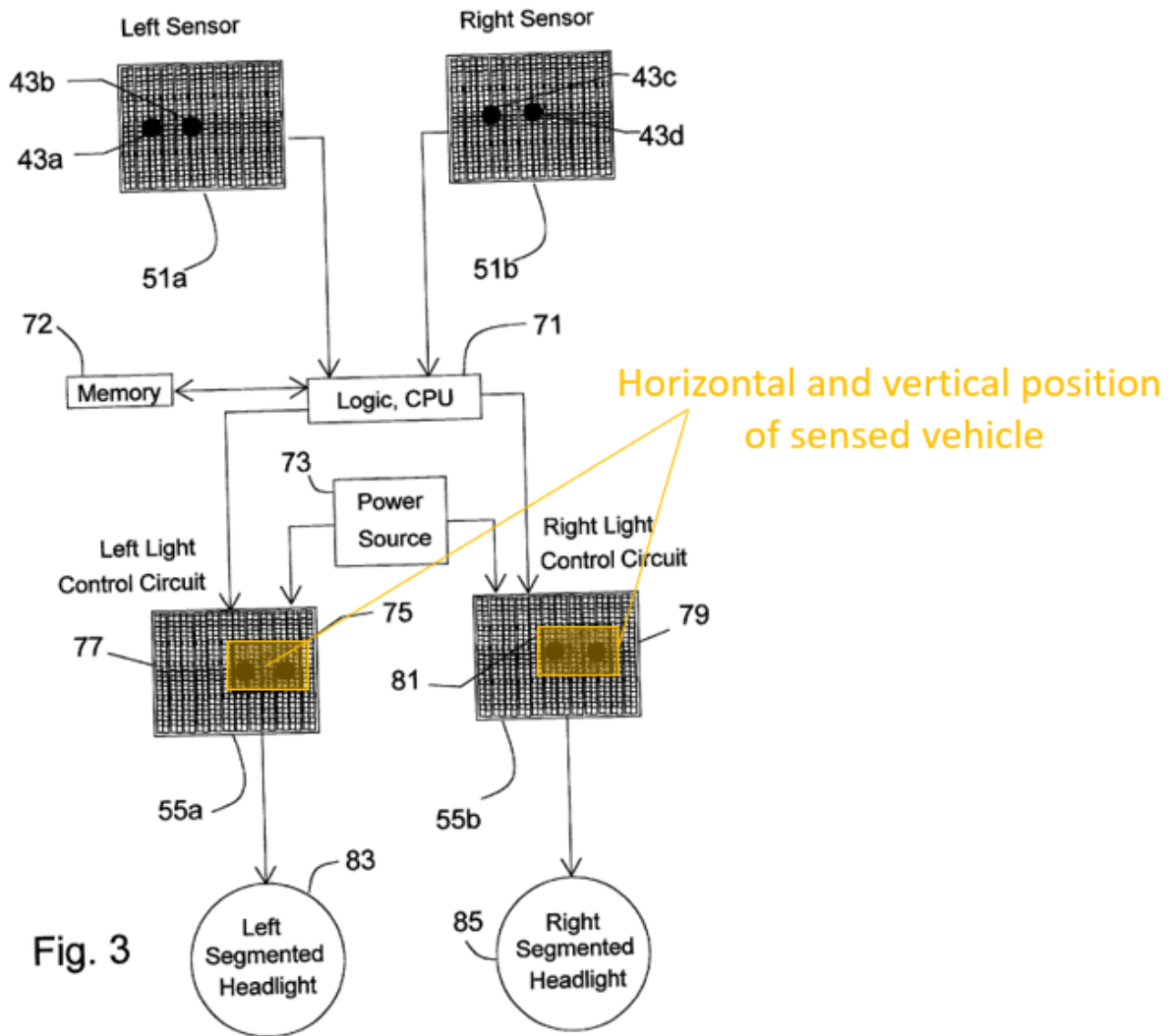
Alden's processor (CPU 71) is configured to determine the position of the other vehicle based on the sensor data:



(*Id.*, Fig. 4; *see also* Fig. 3, [0026]-[0028].) As shown, the logic process used by the CPU to determine the position of an object such as an oncoming vehicle 41 (“other vehicle”) includes: processing sensor data (steps 89, 91, 93, 95); compiling sensor maps (steps 97, 99), which include vertical and horizontal positions of sensed light from an oncoming vehicle; 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].) Alden indicates that this process controls the light emitting elements (such as the LEDs of Figure 5) so that “the light sent to ***the sensed vehicle location*** [*e.g.*, as shown in annotated Figure 3 below] is dimmer than the light sent to all other areas of the headlight distribution area.” (*Id.*, [0028].) 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.*, [0026]-[0028]; *see also* Abstract, [0005], [0029].)



(*Id.*, Figure 3 (annotated).)

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 will also change. (Papanikolopoulos Decl., ¶121.) For example, Alden explains that if threshold light is detected at certain

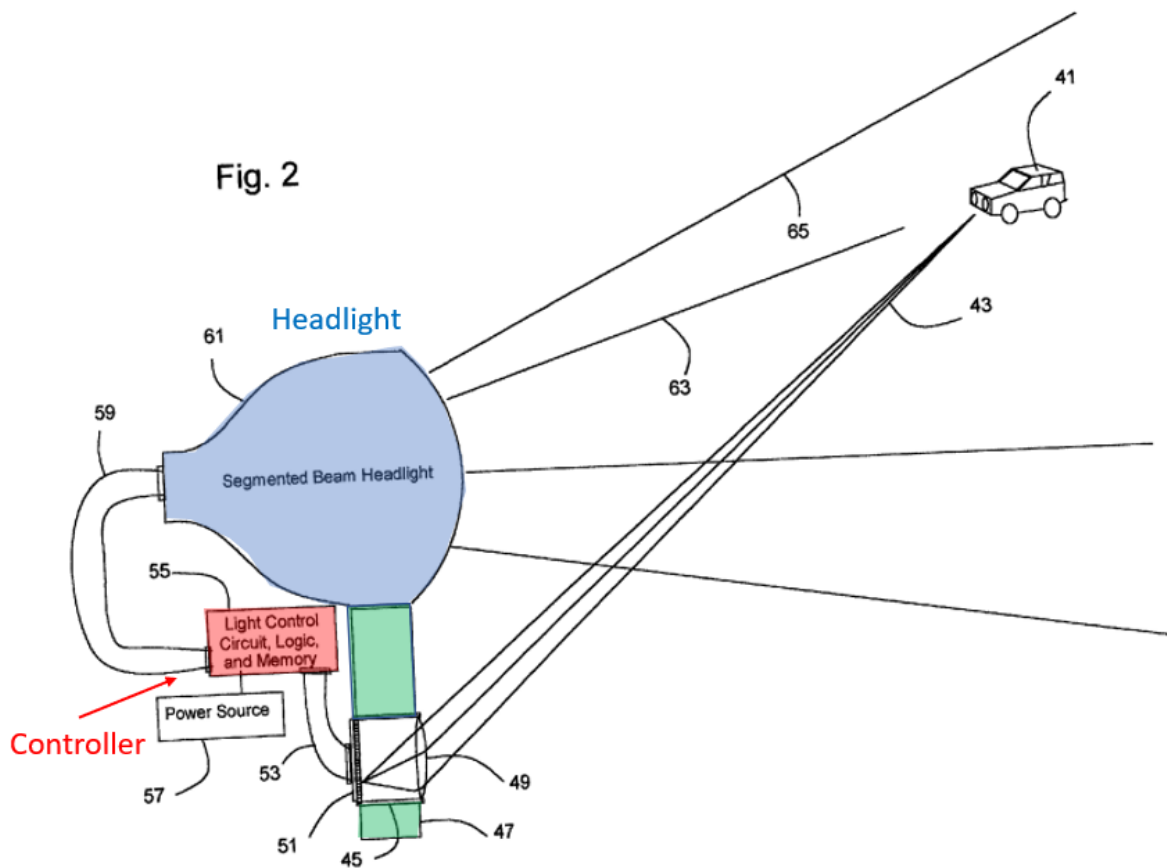
sensor positions such that another object, like an oncoming vehicle, is present, a determination is made that the intensity of light for the headlight sectors corresponding to those sensor positions should be switched to a different light, such as dim or low beam. (*Id.*, Fig. 4, [0027]-[0028]; *see also* Fig. 3.) 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 positions of other vehicles and objects, and whether each sector should be adjusted based on the positions of the same. (Papanikolopoulos Decl., ¶121.)

8[B]/19[B]/30[B]: [1] *[control / controlling], based at least in part on the position, a second plurality of LED light sources providing light directed towards an area including at least a portion of the other vehicle to diminish glare to a driver of the other vehicle by a decrease to intensity of light directed towards and illuminating the area, [2] the light [that is] directed towards and illuminating the area having lower intensity compared to light directed towards points laterally adjacent the area to either side.*

Alden in view of Kobayashi renders obvious Claims 8[B]/19[B]/30[B] (Papanikolopoulos Decl., ¶¶124-126.)

First, Alden discloses controlling its headlights to provide light to an area where a sensed other vehicle is located. *See supra* Claims 8[A]/19[A]/30[A]. As discussed, Alden's system has a processor that determines the position of objects in the headlight distribution area, like oncoming vehicles, and can illuminate those

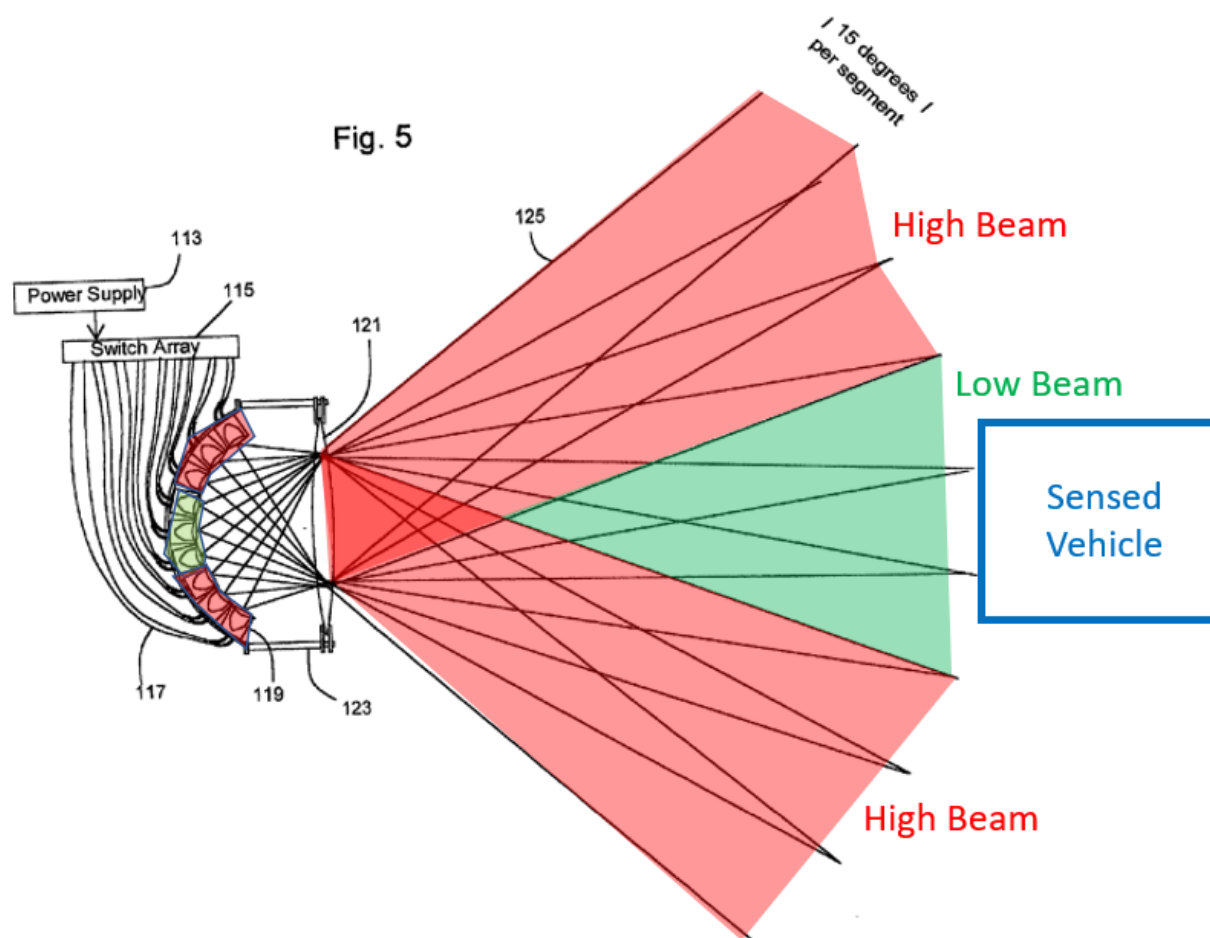
objects with light, such as low beam light to “reduce glare.” *Id.* In Alden this illumination is done by controlling certain LEDs (“second plurality” of LEDs) that emit light in the areas where the other vehicle is located. As discussed, CPU 71 “processes” the sensor data to determine which LEDs direct light to the area of an oncoming vehicle and causes those LEDs (“second plurality”) to emit a decreased intensity, low beam in the area (63) of the detected vehicle (41), while other LED groups, such as those directed light to areas (65) where no other vehicle is present, are switched to high beam light:



(Alden, Fig. 2 (annotated), [0026], [0027] (noting that “the driver of 41 [other vehicle] has minimum glare while the driver of 47 has maximum light.”).) *See also supra* Claims 8[A]/19[A]/30[A].

Alden discloses that the selection of the “second plurality” of LEDs to illuminate the area where the other vehicle is positioned is based on the known directionality associated with those LEDs. (Papanikolopoulos Decl., ¶125.) In particular, Alden’s lighting elements 119 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. (Alden, [0029], Fig. 5.) Thus, each lighting element is directed to a “specified” area, and when Alden illuminates an area (such as one with an oncoming vehicle) with low beam light, it will select and adjust those LEDs that are directing light into that corresponding area where the vehicle is. (Papanikolopoulos Decl., ¶125.) *See also supra* Claim 1[A].

Second, where the position of an oncoming vehicle is detected, for example in a middle area or sector, that area will be dimmed, while the light directed to points in the area or sectors laterally adjacent on either side will be switched to high beam intensity:



(*Id.*, Fig. 5 (annotated), [0026]-[0029]; *see also* Papanikolopoulos Decl., ¶126.)

Again, Alden discloses that this reduces glare for oncoming vehicles: “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.” (Alden, [0027]; *see also* Abstract, [0005].) That is, based on the sensor data, an adaptive headlight beam is generated that is dimmer, or lower in intensity, in an area where another vehicle is sensed as compared to other areas laterally adjacent to the sensed vehicle that are switched to high beam. (Papanikolopoulos Decl., ¶126.)

11. Dependent Claims 10-11, 21-22, 32-33

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

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

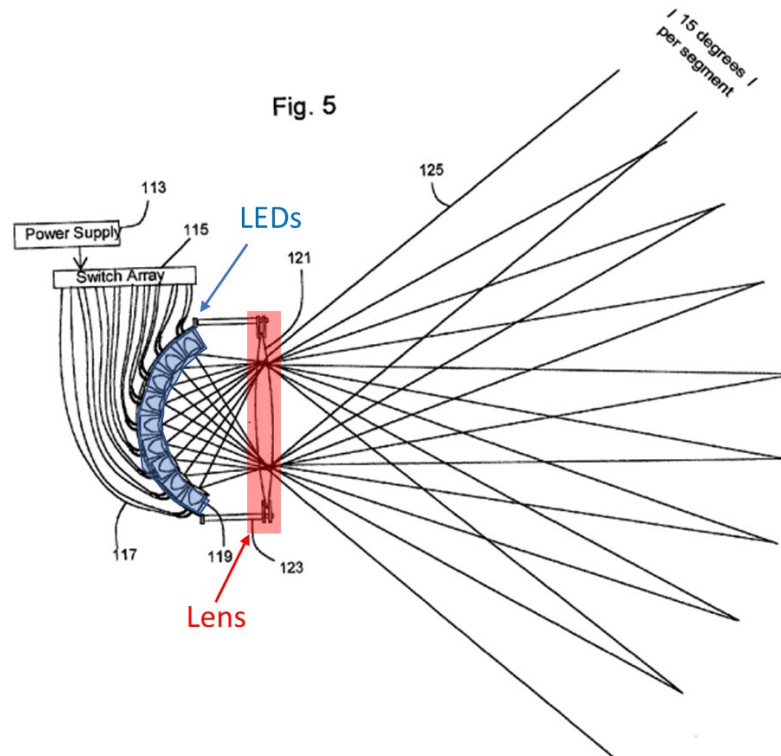
32: *The method of claim 30, further comprising utilizing one or more optical control elements included in the motor vehicle to control light from at least the first plurality or second plurality of the LED light sources.*

11/22/23: *The [system / method / storage medium] of claim [10 / 21 / 33], wherein the optical control elements include at least one of one or more reflectors, refractors or lenses.*

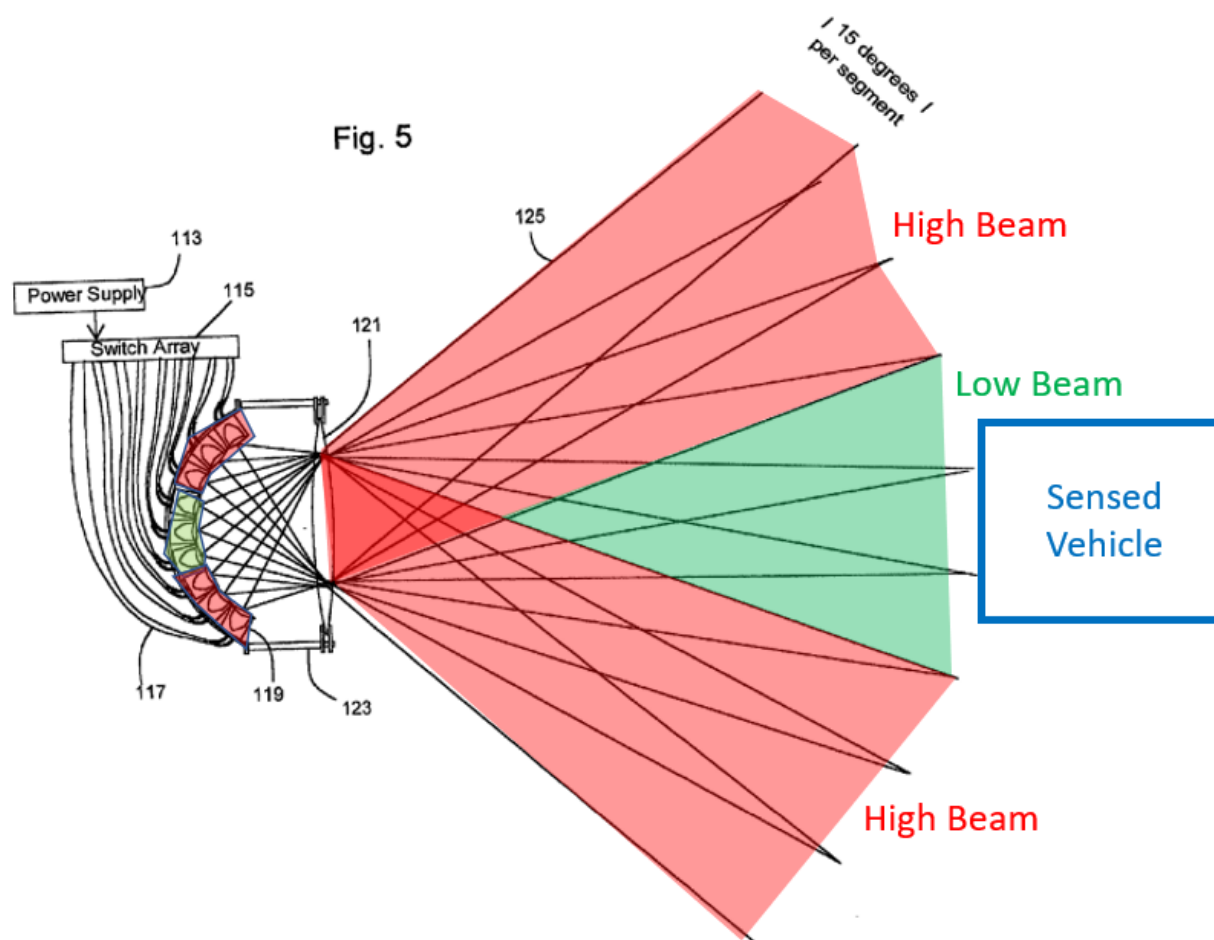
Alden in view of Kobayashi renders obvious Claims 10-11, 21-22, and 32-33. (Papanikolopoulos Decl., ¶¶127-132.) Claims 10, 21, and 32 are substantially similar: each adds “one or more optical control elements” to control light emitted from the LEDs (or groups of LEDs). (*Id.*) Claims 11, 22, and 23 are all identical and add that these optical control elements can include one or more “reflectors, refractors or lenses. (*Id.*)

As shown in Figure 5 of Alden (below), each Alden headlamp is comprised of an array of lighting elements, *e.g.*, LEDs. (Alden, [0029], Fig. 5.) Alden further discloses that these 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.” (*Id.*, [0029].)

Thus, Alden discloses that its vehicle headlight system includes an “optical control element” to control light emitted from one or more of the LEDs, such as the headlight “lens 121.”

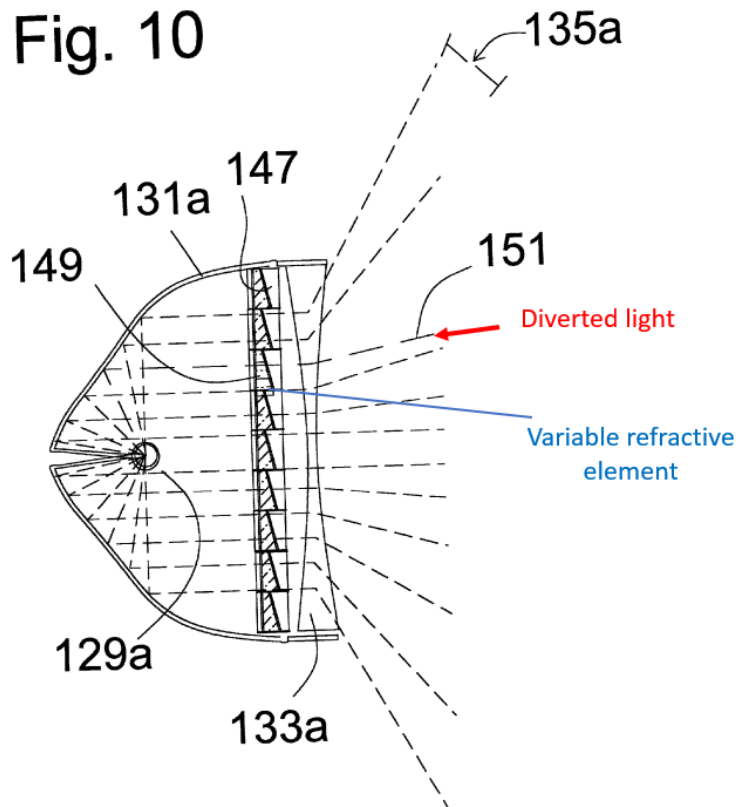


(*Id.*, Fig. 5 (annotated).) When the processor controls the LEDs to emit light, it utilizes the lens element 121 to direct the light into the desired sectors or segments of the headlight distribution area based on their position on the curve relative to the focal point of the lens. (*Id.*, [0029].) For example, if a cluster of LEDs in the area of an oncoming vehicle are to be dimmed to “reduce glare,” light from those LEDs will be redirected by the “optical control element” / “lens 121” when passing through, so as to focus it in the area of the sensed vehicle:



(Alden, Fig. 5 (annotated), [0026]-[0029].)

In addition, Alden’s system can include other “optical control elements,” including a “variable refractive element” in the form of a liquid crystal. (*Id.*, [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).)

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. (Papanikolopoulos Decl., ¶¶131-1332.) 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., ¶131.) 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.*, ¶131.)

B. Ground 2: Alden (Alone or With Beam) In View of Kobayashi Renders Dependent Claims 9, 20, and 31 Obvious

Alden, alone or in combination with US6144158 (“**Beam**”)⁶ (EX1007), in view of Kobayashi renders obvious Claims 9, 20, and 31. (Papanikolopoulos Decl., ¶¶133-151.)

9[A]/20[A]/31[A]: *The [system / storage medium / method] of claim [8 / 19 / 30], wherein: the first plurality and second plurality of LED light sources include at least one common LED light source;*

Alden discloses and renders obvious Claims

9[A]/20[A]/31[A]. (Papanikolopoulos Decl., ¶¶134-137.) As discussed, Alden discloses a plurality of individually-controllable LEDs along a curve in a headlamp that can be used to illuminate different areas, including areas where there are detected vehicles and road curvature. *See supra* Claims 1[E]/12[C]/23[C], 8[B]/19[B]/30[B]. (*See also* Alden, [0061] (teaching that features can be “used in combination to vary illumination in a segmented system”).) Thus, as a POSITA would have understood, the different pluralities of LEDs of LEDs can include

⁶ Beam was issued November 7, 2000, and is prior art under at least § 102(b).

“common LED light sources.” (Papanikolopoulos Decl., ¶134.) For example, each LED can be used both to illuminate the light of a curve, such as with a high beam (“first plurality”), and to project dimmed, low beam light when there is an oncoming vehicle (“second plurality”), depending on “environmental conditions.” (*Id.*)

Further, Alden discloses that its sensing, determination, and adjustment of projected light is a continuous, real-time process. *See supra* Claims 4/15/26. Thus, with the system of Alden, if a vehicle approaches a curve on the left, those LEDs illuminating the curve will project high beam. (Papanikolopoulos Decl., ¶135.) If, however, the equipped vehicle then encounters an oncoming vehicle, the system of Alden will switch those same LEDs that overlap with the area of the oncoming vehicle along the curve (“common LED light sources”) to dimmed, low beam light. (*Id.*)

9[B]/20[B]/31[B]: the control of the second plurality of LED light source[s] is based at least in part on third data received from a non-camera sensor of the motor vehicle;

Alden in view of Kobayashi renders obvious Claims 9[B]/20[B]/31[B]. (Papanikolopoulos Decl., ¶¶138-143.) Claims 9[B]/20[B]/31[B] require that the “second plurality” of LEDs (*i.e.*, those directing reduced intensity light towards another vehicle) can be controlled based in part on “third data received from a non-camera sensor.” (*Id.*, ¶138.)

Alden discloses several methods for controlling its segmented headlights, including: (a) reducing intensity in areas where other vehicles are detected (*e.g.*, Alden, [0025]-[0026], Figs. 1-2); (b) concentrating “light to look around corners” by directing “light into the corner” (*id.*, [0036], Fig. 11); and (c) concentrating light to look up or down hills (*id.*, [0037]-[0038], Figs. 12-13). Alden also discloses that its headlamp LEDs (such as shown in Figure 5) are individually-controllable and can be used in connection with these methods. *See supra* Claim 9[A]/20[B]/31[B]. Alden further discloses that “non-camera” sensors, particularly a “***steering wheel***” ***sensor***, can be used to “change[] the direction of the headlight output” (*e.g.*, based on the angle of the steering wheel). (Alden, [0039]-[0040], Figs. 14-15.) And Alden discloses that “[o]ne or more” of these “methods employed herein may be used in combination to vary illumination in a segmented system.” (*Id.*, [0061].)

A POSITA would have thus understood that the “control” of the “second plurality” of LEDs can be based on data from other sensors, such as the steering wheel sensor. (Papanikolopoulos Decl., ¶¶140-141.) For example, when a vehicle equipped with the system of Alden is traveling straight and there is an oncoming vehicle, light emitted from the “second plurality” of LEDs in the area of the oncoming vehicle is dimmed. (*Id.*, ¶141.) However, if the steering wheel sensor detects that the wheel is turned “x degrees,” indicating that the driver will be turning the vehicle (*see* Alden, Figs. 14-15, [0057]-[0058]), then the “second

plurality” of LEDs would be further controlled to “change[] the direction of the headlight output a corresponding f(x) degrees.” (*Id.*; Papanikolopoulos Decl., ¶141.)

In addition, Alden in view of Kobayashi discloses Claims 9[B]/20[B]/31[B]. (Papanikolopoulos Decl., ¶¶142-143.) Kobayashi indicates that its “road profile calculating means” can be included as part of a **GPS sensor** (“non-camera sensor”) that outputs “map information.” (*Id.*, Fig. 12, 17:3-61, 2:28-50.) It would have been obvious to a POSITA to apply the teachings of Kobayashi and incorporate the GPS sensor with its map data into Alden’s system for the reasons discussed above. *See supra* Claims 1[C]-1[D]. Again, Alden already contemplates the use of multiple sensors, and the inclusion and use of the GPS sensor and map data would simply add a known element in a similar system. (Papanikolopoulos Decl., ¶142.) Further, Alden would continue to perform the same control of its LEDs based on changing “environmental conditions,” only now it would be able to consider GPS sensor and associated map data as well. (*Id.*) Similar to the steering wheel sensor, data from this sensor could be used to cause CPU 71 to further control the “second plurality” of LEDs, adjusting their direction in view of the map data indicating an upcoming road curve. (*Id.*) *See supra* Claims 1[C]-1[D].

9[C]/20[C]/31[C]: the position includes at least one of: a distance associated with the at least one other vehicle, at least one elevation associated with the at

least one other vehicle, or a position within image data captured by at least one of the cameras;

Alden in view of Kobayashi renders obvious Claims 9[C]/20[C]/31[C]. (Papanikolopoulos Decl., ¶144.) Claims 9[C]/20[C]/31[C] require that the determined “position” of the detected other vehicle includes at least one of (i) a distance of the other vehicle, (ii) an elevation of the other vehicle, or (iii) a position with image data captured by the camera sensors. As discussed, Alden’s system detects an oncoming vehicle and discloses that it determines both a “distance” and position of this vehicle using “triangulation.” *See supra* Claims 8/19/30. Further, a position of the two “dots” representing the headlights of the oncoming vehicle within the image data is captured by “camera” sensors. (Papanikolopoulos Decl., ¶144.)

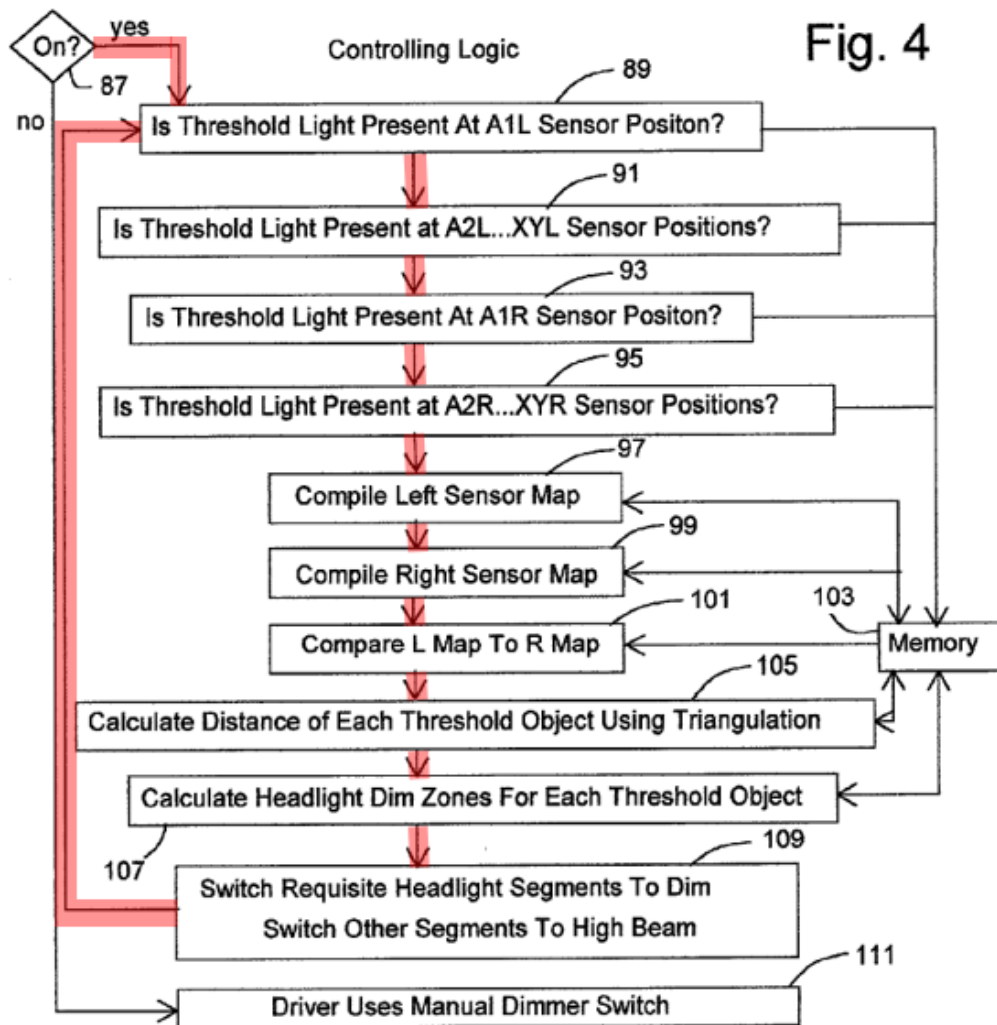
9[D]/20[D]/31[D]: *the first data includes data from a non-camera sensor of the motor vehicle;*

Alden in view of Kobayashi renders obvious Claims 9[D]/20[D]/31[D]. (Papanikolopoulos Decl., ¶145.) Alden in view of Kobayashi discloses receiving first data including map and GPS data (*i.e.*, data from a non-camera sensor). *See supra* Claim 1[C].

9[E]/20[E]/31[E]: either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other;

Alden in view of Kobayashi renders obvious Claims 9[E]/20[E]/31[E]. (Papanikolopoulos Decl., ¶146.) First, as explained above, Alden’s system can select LEDs to illuminate a road curve by selecting a “first plurality” of LEDs. *See supra* Claim 1[E]. Second, if another vehicle is subsequently detected, then a “second plurality” of LEDs, directing light to the sectors where the detected vehicle is located, can then be controlled to produce dim, low beam light in the direction of the other vehicle. *See supra* Claim 8[B]/19[B]/30[B].

Alden in view of Kobayashi discloses an iterative control system of continuously collecting sensed data, calculating the position of an oncoming vehicle or road curvature based on that data, and determining which portions of the headlights need to be dimmed or illuminated based on the new calculation. (*Id.*, Fig. 4, [0028].) Thus, the headlight system is responsive to changing “environmental conditions” in “real time”:



(*Id.*, Fig. 4 (annotated); *see also* Fig. 3, [0026]-[0028].) *See supra* Claims 4/15/26.

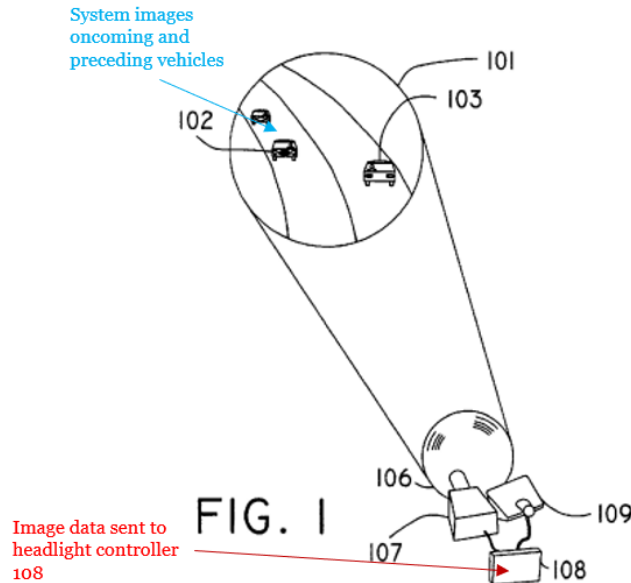
This system would operate to allow the “first plurality” (illuminating a road curvature) and the “second plurality” (reducing glare) of light sources to be controlled iteratively, *i.e.*, subsequent to and accommodative of each other. *See id.* (Papanikolopoulos Decl., ¶146.)

9[F]/20[F]/31[F]: the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and

Alden (alone or in view of Beam) in view of Kobayashi renders obvious Claims 9[F]/20[F]/31[F]. (Papanikolopoulos Decl., ¶¶147-151.) As discussed, Alden discloses reducing light emitted from the selected LEDs (*i.e.*, the “second plurality” of LEDs) to “low beam,” and setting the light emitted from the non-selected LEDs on “high beam.” *See supra* Claims 8/19/30. As a result, the driver of the oncoming vehicle has minimum glare while the driver of the equipped vehicle has maximum light. *Id.* Alden further discloses that the LEDs can be operated in a range of intensities (Alden, [0061]), and a POSITA would have understood that this could include operating at zero. (Papanikolopoulos Decl., ¶147.) A POSITA would understand that turning off LEDs that emit light directly at the driver of the other vehicle would accomplish Alden’s purpose of reducing glare to other drivers. (*Id.*)

In the alternative, Alden in view of Kobayashi and Beam renders obvious Claims 9[F]/20[F]/31[F]. (Papanikolopoulos Decl., ¶¶148-151.) 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 a 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 light from the taillights 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.) Beam further

discloses that the light can be darkened, as lighting elements can be “*blanked* (attenuated by being either absorbed or deflected to an absorbing surface.)” (*Id.*, 4:26-52, 5:33-54.) That is, those lighting elements can be switched to terminate light output, where the light is attenuated. (Papanikolopoulos Decl., ¶¶149-150.)

It would have been obvious to a POSITA to modify Alden to change at least one of the selected “second plurality” of LEDs to a terminated output state, so as to further dim headlight beam output directed to areas of the oncoming vehicles as taught by Beam. (*Id.*, ¶151.) Both Alden and Beam are directed to controlling headlight beams so as 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 the 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 by changing at least one of the selected LEDs to a terminated output state would have merely required the continued use of Alden’s existing system components for their intended purpose. (*Id.*) A POSITA would have recognized that LEDs could be changed into a terminated output state in the same way the Alden system dims the LEDs—by using the left and right light control circuit 55a-55b to control the power supply to the selected LEDs such that no power or current is provided. (Alden, [0027]-[0029].) That is, modifying Alden

to change certain LEDs to a terminated output state would require no additional equipment or changes in the processing steps. (Papanikolopoulos Decl., ¶151.)

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 control circuits in concert with headlamps to increase illumination for a driver while reducing glare for the drivers of other vehicles nearby that driver. (*Id.*) And a POSITA would have been motivated to change the selected LEDs to a terminated output state under certain circumstances to minimize glare to the driver of oncoming vehicles, as taught by Beam, as this is exactly the same purpose of Alden (Alden, Abstract; *see also* Papanikolopoulos Decl., ¶151.)

9[G]/20[G]/31[G]: the light pattern includes at least one of an illumination pattern or an emission pattern of the headlamps.

Alden in view of Kobayashi renders obvious Claims 9[G]/20[G]/31[G]. (Papanikolopoulos Decl., ¶152.) The “light pattern” of Claims 9[G]/20[G]/31[G] relates to detection and subsequent illumination of a road curvature. *See supra* Claims 1[D]/12[B]/23[B]. This light pattern includes an illumination pattern or emission pattern of the headlamps, which are comprised of the multiple LED light sources discussed herein. *See supra* Claims 1[D]-1[E]. For example, the pattern of light emitted from the headlights changes depending on whether an oncoming

vehicle is detected or changes in the road (*e.g.*, curves, hills) are detected. *Id.*; *see also supra* Claim 1[C].

IX. TRIAL SHOULD BE INSTITUTED

A. *Fintiv* Factors

The Board should institute review because Petitioner has been diligent in filing their 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. Given the foregoing, it is speculative that any court will address the distinct invalidity challenges raised in this Petition. *See, e.g., Torchlight Techs., LLC v. Daimler AG, et al.*, No. 1:22-CV-751, D.I. 124-125.

B. 35 U.S.C. § 325(d)

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

First, all of Claims 1-33 are subject to only one other IPR challenge. Unified Patents filed a challenge on only a subset of these claims. Further, the other

challenge against all of Claims 1-33 was 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 Unified's or Volkswagen's IPR challenges against the '029 will ultimately reach a Final Written Decision. Over a quarter of all IPRs settle before Final Written Decision. EX1008 at 9.

Second, significantly, none of the prior art asserted herein was considered by the Examiner, let alone applied in a rejection. Further, none of the other pending IPR proceedings against the '029 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).⁷

X. CONCLUSION

Petitioner respectfully requests that a Trial be instituted. Claims 1-33 of the '029 should be cancelled as anticipated and obvious over the prior art.

⁷ 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 8, 2023

Respectfully submitted,

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Table of Exhibits

Exhibit No.	Description
1001	U.S. Patent No. 11,208,029 (“ ’029 Patent ”)
1002	File History for the ’029 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	U.S. Patent No. 6,049,749 to Kobayashi (“ Kobayashi ”)
1007	U.S. Patent No. 6,144,158 to Beam (“ Beam ”)
1008	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 13,575. This is less than the permitted total under the 37 C.F.R. 42.24(a)(1)(i).

/s/ Celine J. Crowson

Celine J. Crowson (Reg. No. 40,357)
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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 1008 were served on June 8, 2023, by Overnight Courier and hand delivery at the following address of record and addresses known to Petitioner as likely to effect service and the address of record for the '029 patent:

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