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Paper No. 35
Entered: January 14, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner,

IPR2023-01034
Patent 11,208,029 B2

Before JON M. JURGOVAN, JASON W. MELVIN, and
AARON W. MOORE, *Administrative Patent Judges*.

MELVIN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

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I. INTRODUCTION

Mercedes-Benz USA, LLC (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–33 (“the challenged claims”) of U.S. Patent No. 11,208,029 B2 (Ex. 1001, “the ’029 patent”). Yechezkal Evan Spero (“Patent Owner”) filed a Preliminary Response. Paper 10. After additional authorized briefing, we instituted review. Paper 17 (“Institution Decision” or “Inst.”).

Patent Owner filed a Response (Paper 23, “PO Resp.”), Petitioner filed a Reply (Paper 26, “Pet. Reply”), and Patent Owner filed a Surreply (Paper 27, “PO Surreply”). We held an oral hearing on October 23, 2024. Paper 34 (“Tr.”).

For the reasons below, we conclude that Petitioner has proven the challenged claims unpatentable.

A. REAL PARTIES IN INTEREST

As real parties in interest, Petitioner identifies: Mercedes-Benz USA, LLC; Mercedes-Benz Group AG; Mercedes-Benz AG; and Mercedes-Benz Intellectual Property GmbH & Co. KG. Pet. 3. Patent Owner identifies Yechezkal Evan Spero and Torchlight Technologies LLC as the real parties in interest, noting that Torchlight is the exclusive licensee of the ’029 patent. Paper 3, 1 (Patent Owner’s Mandatory Notices).

B. RELATED MATTERS

The parties identify the following related federal district court litigations involving the ’029 patent: *Torchlight Techs. LLC v. Daimler AG et al.*, No. 1:22-cv-00751 (D. Del.); *Torchlight Technologies LLC v. General Motors LLC et al.*, No. 1:22-cv-00752 (D. Del.). Pet. 3; Paper 3, 1.

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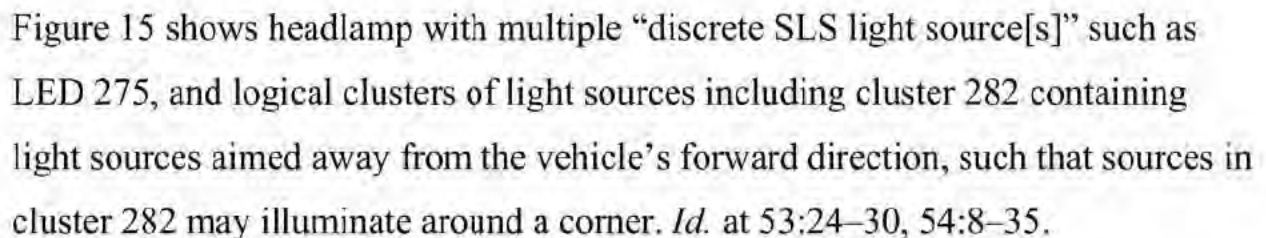
The parties identify the following PTAB *inter partes* reviews of the '029 patent: IPR2022-01500; IPR2023-01586; IPR2023-01122; IPR2023-01226. Pet. 3; Paper 3, 1–2.¹

C. THE '029 PATENT

The '029 patent is titled “Adaptive Headlight System” and relates to motor vehicle headlamps with LED light sources and a processor to control the headlamp light pattern. Ex. 1001, codes (54), (57). The specification more generally describes a lighting device that “incorporates one or more discrete light sources and their ancillary optical and electrical control equipment in an integrated illuminating element.” *Id.* at 13:34–36.

The specification further describes transportation-vehicle applications. *Id.* at 50:49–57:35. In those applications, it refers to an “embodiment of a digital automotive headlamp” as depicted in Figure 15, reproduced below. *Id.* at 52:12–13.

¹ Patent Owner further lists reissue applications, reexaminations, and IPRs involving patents related to the '029 patent. Paper 3, 2–3.



D. CHALLENGED CLAIMS

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1. A system, for a motor vehicle, comprising:
 - a plurality of headlamps, each comprising a plurality of LED light sources;
 - 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:
 - receive first data, including at least map data, indicating a road curvature upcoming along a road on which the motor vehicle is traveling;
 - [²] 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
 - [³] 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.

Ex. 1001, 95:56–96:8. Claims 2–11 depend, directly or indirectly, from claim 1. *Id.* at 96:9–97:44. Claim 12 is independent and recites limitations similar to claim 1’s. *Id.* at 97:45–62. Claims 13–22 depend, directly or indirectly, from claim 12. *Id.* at 97:63–99:27. Claim 23 is independent and recites limitations similar to claim 1’s. *Id.* at 99:28–43. Claims 24–33 depend, directly or indirectly, from claim 23. *Id.* at 99:44–100:66.

² Patent Owner refers to these as the “predictive curve illumination limitations.” PO Resp. 6.

³ Patent Owner refers to these as the “control limitations.” PO Resp. 6.

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E. PRIOR ART AND ASSERTED GROUNDS

This proceeding includes the following unpatentability grounds:

Claim(s) Challenged	35 U.S.C. §⁴	Reference(s)/Basis
1–8, 10–19, 21–30, 32, 33	103	Alden ⁵ , Kobayashi ⁶
9, 20, 31	103	Alden, Beam ⁷ , Kobayashi

Pet. 5. Petitioner also relies on the Declarations of Dr. Nikolaos Papanikolopoulos. Ex. 1003; Ex. 1010.

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner asserts that an ordinarily skilled artisan “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 control systems.” Pet. 8–9 (citing Ex. 1003 ¶ 33). Patent Owner does not dispute that level of ordinary skill in the art. PO Resp. 6. We adopt the undisputed level of ordinary skill in the art for purposes of this decision and refer to people with that skill as skilled artisans.

⁴ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), effective March 16, 2013, amended the applicable statutes. Because the application from which the ’029 patent issued was filed before this date, the pre-AIA version of § 103 applies.

⁵ US 2003/0137849 A1, filed Jan. 22, 2002 (Ex. 1005).

⁶ US 6,049,749, issued Apr. 11, 2000 (Ex. 1006).

⁷ US 6,144,158, issued Nov. 7, 2000 (Ex. 1007).

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B. CLAIM CONSTRUCTION

The parties agree that no express claim construction is required at this stage. Pet. 8; PO Resp. 7. We agree with the parties and therefore do not further construe the claims for this decision. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

C. OBVIOUSNESS OVER ALDEN AND KOBAYASHI

Petitioner asserts that claims 1–8, 10–19, 21–30, 32, and 33 are unpatentable as obvious over Alden and Kobayashi. Pet. 12–68. For most of claim 1’s limitations, Petitioner relies on Alden alone. *Id.* at 12–30.

Alden is a published U.S. Patent Application describing and claiming a segmented-distribution headlight system. Ex. 1005, code (54). Alden’s Figure 2 is reproduced below:

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Fig. 2

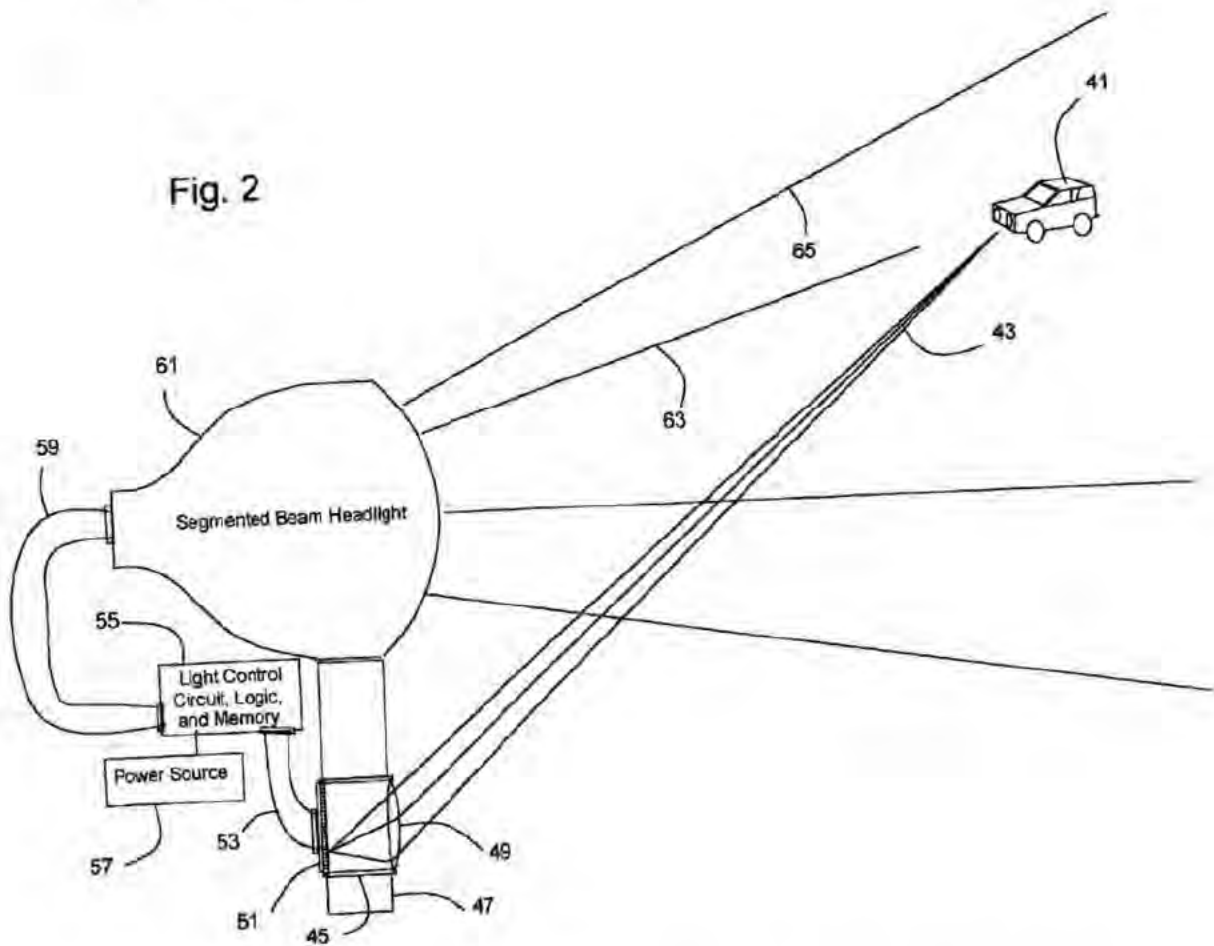


Figure 2 depicts the elements of Alden’s “segmented distribution illumination process,” in which vehicle 41 emits light towards a vehicle with Alden’s invention, and that light illuminates detector array 51 that is part of sensor unit 45; signals representing the received light are sent to light control circuit 55, which controls segmented beam headlight 61 to provide either low or high illumination in its various segments such that light directed toward the vehicle 41 is a low beam and light directed elsewhere is a high beam. *Id.* ¶ 26, Fig. 2.

Alden's system detects spots of light, performs triangulation to calculate the distance to each, then uses the spots' intensity, size, and location information to represent "objects." *Id.* ¶ 27 ("Triangulation is thus used by the CPU to determine

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the distance” when detecting “spots of nearly identical intensity and size representative of the [oncoming vehicle’s] headlights.”), 28 (“The CPU compares the right map to the left map to determine the distance and intensity of each object sensed . . .”).

Once objects have been identified, Alden’s system uses them to determine which headlight zones to dim. *Id.* ¶ 28 (“The location of objects is used to calculate which zones of each headlight need to be dimmed . . .”; “assuming the sensed light is above a threshold intensity or distance”). In that decision, the CPU identifies a corresponding pair of headlights as a vehicle, and accommodates the vehicle by defining a dimming area larger than just the headlights. *Id.* ¶ 27 (“The [dimmed] area is significantly larger than the headlight dots that were initially received by [the light-detector arrays] because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.”). Finally, “[s]ignals are sent to each of the headlight control circuit zones that need to be dimmed,” whereas other zones “remain on high beam.” *Id.* ¶ 28.

With signals from the CPU, Alden’s “segmented beam headlight” projects light in the desired pattern. *E.g., id.* ¶¶ 26, 29. Alden discloses a number of embodiments for the headlight, including one with an array of LEDs (*id.* ¶ 29, Fig. 5) and others with electro-chromatic, liquid-crystal, or variable-refraction elements (*id.* ¶¶ 30–35, Figs. 6–10).

Alden further discloses other applications for its controllable headlights, including one directed to curves in the road. Alden’s Figure 11 is reproduced below:

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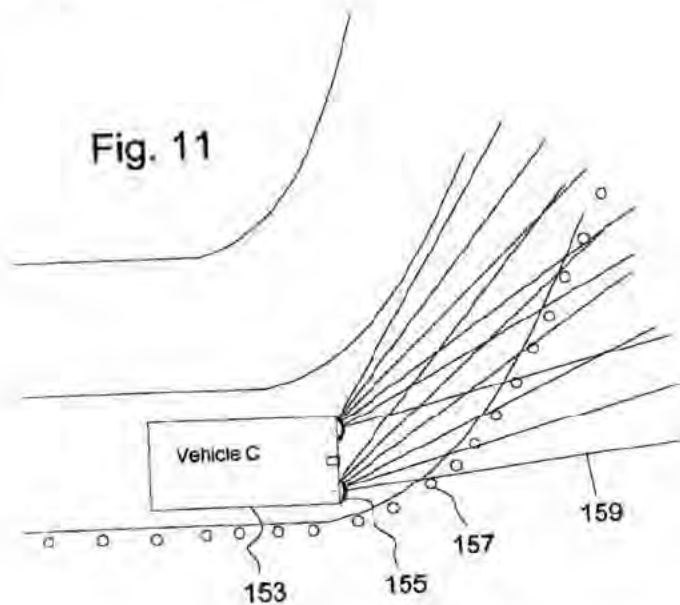


Figure 11 depicts equipped vehicle 153 sensing that the road turns using roadside reflectors 157, causing headlights 155 to “direct light into the corner to maximize the driver’s ability to see there.” Ex. 1005 ¶ 36, Fig. 11. Alden states that the same device already disclosed may direct light as illustrated in Figure 11. *Id.* ¶ 36.

Petitioner additionally relies on Alden’s steering-wheel rotation sensor, which Alden uses to calculate its vehicle’s direction changes and adjust the light projection. Pet. 21 (citing Ex. 1005 ¶¶ 39–40).

For receiving map data indicating an upcoming road curvature, Petitioner relies on Kobayashi, submitting that it would have been obvious to “use map data to identify road curvature when adapting the LEDs of Alden to ‘direct light into the corner.’” Pet. 23–24 (quoting Ex. 1005 ¶ 36). Petitioner reasons that Alden discloses detecting road curvature through roadside reflectors and steering-wheel sensors, and Kobayashi discloses an additional way to detect road curvature. *Id.* at 24. Petitioner continues that, because Kobayashi discloses using map data to control vehicle headlights, skilled artisans would have had reason to adopt its teachings in Alden’s system “to maximize successful detection in different

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environments.” *Id.* at 24–25 (citing Ex. 1003 ¶ 70). Petitioner relies on Kobayashi also for determining a light change to increase light in the direction of road curvature and shaping light based on the road curvature. *Id.* at 27. Finally, Petitioner relies on Kobayashi for the requirement to control the light sources both based on the determined light change and also prior to the vehicle reaching the road curvature. *Id.* at 30.

1. Alden’s ability to increase light in the direction of road curvature

Petitioner relies on Alden’s disclosure of detecting road curvature using roadside reflectors and altering light distribution in response, which is summarized above. Pet. 20–21 (citing Ex. 1005 ¶ 36, Fig. 11).

As noted above, Petitioner relies further on Kobayashi’s use of map data to identify road curvature and adapt the light distribution in response. Pet. 22–25. Petitioner submits that skilled artisans would understand Kobayashi to disclose “an additional known means to detect road curvature: road map data.” *Id.* at 24. Using Kobayashi’s map data to detect road curvature would “maximize successful detection in different environments” such as where a road lacks reflectors. *Id.* at 25.

Patent Owner argues that Alden does not enable a system that detects road curvature. PO Resp. 23–25 (“Alden does not teach any logic for determining the difference between headlights and reflectors . . .”). We do not agree.

We agree with Petitioner that Patent Owner has not demonstrated lack of enablement for Alden’s system detecting road curves. Pet. Reply 1–3. As Petitioner points out, Alden uses both intensity and a detected object’s location (including distance) to inform its response. Ex. 1005 ¶¶ 27–28. Petitioner’s expert testifies that the same physical system used to accommodate oncoming vehicles

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could be used to detect roadside reflectors and direct light into road curves.

Ex. 2041, 78:16–80:24. Further, Petitioner’s expert testifies that skilled artisans would adjust the intensity and distance thresholds to distinguish roadside reflectors from oncoming vehicles. Ex. 1010 ¶¶ 5–7. Based on Alden’s disclosures, we credit Petitioner’s expert’s testimony that Alden’s system could detect and accommodate road curvatures. *Id.*; Ex. 1003 ¶¶ 64–65.

Thus, we do not agree with Patent Owner’s position that Alden’s system has no way of determining whether to dim light for an oncoming vehicle or accommodate a road curvature by increasing light. *See* PO Resp. 25. We agree with Petitioner’s expert that Alden’s system can distinguish the two, as discussed.

Patent Owner argues additionally that Alden’s Figure 5 embodiment does not allow for certain LEDs to be used to illuminate around curves, because the LEDs provide high-beam illumination unless dimmed for an oncoming vehicle. *Id.* at 25–31. That position does not account for Alden’s teachings regarding road curvature.

While Alden describes operation where non-dimmed areas are illuminated with high beam (Ex. 1005 ¶ 27), that relates to preventing glare to oncoming vehicles. Skilled artisans would understand that it is a different use with different requirements where Alden describes directing light into corners. Ex. 2041, 50:9–51:1. Petitioner’s expert explains that the segmented headlight shown in Alden’s Figure 5 can function in both uses by identifying both oncoming vehicles and roadside reflectors. *Id.* at 78:22–80:24. Even when preventing glare to oncoming vehicles, Alden teaches switching certain headlight segments to dim and switching other segments to high beam. Ex. 1005, Fig. 4; *accord id.* ¶ 28. By including a decision about each headlight segment, Alden’s system is thus configured to implement the road-curvature use. And Alden teaches that its invention may be

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used such that each segment is “within a range of intensities between the high beam and the low beam state.” *Id.* ¶ 61. That supports that Alden’s invention is not limited to a binary choice between dimming for oncoming vehicles or providing high-beam illumination.

Petitioner’s expert testifies that the lateral LEDs in Alden’s Figure 5 embodiment may be controlled to illuminate curves. Ex. 1003 ¶ 75; Ex. 1010 ¶ 11. That is consistent with his testimony that, in the road-curvature use, skilled artisans would position the device’s LEDs “to ensure that the beam created by the headlamp is sufficiently wide to illuminate turns.” (*see* PO Resp. 27–28 (quoting Ex. 2066, 111:18–112:5)), because how Figure 5’s LEDs would be operated depends on how they are positioned. Patent Owner submits that Petitioner’s expert agreed that, in Alden’s Figure 5 embodiment, the full pattern would be used for a road with no curves. PO Resp. 28. The expert, however, clarified that using the full pattern “would have been the first application described in Alden,” rather than a general description of Figure 5’s hardware. Ex. 2067, 17:9–18:4. Indeed, as Petitioner’s expert testifies, “Alden discloses a segmented distribution headlight with individually controlled segments with broad functionality.” Ex. 1010 ¶ 12. We see nothing inconsistent about the testimony.

Alden’s Figure 11 also contradicts Patent Owner’s view that all segments would be illuminated, as Figure 11 depicts an asymmetric beam projection. Ex. 1005, Fig. 11. That projection pattern is consistent with Petitioner’s expert’s testimony (Ex. 1010 ¶ 11) that the outermost LEDs would be used for wide illumination, only activated when the system desires to “concentrate light to look around corners in response to road conditions” (Ex. 1005 ¶ 36, Fig. 11).

Patent Owner draws a parallel between Alden’s statement that its invention can “concentrate light to look around corners” when its headlights “direct light into

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the corner” (Ex. 1005 ¶ 36) and Figure 10’s embodiment, which uses variable refraction elements to redirect light from a single illumination source (*id.* ¶ 35). PO Surreply 5–8. We do not agree that Alden’s use of “direct” and “redirect” do not refer to the same process. Alden’s description of the variable refraction elements indicates that they have two states (Ex. 1005 ¶¶ 33–35), and therefore would not be able to flexibly direct light as required by the road-curvature application. We agree with Petitioner that Alden’s general invention works in the Figure 11 application to “concentrate light” towards road curvature. Certain areas of lighting—LEDs in the Figure 5 embodiment—are used for wide illumination, only activated when the system directs light into a curvature.

Patent Owner argues that configuring Alden’s headlight such that it could direct light into a curve, “some amount of forward illumination would be lost.” PO Resp. 34. Thus, Patent Owner argues, such a configuration would not comport with Alden’s goal of maximizing light for the driver. *Id.* We do not agree that Alden requires maximizing light at all times. Rather, to the extent Alden seeks to maximize light for the driver, it’s within the context of using “a high beam to see further ahead” (Ex. 1005 ¶ 5). That is, Alden’s goal is for a driver “to see optimally” (*id.* ¶ 2), not to illuminate as much area as possible. In our view, it is consistent with Alden’s goals for it to reserve some lighting capacity for directing into road curvature, because doing so would better illuminate the road ahead for the driver.

2. Adapting light prior to a road curvature

Claim 1 requires controlling light to enact the determined light change “prior to the motor vehicle reaching the road curvature.” Petitioner relies on Alden’s use of roadside reflectors to identify road curvature and argues that Alden’s system

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would adapt light before the curvature because the reflectors are ahead of a vehicle and the system would react “once it detects light from such reflectors.” Pet. 29–30 (citing Ex. 1003 ¶ 76). Petitioner also points to Kobayashi’s controller, which changes light shaping before a vehicle reaches a curve. *Id.* at 23–24, 30.

Patent Owner argues that Alden’s Figure 11 teaching to direct light into a corner does not include doing so prior to the vehicle entering the turn. PO Resp. 37–38. Patent Owner’s position relies on Alden not discussing the timing of the lighting change depicted in Figure 11. *Id.* at 38. We agree with Petitioner and credit the testimony of Petitioner’s expert that because Alden senses road curvature from roadside reflectors, it would detect road curvature in advance of entering that curvature, adapting the light when the curvature is sensed. Ex. 1010 ¶ 15; Ex. 1003 ¶ 76. Further, Petitioner’s expert testifies that drivers turn the steering wheel before the vehicle enters a curve. *Id.* ¶ 17. Thus, using Alden’s steering-wheel sensor additionally supports a system that adapts light for a road curvature prior to the vehicle entering the curvature.

Considering Kobayashi’s teachings, Patent Owner argues that the asserted combination includes only Kobayashi’s map data, not any aspect of Kobayashi’s control strategy. PO Resp. 39, 21. Even accepting that a combination would use Kobayashi’s map data alone, because Alden’s system already uses information about road curvature before the vehicle enters the curvature, the record supports that adding Kobayashi’s map data, at a minimum, would not change that behavior.

Moreover, we agree with Petitioner that skilled artisans reading Kobayashi would understand that it teaches adapting light for road curvatures before a vehicle reaches a curvature, and would follow that teaching when implementing the combined system. Ex. 1003 ¶ 77. Patent Owner argues further that Kobayashi teaches changing the light direction only once a vehicle has entered a curve.

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PO Resp. 39–40. That position is not consistent with Kobayashi’s disclosures, which show a vehicle at point A, before a road curvature, with the light emitted in the direction of curvature. Ex. 1006, Fig. 10. Petitioner’s expert confirms those relationships. Ex. 1010 ¶ 18. We agree with Petitioner’s expert because the testimony is consistent with Kobayashi’s Figure 10.

Accordingly, we find that the asserted combination would adapt light prior to the vehicle reaching a road curvature.

3. Conclusion on independent claims

As discussed above, Patent Owner challenges whether the asserted combination teaches claim 1’s Predictive Curve Illumination Limitation and Control Limitation. PO Resp. 6, 21–43. Patent Owner does not dispute other aspects of Petitioner’s showing for claim 1.

Independent claims 12 and 23 recite limitations similar to those of claim 1, and Patent Owner challenges Petitioner’s contentions for the same reasons already discussed. PO Resp. 43–44 (claim 12), 45–46 (claim 23).

We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Kobayashi discloses each limitation of claims 1, 12, and 23, and whether skilled artisans would have had reason to combine the references’ teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 1, 12, and 23 would have been obvious over Alden and Kobayashi.

4. Dependent claims 5, 16, 27: increasing light emitted at a level below high-beam light

Claim 5 depends from claim 1 and recites that “the increase of light in the direction of road curvature includes at least an increase of light emitted at a level

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below high-beam light and directed in the direction of the road curvature.”

Ex. 1001, 96:24–27. Claims 16 and 27 recite parallel limitations.

Petitioner submits that skilled artisans would have configured the combined system to direct light below high-beam level into curves because it “would allow the driver to sufficiently see the road curvature, while not blinding potential oncoming vehicles that are not yet visible.” Pet. 42–43 (citing Ex. 1003 ¶ 100). In that regard, Petitioner relies on Alden’s emphasis of reducing glare to other drivers. *Id.* at 43 (citing Ex. 1005 ¶¶ 5–6, 26–29).

Patent Owner argues that configuring a system in that way would be contrary to Alden’s primary object of maximizing light for the driver. PO Resp. 46–50. Patent Owner’s argument relies on its position that Alden operates with a default state of high-beam intensity. *Id.* at 48–49.

As we note above, Alden states that its goal is for a driver “to see optimally” (*id.* ¶ 2), not to illuminate as much area as possible. What a skilled artisan would consider optimal illumination could include either high-beam illumination, as Patent Owner contends, or a lower level, as Petitioner contends. Petitioner’s expert explains that because “an oncoming vehicle may be present or approaching,” skilled artisans had reason to select illumination below high-beam level to avoid blinding such oncoming vehicles that are not yet visible. Ex. 1003 ¶ 99–100. We agree with that testimony that configuring the system as claimed would have “minimize[ed] the risk of blinding another driver that could be coming around the curve.” *Id.* ¶ 100.

Accordingly, we conclude that Petitioner has shown that claims 5, 16, and 27 would have been obvious over Alden and Kobayashi.

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5. Dependent claims 6, 17, 28:
a second road curvature

Claim 6 depends from claim 1 and recites that the processor may determine a second change adapting the light pattern, “to increase light in a direction of a second road curvature” determined based at least on second map data, and control a second plurality of the LED light sources to accommodate the second change “prior to the motor vehicle reaching the second road curvature.” Ex. 1001, 96:28–45. Claims 17 and 28 recite parallel limitations.

Petitioner asserts that because Alden’s system is responsive to detected curvature, “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,” it would control a different plurality of LEDs to illuminate the second curve. Pet. 44, 48–49. Similarly, Petitioner reasons that Kobayashi’s map data would provide different information for Alden’s system to accommodate road turns as the vehicle travels. *Id.* at 44–47, 49.

Patent Owner argues that iterative control does not necessarily mean control prior to reaching a curve. PO Resp. 52–53. While that is true, we find that the combined Alden–Kobayashi system would adapt its light pattern prior to the vehicle reaching a curvature for the reasons discussed above. *See supra* at 14 (§ II.C.2). For those same reasons, we find that it would do so also for subsequent, different, road curvatures.

Accordingly, we conclude that Petitioner has shown that claims 6, 17, and 28 would have been obvious over Alden and Kobayashi.

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*6. Dependent claims 7, 18, 29:**illuminating road curvature with an LED that did not do so prior to the change*

Claim 7 depends from claim 1 and recites that the light increase in the direction of road curvature “includes at least one of expansion of the light pattern . . . or an increase to intensity” and that the determination of light change includes changes to individual LEDs include at least one of “variation to at least one of intensity or color” or “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.” Ex. 1001, 96:46–61.

Petitioner reasons that Alden’s change to accommodate road curvatures expands light in the area of the curve or increases intensity of light in the curve, because Alden describes controlling LED’s to “concentrate” or “direct light” into the curve. Pet. 50 (citing Ex. 1005 ¶ 36). Petitioner further submits that Alden’s Figure 11 shows that light is “directed into the curve” by expanding the beam laterally beyond its normal range. *Id.* at 51–52.

Patent Owner argues that Alden’s Figure 5 embodiment “does not slant or otherwise change the direction of any beam segments emitted by any LED elements 119 of headlight 123.” PO Resp. 55. That is inapposite, as the claims do not require an individual LED element change its emission direction, but rather that the headlight as a whole illuminate an LED with an emission direction that the headlight had not illuminated before the curvature. We understand Patent Owner’s position to rely on the idea that Alden would have illuminated all of its LEDs prior to detecting a road curvature, but we do not agree with that view of how Alden operates. Rather, we agree with Petitioner that Alden would have used LEDs on the sides of its illumination pattern to project light into detected road curvatures. Pet. Reply 16; Ex. 1003 ¶¶ 107, 112; Ex. 1010 ¶¶ 20–22.

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Accordingly, we conclude that Petitioner has shown that claims 7, 18, and 29 would have been obvious over Alden and Kobayashi.

7. Dependent claims 8, 19, 30:
diminishing glare to another vehicle

Claim 8 depends from claim 1 and further recites “one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle” and require the processor have capability to determine a position of the other vehicle using data from the camera

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

Ex. 1001, 96:62–97:14. Claims 19 and 30 recite parallel limitations.

Petitioner relies on Alden’s teachings that its system “detects other vehicles and controls LEDs to direct dimmed, low beam light into areas where those other vehicles are located.” Pet. 52–63. Those teachings are summarized above. *See supra* at 7–9.

a. Alden’s Figure 5 embodiment

Patent Owner argues that Alden does not sufficiently disclose its Figure 5 embodiment to support Petitioner’s contentions. PO Resp. 56–60.

First, we do not agree with Patent Owner that Alden’s Figure 5 depicts a device with only a single row of lighting elements. *See id.* at 57; PO Surreply 13–14. Although Figure 5 shows one embodiment of Alden’s “segmented headlight means and controlling switch array” (Ex. 1005 ¶ 29), the segmented headlight is

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merely one aspect of Alden's invention. The segmented headlight receives signals from a "light control circuit"—logic executing on a CPU that controls the switch array, *Id.* ¶¶ 26, 27, Figs. 2, 3. Thus, it is important to view Figure 5 and the corresponding description with an eye to the broader context in which it operates.

Alden discusses "elements of a segmented distribution illumination process" in connection with Figure 2. Ex. 1005 ¶ 26. The described process uses "a segmented beam headlight 61" to differentially illuminate sectors of the light distribution based on light sensed by a detector array and logic in a light-control circuit. *Id.* ¶ 26, Fig. 2. Alden's description is generic to the specific headlight embodiment, and states that "[s]ome methods employed within [segmented beam headlight] 61 to segment light into independently controlled sectors are discussed later." *Id.* Similarly, Figure 3 and its associated discussion provides "a more detailed illustration of the information flow, processes and architecture of the elements described in FIG. 2." *Id.* ¶ 27, Fig. 3. Figure 3 is reproduced below:

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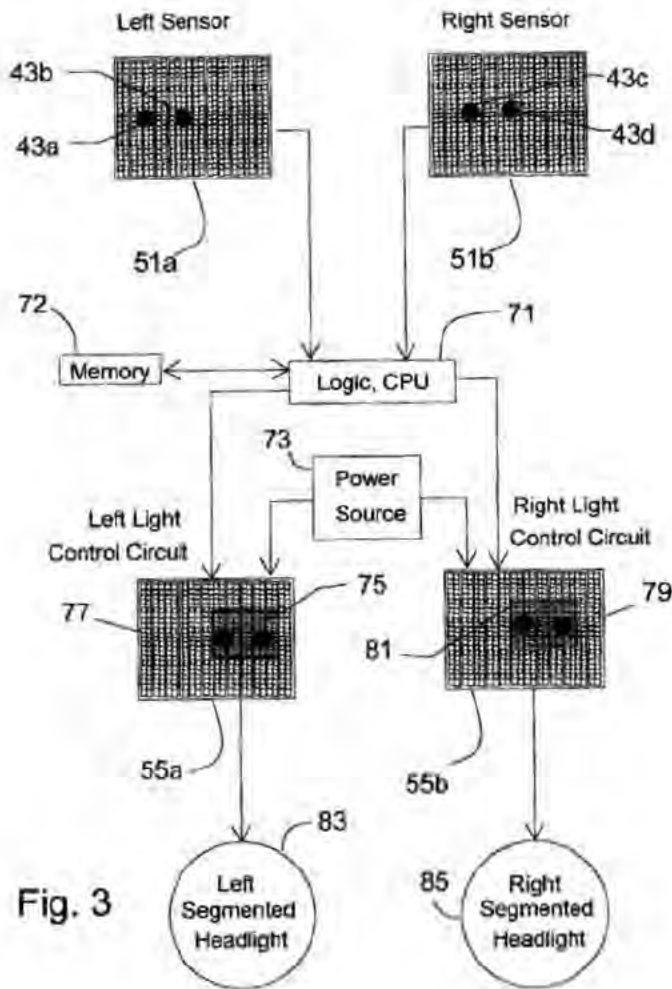


Figure 3 depicts “the information flow, processes and architecture of the elements described in FIG. 2” including sensors 51a/b with illuminated spots 43a/b/c/d, logic and CPU 71, light control circuits 55a/b, and segmented headlights 83/85. *Id.* ¶ 27, Fig. 3.

Figure 3 depicts segmented headlights 83 and 85 generically, and the description refers to them without limiting the particular form of those headlights. *Id.* Thus, when Alden describes that Figure 5 “illustrates the segmented headlight means and controlling switch array in a first embodiment,” that does not describe an aspect disconnected from the components and operation depicted in Figures 2 or

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3, but rather provides details regarding one embodiment of the segmented headlights included in Figures 2 and 3. *See id.* ¶ 29.

Importantly, Figure 3 unambiguously depicts two-dimensional sensor arrays 51a/b and two-dimensional control circuits 55a/b. *Id.*, Fig. 3. That figure and the corresponding text indicate that Alden's process for dimming illumination sectors involves aspects in the vertical direction—the shaded boxes 75/77 representing dimmed illumination extend beyond the sensed lights 43a/b/c/d more in the vertical direction than in the horizontal direction, and “[t]he 75 area is significantly larger than the headlight dots that were initially received by 51a and 51b because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.” *Id.* ¶ 27, Fig. 3.

Moreover, Alden's description of Figure 3's logic—though Figure 4's flow chart and corresponding text—leaves no doubt that Alden's process uses two-dimensional analysis. As Alden describes, the CPU checks each sector of the light sensor, for the left sensor beginning with sector A1L, proceeding to A2L and continuing through XYL. *Id.* ¶ 28, Fig. 4. The same process occurs for the right sensor, checking sectors A1R through XYR. *Id.*

Finally, Alden describes additional applications for its invention, beyond those used to dim light sectors for oncoming vehicles. Those applications include where the invention is “used to concentrate light to look up a hill in response to road conditions” and “look down a hill in response to road conditions.” *Id.* ¶¶ 55, 56, Figs. 12, 13. From that description and the corresponding figures, it is apparent that those applications use Alden's ability to control sectors along the vertical axis within the segmented headlight that effects illumination.

While Alden's Figure 5 shows a sectional view of a segmented-headlight embodiment, thus depicting a single line of LEDs, that does not restrict the

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embodiment to a one-dimensional array. Indeed, Alden's disclosures discussed above contradict such a view, as do the disclosures regarding Figure 5 and other segmented-headlight embodiments. We credit Petitioner's expert's testimony in this regard. Ex. 2041, 59:10–12 (“[I]t’s very clear we’re talking about a two-dimensional structure that is map of this set of slices in figure 5.”); *accord id.* at 56:25–60:18. The Figure 5 embodiment includes a switch array to control the individual lighting elements, with “[e]ach lighting element being independently controlled by a corresponding switch in an array of switches 115.” Ex. 1005 ¶ 29. The Figure 6 embodiment includes a face-on view of the segmented headlight plainly showing a two-dimensional array, in addition to a sectional view similar to Figure 5’s. *Id.* at Fig. 6. And Alden describes that the Figure 6 embodiment uses “switch array similar to 115 and the process previously described herein.” *Id.* ¶ 30. The Figure 6 description expressly refers to the same reference numeral as the Figure 5 description, making a plain connection.

Considering Alden's description of its sensing-and-control circuit in connection with Figure 3, which illustrates a two-dimensional array, and its description of Figure 5's segmented headlight as working with that approach, we find that Alden's LED-based segmented headlight is capable of selective illumination in two dimensions. Ex. 1005 ¶¶ 27, 29, Figs. 3, 5.

Patent Owner relies heavily on Alden's statement that “[t]he [light element] 119 and other 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.* ¶ 29; PO Resp. 57 (“Alden merely describes a row of LEDs positioned along the focal point of a lens.”). It is uncontroversial that the lens has a single focal point, though there are many curves passing through that focal point, and thus many curves on which lighting elements

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may be arranged. While Figure 5 shows elements along one such curve, that does not preclude the existence of other elements that fall on other curves. Thus, we do not agree that Alden's statement regarding the focal point restricts Figure 5 to depicting an embodiment with one row of lights.

Patent Owner also faults Petitioner's expert for characterizing the figures as conceptual. PO Resp. 58; PO Surreply 14, 17–18. But there is nothing problematic with conceptual figures, particularly where the corresponding description makes clear how the invention operates. For example, Patent Owner complains that Petitioner's expert "could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to create the beam spread illustrated therein." PO Resp. 58–59 (emphasis omitted). We would not expect Dr. Papanikolopoulos to explain that—the beam spread of any optical system will depend on the lens used and the relative position of the light sources to the lens, so it is unclear why Patent Owner expects the particular switch array to determine beam spread. When asked about beam spread (Ex. 2041, 107:11–12), Dr. Papanikolopoulos stated that it would depend on the specifics of an overall system and could not be determined by Alden's figures (*id.* at 108, 4–10).

Because Alden describes its segmented headlights as implementing a process using two-dimensional signals for two-dimensional dimming functionality, we find that Figure 5 depicts a section of an embodiment that contains more than a single row of lighting elements. Stated otherwise, Alden's disclosures are consistent with each other and are directed to a two-dimensional approach to sensing, control, and illumination. Based on our review of the record, we credit the testimony of Petitioner's expert that Alden's Figure 5 embodiment includes multiple rows of LEDs. Ex. 1010 ¶¶ 23–28.

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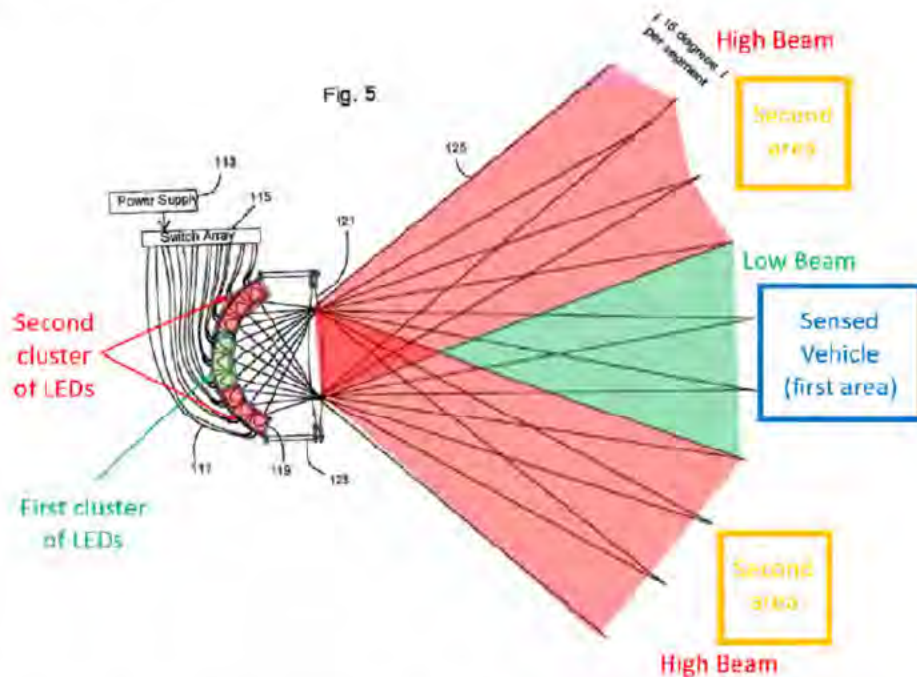
Finally, we agree with Petitioner that the challenged claims do not require a two-dimensional approach. Pet. Reply 20. Although Patent Owner asserts that Alden fails to provide an enabling disclosure (PO Resp. 57), Patent Owner has not addressed the legal standard for lack of enablement. In particular, to overcome the presumption that prior-art disclosures are enabled, Patent Owner must show ordinarily skilled artisans would require undue experimentation to practice the disclosed invention. *See Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1354–55 (Fed. Cir. 2003); *In re Antor Media Corp.*, 689 F.3d 1282, 1287–88 (Fed. Cir. 2012). Other than arguing that Figure 5 discloses a single-row embodiment that is unusable with Alden’s other disclosures, Patent Owner has made no attempt to show Alden lacks enablement. Patent Owner has not addressed what experimentation skilled artisans would require to practice an invention using Alden’s Figure 5 segmented headlight with the remainder of Alden’s system as disclosed in Figures 2, 3, and 4, and Alden’s corresponding textual description. Thus, even viewing Alden’s Figure 5 as a single row of LEDs would not undermine Petitioner’s positions here or change our conclusions, because it would still disclose the claimed elements, and we conclude that Alden teaches both accommodating detected road curvatures and oncoming vehicles using Figure 5’s headlight.

b. Petitioner’s annotations

Patent Owner argues also that Petitioner’s annotations mischaracterize Alden’s disclosures by using an inaccurate scale for the sensed vehicle as compared to the headlight. PO Resp. 60. Petitioner’s annotated version of Alden’s Figure 5 is reproduced below:

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Pet. 63 (quoting and annotating Ex. 1005, Fig. 5). Petitioner’s annotations designate and highlight red a central cluster of lighting elements within Figure 5’s array as a “First cluster of LEDs” and designate and highlight green the remainder of the array (to both sides of the first cluster) as a “Second cluster of LEDs.” *Id.* The annotations further highlight the light beams emitted from the segmented headlight by the two clusters as green and red, respectively, and show a “Sensed Vehicle (first area)” within the “Low Beam,” green portion emitted by the first cluster and a “Second area” as the “High Beam,” red portion emitted by the second cluster. *Id.*

As Petitioner points out, its annotations are “demonstrative of what is described in Alden, and are not the creation of a scaled technical drawing.” Pet. Reply 22. Petitioner’s expert testifies that Alden’s figures are conceptual in nature (Ex. 1010 ¶ 29) and we view Petitioner’s annotations as consistent with that conceptual nature. There would be no use in a drawing that accurately represented the scale of both Alden’s segmented headlight and an oncoming vehicle, because

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the headlight would be too small to resolve any detail. That reality is reflected in Alden's Figure 2, reproduced above, which uses different scales to depict the segmented distribution system versus an oncoming vehicle. *See* Ex. 1005, Fig. 2. Thus, we do not fault Petitioner's annotations for representing an oncoming vehicle as falling within a small portion of the projected beam. Indeed, Alden indicates Figure 5 depicts an embodiment in which each lighting element provides 15 degrees of the overall illumination. *Id.* ¶ 39, Fig. 5. Using that example, each element's illumination would spread about 39 feet at a distance of 150 feet.⁸ The challenged claims do not restrict the distance at which an "other vehicle" is accommodated. Alden's Figure 5 example depicts a system that would provide segments to isolate the vehicle at some reasonable distance from Alden's system.

We do not rely on Petitioner's annotations to reach our conclusions that Alden discloses the '029 patent's claimed invention, for any challenged claim. That said, we conclude that Petitioner's annotations accurately represent Alden's disclosures, without purporting to depict the scale of oncoming vehicles relative to Alden's segmented headlight.

c. Determining the position of other vehicles

Claim 8 requires the controller be able to "determine a position associated with the at least one other vehicle based at least in part on second data captured by at least one of the one or more cameras." Ex. 1001, 97:1–3. Patent Owner argues that Alden's system does not detect oncoming vehicles, as opposed to simply detecting spots of light from such vehicles. PO Resp. 61–62. In that regard, Patent Owner faults Alden for not using camera data "to generate a bounding box around the contours of the vehicle." *Id.* at 62 (emphasis omitted).

⁸ $150 \cdot \sin(15^\circ) = 38.8$

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We agree with Petitioner that Alden discloses the claimed capability. Alden's system does not simply dim its headlights where it detects spots of light. Rather, it performs a multistep process in which those spots are detected, analyzed with triangulation to determine distance, and then used to determine dimming zones. Ex. 1005 ¶¶ 27–28. Alden discloses that its sensor “detects the two headlights” of an oncoming vehicle when “[e]lectrons corresponding to the position and intensity of light are categorized by a logic and CPU 71 and stored in a memory 72.” *Id.* ¶ 27. Petitioner's expert noted that Alden's description “move[s] from lights – thresholding lights to objects, and then calculate[s] distance of each thresholding object using triangulation.” Ex. 2041, 109:23–110:2. That testimony supports our view that Alden first detects lights, uses those detected lights to identify and classify an oncoming car, then dims the headlight output to prevent glare.

Alden's dimming decision particularly indicates that it classifies pairs of detected headlights as oncoming vehicles. The CPU makes “assumptions about the space that may potentially be occupied by the driver of the sensed vehicle” and identifies an area of the segmented headlight to dim that is “significantly larger than the headlight dots that were initially received.” Ex. 1005 ¶ 27. The way Alden's system selects sectors surrounding detected light indicates that it identifies vehicles, not just spots of light. It does not simply expand an area around each detected light; it dims an area to encompass the driver of the identified vehicle. Ex. 1005 ¶ 27, Fig. 3. By treating a pair of corresponding detected lights collectively for dimming, Alden indicates that it classifies pairs of detected lights as vehicles. We find that Alden determines a position associated with another vehicle as claimed.

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Accordingly, we conclude that Petitioner has shown that claims 8, 19, and 30 would have been obvious over Alden and Kobayashi.

8. Dependent claims 21, 32:
utilizing control elements

Claim 21 depends from claim 19 (and thus indirectly from claim 12) and further recites that the processor can “utilize one or more optical control elements included in the motor vehicle to control light” from one of the LED pluralities. Ex. 1001, 99:19–24. Claim 32 recites a parallel limitation in a method claim.

Petitioner addresses claims 21 and 32 together with dependent claims 10, 11, 22, and 23. Pet. 64–68. Claim 10 depends from claim 1 and further recites “one or more optical elements for controlling light from one or more of the LED light sources.” Ex. 1001, 97:39–41. Claim 11 depends from claim 10 and further recites that “the optical control elements include at least one of one or more reflectors, refractors or lenses.” *Id.* at 97:42–44. Claims 22 and 33 depend from claims 21 and 32, respectively, and recite limitations parallel to those of claim 11. Petitioner asserts that claims 10, 21, and 32 are substantially similar in requiring “optical control elements” and that claims 11, 22, and 33 are identical to each other in restricting the optical control elements to “reflectors, refractors or lenses.” Pet. 64.

Petitioner relies on Alden’s disclosure of using lens element 121 in the Figure 5 embodiment. *Id.* at 64–65. Petitioner submits that Alden’s processor “utilizes the lens element 121 to direct 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.* at 65 (citing Ex. 1005 ¶ 29).

Patent Owner argues that “a simple lens, such as 121 [in Alden’s Figure 5], will not suffice for the proof.” PO Resp. 67. Petitioner, on the other hand, submits that the claims do not require an “active” element and therefore read on Alden’s

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lens, which Alden's processor uses because it must consider how the lens affects where light from each LED will illuminate in the target space. Pet. Reply 27–28.

We agree with Petitioner. By simply using “utilize” to reference the optical control elements, the claim language does not impose an active-control requirement. Patent Owner does not explain its position in the Response, but elaborates in the Surreply, where Patent Owner submits that the specification discloses both passive and active optical control elements, and claim language directed to a processor executing instructions must be directed to active optics. PO Surreply 19.

Patent Owner's position is belied by dependent claims 22 and 33, which recite that the optical control elements are “reflectors, refractors or lenses.” As Petitioner points out, those claims indicate that passive elements are within the scope of claims 21 and 32. Tr. 43:3–25. Patent Owner takes the position that claim 22's further recitation regarding the optical control elements has no bearing on how to read claim 21 (Tr. 84:20–85:2), but we do not agree. Rather, Petitioner's reading is more consistent with the claim language as a whole.

As to claim 21's language that the processor executes instructions to utilize the optical control elements, logically, that language may be satisfied by instructions causing the processor to consider the effect a lens has on the light distribution and controlling the LEDs to account for that effect. Claim 21's language requires the processor control light from the LEDs, not control the optical control elements. *See* Tr. 96:6–13.

For the foregoing reasons, we conclude that Alden's system utilizes its lens to control light from the LEDs, satisfying claim 21 and 32's additional limitations. Accordingly, Petitioner has shown that claims 21 and 32 would have been obvious over Alden and Kobayashi.

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9. Uncontested claims

For dependent claims 2–4, 10, 11, 13–15, 22, 24–26, and 33, Petitioner provides unpatentability contentions showing where Alden or Kobayashi discloses the additional limitations of each claim. Pet. 33–41, 64–68. Other than as discussed above, Patent Owner does not challenge those contentions. We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Kobayashi discloses each limitation of claims 2–4, 10, 11, 13–15, 22, 24–26, and 33, and whether skilled artisans would have had reason to combine the references’ teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 2–4, 10, 11, 13–15, 22, 24–26, and 33 would have been obvious over Alden and Kobayashi.

D. OBVIOUSNESS OVER ALDEN, BEAM, AND KOBAYASHI

Claim 9 depends from claim 8, and thus indirectly from claim 1. Ex. 1001, 97:15–38. Claims 20 and 31 depend from claims 19 and 30, respectively, and recite limitations parallel to claim 9’s.

1. Controlling light sources based in part on data from a non-camera sensor

Claim 9 requires “third data received from a non-camera sensor,” in addition to claim 8’s “second data captured by at least one of the one or more cameras” and claim 1’s “first data, including at least map data.” *Id.* at 97:19–20, 97:1–3, 95:63–65. As discussed above, claim 8 requires “control, based at least in part on the position [of another vehicle determined from camera data]” of a second LED plurality directed towards the other vehicle “to diminish glare to a driver of the other vehicle.” *Id.* at 97:5–14. Claim 9 further requires that “the control of the

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second plurality of LED light sources is based at least in part on third data received from a non-camera sensor.” *Id.* at 97:18–20.

Petitioner points to Alden’s steering-wheel (non-camera) sensor and that it may be used to accommodate road curvature “in combination” with Alden’s camera sensor, which is used to accommodate oncoming vehicles. Pet. 70. Thus, reasons Petitioner, when a vehicle with Alden’s system “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” but “if the steering wheel sensor detects that the wheel is turned ‘x degrees,’ indicating that the driver will be turning the vehicle, then the ‘second plurality’ of LEDs would be further controlled to ‘change[] the direction of the headlight output a corresponding f(x) degrees.” *Id.* at 70–71 (citing Ex. 1005 ¶ 57–58, Figs. 14–15; Ex. 1003 ¶ 141). Petitioner points additionally to Kobayashi’s GPS sensor, asserting that the combined system would use data from that non-camera sensor to control the second LED plurality, “adjusting their direction in view of the map data indicating an upcoming road curve.” *Id.* at 71.

Patent Owner challenges that approach to the claim language and submits that controlling light as required by claim 9 requires control “to diminish glare” to oncoming vehicles, as recited in claim 8. PO Resp. 63–64. Patent Owner argues that neither Alden’s steering-wheel sensor nor Kobayashi’s GPS sensor satisfies that role. *Id.* at 65.

Petitioner responds Patent Owner’s view of the claim language by arguing that, in Alden, “dimming to reduce glare is maintained in the direction of an oncoming vehicle as the equipped vehicle turns, by shifting the dimmed light by an amount equal to the turning of the steering wheel.” Pet. Reply 25. Patent Owner asserts that Petitioner’s view of the claim has changed in response to Patent

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Owner's construction of claim 9's "the control" language. PO Surreply 24. We consider any change in Petitioner's position appropriate in light of Patent Owner's claim-construction position, raised in the Response. *See Axonics, Inc. v. Medtronic, Inc.*, 75 F.4th 1374, 1383 (Fed. Cir. 2023).⁹

Patent Owner argues that, if Alden's beam shifts in response to detected road curvature,¹⁰ and a detected vehicle falls within the shifted beam, the system would dim a portion of light within the shifted beam to address glare to the vehicle. PO Surreply 23. We agree, and conclude that shows that Alden's system satisfies claim 9's language. When Alden's system shifts its beam to accommodate road curvature (using a non-camera sensor), the shifted beam may illuminate an oncoming vehicle. And Alden's system would operate as detailed above to dim a portion of the beam corresponding to the detected oncoming vehicle. Thus, the LED plurality directed towards that vehicle would be controlled to reduce glare to the vehicle as a result of both the non-camera sensor and the camera sensor, as claimed.

This view of the claim language comports with testimony from Patent Owner's expert. When asked about what non-camera sensors the '029 patent describes to control headlights, he named only a steering sensor, specifically stating that it is used "in controlling a second plurality of the light sensors." Ex. 1012, 132:16–21. This additionally supports Petitioner's view that Alden's steering sensor satisfies the claim language.

⁹ In the Preliminary Response, Patent Owner did not contest unpatentability based on claim 9's "the control" language. *See* Paper 10, 41–42.

¹⁰ We conclude above that Alden's beam does shift in that manner. *See supra* at 11 (§ II.C.1).

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Accordingly, we conclude that Alden’s disclosures support that Alden’s system satisfies claim 9, 20, and 31’s “the control” language.

2. Terminating light from an LED

Claim 9 further recites that controlling a second plurality of LEDs “includes termination of light from at least one LED providing light directed to the area prior to the termination.” Ex. 1001, 97:33–36.

Petitioner asserts first that skilled artisans would have understood that Alden’s approach of dimming an LED “could include operating at zero” and 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.” Pet. 75 (citing Ex. 1003 ¶ 147). Petitioner asserts additionally that claims 9, 20, and 31 would have been obvious over Alden, Beam, and Kobayashi. Pet. 68–79.

Beam discloses an adaptive-headlight system that uses a sensor to detect other vehicles and dim its headlights to prevent light that “would dazzle the driver” of another vehicle. Ex. 1007, codes (54), (57), 1:5–18, 2:53–3:3. Beam discloses that portions of its light may be “blanked (attenuated by being either absorbed or deflected to an absorbing surface.)” *Id.* at 4:26–52; *accord id.* at 2:59–65 (“[T]he area of the beam that would dazzle the driver will be darkened, while maintaining f[u]ll intensity elsewhere.”).

Petitioner relies on Beam’s headlight system using individually controlled microbeams to eliminate glare for other vehicles, “controlled to darken light directed to the areas of the sensed oncoming and preceding vehicles.” *Id.* at 76 (emphasis omitted) (citing Ex. 1007, 4:9–25, 4:45–59, 5:61–6:8, 6:61–7:8). Petitioner points also to Beam’s disclosure that its lighting elements can be

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“blanked” (*id.* at 77 (quoting Ex. 1007, 4:26–52, 5:33–54)), which skilled artisans would understand as terminating light output (*id.* (citing Ex. 1003 ¶¶ 149–150)).

Petitioner submits that skilled artisans would have had reason to incorporate Beam’s blanking approach in Alden’s system by changing one of Alden’s LEDs to a non-emitting state “to further dim headlight beam output directed to areas of the oncoming vehicles as taught by Beam.” Pet. 77 (citing Ex. 1003 ¶ 151). In Petitioner’s view, skilled artisans had reason to make the combination “to minimize glare to the driver of oncoming vehicles.” Pet. 78.

Patent Owner argues that using Beam’s method of terminating light from an LED (blanking) would contravene Alden’s “primary object” of maximizing light for the driver. PO Resp. 66–67. We do not agree, because Alden unambiguously seeks to diminish glare to oncoming vehicles, as discussed above. We agree with Petitioner that using Beam’s blanking method would facilitate diminishing glare to oncoming vehicles. *See* Pet. Reply 26.

Accordingly, we conclude that Petitioner has shown that claims 9, 20, and 31 would have been obvious over Alden, Beam, and Kobayashi.

III. CONCLUSION¹¹

For the reasons discussed above, we conclude Petitioner has proven the challenged claims unpatentable. In summary:

¹¹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to

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Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–8, 10–19, 21–30, 32, 33	103	Alden, Kobayashi	1–8, 10–19, 21– 30, 32, 33	
9, 20, 31	103	Alden, Beam, Kobayashi	9, 20, 31	
Overall Outcome			1–33	

IV. ORDER

Accordingly, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–33 of the '029 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

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Paper: 29
Entered: December 9, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner.

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Patent 9,955,551 B2

Before JON M. JURGOVAN, JASON W. MELVIN, and
AARON W. MOORE, *Administrative Patent Judges*.

MELVIN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

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I. INTRODUCTION

Mercedes-Benz USA, LLC (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 8, 10–18, and 24–47 (“the challenged claims”) of U.S. Patent No. 9,955,551 B2 (Ex. 1001, “the ’551 patent”). Yechezkal Evan Spero (“Patent Owner”) filed a Preliminary Response. (Paper 7, “Prelim. Resp.”). After additional authorized briefing, we instituted review. Paper 10 (“Institution Decision” or “Inst.”).

Patent Owner filed a Response (Paper 15, “PO Resp.”), Petitioner filed a Reply (Paper 17, “Pet. Reply”), and Patent Owner filed a Surreply (Paper 19, “PO Surreply”). We held an oral hearing on October 23, 2024. Paper 28 (“Tr.”).

For the reasons below, we conclude that Petitioner has proven the challenged claims unpatentable.

A. REAL PARTIES IN INTEREST

As real parties in interest, Petitioner identifies: Mercedes-Benz USA, LLC; Mercedes-Benz Group AG; Mercedes-Benz AG; and Mercedes-Benz Intellectual Property GmbH & Co. KG. Pet. 2. Patent Owner identifies Yechezkal Evan Spero and Torchlight Technologies LLC as the real parties in interest, noting that Torchlight is the exclusive licensee of the ’551 patent. Paper 4, 1 (Patent Owner’s Mandatory Notices).

B. RELATED MATTERS

The parties identify the following related federal district court litigations of the ’551 patent: *Torchlight Techs. LLC v. Daimler AG et al.*, No. 1:22-cv-00751 (D. Del.); *Torchlight Technologies LLC v. General Motors LLC et al.*, No. 1:22-cv-00752 (D. Del). Pet. 2–3; Paper 4, 1.

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The parties identify the following PTAB *inter partes* reviews of the '551 patent: IPR2023-00315; IPR2023-00318; IPR2023-00336; IPR2023-01040; IPR2023-01225. Pet. 3; Paper 4, 2.¹ Patent Owner identifies pending Reissue Application 16/858,342. Paper 4, 1.

C. THE '551 PATENT

The '551 patent is titled “Detector Controlled Illuminating System” and relates to an “illuminating device” whereby “illumination intensity and spectrum” are varied to illuminate “areas according to the principles of correct lighting practice,” e.g., “adapt to ambient lighting, movement, visual tasks being performed, and environmental and personal conditions.” Ex. 1001, codes (54), (57). The specification generally describes a lighting device that “incorporates one or more discrete light sources and their ancillary optical and electrical control equipment in an integrated illuminating element.” *Id.* at 13:34–36. The combined unit is referred to as a Digital Lighting Fixture (DLF). *Id.* at 18:18–22.

The specification further describes transportation vehicle applications. *Id.* at 50:38–57:37. One such application involves a DLF headlamp device that includes a cluster of LEDs for flexible illumination. *Id.* at 50:50–58. With LEDs having a variety of aims, the headlamp’s light distribution pattern may be controlled based on a number of factors, including detected oncoming vehicles. *See id.* at 51:43–47, 52:59–65.

D. CHALLENGED CLAIMS

Petitioner challenges claims 8, 10–18, and 24–47. *See* Pet. 5. Independent claim 8 is reproduced below, with additional formatting to distinguish limitations:

¹ Patent Owner further lists IPRs involving patents related to the '551 patent. Paper 4, 1–3.

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8. An illuminating device which provides light to meet an illumination requirement of an illuminated area in which visual activities are performed, where different sub-areas of the illuminated area need to be illuminated at a different intensity and/or at a different spectrum than another sub-area of the illuminated area, comprising:
 - a light fixture including a multiplicity of directional light sources including at least two directional light sources pointing in different directions thereby illuminating different sub-areas of the illuminated area,
 - the light fixture having movable structure for aiming the directional light sources mounted thereon in a defined direction;
 - a camera for obtaining images of the illuminated area functioning as a detector for at least one of (i) a light detector (ii) a spectrum detector, (iii) a motion detector, (iv) a measuring detector for sensing a geometry of the illuminated area, and (v) a detector for sensing at least one of work surfaces and road objects and at least one of vehicles and people;
 - a controller for adjusting a light intensity and a direction of each of the directional light sources;
 - a processor with
 - stored algorithms and data for identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance
 - any of which is used by said processor for determining illumination within the illuminated area using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables
 - wherein said processor, upon calculating the required illumination parameters according to best practice standards, directs the controller to adjust the directional

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light sources that illuminates the specific sub-areas to meet the illumination requirements of the visual activities.

Ex. 1001, 96:38–97:3. Claims 10–18 depend from claim 8, directly or indirectly.

Id. at 97:13–60. Claim 35 depends from claim 8, indirectly through claim 14.

Ex. 2014, 1185 (3:47–4:4).

Independent claim 24 is reproduced below:

24. An illuminating device having automatic control of light provided to an illuminated area comprising:

- a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
- a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;

electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;

one or more processors;

one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;

a controller, including at least one of the one or more processors, integrated with the structure via mounting, in communication with the controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and

memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:

determine coordinates corresponding to an other vehicle, based on the coordinate-specific information;

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select a cluster of the LEDs that emit light toward a portion of the other vehicle based on the LEDs having emission aimings associated with the first coordinates; and

change emission of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster to create headlamp illumination that preserves a first level of illumination illuminating past the other vehicle while preventing glare to a driver of the other vehicle.

Ex. 2014, 1184(1:21–63).² Claims 25–31 depend from claim 24, directly or indirectly. *Id.* (1:64–2:41). Claim 32 is independent and recites limitations similar to those of claim 24. *Id.* at 1184–85 (2:42–3:19); *see* Pet. Appx. A. Claims 33, 34, and 36–39 depend from claim 32, directly or indirectly. *Id.* at 1185 (3:20–46, 4:5–19). Claim 40 is independent and recites limitations similar to those of claim 24. *Id.* at 1185–86 (4:20–5:5); *see* Pet. Appx. A. Claims 41–47 depend from claim 40, directly or indirectly. *Id.* at 1186 (5:6–6:23).

² Through *ex parte* reexamination, original claim 6 was canceled and new claims 24–87 issued in a Reexamination Certificate. Ex. 2014, 1184–90. A number of typographical errors were corrected through a Certificate of Correction. *Id.* at 1214–19.

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E. PRIOR ART AND ASSERTED GROUNDS

This proceeding includes the following unpatentability grounds:

Claims Challenged	35 U.S.C. § ³	References/Basis
24–27, 29–31, 32–35, 37–39, 40–43, 45–47	102	Alden ⁴
24–27, 29–31, 32–35, 37–39, 40–43, 45–47	103	Alden
28, 36, 44	103	Alden, Kobayashi ⁵
8, 10–14	103	Alden, Kondo ⁶
15–18	103	Alden, Kondo, Stam ⁷

Pet. 5. Petitioner also relies on the Declaration of Dr. Nikolaos Papanikolopoulos. Ex. 1003.

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner asserts that an ordinarily skilled artisan “would have had an undergraduate degree in mechanical engineering, electrical engineering, automotive engineering, optical engineering, applied physics, computer science, or

³ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), effective March 16, 2013, amended the applicable statutes. Because the application from which the ’551 patent issued was filed before this date, the pre-AIA versions of §§ 102 and 103 apply.

⁴ US 2003/0137849 A1, filed Jan. 22, 2002 (Ex. 1005).

⁵ US 6,049,749, issued Apr. 11, 2000 (Ex. 1006).

⁶ US 2002/0057572 A1, published May 16, 2002 (Ex. 1007).

⁷ WO 2001/70538 A2, published Sept. 27, 2001 (Ex. 1008).

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similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting control systems.” Pet. 9 (citing Ex. 1003 ¶ 33). Patent Owner does not dispute that level of ordinary skill in the art. PO Resp. 6. We adopt the undisputed level of ordinary skill in the art and refer to people with it as skilled artisans.

B. CLAIM CONSTRUCTION

Other than the two terms discussed below, we do not further construe the claims for this decision. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. “identifying”

Claim 8 recites

a processor with stored algorithms and data for identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance.

Ex. 1001, 96:56–62. Petitioner’s challenge relies on identifying road objects and vehicles. Pet. 76, 19–20, 23–32. Petitioner addresses the claim language without express construction. *Id.* at 9.

Patent Owner proposes that “identify” should be construed as “show to be a certain person or thing.” PO Resp. 21. To that end, Patent Owner relies on a dictionary definition as establishing the ordinary meaning (Ex. 2065, 902) and

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asserts consistency in the '551 patent's specification, "which describes identifying different objects, such as a person, sign, or vehicle," according to Patent Owner (PO Resp. 21 (citing Ex. 1001, 44:67–45:3, 51:59–67, 52:19–27, 52:66–53:4, 63:9–12, 64:46–49, 69:54–57, 75:48–62, 76:33–39)). Patent Owner asserted during the hearing that, under its proposed construction, "the proof for identifying has to fix the identity of the detected light as a vehicle." Tr. 68:3–24; *accord id.* at 77:13–78:14 (asserting the construction requires a system to "confirm that that which it detected is, in fact, a vehicle"). Thus, the claim-construction dispute relates to verifying an identification, not to the specificity of what is identified.

Petitioner replies that "[t]here is no basis to limit the claims" based on Patent Owner's dictionary definition but does not further elaborate on how we should apply "identify" as claimed. Reply 12–13 n.6.

The problem with Patent Owner's claim-construction position is that neither the dictionary definition nor the '551 patent's specification establish any degree of proof, verification, or confirmation that an object has been correctly identified. The specification discloses that "techniques known in the art" may be used "to classify, identify or locate the contents" visible to a camera sensor. Ex. 1001, 44:67–45:9. That does not establish any certainty obtained by the preexisting techniques. The specification states that the system can "illuminate distant overhead and roadside signs" and can use "[i]mage recognition via a camera" so that the illumination beam may "follow the retroreflective sign as the vehicle moves." *Id.* at 51:59–67. That disclosure does not speak to any degree of confirmation or certainty. The specification's other disclosures are no different. *Id.* at 52:19–27 (disclosing automated control over lighting and referencing "automatic dimming of high beam due to detection of oncoming vehicles"), 52:66–53:4 ("Using color and pattern recognition techniques it is possible to determine what is a sign."), 63:9–12

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(“Using real time image processing methodologies with image and scene recognition technology known in the art, room or outdoor area elements, objects and people are identified.”), 64:46–49 (“Using machine vision technology known in the art such as neural networks training and other pattern recognition techniques the vision system has sensor, algorithmic and computation means for identifying devices or objects.”), 69:54–57 (“In a preferred embodiment of the invention the logical controller 454 receiving image input from the camera 453 and running pattern recognition software will identify what is the visual task a person is trying to perform.”), 75:48–62 (“Using programmed scene recognition algorithms, the luminaire’s computer vision system comprised of the camera sensor 496 and logical controller 494 identifies the food on the plate, looks-up in storage the recommended CCT and powers each of the different colored LED chips aimed thereon at the correct power level in order to provide the optimal color illumination.”), 76:33–39 (“[A] camera vision system has algorithmic means to identify and track the position of people and objects and the logical controller has motion control means for re-aiming the light sources towards targeted elements and changing the power level to the LED chips.”). None of those disclosures addresses a requirement for confirming or verifying an identification that the system makes; nor does any address a particular accuracy requirement in identifying an object.

Based on the specification using “identify” without any requirement that identifying an object requires confirmation or verification of the object’s true identify, we do not adopt Patent Owner’s proposed construction. Although the construction itself similarly does not expressly require the confirmation or verification that Patent Owner seeks to impose, we understand that to be Patent Owner’s intent, and accordingly do not adopt the proposed construction. The

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parties dispute no other aspect of “identify,” and we therefore need not expressly construe the term.

2. “sensor data”

Dependent claims 29, 37, and 45 each depend from a claim reciting a controller that can “identify an upcoming road curvature along a road on which the motor vehicle is traveling” and further recite:

wherein the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.

E.g., Ex. 2014, 1184, 2:31–35. Although Petitioner asserts no claim term requires construction (Pet. 9), Patent Owner contends that “based at least in part on sensor data” requires identifying road curvature using light sensors, not using steering-wheel position (PO Resp. 55–57). We do not view this as a claim-construction dispute because Petitioner relies on Alden’s light sensor identifying road curvature by detecting roadside reflectors (*see* Pet. 58–59; Pet. Reply 19–20). Thus, Petitioner’s contentions already assert the “sensor data” in claims 29, 37, and 45 as construed by Patent Owner—data from a “camera” as recited in the independent claims. *See infra* at 31 (§ II.C.6).

C. ANTICIPATION BY ALDEN

Petitioner asserts that claims 24–27, 29–35, 37–43, and 45–47 are anticipated by Alden. Pet. 10–62. Patent Owner disputes only certain aspects of Petitioner’s contentions, discussed below.

Alden is a published U.S. Patent Application describing and claiming a segmented-distribution headlight system. Ex. 1005, code (54). Alden’s Figure 2 is reproduced below:

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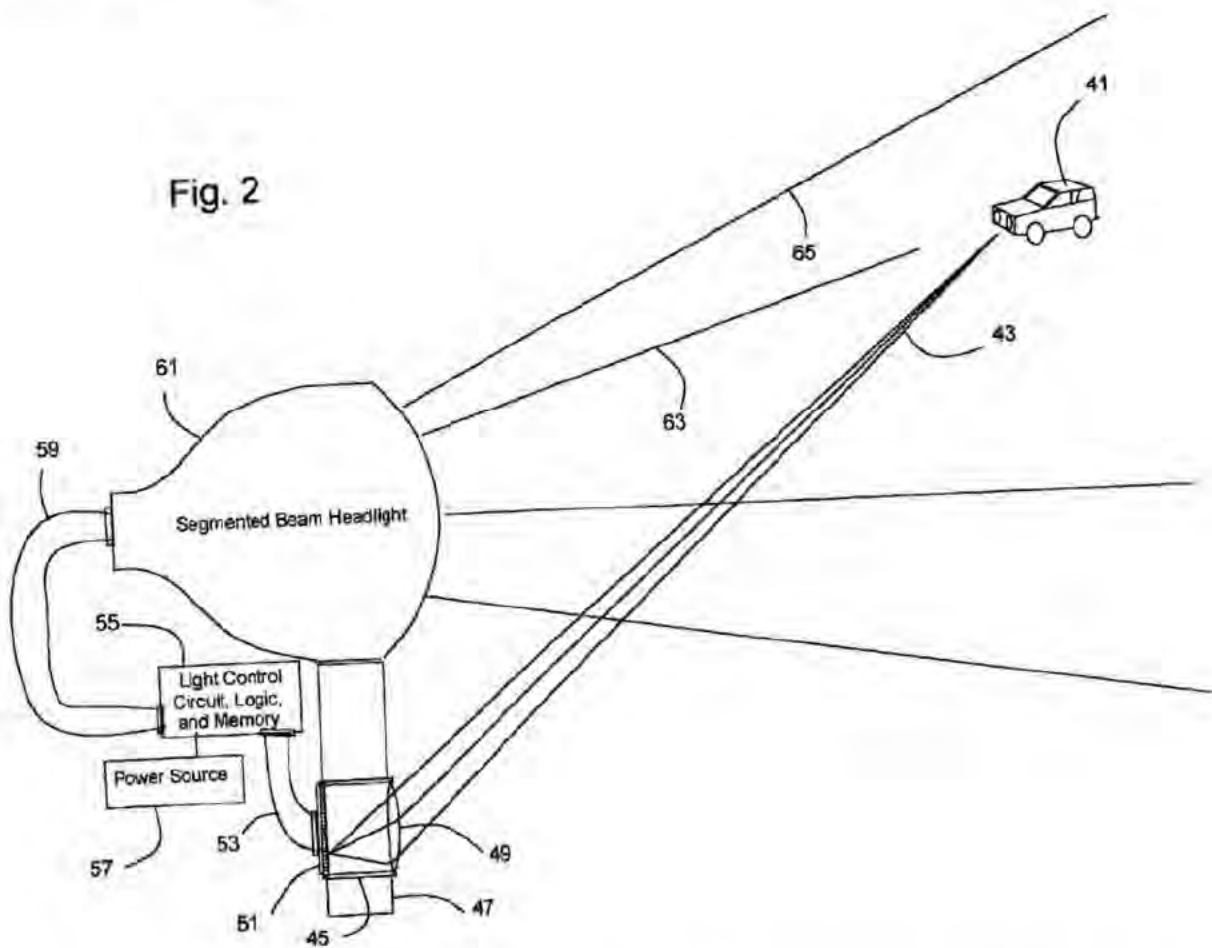


Figure 2 depicts the elements of Alden's "segmented distribution illumination process," in which vehicle 41 emits light towards a vehicle with Alden's invention, and that light illuminates detector array 51 that is part of sensor unit 45; signals representing the received light are sent to light control circuit 55, which controls segmented beam headlight 61 to provide either low or high illumination in its various segments such that light directed toward the vehicle 41 is a low beam and light directed elsewhere is a high beam. *Id.* ¶ 26, Fig. 2.

Alden's system detects spots of light, performs triangulation to calculate the distance to each, then uses the spots' intensity, size, and location information to represent "objects." *Id.* ¶ 27 ("Triangulation is thus used by the CPU to determine

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the distance” when detecting “spots of nearly identical intensity and size representative of the [oncoming vehicle’s] headlights.”), 28 (“The CPU compares the right map to the left map to determine the distance and intensity of each object sensed . . .”).

Once objects have been identified, Alden’s system uses them to determine which headlight zones to dim. *Id.* ¶ 28 (“The location of objects is used to calculate which zones of each headlight need to be dimmed . . .”; “assuming the sensed light is above a threshold intensity or distance”). In that decision, the CPU identifies a corresponding pair of headlights as a vehicle, and accommodates the vehicle by defining a dimming area larger than just the headlights. *Id.* ¶ 27 (“The [dimmed] area is significantly larger than the headlight dots that were initially received by [the light-detector arrays] because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.”). Finally, “[s]ignals are sent to each of the headlight control circuit zones that need to be dimmed,” whereas other zones “remain on high beam.” *Id.* ¶ 28.

With signals from the CPU, Alden’s “segmented beam headlight” projects light in the desired pattern. *E.g., id.* ¶¶ 26, 29. Alden discloses a number of embodiments for the headlight, including one with an array of LEDs (*id.* ¶ 29, Fig. 5) and others with electro-chromatic, liquid-crystal, or variable-refraction elements (*id.* ¶¶ 30–35, Figs. 6–10). Because the challenged claims recite LED-based devices, Alden’s LED embodiment is central to this dispute and is discussed in more detail below.

Alden concludes by broadly claiming:

1. A vehicular headlight system producing a light distribution area, comprising
 - a means for sensing the location of other vehicles,

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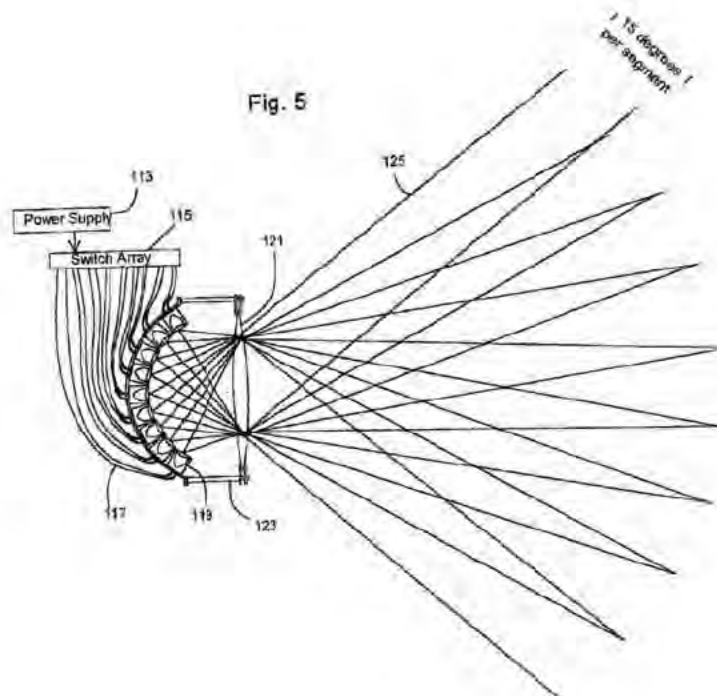
a means for diminishing the amount of light directed to said other vehicles, wherein

light directed to areas within the light distribution area not containing said other vehicles is not diminished.

Id., claim 1.

1. Claim 24

Patent Owner argues that Alden does not teach a controller that can “change emission of the selected cluster of LEDs relative to emission of other LEDs not included in the cluster to create headlamp illumination that preserves a first level of illumination illuminating past the other vehicle while preventing glare to a driver of the other vehicle.” PO Resp. 30–39. Patent Owner’s argument takes two forms: that Alden’s Figure 5 embodiment is not enabled (*id.* at 30–34); and that Petitioner’s annotated versions of Figure 5 use an inaccurate scale and therefore mischaracterize Alden’s disclosure (*id.* at 35–39). Alden’s Figure 5 is reproduced below:



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Ex. 1005, Fig. 5. Figure 5 depicts an embodiment of Alden's segmented headlight 123 and controlling switch array 115, including an array of individual lighting elements 119 (which can be LEDs) projecting light through headlight lens 121 to create beams of emitted light 125. *Id.* ¶ 29.

a. Alden's enablement

In the Institution Decision, we preliminarily determined that Alden's Figure 5 depicts one section through a two-dimensional array of lighting elements. Inst. 15–16; *see* PO Resp. 31. Patent Owner contends that was erroneous, arguing that Alden does not describe Figure 5 as showing a two-dimensional array, and that it would be improper to draw parallels between Figure 5 and Alden's other figures. PO Resp. 31–33. Petitioner responds that Patent Owner fails to meet the legal standard for proving lack of enablement, and that Alden's disclosures sufficiently enable its practice. Pet. Reply 1–9.

First, we do not agree with Patent Owner that Alden's Figure 5 depicts a device with only a single row of lighting elements. Although Figure 5 shows one embodiment of Alden's "segmented headlight means and controlling switch array" (Ex. 1005 ¶ 29), the segmented headlight is merely one aspect of Alden's invention. The segmented headlight receives signals from a "light control circuit"—logic executing on a CPU that controls the switch array. *Id.* ¶¶ 26, 27, Figs. 2, 3. Thus, it is important to view Figure 5 and the corresponding description with an eye to the broader context in which it operates.

Alden discusses "elements of a segmented distribution illumination process" in connection with Figure 2. Ex. 1005 ¶ 26. The described process uses "a segmented beam headlight 61" to differentially illuminate sectors of the light distribution based on light sensed by a detector array and logic in a light-control

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circuit. *Id.* ¶ 26, Fig. 2. Alden’s description is generic to the specific headlight embodiment, and states that “[s]ome methods employed within [segmented beam headlight] 61 to segment light into independently controlled sectors are discussed later.” *Id.* Similarly, Figure 3 and its associated discussion provides “a more detailed illustration of the information flow, processes and architecture of the elements described in FIG. 2.” *Id.* ¶ 27, Fig. 3. Figure 3 is reproduced below:

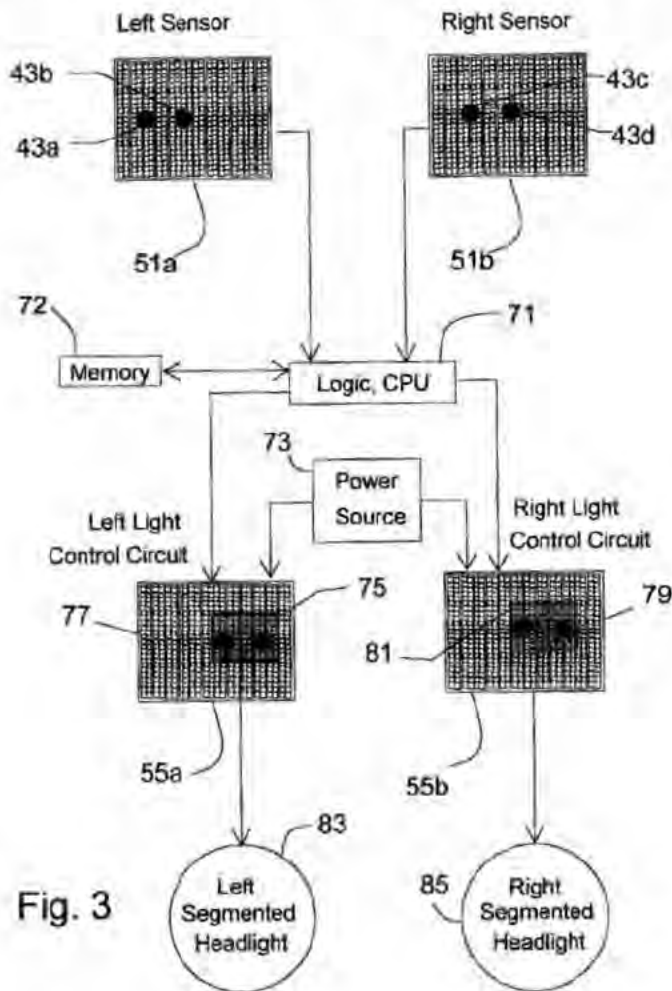


Figure 3 depicts “the information flow, processes and architecture of the elements described in FIG. 2” including sensors 51a/b with illuminated spots 43a/b/c/d,

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logic and CPU 71, light control circuits 55a/b, and segmented headlights 83/85. *Id.* ¶ 27, Fig. 3.

Figure 3 depicts segmented headlights 83 and 85 generically, and the description refers to them without limiting the particular form of those headlights. *Id.* Thus, when Alden describes that Figure 5 “illustrates the segmented headlight means and controlling switch array in a first embodiment,” that does not describe an aspect disconnected from the components and operation depicted in Figures 2 or 3, but rather provides details regarding one embodiment of the segmented headlights included in Figures 2 and 3. *See id.* ¶ 29.

Importantly, Figure 3 unambiguously depicts two-dimensional sensor arrays 51a/b and two-dimensional control circuits 55a/b. *Id.*, Fig. 3. That figure and the corresponding text indicate that Alden’s process for dimming illumination sectors involves aspects in the vertical direction—the shaded boxes 75/77 representing dimmed illumination extend beyond the sensed lights 43a/b/c/d more in the vertical direction than in the horizontal direction, and “[t]he 75 area is significantly larger than the headlight dots that were initially received by 51a and 51b because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.” *Id.* ¶ 27, Fig. 3.

Moreover, Alden’s description of Figure 3’s logic—though Figure 4’s flow chart and corresponding text—leaves no doubt that Alden’s process uses two-dimensional analysis. As Alden describes, the CPU checks each sector of the light sensor, for the left sensor beginning with sector A1L, proceeding to A2L and continuing through XYL. *Id.* ¶ 28, Fig. 4. The same process occurs for the right sensor, checking sectors A1R through XYR. *Id.*

Finally, Alden describes additional applications for its invention, beyond those used to dim light sectors for oncoming vehicles. Those applications include

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where the invention is “used to concentrate light to look up a hill in response to road conditions” and “look down a hill in response to road conditions.” *Id.* ¶¶ 55, 56, Figs. 12, 13. From that description and the corresponding figures, it is apparent that those applications use Alden’s ability to control sectors along the vertical axis within the segmented headlight that effects illumination.

While Alden’s Figure 5 shows a sectional view of a segmented-headlight embodiment, thus depicting a single line of LEDs, that does not restrict the embodiment to a one-dimensional array. Indeed, Alden’s disclosures discussed above contradict such a view, as do the disclosures regarding Figure 5 and other segmented-headlight embodiments. We credit Petitioner’s expert’s testimony in this regard. Ex. 2041, 59:10–12 (“[I]t’s very clear we’re talking about a two-dimensional structure that is map of this set of slices in figure 5.”); *accord id.* at 56:25–60:18. The Figure 5 embodiment includes a switch array to control the individual lighting elements, with “[e]ach lighting element being independently controlled by a corresponding switch in an array of switches 115.” *Id.* ¶ 29. The Figure 6 embodiment includes a face-on view of the segmented headlight plainly showing a two-dimensional array, in addition to a sectional view similar to Figure 5’s. *Id.* at Fig. 6. And Alden describes that the Figure 6 embodiment uses “switch array similar to 115 and the process previously described herein.” *Id.* ¶ 30.

Patent Owner contends also that we should not rely on the Figure 6 embodiment to understand the Figure 5 embodiment. PO Resp. 31–32. According to Patent Owner, because the two embodiments are “distinct” and “incompatible” with each other, we should not evaluate parallels in their descriptions. *Id.*; *accord* PO Surreply 6–7. We do not agree, because the Figure 6 description expressly refers to the same reference numeral as the Figure 5 description, making a plain connection. In other regards, Patent Owner’s argument is premised on limiting

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Figure 5's embodiment to a single row of lighting elements; we do not agree with that restriction.

Considering Alden's description of its sensing-and-control circuit in connection with Figure 3, which illustrates a two-dimensional array, and its description of Figure 5's segmented headlight as working with that approach, we find that Alden's LED-based segmented headlight is capable of selective illumination in two dimensions. *Id.* ¶¶ 27, 29, Figs. 3, 5.

Patent Owner relies heavily on Alden's statement that "[t]he [light element] 119 and other 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.* ¶ 29; PO Resp. 31 ("Alden merely describes a row of LEDs positioned along the focal point of a lens."). It is uncontroversial that the lens has a single focal point, though there are many curves passing through that focal point, and thus many curves on which lighting elements may be arranged. While Figure 5 shows elements along one such curve, that does not preclude the existence of other elements that fall on other curves. Thus, we do not agree that Alden's statement regarding the focal point restricts Figure 5 to depicting an embodiment with one row of lights.

Patent Owner also faults Petitioner's expert for characterizing the figures as conceptual. PO Resp. 32–33. But there is nothing problematic with conceptual figures, particularly where the corresponding description makes clear how the invention operates. For example, Patent Owner complains that Petitioner's expert "could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to create the beam spread illustrated therein." *Id.* at 32 (emphasis omitted). We would not expect Dr. Papanikolopoulos to explain that—the beam spread of any optical system will depend on the lens used and the relative

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position of the light sources to the lens, so it is unclear why Patent Owner expects the particular switch array to determine beam spread. When asked about beam spread (Ex. 2041, 107:11–12), Dr. Papanikolopoulos stated that it would depend on the specifics of an overall system and could not be determined by Alden’s figures (*id.* at 108, 4–10). Patent Owner finds fault in the mismatch between Figure 3’s “200+ switches” and Figure 5’s nine LEDs. PO Resp. 33. But that mismatch represents the conceptual nature of the figures, rather than signaling a fundamental disconnect between the two figures such that Alden’s disclosures do not enable its invention. The same problem tarnishes Patent Owner’s complaint that “Alden lacks details regarding how the hypothetical structure would be put together—notable whether the two-dimensional LED structure would form a semi-cylinder, a semi-sphere or a flat plane (among other choices), which informs the control strategy and resultant beam spread.” PO Surreply 10. Those details are not required by Alden’s description because they do not fundamentally change Alden’s invention.

Because Alden describes its segmented headlights as implementing a process using two-dimensional signals for two-dimensional dimming functionality, we find that Figure 5 depicts a section of an embodiment that contains more than a single row of lighting elements. Stated otherwise, Alden’s disclosures are consistent with each other and are directed to a two-dimensional approach to sensing, control, and illumination.

Further, we agree with Petitioner that Patent Owner has not addressed the legal standard for lack of enablement. Pet. Reply 2. In particular, to overcome the presumption that prior-art disclosures are enabled, Patent Owner must show ordinarily skilled artisans would require undue experimentation to practice the disclosed invention. *See Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d

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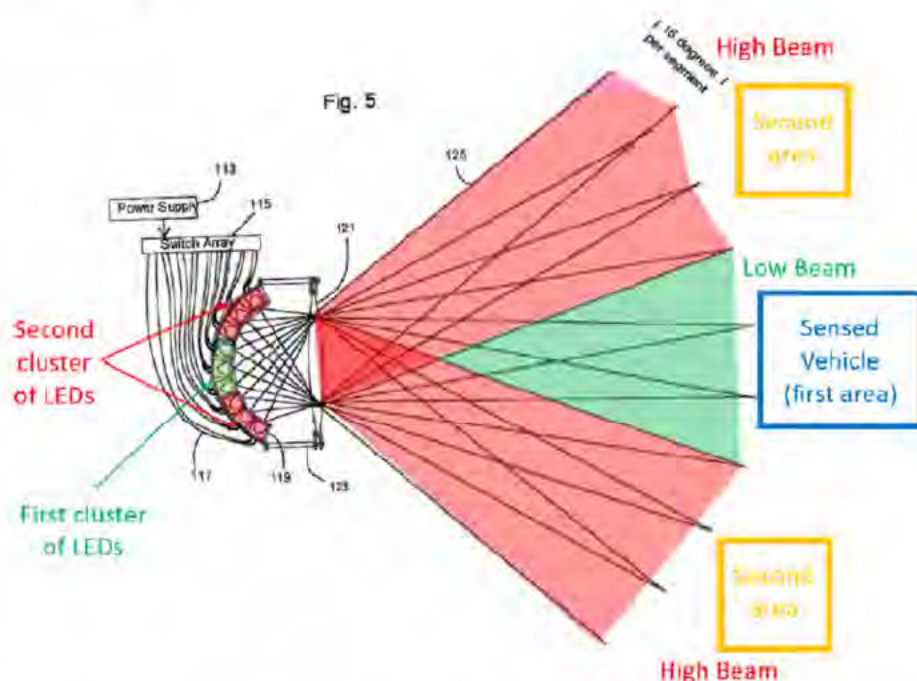
1313, 1354–55 (Fed. Cir. 2003); *In re Antor Media Corp.*, 689 F. 3d 1282, 1287–88 (Fed. Cir. 2012). We do not agree with Patent Owner that Alden lacks a presumption of enablement (*see* PO Surreply 7–8), because we determine that Petitioner’s contentions rely on Alden’s disclosures regarding its invention as a whole. Other than arguing that Figure 5 discloses a single-row embodiment that is unusable with Alden’s other disclosures, Patent Owner has made no attempt to show Alden lacks enablement. Patent Owner has not addressed what experimentation skilled artisans would require to practice an invention using Alden’s Figure 5 segmented headlight with the remainder of Alden’s system as disclosed in Figures 2, 3, and 4, and Alden’s corresponding textual description.

We therefore determine that Patent Owner has not shown Alden to lack enablement for its disclosed invention.

b. Inaccurate scale

Patent Owner argues that Petitioner mischaracterizes Alden’s disclosure by applying out-of-scale annotations to Figure 5. PO Resp. 35–39. Petitioner’s annotated version of Alden’s Figure 5 is reproduced below:

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Pet. 30 (quoting and annotating Ex. 1005, Fig. 5). Petitioner’s annotations designate and highlight red a central cluster of lighting elements within Figure 5’s array as a “First cluster of LEDs” and designate and highlight green the remainder of the array (to both sides of the first cluster) as a “Second cluster of LEDs.” *Id.* The annotations further highlight the light beams emitted from the segmented headlight by the two clusters as green and red, respectively, and show a “Sensed Vehicle (first area)” within the “Low Beam,” green portion emitted by the first cluster and a “Second area” as the “High Beam,” red portion emitted by the second cluster. *Id.*

Patent Owner complains that “at the distance shown from the headlight, the annotated oncoming vehicle is too small relative to the size of the headlight” and that “the annotated vehicle has a width less than that of the headlight structure.” PO Resp. 35. The argument makes no sense. As Petitioner points out, the annotations are “demonstrative of what is described in Alden, and are not the creation of a scaled technical drawing.” Pet. Reply 15. There would be no use in a

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drawing that accurately represented the scale of both Alden's segmented headlight and an oncoming vehicle, because the headlight would be too small to resolve any detail. That reality is reflected in Alden's Figure 2, reproduced above, which uses different scales to depict the segmented distribution system versus an oncoming vehicle. *See* Ex. 1005, Fig. 2. Thus, we do not fault Petitioner's annotations for representing an oncoming vehicle as falling within a small portion of the projected beam. Indeed, as we noted in the Institution Decision, Alden indicates Figure 5 depicts an embodiment in which each lighting element provides 15 degrees of the overall illumination. *Id.* ¶ 39, Fig. 5. Using that example, each element's illumination would spread about 39 feet at a distance of 150 feet.⁸ The challenged claims do not restrict the distance at which an "other vehicle" is accommodated. Alden's Figure 5 example depicts a system that would provide segments to isolate the vehicle at some reasonable distance from Alden's system. Relatedly, Patent Owner argues that if Alden's Figure 5 embodiment shows the concept of an LED-based segmented headlight, then it lacks the details required to anticipate. PO Resp. 37–38. We do not agree, as the detail that Petitioner seeks is both unrestricted by the challenged claims and notably absent from the '551 patent's disclosures.

According to Patent Owner, [i]f Petitioner's annotations do not precisely represent Alden's disclosure, then they necessarily depict operations/scenarios not expressly described in Alden." *Id.* at 37. But generally disclosing an invention, as does Alden, allows for general annotations, as are Petitioner's. The point is not to substitute for Alden's disclosures but to graphically summarize those disclosures.

⁸ $150 \cdot \sin(15^\circ) = 38.8$

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We do not rely on Petitioner's annotations to reach our conclusions that Alden discloses the '551 patent's claimed invention, for any challenged claim.

Patent Owner relies on its scale argument to submit that the record lacks evidence that Alden's system provides high-beam light illuminating past the vehicle depicted in Petitioner's annotated Figure 5. *Id.* at 38. Alden, however, amply discloses that aspect of claim 24. Alden's Figure 1 is reproduced below:

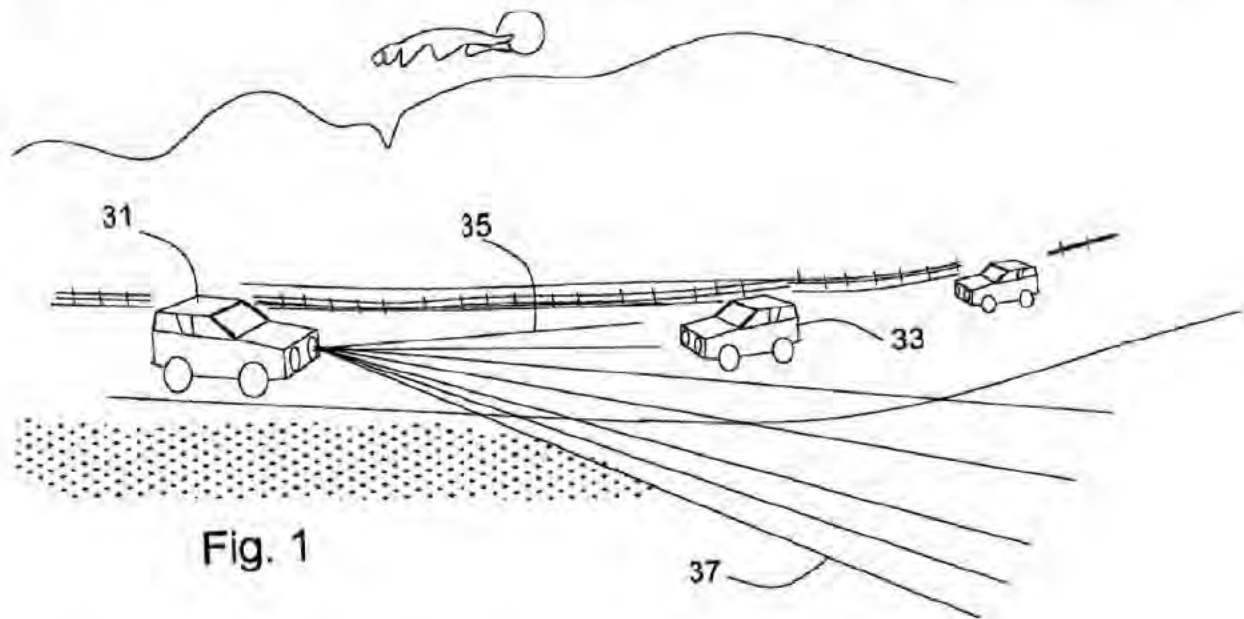


Figure 1 shows vehicle with Alden's invention 31 emitting low-beam illumination 35 towards oncoming vehicle 33 while concurrently emitting high-beam illumination 37 past vehicle 33. Ex. 1005 ¶ 25, Fig. 1. This disclosure suffices to show that Alden's system "preserves a first level of illumination illuminating past the other vehicle while preventing glare to a driver of the other vehicle" as claimed. Additionally, Figure 5 supports that conclusion because it shows segments that would correspond to a detected vehicle (and therefore be illuminated with low-beam illumination) and other segments that would be

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illuminated with high-beam illumination, as per Petitioner's annotations reproduced above.

We conclude that Petitioner's annotations accurately represent Alden's disclosures, without purporting to depict the scale of oncoming vehicles relative to Alden's segmented headlight.

2. Claim 32

Independent claim 32 differs from claim 24, in part, by requiring the beam directed towards the detected vehicle be "diminished in intensity relative to the broader field of illumination illuminating at least above and on both sides of the beam." Ex. 2014, 1184–85 (2:42–3:19). Petitioner relies on Alden's disclosures that light is reduced in a rectangle around detected headlights, but provided with full illumination all around such a rectangle, as reflected in Alden's Figure 3. Pet. 41–42.

Patent Owner contends that Alden does not describe using its Figure 5 embodiment to create a beam that illuminates above the non-glaring zone. PO Resp. 39–42. But Patent Owner's argument merely repackages the same arguments discussed above regarding Alden's Figure 5 embodiment: that it is limited to a one-dimensional light array and would need modification to work with Alden's Figure 3 disclosures. *Id.* For the reasons discussed above, we do not agree with Patent Owner's position on those issues.

For the reasons submitted by Petitioner, we find that Alden discloses providing illumination around the area dimmed for a detected vehicle, including above and on both sides of the vehicle. Pet. 41–42.

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3. Claim 40

Independent claim 40 differs from claim 24, in part, because it requires detecting two simultaneous other cars (rather than one) and providing two corresponding areas of dimmed illumination, separated by non-dimmed illumination. Ex. 2014, 1185–86(4:20–5:5). Petitioner contends that Alden discloses detecting multiple vehicles and dimming in response to them, and consistently allows for more than a single vehicle. Pet. 47–51; Pet. Reply 16–17. We agree.

Alden’s system can “sens[e] the location of other vehicles” and “diminish[] the amount of light directed to said other vehicles” Ex. 1005, claim 1. That claim scope requires identifying and accommodating multiple simultaneous vehicles.

Alden generally describes a system where “all areas with other drivers present receive low beams so as to minimize the glare.” Ex. 1005, code (57); *accord id.* (“produces low beams in areas where vehicles are present”). The system can “detect the sector in which [oncoming vehicle] 33 (or any other vehicle) is located,” suggesting that multiple simultaneous vehicles may be detected, and uses plural language to reference “sensing locations of vehicles.” *Id.* ¶ 25. Alden describes providing low beam high-beam “illumination where no vehicle is detected,” which is consistent with accommodating multiple vehicles. *Id.*

Patent Owner argues that Alden “nowhere clearly describes or specifically illustrates concurrent detection of two vehicles.” PO Resp. 44. In Patent Owner’s view, Alden lacks any teaching of “how multiple (e.g., four or more) spots of detected light would be grouped or evaluated in order to designate sectors in the distribution area corresponding to each of multiple oncoming vehicles.” PO Resp. 45. But that ignores Alden using sensed light to identify objects—detected headlights—and then using those objects’ locations (including distance) to

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identify vehicles for dimming: “The location of objects is used to calculate which zones of each headlight need to be dimmed” (Ex. 1005 ¶ 28) and the dimming processing includes “assumptions about the space that may potentially be occupied by the driver of the sensed vehicle” (*id.* ¶ 27). Alden’s approach of associating a dimmed rectangle with an identified vehicle and making that rectangle “significantly larger than the headlight dots” that were detected to accommodate the vehicle’s driver (*id.* ¶ 27, Fig. 3) indicates that Alden’s dimming processes treats vehicles as distinct entities. Thus, Alden’s disclosures support that the process it describes for accommodating a single vehicle applies equally to multiple simultaneous vehicles.

Patent Owner contends that Alden’s triangulation “would be of no value” in accommodating “multiple oncoming vehicles located at similar distances from the equipped vehicle” (PO Resp. 45) but does not explain the legal significance.⁹ Even if Alden’s triangulation wouldn’t help distinguish cars a similar distance away, Alden’s dimming approach uses more than just distance information, so the criticism is inapposite. *See* Ex. 1005 ¶ 28. And whether Alden’s system might perform less optimally in one multi-vehicle situation does undermine accommodating multiple vehicles, as Alden otherwise describes.

We agree with Petitioner that Patent Owner’s reading of Alden is strained and illogical to the extent it limits Alden to accommodating only one oncoming

⁹ Patent Owner points out that Petitioner’s expert stated in a paper that stereo algorithms (as Alden’s triangulation would require) were “unfeasible.” Ex. 2063, 37 (“The inherent complexity of stereo algorithms and the need to solve the correspondence problem makes them unfeasible for real-time applications.”); PO Resp. 45. But Patent Owner does not attempt to show that Alden’s triangulation lacks enablement.

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vehicle at a time. Pet. Reply 17. We find that Alden discloses simultaneously accommodating multiple vehicles for the reasons discussed.

4. Dependent claims 26, 34, 42

Claim 26 depends from claim 24 and additionally requires the ability to “identify an upcoming road curvature along a road on which the motor vehicle is traveling” and accommodate that curvature by adapting the headlamp’s light pattern. Ex. 2014, 1184 (2:3–12). Claims 34 and 42 depend from claims 32 and 40, respectively, and recite parallel limitations.

Petitioner points to Alden’s disclosure that its system may be used to “concentrate light to look around corners in response to road conditions.” Ex. 1005 ¶ 36. Alden’s Figure 11 is reproduced below:

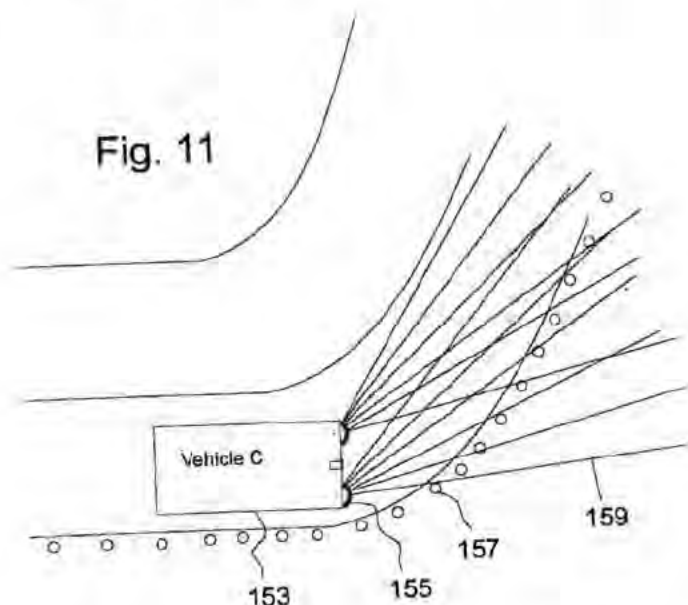


Figure 11 depicts equipped vehicle 153 sensing that the road turns using roadside reflectors 157, causing headlights 155 to “direct light into the corner to maximize the driver’s ability to see there.” Ex. 1005 ¶ 36, Fig. 11. Alden states that the same device already disclosed may direct light as illustrated in Figure 11. *Id.* ¶ 36.

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Petitioner additionally relies on Alden's steering-wheel rotation sensor, which Alden uses to calculate its vehicle's direction changes and adjust the light projection. Pet. 55 (citing Ex. 1005 ¶¶ 39–40).

Patent Owner challenges Petitioner's contentions, arguing that Alden "fails to teach" claim 26's additional limitations because it "never describes *how* its system can sense a 'curve' by detecting incoming light from a reflector or what to do with beam segments and distribution area sectors if it did sense a curve."

PO Resp. 49. In particular, Patent Owner asserts that Alden has no way to distinguish light from roadside reflectors from other detected light. *Id.* Patent Owner views Alden's brief mention of detecting road curves using roadside reflectors as insufficiently detailed to enable practice of that approach. *Id.*

We agree with Petitioner that Patent Owner has not demonstrated lack of enablement for Alden's system detecting road curves. Pet. Reply 9–10. As Petitioner points out, Alden uses both intensity and a detected object's location (including distance) to inform its response. Ex. 1005 ¶¶ 27–28. Further, Petitioner's expert testifies that skilled artisans would adjust the intensity and distance thresholds to distinguish roadside reflectors from oncoming vehicles. Ex. 1003 ¶ 150; *see also* Ex. 2041, 78:16–80:24 (explaining that the same physical system used to accommodate oncoming vehicles could be used to detect roadside reflectors and direct light into road curves). Based on Alden's disclosures, we credit Petitioner's expert's testimony that Alden's system would detect and accommodate road curvatures as claimed by the '551 patent. Ex. 1003 ¶ 111. Although Patent Owner argues that Alden's system could not do so while also accommodating oncoming vehicles, that position is based on the argument that "the system can't tell the difference between signs and headlights." PO

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Surreply 19–21. We agree with Petitioner’s expert that Alden’s system can distinguish the two, as discussed.

Accordingly, based on the full record, we find that Alden discloses the limitations of claims 26, 34, and 42.

5. Dependent claims 27, 35, 43

Claim 27 depends from claim 26 and further recites aspects of how the light is changed. Ex. 2014, 1184 (2:12–26). Claims 35 and 43 depend from claims 34 and 42, respectively, and recite parallel limitations. Relevant here, claim 27 requires changing “the light pattern in at least one of color, intensity[,], or spatial distribution” in response to detected road curvature. *Id.*

Petitioner addresses that requirement through Alden’s teaching to “concentrate light to look around corners in response to road conditions.” Ex. 1005 ¶ 36, Fig. 11; Pet. 57–58. Patent Owner contends that Alden cannot change the light in the direction of road curvature because, “in all segmented beam headlight embodiments of Alden, all beam segments are always activated at high intensity unless specifically dimmed.” PO Resp. 52; *accord id.* at 14–15.

Patent Owner’s position conflates Alden’s embodiments with their uses. While Alden describes operation where non-dimmed areas are illuminated with high beam (Ex. 1005 ¶ 27), that relates to preventing glare to oncoming vehicles. Skilled artisans would understand that it is a different use with different requirements where Alden describes directing light into corners. Ex. 2041, 50:9–51:1. Petitioner’s expert explains that the segmented headlight shown in Alden’s Figure 5 can function in both uses by identifying both oncoming vehicles and roadside reflectors. *Id.* at 78:22–80:24. As Petitioner points out, even when preventing glare to oncoming vehicles, Alden teaches switching certain headlight

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segments to dim and switching other segments to high beam. Ex. 1005, Fig. 4; *accord id.* ¶ 28. By including a decision about each headlight segment, Alden’s system is thus configured to implement the road-curvature use. And Alden teaches that its invention may be used such that each segment is “within a range of intensities between the high beam and the low beam state.” *Id.* ¶ 61. That supports that Alden’s invention is not limited to a binary choice between dimming for oncoming vehicles or providing high-beam illumination. As to the specific hardware configuration, we credit the testimony of Petitioner’s expert that, in the road-curvature use, skilled artisans would position the device’s LEDs “to ensure that the beam created by the headlamp is sufficiently wide to illuminate turns.” Ex. 1003 ¶ 111. That explanation is consistent with Alden’s Figure 11, which contradicts Patent Owner’s view that all segments would be illuminated, as Figure 11 depicts an asymmetric beam projection. Ex. 1005, Fig. 11. Thus, Figure 11 itself shows “how fixed, unsteerable LEDs can be used to ‘concentrate’ light” (*see* PO Surreply 12)—certain LEDs are used for wide illumination, only activated when the system desires to “concentrate light to look around corners in response to road conditions” (Ex. 1005 ¶ 36, Fig. 11).

Based on the foregoing evidence, we find that Alden’s invention is not limited to uses where it only dims in response to oncoming vehicles. Further, we find that Alden’s invention may perform the variety of uses that Alden discloses, which include both dimming for oncoming vehicles and increasing light in the direction of detected road curvature.

6. Dependent claims 29, 37, 45

Claim 29 depends from claim 26 and further recites “wherein the identification of the upcoming road curvature is based at least in part on sensor

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data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.” Ex. 2014, 1184 (2:31–35). Claims 37 and 45 depend from claims 34 and 42, respectively, and recite parallel limitations.

Petitioner relies on Alden’s disclosures that its “system can sense when a road curves in front of a vehicle based on sensor data detecting road reflectors 157.” Pet. 58 (citing Ex. 1005 ¶ 36, Fig. 11). Petitioner further points out that Alden can include steering wheel “rotation sensors” to “further detect when a vehicle is approaching an upcoming road curve.” *Id.* at 59 (citing Ex. 1005 ¶¶ 39–40, Figs. 14, 15).

Patent Owner contends that Petitioner improperly relies on the steering-wheel sensor, whereas the claims require the curvature identification be “based at least in part on sensor data provided by one or more of the sensors [for detecting coordinate-specific information about the illuminated area].” PO Resp. 55–56. Patent Owner’s argument ignores that Petitioner relies primarily on Alden’s camera sensing roadside reflectors to detect road curvature, as described above. Although Petitioner points further to an additional benefit from Alden’s steering-wheel rotation sensor, that does not undermine Petitioner’s primary contention, because the claim language requires only that the road curvature be identified “based at least in part” on the camera. Petitioner’s contentions are consistent with the claim language.

Patent Owner contends in the Surreply that Alden’s system could not use the road reflectors to identify an upcoming curve because it cannot distinguish between headlights and road signs. PO Surreply 23. We do not agree with that characterization of Alden, as discussed above regarding claim 26. *See supra* at 29 (§ II.C.4).

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Other than as discussed above, Patent Owner does not contest Petitioner's reliance on Alden's use of its camera to detect road curvature.

7. Conclusion

Other than as discussed, Patent Owner does not contest Petitioner's showing for claims 24–27, 29–35, 37–43, and 45–47.¹⁰ See PO Resp. 25–60. We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether Alden discloses each limitation of the claims challenged as anticipated. Based on the full record, we conclude that Petitioner has proven that Alden anticipates claims 24–27, 29–35, 37–43, and 45–47. Pet. 10–62; Pet. Reply 1–11, 13–20.

D. OBVIOUSNESS OVER ALDEN

Petitioner presents its first ground as asserting “Alden Anticipates and Renders Obvious Claims 24–27, 29–35, 37–43, 45–47.” Pet. 11. We consider obviousness over Alden a separate ground from anticipation. We noted in the Institution Decision that “[i]t does not appear that Petitioner has provided any basis on which to account for differences between Alden and the challenged claims based on Alden's disclosures alone (as considered by a skilled artisan).” Inst. 17. Patent Owner agrees with that view of Petitioner's obviousness contentions. PO Resp. 57–60.

Petitioner contends it sufficiently demonstrates obviousness by explaining how skilled artisans would understand Alden's disclosures, and that its

¹⁰ In the Surreply, Patent Owner asserts a deficiency in Petitioner proofs regarding the “cluster” in claims 25, 27, 33, 35, 41, and 43. PO Surreply 15. Patent Owner did not raise that argument in the Response and therefore forfeited it. See Paper 11, 9 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”).

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obviousness contentions merely account for any minor differences between Alden's express disclosures and how skilled artisans would understand them. Pet. Reply 20–21.

How obviousness applies here would depend on what aspect was deemed insufficient for anticipation. Because we conclude above that Alden's disclosures support Petitioner's anticipation ground (*see supra* § II.C), we have no reason to determine whether the claims may be obviousness over Alden alone.

E. OBVIOUSNESS OVER ALDEN AND KOBAYASHI

For claims 28, 36, and 44, Petitioner relies on Alden in combination with Kobayashi to assert the claimed subject matter would have been obvious. Pet. 62–65. Claim 28 depends from claim 26 and further recites “wherein identification of the upcoming road curvature is based at least in part on map data and wherein the adaptation of the light pattern is based at least in part on the map data.” Ex. 2014, 1184 (2:27–30).

Petitioner asserts that skilled artisans would have had reason to incorporate Kobayashi's teachings that its controller receives “road map information” from a “road profile calculating means” and uses it to adjust the headlamp's illumination. Pet. 63–64. Petitioner reasons that it would be obvious to “apply these teachings to Alden to use map data to identify road curvature when adapting the LEDs of Alden to ‘direct light into the corner.’” *Id.* at 64 (citing Ex. 1003 ¶ 122). And Petitioner asserts that skilled artisans had reason to do so because it would “maximize successful detection in different environments” such as where the road lack reflectors. *Id.* at 65 (citing Ex. 1003 ¶ 123).

Other than as discussed above regarding Alden's disclosures, Patent Owner does not contest Petitioner's showing for claims 28, 36, and 44. We have

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considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Kobayashi discloses each limitation of claims 28, 36, and 44, and whether skilled artisans would have had reason to combine the references' teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 28, 36, and 44 would have been obvious over Alden and Kobayashi. Pet. 62–65.

F. OBVIOUSNESS OVER ALDEN AND KONDO

Petitioner asserts that the subject matter of claims 8 and 10–14 would have been obvious over Alden and Kondo. Pet. 65–84. Kondo discloses a vehicle headlamp system with certain lights mounted on swivels so that they may be directed as desired to adjust illumination. Ex. 1007, code (57), ¶¶ 5, 8, 16–18, 30–31, Fig. 2.

Petitioner asserts “[i]t would have been obvious to include LEDs of Alden on a moveable structure as taught by Kondo.” Pet. 72 (citing Ex. 1003 ¶ 130). In Petitioner’s view, “Kondo simply provides a known alternative for re-directing” light in the direction of a curve or turn to improve driver visibility. *Id.* Petitioner asserts that Kondo’s approach “can accommodate sharp turns by using a swivel structure to adjust the physical direction of lights” and that using Kondo’s structure “would have given greater flexibility in controlling the directionality of emitted beams.” *Id.* at 73 (citing Ex. 1003 ¶ 132). Patent Owner does not dispute Petitioner’s contentions directed to Kondo but does dispute one aspect of the claims challenged under this ground.

1. Claim 8

Claim 8 recites a processor capable of “identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by

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people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance.” Ex. 1001, 96:56–62. Petitioner contends that Alden’s system identifies vehicles as discussed above regarding claim 24—by detecting lights from vehicle headlights then using position and intensity information of the detected lights to identify an oncoming vehicle. Pet. 23–32, 76; Pet. Reply 11–12.

Patent Owner contends that, to “identify,” the processor must “show to be a certain person or thing,” and that Alden does not disclose identifying vehicles because it “merely assumes that detected incoming light above a threshold from any and all sources always indicates the presence of an oncoming vehicle.” PO Resp. 23; *accord id.* at 21–25. In Petitioner’s view, Alden satisfies Patent Owner’s construction because “it shows that something (in this case, a light source) is a certain thing (in this case, an oncoming vehicle) based on the intensity of the detected light.” Pet. Reply 12–13 n.6. As discussed above, we do not agree with Patent Owner that “identifying” requires verification or confirmation of an object’s true identity. *See supra* at 8–11 (§ II.B.1). Even so, the parties dispute whether Alden’s system identifies oncoming vehicles.

According to Patent Owner, Alden’s system “detects incoming light having an intensity above a threshold,” then “dims those segmented light distribution elements whose beam segments illuminate corresponding sectors of the distribution area where the detected light is located and selected surrounding sectors.” PO Resp. 22 (citing Ex. 1005 ¶¶ 27–28). In Patent Owner’s view, because Alden’s system “merely assumes that detected incoming light above a threshold from any and all sources always indicates the presence of an oncoming vehicle,” it cannot identify a vehicle. *Id.* at 23.

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Petitioner points out that one of Alden's key purposes is to "sense the locations of other vehicles" and control headlights to prevent glare to those vehicles. Pet. Reply 11–12 (quoting Ex. 1005 ¶ 6). Petitioner emphasizes that Alden's analysis uses intensity and distance information to indicate whether detected light is from an oncoming vehicle, and dims the area above detected headlights because it may be "occupied by the driver." Pet. Reply 11–12; *id.* at 12 n.5.

We agree with Petitioner. Alden's system does not simply dim its headlights where it detects spots of light. Rather, it performs a multistep process in which those spots are detected, analyzed with triangulation to determine distance, and then used to determine dimming zones. Ex. 1005 ¶¶ 27–28. Alden discloses that its sensor "detects the two headlights" of an oncoming vehicle when "[e]lectrons corresponding to the position and intensity of light are categorized by a logic and CPU 71 and stored in a memory 72." *Id.* ¶ 27. Petitioner's expert noted that Alden's description "move[s] from lights – thresholding lights to objects, and then calculate[s] distance of each thresholding object using triangulation." Ex. 2041, 109:23–110:2. That testimony supports our view that Alden first detects lights, uses those detected lights to identify an oncoming car, then dims the headlight output to prevent glare.

Alden's dimming decision particularly indicates that it identifies oncoming vehicles. The CPU makes "assumptions about the space that may potentially be occupied by the driver of the sensed vehicle" and identifies an area of the segmented headlight to dim that is "significantly larger than the headlight dots that were initially received." Ex. 1005 ¶ 27. Patent Owner agrees that Alden dims "selected surrounding sectors" around detected light (PO Resp. 22), and the way Alden selects those sectors indicates that it identifies vehicles. It does not simply

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expand an area around each detected light; it dims an area to encompass the driver of the identified vehicle. Ex. 1005 ¶ 27, Fig. 3. By treating a pair of corresponding detected lights collectively for dimming, Alden indicates that it identifies vehicles.

Patent Owner submits that “[h]ow, why (or even if) the two points are associated with each other is never expressed” (PO Surreply 2–3), but we do not agree. Because Alden discusses associating an object with each detected headlight and then using those objects’ locations to calculate dimming, and dims areas that address two headlight objects collectively (Ex. 1005 ¶¶ 27–28), Alden indicates that it associates two detected headlights with each other.

Further, as Petitioner notes, “[c]laim 8 does not require a particular method to identify vehicles or level of accuracy.” *Id.* at 12.¹¹ Thus, whether Alden’s system might respond to non-vehicles in certain situations (*see* PO Resp. 22) does not bear on whether it identifies vehicles.

For the reasons discussed, we find that Alden’s system identifies oncoming vehicles.

2. Conclusion

Patent Owner does not otherwise contest Petitioner’s obviousness challenges to claims 8 and 10–14.¹² We have considered the full record, including evidence

¹¹ Because we do not agree with Patent Owner’s proposed claim construction, which would require some verification or confirmation of an identified vehicle (*see supra* at 8–10 (§ II.B.1)), we agree with Petitioner that claim 8 does not require a particular method or accuracy.

¹² In the Surreply, Patent Owner contests whether Alden discloses “pattern recognition” to determine illumination, as Petitioner asserts relative to claim 8. PO Surreply 2–6; Pet. 76–78. Patent Owner did not raise that argument in the Patent Owner Response and therefore forfeited it. *See* Paper 11, 9 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”).

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and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Kondo discloses each limitation of claims 8 and 10–14, and whether skilled artisans would have had reason to combine the references' teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 8 and 10–14 would have been obvious over Alden and Kondo. Pet. 65–84.

G. OBVIOUSNESS OVER ALDEN, KONDO, AND STAM

For claims 15–18, which depend from claim 8, directly or indirectly, Petitioner asserts that Stam or Alden discloses the additionally recited limitations. Pet. 85–89. Stam discloses a system for controlling exterior vehicle lights. Ex. 1008, codes (54), (57), Fig. 11. Stam's system uses information from sensors including an imaging sensor and controls exterior lights such as fog lamps. *Id.* at 2:28–5:23, 25:4–5, 27:14–17, 63:15–16. Petitioner reasons that skilled artisans had reason to use Stam's teachings so that the same sensor used for headlights—Alden's camera—would detect conditions such as fog and control other exterior lights based on those conditions. Pet. 86–87.

Other than as discussed above regarding Alden's disclosures, Patent Owner does not contest Petitioner's showing for claims 15–18. We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden, Kondo, and Stam discloses each limitation of claims 15–18, and whether skilled artisans would have had reason to combine the references' teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 15–18 would have been obvious over Alden, Kondo, and Stam. Pet. 85–89.

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III. CONCLUSION¹³

For the reasons discussed above, we conclude Petitioner has proven the challenged claims unpatentable. In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
24–27, 29–31, 32–35, 37–39, 40–43, 45–47	102	Alden	24–27, 29–31, 32–35, 37–39, 40–43, 45–47	
24–27, 29–31, 32–35, 37–39, 40–43, 45–47	103	Alden ¹⁴		
28, 36, 44	103	Alden, Kobayashi	28, 36, 44	
8, 10–14	103	Alden, Kondo	8, 10–14	
15–18	103	Alden, Kondo, Stam	15–18	
Overall Outcome			8, 10–18, 24–47	

¹³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending ALA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

¹⁴ We do not address obviousness over Alden alone because we determine the claims challenged in this ground to be anticipated by Alden.

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IV. ORDER

Accordingly, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 8, 10–18, and 24–47 of the '551 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Paper 29
Entered: December 10, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner.

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Before JON M. JURGOVAN, JASON W. MELVIN, and
AARON W. MOORE, *Administrative Patent Judges*.

MELVIN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

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I. INTRODUCTION

Mercedes-Benz USA, LLC (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 48–87 (“the challenged claims”) of U.S. Patent No. 9,955,551 B2 (Ex. 1001, “the ’551 patent”). Yechezkal Evan Spero (“Patent Owner”) filed a Preliminary Response. (Paper 7, “Prelim. Resp.”). After additional authorize briefing, we instituted review. Paper 10 (“Institution Decision” or “Inst.”).

Patent Owner filed a Response (Paper 15, “PO Resp.”), Petitioner filed a Reply (Paper 17, “Pet. Reply”), and Patent Owner filed a Surreply (Paper 19, “PO Surreply”). We held an oral hearing on October 23, 2024. Paper 28 (“Tr.”).

For the reasons below, we conclude that Petitioner has proven the challenged claims unpatentable.

A. REAL PARTIES IN INTEREST

As real parties in interest, Petitioner identifies: Mercedes-Benz USA, LLC; Mercedes-Benz Group AG; Mercedes-Benz AG; and Mercedes-Benz Intellectual Property GmbH & Co. KG. Pet. 2. Patent Owner identifies Yechezkal Evan Spero and Torchlight Technologies LLC as the real parties in interest, noting that Torchlight is the exclusive licensee of the ’551 patent. Paper 4, 1 (Patent Owner’s Mandatory Notices).

B. RELATED MATTERS

The parties identify the following related federal district court litigations of the ’551 patent: *Torchlight Techs. LLC v. Daimler AG et al.*, No. 1:22-cv-00751 (D. Del.); *Torchlight Technologies LLC v. General Motors LLC et al.*, No. 1:22-cv-00752 (D. Del). Pet. 2–3; Paper 4, 1.

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The parties identify the following PTAB *inter partes* reviews of the '551 patent: IPR2023-00315; IPR2023-00318; IPR2023-00336; IPR2023-01039; IPR2023-01225. Pet. 3; Paper 4, 2.¹ Patent Owner identifies pending Reissue Application 16/858,342. Paper 4, 1.

C. THE '551 PATENT

The '551 patent is titled “Detector Controlled Illuminating System” and relates to an “illuminating device” whereby “illumination intensity and spectrum” are varied to illuminate “areas according to the principles of correct lighting practice,” e.g., “adapt to ambient lighting, movement, visual tasks being performed, and environmental and personal conditions.” Ex. 1001, codes (54), (57). The specification generally describes a lighting device that “incorporates one or more discrete light sources and their ancillary optical and electrical control equipment in an integrated illuminating element.” *Id.* at 13:34–36. The combined unit is referred to as a Digital Lighting Fixture (DLF). *Id.* at 18:18–22.

The specification further describes transportation vehicle applications. *Id.* at 50:38–57:37. One such application involves a DLF headlamp device that includes a cluster of LEDs for flexible illumination. *Id.* at 50:50–58. With LEDs having a variety of aims, the headlamp’s light distribution pattern may be controlled based on a number of factors, including detected oncoming vehicles. *See id.* at 51:43–47, 52:59–65.

¹ Patent Owner further lists IPRs involving patents related to the '551 patent. Paper 4, 1–3.

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D. CHALLENGED CLAIMS

Petitioner challenges claims 48–87. *See* Pet. 5. Independent claim 48 is reproduced below, with additional formatting to distinguish limitations:

48. An illuminating device having automatic control of light provided to an illuminated area comprising:
- a structure for incorporating illuminating device elements, wherein the structure comprises a motor vehicle;
 - a plurality of individually controllable LEDs incorporated in the structure via at least one headlamp mounted to the structure, each headlamp including at least one of the LEDs, the LEDs in communication with a power source;
 - electronic circuitry apparatus for the controlled powering of the LEDs and other of the illuminating device elements;
 - one or more processors;
 - one or more sensors, including one or more cameras, placed on the structure for detecting coordinate-specific information about the illuminated area, at least one of said cameras in communication with power, and in communication with at least one of the one or more processors;
 - a controller including at least one of the one or more processors, integrated with the structure via mounting, in communication with the LED controlling power electronic circuitry apparatus, said controller arranged to process the information communicated from the cameras and to automatically control the light provided to the illuminated area; and
 - memory storing instructions that, when executed by one or more processors of the controller, enable the controller to:
 - illuminate a portion of at least one object, indicated by data from at least one of the one or more sensors, by selecting a first cluster of the LEDs to emit first light directed towards a first area including the at least the portion of at least one object, the first area determined based at least in part on the data, the first cluster selected based at least in part on known aimings of light associated with the first cluster

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determined to correspond to the first area, and the first light determined based at least in part on classifying the object based at least in part on the data; and

control light emitted from the first cluster directed towards the first area to be different in at least one emission characteristic, based on the first light determination, from second light emitted from a second, different cluster of the LEDs, directed towards one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area.

Ex. 2014, 1186–87 (6:24–7:5), 1216–17 (Certificate of Correction).² Claims 56, 64, 72, and 80 are independent and recite limitations similar to those of claim 48, while the remaining challenged claims depend from one of the challenged independent claims, directly or indirectly. *Id.* at 1187–90 (7:6–14:52); *see* Pet. Appx. A, Appx. B.

² Through *ex parte* reexamination, original claim 6 was canceled and new claims 24–87 issued in a Reexamination Certificate. Ex. 2014, 1184–90. A number of typographical errors were corrected through a Certificate of Correction. *Id.* at 1214–19.

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E. PRIOR ART AND ASSERTED GROUNDS

This proceeding includes the following unpatentability grounds:

Claim(s) Challenged	35 U.S.C. § ³	Reference(s)/Basis
48, 50, 53–59, 61–67, 69–75, 77–83, 85–87	102	Alden ⁴
48, 50, 53–59, 61–67, 69–75, 77–83, 85–87	103	Alden
49, 51 ⁵	103	Alden, Beam ⁶
49, 51	103	Alden, Stam ⁷ , Beam
52, 60, 68, 76, 84	103	Alden, Kobayashi ⁸

Pet. 5. Petitioner also relies on the Declaration of Dr. Nikolaos Papanikolopoulos. Ex. 1003.

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner asserts that an ordinarily skilled artisan “would have had an undergraduate degree in mechanical engineering, electrical engineering, automotive engineering, optical engineering, applied physics, computer science, or

³ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), effective March 16, 2013, amended the applicable statutes. Because the application from which the ’551 patent issued was filed before this date, the pre-AIA versions of §§ 102 and 103 apply.

⁴ US 2003/0137849 A1, filed Jan. 22, 2002 (Ex. 1005).

⁵ We include claim 51 in the Alden–Beam and Alden–Stam–Beam grounds rather than the Alden grounds for the reasons discussed below. *See infra* at 39 (§ II.F.2)

⁶ US 6,144,158, issued Nov. 7, 2000 (Ex. 1007).

⁷ WO 2001/70538 A2, published Sept. 27, 2001 (Ex. 1008).

⁸ US 6,049,749, issued April 11, 2000 (Ex. 1006).

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similar disciplines, along with two years of experience working with intelligent vehicle systems, automotive control systems, or lighting control systems.” Pet. 9 (citing Ex. 1003 ¶ 33). Patent Owner does not dispute that level of ordinary skill in the art. PO Resp. 6. We adopt the undisputed level of ordinary skill in the art and refer to people with it as skilled artisans.

B. CLAIM CONSTRUCTION

Other than as discussed below,⁹ we do not further construe the claims for this decision. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. “classifying the object”

Claim 48 requires a controller that can: “illuminate a portion of at least one object . . . by selecting a first cluster of the LEDs to emit first light directed towards a first area . . . the first light determined based at least in part on classifying the object.” Ex. 2014, 1186–87 (6:24–7:5).

Patent Owner contends that we should construe “classifying the object” according to its ordinary meaning such that “‘classify’ is to arrange or group in classes according to some system or principle.” PO Resp. 30 (citing Ex. 2065, 334 (dictionary definition)). Petitioner submits that “[t]here is no basis to limit the claims” based on a portion of a dictionary definition but does not further elaborate on how we should apply “classifying” as claimed. Pet. Reply 10 n.6. Patent Owner uses its proposed construction to argue that Alden does not disclose “classifying”

⁹ In addition to the two terms discussed in this section, we address the construction of “areas laterally adjacent to the target” below. *See infra* at 28 (§ II.D.4.a).

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objects because it “simply detects incoming light having an intensity above a threshold” and “merely assumes that such detected light correlates with the presence of an oncoming vehicle; with no ability to identify and then classify a vehicle from multiple types of objects.” PO Resp. 30–31. Similarly, Patent Owner asserts that, “as properly construed,” claim 48 requires “assigning an object a classification among multiple classes or types of objects.” *Id.* at 32 (emphasis omitted). That restriction, however, is not supported by Patent Owner’s dictionary definition or specification cites.

Patent Owner contends that the specification supports the proposed construction because it “describes identifying and classifying between different types of objects, such as a person, sign, or vehicle.” PO Resp. 30. The specification discloses that “techniques known in the art” may be used “to classify, identify or locate the contents” visible to a camera sensor. Ex. 1001, 44:67–45:9. That does not speak to any requirements for classification.

The specification states that the system can “illuminate distant overhead and roadside signs” and can use “[i]mage recognition via a camera” so that the illumination beam may “follow the retroreflective sign as the vehicle moves.” *Id.* at 51:59–67. That disclosure similarly does not indicate that the system must choose from multiple classes or types of objects. Similarly, the specification states that “determining what is a sign” makes it “possible to . . . illuminate distant overhead and roadside signs for a longer time, yet not blind oncoming traffic due to the narrow beam.” *Id.* at 52:66–53:4. In that example, the specification states that not blinding oncoming traffic is “due to the narrow beam” rather than from simultaneously accommodating oncoming traffic with active dimming. In other words, the specification describes applications where the system would not have to choose from multiple classes or types of objects. *See also id.* at 52:19–27

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(disclosing automated control over lighting and referencing “automatic dimming of high beam due to detection of oncoming vehicles”).

In some instances, the specification discloses identifying “objects and people” or “devices or objects,” indicating some ability to distinguish between different classes. *See id.* at 63:9–12 (“Using real time image processing methodologies with image and scene recognition technology known in the art, room or outdoor area elements, objects and people are identified.”), 64:46–49 (“Using machine vision technology known in the art such as neural networks training and other pattern recognition techniques the vision system has sensor, algorithmic and computation means for identifying devices or objects.”), 76:33–39 (“[A] camera vision system has algorithmic means to identify and track the position of people and objects and the logical controller has motion control means for re-aiming the light sources towards targeted elements and changing the power level to the LED chips.”). One passage describes an embodiment in which the system can identify a variety of possible foods. *Id.* at 75:48–62 (“Using programmed scene recognition algorithms, the luminaire’s computer vision system comprised of the camera sensor 496 and logical controller 494 identifies the food on the plate, looks-up in storage the recommended CCT and powers each of the different colored LED chips aimed thereon at the correct power level in order to provide the optimal color illumination.”). And another describes identifying a person’s “visual task.” *Id.* at 69:54–57 (“In a preferred embodiment of the invention the logical controller 454 receiving image input from the camera 453 and running pattern recognition software will identify what is the visual task a person is trying to perform.”).

None of those disclosures, however, purports to restrict the ’551 patent’s invention as a whole—they are examples. And none of those disclosures is

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sufficiently clear to impart a requirement on “classifying” such that a system must choose from multiple classes or types of objects.

The parties do not appear to dispute that “classifying the object” includes arranging or grouping the object according to some system or principle. Thus, there is no need to further construe the claims for purposes of this decision.

2. “sensor data”

Claims 53, 61, 69, 77, and 85 each indirectly depend from a claim reciting that the controller can “identify an upcoming road curvature along a road on which the motor vehicle is traveling” and further recite:

the identification of the upcoming road curvature is based at least in part on sensor data provided by one or more of the sensors of the vehicle and wherein the adaptation of the light pattern is based at least in part on the sensor data.

E.g., Ex. 2014, 1187 (8:3–7). Although Petitioner asserts no claim term requires construction (Pet. 8), Patent Owner contends that “based at least in part on sensor data” requires identifying road curvature using light sensors, not using steering-wheel position (PO Resp. 60–62). We do not view this as a claim-construction dispute because Petitioner relies on Alden’s light sensor identifying road curvature by detecting roadside reflectors (*see* Pet. 67; Pet. Reply 24–25). Thus, Petitioner’s contentions already assert the “sensor data” in claims 53, 61, 69, 77, and 85 as construed by Patent Owner—data from a “camera” as recited in the independent claims. *See infra* at 36 (§ II.D.9).

C. ALDEN’S DISCLOSURES

Alden is a published U.S. Patent Application describing and claiming a segmented-distribution headlight system. Ex. 1005, code (54). Alden’s Figure 2 is reproduced below:

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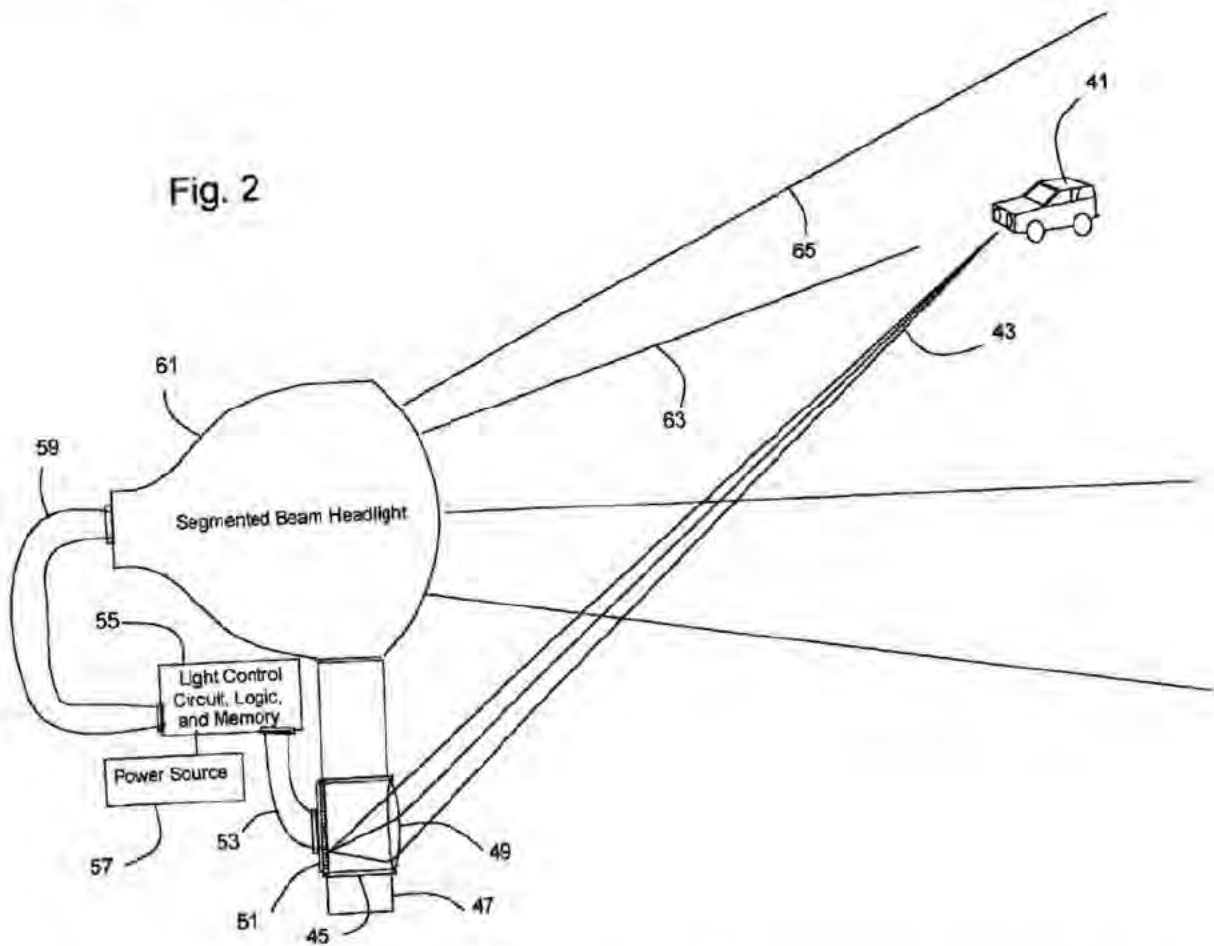


Figure 2 depicts the elements of Alden's "segmented distribution illumination process," in which vehicle 41 emits light towards a vehicle with Alden's invention, and that light illuminates detector array 51 that is part of sensor unit 45; signals representing the received light are sent to light control circuit 55, which controls segmented beam headlight 61 to provide either low or high illumination in its various segments such that light directed toward the vehicle 41 is a low beam and light directed elsewhere is a high beam. *Id.* ¶ 26, Fig. 2.

Alden's system detects spots of light, performs triangulation to calculate the distance to each, then uses the spots' intensity, size, and location information to represent "objects." *Id.* ¶ 27 ("Triangulation is thus used by the CPU to determine

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the distance” when detecting “spots of nearly identical intensity and size representative of the [oncoming vehicle’s] headlights.”), 28 (“The CPU compares the right map to the left map to determine the distance and intensity of each object sensed . . .”).

Once objects have been identified, Alden’s system uses them to determine which headlight zones to dim. *Id.* ¶ 28 (“The location of objects is used to calculate which zones of each headlight need to be dimmed . . .”; “assuming the sensed light is above a threshold intensity or distance”). In that decision, the CPU identifies a corresponding pair of headlights as a vehicle, and accommodates the vehicle by defining a dimming area larger than just the headlights. *Id.* ¶ 27 (“The [dimmed] area is significantly larger than the headlight dots that were initially received by [the light-detector arrays] because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.”). Finally, “[s]ignals are sent to each of the headlight control circuit zones that need to be dimmed,” whereas other zones “remain on high beam.” *Id.* ¶ 28.

With signals from the CPU, Alden’s “segmented beam headlight” projects light in the desired pattern. *E.g., id.* ¶¶ 26, 29. Alden discloses a number of embodiments for the headlight, including one with an array of LEDs (*id.* ¶ 29, Fig. 5) and others with electro-chromatic, liquid-crystal, or variable-refraction elements (*id.* ¶¶ 30–35, Figs. 6–10). Because the challenged claims recite LED-based devices, Alden’s LED embodiment is central to this dispute and is discussed in more detail below.

Alden concludes by broadly claiming:

1. A vehicular headlight system producing a light distribution area, comprising
 - a means for sensing the location of other vehicles,

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a means for diminishing the amount of light directed to said other vehicles, wherein

light directed to areas within the light distribution area not containing said other vehicles is not diminished.

Id., claim 1.

Patent Owner challenges certain aspects of Alden’s disclosures and Petitioner’s assertions regarding those disclosures. We first address the broad challenges that affect all grounds. *See* PO Resp. 24–29.

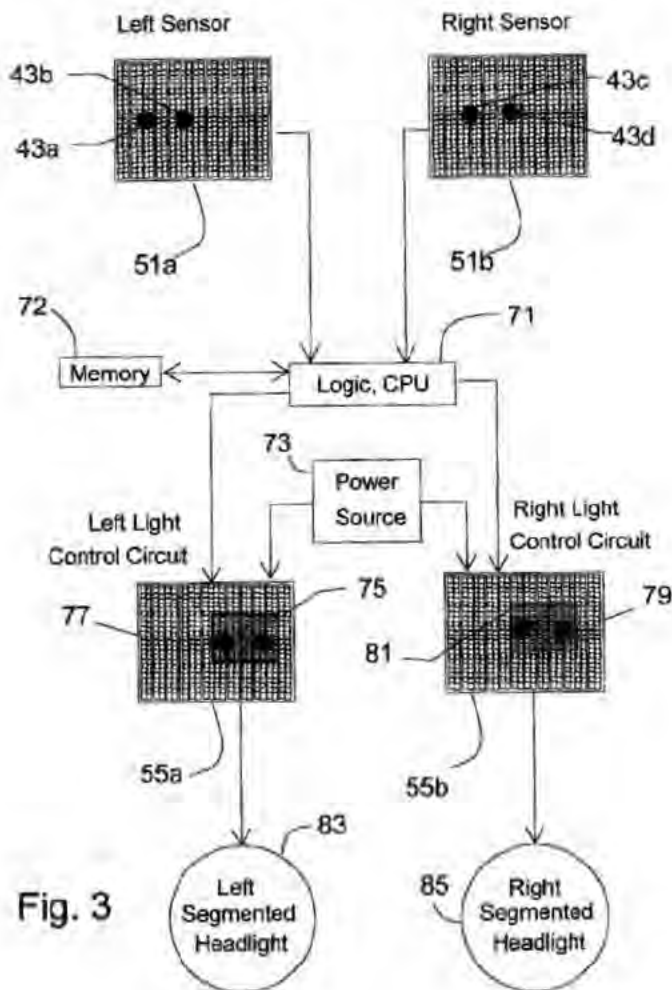
1. Alden’s enablement

In the Institution Decision, we preliminarily determined that Alden’s Figure 5 depicts one section through a two-dimensional array of lighting elements. Inst. 17; *see* PO Resp. 24–25. Patent Owner contends that was erroneous, arguing that Alden does not describe Figure 5 as showing a two-dimensional array, and that it would be improper to draw parallels between Figure 5 and Alden’s other figures. PO Resp. 25–26. Petitioner responds that Patent Owner fails to meet the legal standard for proving lack of enablement, and that Alden’s disclosures sufficiently enable its practice. Pet. Reply 2–8.

First, we do not agree with Patent Owner that Alden’s Figure 5 depicts a device with only a single row of lighting elements. Although Figure 5 shows one embodiment of Alden’s “segmented headlight means and controlling switch array” (Ex. 1005 ¶ 29), the segmented headlight is merely one aspect of Alden’s invention. The segmented headlight receives signals from a “light control circuit”—logic executing on a CPU that controls the switch array. *Id.* ¶¶ 26, 27, Figs. 2, 3. Thus, it is important to view Figure 5 and the corresponding description with an eye to the broader context in which it operates.

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Alden discusses “elements of a segmented distribution illumination process” in connection with Figure 2. Ex. 1005 ¶ 26. The described process uses “a segmented beam headlight 61” to differentially illuminate sectors of the light distribution based on light sensed by a detector array and logic in a light-control circuit. *Id.* ¶ 26, Fig. 2. Alden’s description is generic to the specific headlight embodiment, and states that “[s]ome methods employed within [segmented beam headlight] 61 to segment light into independently controlled sectors are discussed later.” *Id.* Similarly, Figure 3 and its associated discussion provides “a more detailed illustration of the information flow, processes and architecture of the elements described in FIG. 2.” *Id.* ¶ 27, Fig. 3. Figure 3 is reproduced below:



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Figure 3 depicts “the information flow, processes and architecture of the elements described in FIG. 2” including sensors 51a/b with illuminated spots 43a/b/c/d, logic and CPU 71, light control circuits 55a/b, and segmented headlights 83/85. *Id.* ¶ 27, Fig. 3.

Figure 3 depicts segmented headlights 83 and 85 generically, and the description refers to them without limiting the particular form of those headlights. *Id.* Thus, when Alden describes that Figure 5 “illustrates the segmented headlight means and controlling switch array in a first embodiment,” that does not describe an aspect disconnected from the components and operation depicted in Figures 2 or 3, but rather provides details regarding one embodiment of the segmented headlights included in Figures 2 and 3. *See id.* ¶ 29.

Importantly, Figure 3 unambiguously depicts two-dimensional sensor arrays 51a/b and two-dimensional control circuits 55a/b. *Id.*, Fig. 3. That figure and the corresponding text indicate that Alden’s process for dimming illumination sectors involves aspects in the vertical direction—the shaded boxes 75/77 representing dimmed illumination extend beyond the sensed lights 43a/b/c/d more in the vertical direction than in the horizontal direction, and “[t]he 75 area is significantly larger than the headlight dots that were initially received by 51a and 51b because, the CPU has made assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.” *Id.* ¶ 27, Fig. 3.

Moreover, Alden’s description of Figure 3’s logic—though Figure 4’s flow chart and corresponding text—leaves no doubt that Alden’s process uses two-dimensional analysis. As Alden describes, the CPU checks each sector of the light sensor, for the left sensor beginning with sector A1L, proceeding to A2L and continuing through XYL. *Id.* ¶ 28, Fig. 4. The same process occurs for the right sensor, checking sectors A1R through XYR. *Id.*

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Finally, Alden describes additional applications for its invention, beyond those used to dim light sectors for oncoming vehicles. Those applications include where the invention is “used to concentrate light to look up a hill in response to road conditions” and “look down a hill in response to road conditions.” *Id.* ¶¶ 55, 56, Figs. 12, 13. From that description and the corresponding figures, it is apparent that those applications use Alden’s ability to control sectors along the vertical axis within the segmented headlight that effects illumination.

While Alden’s Figure 5 shows a sectional view of a segmented-headlight embodiment, thus depicting a single line of LEDs, that does not restrict the embodiment to a one-dimensional array. Indeed, Alden’s disclosures discussed above contradict such a view, as do the disclosures regarding Figure 5 and other segmented-headlight embodiments. We credit Petitioner’s expert’s testimony in this regard. Ex. 2041, 59:10–12 (“[I]t’s very clear we’re talking about a two-dimensional structure that is map of this set of slices in figure 5.”); *accord id.* at 56:25–60:18. The Figure 5 embodiment includes a switch array to control the individual lighting elements, with “[e]ach lighting element being independently controlled by a corresponding switch in an array of switches 115.” Ex. 1005 ¶ 29. The Figure 6 embodiment includes a face-on view of the segmented headlight plainly showing a two-dimensional array, in addition to a sectional view similar to Figure 5’s. *Id.* at Fig. 6. And Alden describes that the Figure 6 embodiment uses “switch array similar to 115 and the process previously described herein.” *Id.* ¶ 30.

Patent Owner contends also that we should not rely on the Figure 6 embodiment to understand the Figure 5 embodiment. PO Resp. 25–26. According to Patent Owner, because the two embodiments are “distinct” and “incompatible” with each other, we should not evaluate parallels in their descriptions. *Id.*; *accord* PO Surreply 4. We do not agree, because the Figure 6 description expressly refers

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to the same reference numeral as the Figure 5 description, making a plain connection. In other regards, Patent Owner's argument is premised on limiting Figure 5's embodiment to a single row of lighting elements; we do not agree with that restriction.

Considering Alden's description of its sensing-and-control circuit in connection with Figure 3, which illustrates a two-dimensional array, and its description of Figure 5's segmented headlight as working with that approach, we find that Alden's LED-based segmented headlight is capable of selective illumination in two dimensions. Ex. 1005 ¶¶ 27, 29, Figs. 3, 5.

Patent Owner relies heavily on Alden's statement that "[t]he [light element] 119 and other 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.* ¶ 29; PO Resp. 25 ("Alden merely describes a row of LEDs positioned along the focal point of a lens."). It is uncontroversial that the lens has a single focal point, though there are many curves passing through that focal point, and thus many curves on which lighting elements may be arranged. While Figure 5 shows elements along one such curve, that does not preclude the existence of other elements that fall on other curves. Thus, we do not agree that Alden's statement regarding the focal point restricts Figure 5 to depicting an embodiment with one row of lights.

Patent Owner also faults Petitioner's expert for characterizing the figures as conceptual. PO Surreply 14, 17–18. But there is nothing problematic with conceptual figures, particularly where the corresponding description makes clear how the invention operates. For example, Patent Owner complains that Petitioner's expert "could not explain how the switch array shown in Figure 3 controls the LED array shown in Figure 5 to create the beam spread illustrated therein." PO Resp. 27

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(emphasis omitted). We would not expect Dr. Papanikolopoulos to explain that—the beam spread of any optical system will depend on the lens used and the relative position of the light sources to the lens, so it is unclear why Patent Owner expects the particular switch array to determine beam spread. When asked about beam spread (Ex. 2041, 107:11–12), Dr. Papanikolopoulos stated that it would depend on the specifics of an overall system and could not be determined by Alden’s figures (*id.* at 108, 4–10). Patent Owner finds fault in the mismatch between Figure 3’s “200+ switches” and Figure 5’s nine LEDs. PO Surreply 2. But that mismatch represents the conceptual nature of the figures, rather than signaling a fundamental disconnect between the two figures such that Alden’s disclosures do not enable its invention. The same problem tarnishes Patent Owner’s complaint that “Alden lacks details regarding how the hypothetical structure would be put together—notably whether the two-dimensional LED structure would form a semi-cylinder, a semi-sphere or a flat plane (among other choices), which informs the control strategy and resultant beam spread.” PO Surreply 4–5. Those details are not required by Alden’s description because they do not fundamentally change Alden’s invention.

Because Alden describes its segmented headlights as implementing a process using two-dimensional signals for two-dimensional dimming functionality, we find that Figure 5 depicts a section of an embodiment that contains more than a single row of lighting elements. Stated otherwise, Alden’s disclosures are consistent with each other and are directed to a two-dimensional approach to sensing, control, and illumination.

Further, we agree with Petitioner that Patent Owner has not addressed the legal standard for lack of enablement. Pet. Reply 2–3. In particular, to overcome the presumption that prior-art disclosures are enabled, Patent Owner must show

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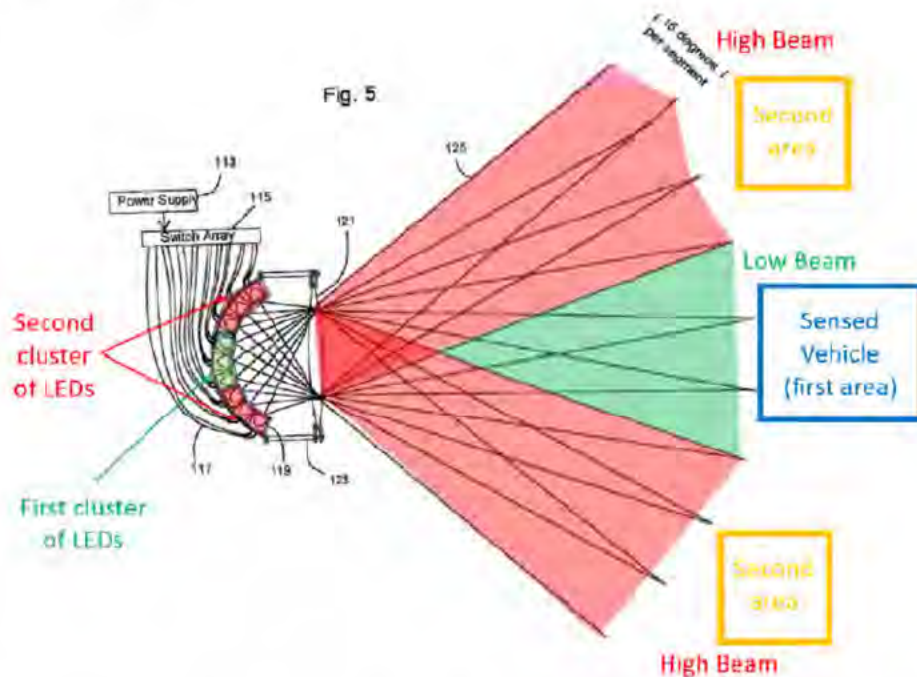
ordinarily skilled artisans would require undue experimentation to practice the disclosed invention. *See Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1354–55 (Fed. Cir. 2003); *In re Antor Media Corp.*, 689 F.3d 1282, 1287–88 (Fed. Cir. 2012). We do not agree with Patent Owner that Alden lacks a presumption of enablement (*see* PO Surreply 2), because we determine that Petitioner’s contentions rely on Alden’s disclosures regarding its invention as a whole. Other than arguing that Figure 5 discloses a single-row embodiment that is unusable with Alden’s other disclosures, Patent Owner has made no attempt to show Alden lacks enablement. Patent Owner has not addressed what experimentation skilled artisans would require to practice an invention using Alden’s Figure 5 segmented headlight with the remainder of Alden’s system as disclosed in Figures 2, 3, and 4, and Alden’s corresponding textual description.

We therefore determine that Patent Owner has not shown Alden to lack enablement for its disclosed invention.

2. Petitioner’s annotations

Patent Owner argues that Petitioner mischaracterizes Alden’s disclosure by applying out-of-scale annotations to Figure 5. PO Resp. 37–40. Petitioner’s annotated version of Alden’s Figure 5 is reproduced below:

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Pet. 29 (quoting and annotating Ex. 1005, Fig. 5). Petitioner’s annotations designate and highlight red a central cluster of lighting elements within Figure 5’s array as a “First cluster of LEDs” and designate and highlight green the remainder of the array (to both sides of the first cluster) as a “Second cluster of LEDs.” *Id.* The annotations further highlight the light beams emitted from the segmented headlight by the two clusters as green and red, respectively, and show a “Sensed Vehicle (first area)” within the “Low Beam,” green portion emitted by the first cluster and a “Second area” as the “High Beam,” red portion emitted by the second cluster. *Id.*

Patent Owner complains that “at the distance shown from the headlight, the annotated oncoming vehicle is too small relative to the size of the headlight” and that “the annotated vehicle has a width less than that of the headlight structure.” PO Resp. 38. The argument makes no sense. As Petitioner points out, the annotations are “demonstrative of what is described in Alden, and are not the creation of a scaled technical drawing.” Pet. Reply 13. There would be no use in a

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drawing that accurately represented the scale of both Alden's segmented headlight and an oncoming vehicle, because the headlight would be too small to resolve any detail. That reality is reflected in Alden's Figure 2, reproduced above, which uses different scales to depict the segmented distribution system versus an oncoming vehicle. *See* Ex. 1005, Fig. 2. Thus, we do not fault Petitioner's annotations for representing an oncoming vehicle as falling within a small portion of the projected beam. Indeed, as we noted in the Institution Decision, Alden indicates Figure 5 depicts an embodiment in which each lighting element provides 15 degrees of the overall illumination. *Id.* ¶ 39, Fig. 5. Using that example, each element's illumination would spread about 39 feet at a distance of 150 feet.¹⁰ The challenged claims do not restrict the distance at which an "other vehicle" is accommodated. Alden's Figure 5 example depicts a system that would provide segments to isolate the vehicle at some reasonable distance from Alden's system. Relatedly, Patent Owner argues that if Alden's Figure 5 embodiment shows the concept of an LED-based segmented headlight, then it lacks the details required to anticipate. PO Resp. 40. We do not agree, as the detail that Petitioner seeks is both unrestricted by the challenged claims and notably absent from the '551 patent's disclosures.

According to Patent Owner, [i]f Petitioner's annotations do not precisely represent Alden's disclosure, then they necessarily depict operations/scenarios not expressly described in Alden." *Id.* at 40 (emphasis omitted). But generally disclosing an invention, as does Alden, allows for general annotations, as are Petitioner's. The point is not to substitute for Alden's disclosures but to graphically summarize those disclosures. We do not rely on Petitioner's annotations to reach

¹⁰ $150 \cdot \sin(15^\circ) = 38.8$

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our conclusions that Alden discloses the '551 patent's claimed invention, for any challenged claim.

We conclude that Petitioner's annotations accurately represent Alden's disclosures, without purporting to depict the scale of oncoming vehicles relative to Alden's segmented headlight.

D. ANTICIPATION BY ALDEN

Petitioner asserts that claims 48, 50, 53–59, 61–67, 69–75, 77–83, and 85–87 are anticipated by Alden. Pet. 11–71. Patent Owner disputes only certain aspects of Petitioner's contentions, discussed below.

1. Claim 48

a. *"classifying the object"*

As noted above, claim 48 requires a controller that can: "illuminate a portion of at least one object . . . by selecting a first cluster of the LEDs to emit first light directed towards a first area . . . the first light determined based at least in part on classifying the object." Ex. 2014, 1186–87 (6:24–7:5). And as discussed above, we do not agree with Patent Owner that "classifying the object" requires selecting from among multiple types of objects. *See supra* at 7 (§ II.B.1).

Petitioner asserts that claim 48 "does not require a particular method to classify objects or level of accuracy." Pet. Reply 10. Petitioner contends that Alden's system classifies light-emitting objects as vehicles when the light intensity received from them is above a certain threshold and the system identifies headlights. Pet. 33 (asserting classifying "based on sensed light above a threshold, and if it is determined to be an oncoming vehicle (such as based on light emitted from its headlights)"); Pet. Reply 9–10 n.5. Petitioner points out that one of Alden's key purposes is to "sense the locations of other vehicles" and control

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headlights to prevent glare to those vehicles. Pet. Reply 9 (quoting Ex. 1005 ¶ 6) (emphasis omitted). Petitioner emphasizes that Alden’s analysis uses intensity and distance information to indicate whether detected light is from an oncoming vehicle, and dims the area above detected headlights because it may be “occupied by the driver.” *Id.* at 9–10; *id.* at 10 n. 5.

Patent Owner argues that “Alden’s system simply detects incoming light having an intensity above a threshold” and therefore does not classify detected objects. PO Resp. 30–33. Patent Owner argues also that Alden does not disclose “any mechanism for classifying the object.” *Id.* at 31.

We agree with Petitioner. Alden’s system does not simply dim its headlights where it detects spots of light. Rather, it performs a multistep process in which those spots are detected, analyzed with triangulation to determine distance, and then used to determine dimming zones. Ex. 1005 ¶¶ 27–28. Alden discloses that its sensor “detects the two headlights” of an oncoming vehicle when “[e]lectrons corresponding to the position and intensity of light are categorized by a logic and CPU 71 and stored in a memory 72.” *Id.* ¶ 27. Petitioner’s expert noted that Alden’s description “move[s] from lights – thresholding lights to objects, and then calculate[s] distance of each thresholding object using triangulation.” Ex. 2041, 109:23–110:2. That testimony supports our view that Alden first detects lights, uses those detected lights to identify and classify an oncoming car, then dims the headlight output to prevent glare.

Alden’s dimming decision particularly indicates that it classifies pairs of detected headlights as oncoming vehicles. The CPU makes “assumptions about the space that may potentially be occupied by the driver of the sensed vehicle” and identifies an area of the segmented headlight to dim that is “significantly larger than the headlight dots that were initially received.” Ex. 1005 ¶ 27. Patent Owner

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agrees that Alden dims “selected surrounding sectors” around detected light (PO Resp. 30), and the way Alden selects those sectors indicates that it identifies vehicles. It does not simply expand an area around each detected light; it dims an area to encompass the driver of the identified vehicle. Ex. 1005 ¶ 27, Fig. 3. By treating a pair of corresponding detected lights collectively for dimming, Alden indicates that it classifies pairs of detected lights as vehicles.

Patent Owner submits that Alden’s system “never receives, stores or processes image data to differentiate between detected light sources.” PO Surreply 8 (emphasis omitted). That assertion contradicts Alden’s disclosures, which state that incoming light detected by the sensor is “categorized by a logic and CPU 71 and stored in memory 72.” Ex. 1005 ¶ 27. Alden’s system performs triangulation to determine the distance of each detected object, and uses that determined distance in its dimming calculations. *Id.* And, as discussed, the dimming calculation considers a pair of detected objects collectively in order to make “assumptions about the space that may potentially be occupied by the driver of the sensed vehicle.” *Id.* ¶ 27, Fig. 3.

Part of Patent Owner’s argument relates to differentiating “classifying,” as used in claim 48, from “identifying” as used in claim 8 (challenged in IPR2024-01039). PO Surreply 9; *see* Tr. 78:19–80:2. While we agree that “identifying” and “classifying” may have different ultimate scope, that does not foreclose each term from reading on Alden’s disclosures. As discussed here and the related Final Written Decision in IPR2024-01039, we find that Alden discloses both identifying and classifying oncoming vehicles based on the same process where Alden’s system detects incoming light, calculates the location for each spot of detected light above a threshold brightness, and then dims its segmented

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headlight in areas that correspond to pairs of detected light that Alden assumes to be oncoming vehicles.

b. “one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area”

Claim 48 recites a controller capable of selecting two clusters to emit light: one towards a first area including an object, and one towards “one or more illuminated second areas at a common elevation with the first area and laterally adjacent to the area.” Ex. 2014, 1186–87 (6:54–7:5). Claims 56 and 72 recite similar limitations. *Id.* at 1187 (8:54–56), 1189 (11:65–12:2, 12:11–12).

Petitioner notes that Alden’s Figure 5 embodiment depicts light divided into 15-degree sectors that are “on the same plane (‘common elevation’) and next to one another (‘laterally adjacent’).” Pet. 35. Petitioner relies on Alden’s description that sectors where a vehicle is detected will be dimmed while other sectors will be switched to high beam. *Id.* at 35–36 (citing Ex. 1005 ¶¶ 25–29, Figs. 1, 2, 5), 54–55.

Patent Owner argues that because Petitioner relies on Alden’s Figure 5, its contentions fail because Alden’s Figure 5 is not enabled and because Alden provides insufficient detail regarding how the embodiment would work. PO Resp. 33–36. As discussed above, we do not agree. *See supra* at 13 (§ II.C.1). Patent Owner argues also that Petitioner’s annotations apply a “completely inaccurate scale” and therefore misrepresent Alden’s disclosures. PO Resp. 37–40. As discussed above, we also do not agree with that position. *See supra* at 19 (§ II.C.2).

Based on Petitioner’s contentions relying on Alden as understood by skilled artisans, we find that Alden discloses emitting light towards an area with an

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oncoming vehicle, and emitting light at a higher intensity towards areas at a common elevation with and laterally adjacent the first area.

2. Claim 56

Claim 56 recites a limitation very similar to claim 48's discussed above requiring differential illumination to two areas at common elevations. *See* Ex. 2014, 1187 (8:52–57) (“reduce intensity of illumination to non-glaring illumination of a first area associated with the at least one other vehicle, relative to intensity of illumination on both sides of the first area at elevations common with the first area illuminated by a second cluster of the LEDs, by control of emission from the first cluster”).

Patent Owner challenges Petitioner's contentions regarding the above-noted limitation for the same reasons discussed above regarding claim 48 (PO Resp. 41–42), and we reach the same conclusions discussed above.

3. Claim 64

Claim 64 requires that the system select a first cluster of LEDs having light directed towards the other vehicle and control that cluster to diminish glare to the other vehicle's driver; in that way it's limitations are similar to claim 48's. Ex. 2014, 1188 (9:50–10:34). Claim 64 additionally requires selecting “a second, different cluster of the LEDs . . . directed towards the other vehicle . . . [at] a second, subsequent position” and controlling light to diminish glare at that second position. *Id.* For the limitations similar to claim 48's, Patent Owner challenges Petitioner's claim 64 contentions for the same reasons discussed above regarding claim 48 (PO Resp. 42–43), and we reach the same conclusions discussed above.

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a. “a second, subsequent position associated with the other vehicle”

For claim 64’s limitation that requires accommodating the other vehicle at “a second, subsequent position associated with the other vehicle,” Petitioner asserts that Alden discloses this process because Alden discloses continuous operation where it iteratively calculates an oncoming vehicle’s position and uses that to dim headlight sectors directed towards the vehicle. Pet. 47–50.

We agree. When describing its process logic, Alden discloses that “[t]he process then begins again so as to be responsive to changing environmental conditions in real time.” Ex. 1005 ¶ 28. That disclosure could not be more clear, and comports with Figure 4’s flow chart, which shows a corresponding loop from the dimming step 109 to the first light-detection step 89. *Id.* Fig. 4. Claim 64’s “second, subsequent position” limitations read on Alden’s iterative process because they recite nothing more than repeating a process.

Patent Owner quibbles with Petitioner’s annotations used to explain how Alden would track a moving vehicle. PO Resp. 43–46. Although Patent Owner submits that its arguments here do not depend on the scale or enablement arguments discussed above (*see id.* at 45), they rely on similarly misreading Petitioner’s annotations. Those annotations do not provide the anticipation evidence here—Alden’s disclosures discussed above do so. Based on those disclosures, we find that Alden discloses the “second, subsequent position” limitations.

4. Claim 72

a. “areas laterally adjacent to the target”

Claim 72 recites a controller that can “vary illumination provided to the target by the selected cluster, relative to illumination provided to areas laterally

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adjacent to the target.” Ex. 2014, 1189 (11:65–12:2, 12:11–12). Petitioner notes that Alden’s Figure 5 depicts light divided into 15-degree sectors that are “on the same plane (‘common elevation’) and next to one another (‘laterally adjacent’).” Pet. 35–36. Petitioner relies on Alden’s description that sectors where a vehicle is detected will be dimmed while other sectors will be switched to high beam. *Id.* (citing Ex. 1005 ¶¶ 25–29, Figs. 1, 2, 5), 54–55.

Patent Owner argues that the claim language does not read on Alden’s system because, in Alden, “the areas laterally adjacent the target are also illuminated in low beams.” PO Resp. 47 (citing Pet. 54). Patent Owner’s argument appears to be premised on a claim construction that would require the claimed system to provide dimmed illumination to the target but not allow that dimmed illumination to extend beyond the target’s boundaries to any degree. Patent Owner has not supported such a construction.

Patent Owner contends further that “the nine-beam, disparately aimed array of [Alden’s] Figure [5] has never been shown to be able to create and maintain the claimed variance of illumination, which is relative to the target, and not the sector.” PO Resp. 48 (emphasis omitted). But the ’551 patent never gives any indication that such a system could be required. When describing “a preferred embodiment of a digital automotive headlamp,” the ’551 patent depicts a headlight with eleven LEDs across its width. Ex. 1001, 52:1–2, Fig. 15. That embodiment could not provide the spatial resolution that Patent Owner asserts for claim 72. Additionally, the ’551 patent’s written description notes the narrowest-dispersion LEDs had “two half angle 8 degrees” (Ex. 1001, 52:55–59), which is only about half the spread of the lights in Alden’s Figure 5 (Ex. 1005, Fig. 5 (“15 degrees per segment”)). The ’551 patent’s specification does not describe a device capable of

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varying illumination to an area precisely defined by a target object, as Patent Owner reads claim 72's "laterally adjacent" limitation.

Thus, we see no basis for adopting Patent Owner's construction. We do not agree that claim 72 requires varying illumination to an area precisely defined by the target vehicle. Rather, Petitioner accurately states that "[a]ll the claim requires is that illumination towards the target is varied relative to areas laterally adjacent to the target." Pet. Reply 18. Based on that understanding of the claim language, we find that Alden discloses the claimed system.

b. "maintain a variance of illumination . . . when subsequent data . . . indicates a change in position of the target"

Claim 72 recites a controller that can

maintain a variance of illumination provided to the target relative to the laterally adjacent areas, when subsequent data from one or more of the cameras indicates a change in position of the target relative to the motor vehicle, by repeating the determination of target location, selection of the cluster and variance to illumination provided to the target, relative to the laterally adjacent areas, based on the subsequent data.

Ex. 2014, 1189 (12:4–11). That parallels the language in claim 64 discussed above regarding "a second, subsequent position associated with the other vehicle." See *supra* at 27 (§ II.D.3.a).

Patent Owner argues that Alden does not disclose this aspect of claim 72 because, even if there were a position where Alden dimmed an area precisely defined by the target vehicle, it would not be able to maintain that illumination pattern when the target changed position. PO Resp. 47–48. Because we do not limit the claimed illumination pattern as Patent Owner asserts (*see supra* at 27 (§ II.D.4.a)), we do not agree with this argument. Rather, Alden satisfies the claim

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language for the same reasons discussed above regarding claim 64. *See supra* at 27 (§ II.D.3.a).

5. Claim 80

a. “a plurality of positions”

Claim 80 recites a controller that can identify “a plurality of positions associated with the target as the target move[s] relative to the motor vehicle” and change light from LEDs aimed toward the target relative to LEDs aimed laterally adjacent the target, as the target moves. Ex. 2014, 1190 (13:30–40). As with limitations discussed above, Patent Owner challenges Petitioner’s contentions, arguing that “Petitioner does not demonstrate the subsequent change at a second time, as claimed.” PO Resp. 49. Alden satisfies the claim language for the same reasons discussed above regarding claim 64. *See supra* at 27 (§ II.D.3.a).

b. *Relativistic control*

Petitioner challenges claim 80 largely by referring to Petitioner’s contentions for other claims. Pet. 58–59. As to the claimed light change, Petitioner points to its contentions for limitations 48[g], 64[l], and 72[m]. *Id.* at 59. Those limitations relate to Alden’s disclosures of dimming for an oncoming vehicle (*id.* at 25–30), iteratively repeating the dimming operation to accommodate a moving other vehicle (*id.* at 50), and doing both for laterally adjacent sectors that are switched to high beam (*id.* at 55–56).

Patent Owner submits that “elements 48[g] and 64[l] do not relate to the relativistic concept of control as claimed in 80” and that Petitioner’s proof for claim 72 “is again loosely directed at sector-based analysis with insufficient detail to even demonstrate the different language of claim 80.” PO Resp. 49–50. Patent Owner stresses claim 80’s language requiring “change . . . first light associated

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with one or more LEDs aimed toward at least a portion of the target, relative to second light associated with other one or more of the LEDs aimed laterally adjacent the target on either side, as the target moves relative to the motor vehicle.” *Id.* at 50 (emphasis omitted).

Alden discloses changing light directed toward oncoming vehicles, to reduce the intensity of such light relative to light directed where no oncoming vehicle is identified. Ex. 1005 ¶¶ 27–28; *see* Pet. 26–28. Thus, Alden discloses claim 80’s “relativistic concept of control.”

6. “non-contiguous LEDs”
(dependent claims 49, 51, 57, 59, 65, 67, 73, and 75)

Claim 57 depends from claim 56 and further recites, *inter alia*, that “at least one of the first cluster or the second cluster includes non-contiguous LEDs.” Ex. 2014, 1187 (8:65–66). Additional claims recite clusters with non-contiguous LEDs—claims 49, 51, 59, 65, 67, 73, and 75.

Petitioner asserts Alden discloses clusters with non-contiguous LEDs because it uses two separate headlight assemblies and dims a portion of each one to dim the light projected towards oncoming vehicles. *E.g.*, Pet. 44.

In the Surreply, Patent Owner asserts that Petitioner’s claim 72 contentions do not show “how the ‘cluster’ in claim 73 can be met by a ‘cluster’ of LEDs from both lamps and fails to show the impact of overlapping additive light from the second lamp on the claimed outcome.” PO Surreply 16 (emphasis omitted). Patent Owner asserts that the same issue applies to claims 57, 59, 65, 67, 75, 81, and 83. *Id.* at 17 n.2. Patent Owner, however, did not raise that issue in the Patent Owner Response and therefore forfeited it. Paper 11, 9 (“Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.”). That conclusion applies to the claims listed by Patent Owner (some of which do not

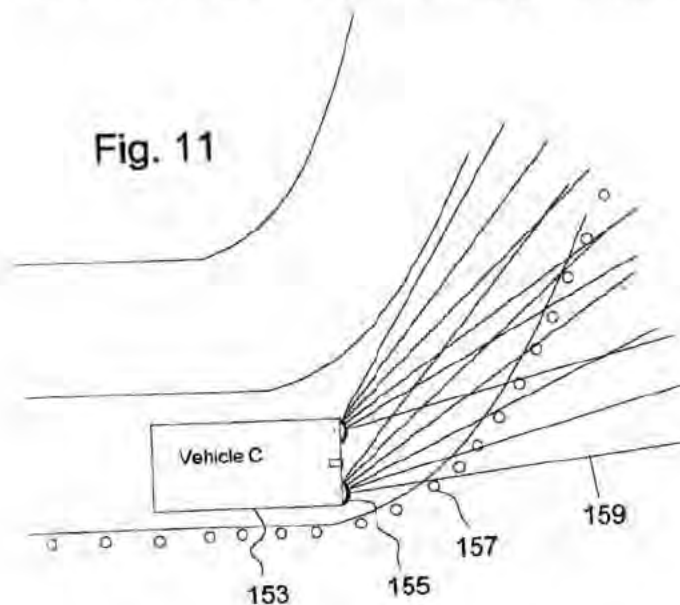
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recite clusters with non-contiguous LEDs) as well as other claims reciting clusters with non-contiguous LEDs that Patent Owner did not include in its belated assertion.¹¹

7. *“identify an upcoming road curvature”*
(dependent claims 50, 58, 66, 74, and 82)

Claim 50 depends from claim 48 and further recites that the controller can: “identify an upcoming road curvature along a road on which the motor vehicle is traveling; and accommodate the upcoming road curvature by adaptation of a light pattern of at least one of the headlamps.” Ex. 2014, 1187 (7:33–36). Claims 58, 66, 74, and 82 depend from other claims and recite parallel limitations.

Petitioner points to Alden’s disclosure that its system may be used to “concentrate light to look around corners in response to road conditions.” Ex. 1005 ¶ 36; Pet. 62–65. Alden’s Figure 11 is reproduced below:



¹¹ Patent Owner does not explain why it believes the listed claims exclusively implicate the same issue. PO Surreply 16–17 n.2.

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Figure 11 depicts equipped vehicle 153 sensing that the road turns using roadside reflectors 157, causing headlights 155 to “direct light into the corner to maximize the driver’s ability to see there.” Ex. 1005 ¶ 36, Fig. 11. Alden states that the same device already disclosed may direct light as illustrated in Figure 11. *Id.* ¶ 36.

Petitioner additionally relies on Alden’s steering-wheel rotation sensor, which Alden uses to calculate its vehicle’s direction changes and adjust the light projection. Pet. 63–64 (citing Ex. 1005 ¶¶ 39–40).

Patent Owner challenges Petitioner’s contentions, arguing that Alden “never describes *how* its system can sense a ‘curve’ by detecting incoming light from a reflector or what to do with beam segments and distribution area sectors if it did sense a curve.” PO Resp. 51. In particular, Patent Owner asserts that Alden has no way to distinguish light from roadside reflectors from other detected light. *Id.* Patent Owner views Alden’s brief mention of detecting road curves using roadside reflectors as insufficiently detailed to enable practice of that approach. *Id.* at 52.

We agree with Petitioner that Patent Owner has not demonstrated lack of enablement for Alden’s system detecting road curves. Pet. Reply 21. As Petitioner points out, Alden uses both intensity and a detected object’s location (including distance) to inform its response. Ex. 1005 ¶¶ 27–28. Petitioner’s expert testifies that the same physical system used to accommodate oncoming vehicles could be used to detect roadside reflectors and direct light into road curves. Ex. 2041, 78:16–80:24. Further, Petitioner’s expert testifies that skilled artisans would adjust the intensity and distance thresholds to distinguish roadside reflectors from oncoming vehicles. IPR2023-01039, Ex. 1003 ¶ 150. Based on Alden’s disclosures, we credit Petitioner’s expert’s testimony that Alden’s system would detect and accommodate road curvatures as claimed by the ’551 patent. Ex. 1003

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¶¶ 132–134. Although Patent Owner argues that Alden’s system could not do so while also accommodating oncoming vehicles, that position is based on the argument that “the system can’t tell the difference between signs and headlights.” PO Surreply 21–23. Patent Owner contends that “detected intensity is a function of both distance and emission intensity” so a threshold couldn’t distinguish headlights from signs. *Id.* at 24–25. That position ignores that Alden uses triangulation to calculate each object’s distance, as discussed, which would allow it to distinguish different types of objects using an intensity threshold. We agree with Petitioner’s expert that Alden’s system can distinguish the two, as discussed.

Accordingly, we find that Alden discloses the limitations of claims 50, 58, 66, 74, and 82.

8. “accommodate the road curvature by changing illumination in at least a direction of the road curvature”
(dependent claims 51, 59, 67, 75, and 83)

Claim 51 depends from claim 50 and further restricts aspects of how the device operates; relevant here, claim 51 further recites that the controller can “accommodate the road curvature by changing illumination in at least a direction of the road curvature by adaptation of the light pattern in at least one of color, intensity or spatial distribution by modification of light associated with one or more of the LEDs” Ex. 2014, 1187 (7:60–65). Claims 59, 67, 75, and 83 depend from other claims and recite parallel limitations.

Petitioner addresses the accommodation requirement through Alden’s teaching to “concentrate light to look around corners in response to road conditions.” Ex. 1005 ¶ 36, Fig. 11; Pet. 66–67. Patent Owner contends that Alden cannot change the light in the direction of road curvature because, “in all segmented beam headlight embodiments of Alden, the beam segments are always

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active at high intensity unless specifically dimmed.” PO Resp. 55; *accord id.* at 14–15.

Patent Owner’s position conflates Alden’s embodiments with their uses. While Alden describes operation where non-dimmed areas are illuminated with high beam (Ex. 1005 ¶ 27), that relates to preventing glare to oncoming vehicles. Skilled artisans would understand that it is a different use with different requirements where Alden describes directing light into corners. Ex. 2041, 50:9–51:1. Petitioner’s expert explains that the segmented headlight shown in Alden’s Figure 5 can function in both uses by identifying both oncoming vehicles and roadside reflectors. *Id.* at 78:22–80:24. As Petitioner points out, even when preventing glare to oncoming vehicles, Alden teaches switching certain headlight segments to dim and switching other segments to high beam. Ex. 1005, Fig. 4; *accord id.* ¶ 28. By including a decision about each headlight segment, Alden’s system is thus configured to implement the road-curvature use. And Alden teaches that its invention may be used such that each segment is “within a range of intensities between the high beam and the low beam state.” *Id.* ¶ 61. That supports that Alden’s invention is not limited to a binary choice between dimming for oncoming vehicles or providing high-beam illumination. As to the specific hardware configuration, we credit the testimony of Petitioner’s expert that, in the road-curvature use, skilled artisans would position the device’s LEDs “to ensure that the beam created by the headlamp is sufficiently wide to illuminate turns.” Ex. 1003 ¶ 134. That explanation is consistent with Alden’s Figure 11, which contradicts Patent Owner’s view that all segments would be illuminated, as Figure 11 depicts an asymmetric beam projection. Ex. 1005, Fig. 11. Thus, Figure 11 itself shows “how fixed, unsteerable LEDs can be used to ‘concentrate’ light” (*see* PO Surreply 6)—certain LEDs are used for wide illumination, only

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activated when the system desires to “concentrate light to look around corners in response to road conditions” (Ex. 1005 ¶ 36, Fig. 11).

Based on the foregoing evidence, we find that Alden’s invention is not limited to uses where it only dims in response to oncoming vehicles. Further, we find that Alden’s invention may perform the variety of uses that Alden discloses, which include both dimming for oncoming vehicles and increasing light in the direction of detected road curvature.

9. “the sensor data”
(dependent claims 53, 61, 69, 77, and 85)

Claim 53 depends from claim 50 and further recites that “identification of the upcoming road curvature” and “adaptation of the light pattern” are both “based at least in part on sensor data provided by one or more of the sensors of the vehicle.” Ex. 2014, 1187 (8:3–7). Claims 61, 69, 77, and 85 depend from other claims and recite parallel limitations.

Petitioner relies on Alden’s disclosures that its “system can sense when a road curves in front of a vehicle based on sensor data detecting reflectors 157.” Pet. 67 (citing Ex. 1005 ¶ 36, Fig. 11). Petitioner further points out that Alden can include a steering-wheel “rotation sensor” to “further detect when a vehicle is approaching an upcoming road curve.” *Id.* (citing Ex. 1005 ¶¶ 39–40, Figs. 14, 15).

Patent Owner contends that Petitioner improperly relies on the steering-wheel sensor, whereas the claims require the curvature identification be “based at least in part on sensor data provided by one or more of the sensors [for detecting coordinate-specific information about the illuminated area].” PO Resp. 60–61. Patent Owner’s argument ignores that Petitioner relies primarily on Alden’s camera sensing roadside reflectors to detect road curvature, as described above. Although Petitioner points further to an additional benefit from Alden’s steering-

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wheel rotation sensor, that does not undermine Petitioner’s primary contention, because the claim language requires only that the road curvature be identified “based at least in part” on the camera. Petitioner’s contentions are consistent with the claim language.

Patent Owner contends in the Surreply that Alden’s system could not use the road reflectors to identify an upcoming curve because it cannot distinguish between headlights and road signs. PO Surreply 25. We do not agree with that characterization of Alden, as discussed above regarding claim 50. *See supra* at 33 (§ II.D.7).

Other than as discussed above, Patent Owner does not contest Petitioner’s reliance on Alden’s use of its camera to detect road curvature.

10. Conclusion

Other than as discussed, Patent Owner does not contest Petitioner’s showing for claims 48, 50, 53–59, 61–67, 69–75, 77–83, and 85–87. *See* PO Resp. 23–65. We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether Alden discloses each limitation of the claims challenged as anticipated. Based on the full record, we conclude that Petitioner has proven that Alden anticipates claims 48, 50, 53–59, 61–67, 69–75, 77–83, and 85–87. Pet. 11–71; Pet. Reply 1–25.

E. OBVIOUSNESS OVER ALDEN

Petitioner presents its first ground as asserting “Alden Anticipates and Renders Obvious Claims 48, 50–51, 53–59, 61–67, 69–75, 77–83, and 85–87.” Pet. 11. As reflected in our description of asserted grounds above, we consider obviousness over Alden a separate ground from anticipation. *See supra* at 6 (§ I.E). We noted in the Institution Decision that “[i]t does not appear that Petitioner has

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provided any basis on which to account for differences between Alden and the challenged claims based on Alden's disclosures alone (as considered by a skilled artisan)." Inst. 19–20. Patent Owner agrees with that view of Petitioner's obviousness contentions. PO Resp. 62–65.

Petitioner contends it sufficiently demonstrates obviousness by explaining how skilled artisans would understand Alden's disclosures, and that its obviousness contentions merely account for any minor differences between Alden's express disclosures and how skilled artisans would understand them. Pet. Reply 27.

How obviousness applies here would depend on what aspect was deemed insufficient for anticipation. Because we conclude above that Alden's disclosures support Petitioner's anticipation ground (*see supra* § II.D), we have no reason to determine whether the claims may be obviousness over Alden alone.

F. OBVIOUSNESS OVER ALDEN AND BEAM

1. Claim 49

Claim 49 depends from claim 48 and recites multiple additional limitations. Ex. 2014, 1187 (7:6–28). Petitioner identifies Alden's teachings that disclose most of those limitations. Pet. 72–81. Claim 49, in part, recites changing "at least one LED of the cluster to a non-emitting state." For that limitation, Petitioner relies on Beam to modify Alden's system.

Beam discloses an adaptive-headlight system that uses a sensor to detect other vehicles and dim its headlights to prevent light that "would dazzle the driver" of another vehicle. Ex. 1007, codes (54), (57), 1:5–18, 2:53–3:3. Beam discloses that portions of its light may be "blanked (attenuated by being either absorbed or deflected to an absorbing surface.)" *Id.* at 4:26–52; *accord id.* at 2:59–65 ("[T]he

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area of the beam that would dazzle the driver will be darkened, while maintaining f[u]ll intensity elsewhere.”). Petitioner reasons that skilled artisans would have had reason to incorporate Beam’s blanking approach in Alden’s system by changing one of Alden’s LEDs to a non-emitting state “to minimize glare to the driver of oncoming vehicles.” Pet. 78–79.

Other than as discussed above regarding claim 48, Patent Owner does not challenge Petitioner’s contentions for claim 49.

We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Beam discloses each limitation of claim 49, and whether skilled artisans would have had reason to combine the references’ teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claim 49 would have been obvious over Alden and Beam. Pet. 72–81.

2. Claim 51

Claim 51 depends from claim 50. Ex. 2014, 1187 (7:37). Relevant here, claim 51 recites that controlling light emitted from the first cluster “includes a change of at least one LED of the cluster to a non-emitting state.” Ex. 2014, 1187 (7:49–51).

Petitioner addresses claim 51 in conjunction with claims 59, 67, 75, and 83, which recite similar limitations. Pet. 65–67. Petitioner states that claim 51 is substantively identical to claim 49, other than an additional limitation relating to accommodating road curvature. *Id.* at 65. Petitioner asserts that the common aspects of claim 51 are anticipated and obvious for the same reasons as claim 49. *Id.*

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Patent Owner points out that Alden does not disclose changing an LED to a non-emitting state and argues that Petitioner thus fails to show anticipation.

PO Resp. 58–59. Petitioner responds that because it incorporated its claim-49 contentions to the claim-51 challenge, the Petition shows that claim 51 is obvious over Alden and Beam. Pet. Reply 26. Patent Owner believes we should not address what it considers a new ground. PO Surreply 26.

Because the Petition plainly relies on the contentions against claim 49 as part of the challenge to claim 51, we agree with Petitioner that the substance of the challenge to claim 51 is obviousness over Alden and Beam. Pet. Reply 26–27. Because claim 49 was not challenged as anticipated, there is no other possible result of incorporating the claim-49 contentions to those against claim 51. This understanding of the Petition does not introduce a new substantive issue, as the limitation at issue is the same as for claim 49, discussed above. Thus, Patent Owner has not been prejudiced.

We conclude that claim 51 is obvious over Alden and Stam for the reasons explained by Petitioner. Pet. 65–67, 72–81.

G. OBVIOUSNESS OVER ALDEN, STAM, AND BEAM

Petitioner additionally asserts that one element of claim 49 would have been obvious over a combination of Alden, Stam, and Beam. Pet. 74–75. Because we determine claim 49 would have been obvious over Alden and Beam, we do not address this additional ground.

H. OBVIOUSNESS OVER ALDEN AND KOBAYASHI

Claim 52 depends from claim 50 and recites that both “identification of the upcoming road curvature” and “adaptation of the [light] pattern” are “based at least

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in part on the map data.” Ex. 2014, 1187 (7:66–8:2). Claims 60, 68, 76, and 84 depend from other claims and recite parallel limitations.

Petitioner asserts that skilled artisans would have had reason to incorporate Kobayashi’s teachings that its controller adjusts the headlight aiming based on input from a “road profile calculating means” that uses “map information including the road profile.” Pet. 82–84. Petitioner reasons that it would be obvious to “include map data from Kobayashi into the system of Alden to further control lighting around road curvatures.” *Id.* at 84 (citing Ex. 1003 ¶ 161). And Petitioner asserts that skilled artisans had reason to do so because it would “maximize successful detection in different environments” such as where the road lacks reflectors. *Id.* (citing Ex. 1003 ¶ 161).

Other than as discussed above regarding Alden’s disclosures, Patent Owner does not contest Petitioner’s showing for claims 52, 60, 68, 76, and 84. We have considered the full record, including evidence and arguments presented by Petitioner and Patent Owner on whether the combination of Alden and Kobayashi discloses each limitation of claims 52, 60, 68, 76, and 84, and whether skilled artisans would have had reason to combine the references’ teachings as asserted. Based on the full record, we conclude that Petitioner has proven that claims 52, 60, 68, 76, and 84 would have been obvious over Alden and Kobayashi. Pet. 82–84.

III. CONCLUSION¹²

For the reasons discussed above, we conclude Petitioner has proven the challenged claims unpatentable. In summary:

¹² Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a*

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Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
48, 50, 53–59, 61–67, 69–75, 77–83, 85–87	102	Alden	48, 50, 53–59, 61–67, 69–75, 77–83, 85–87	
48, 50, 53–59, 61–67, 69–75, 77–83, 85–87	103	Alden ¹³		
49, 51	103	Alden, Beam	49, 51	
49, 51	103	Alden, Stam, Beam ¹⁴		
52, 60, 68, 76, 84	103	Alden, Kobayashi	52, 60, 68, 76, 84	
Overall Outcome			48–87	

Pending AIA Trial Proceeding. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

¹³ We do not address obviousness over Alden alone because we determine the claims challenged in this ground to be anticipated by Alden. See *supra* at 10–37 (§ II.C).

¹⁴ We do not address this ground because we determine claims 49 and 51 would have been obvious over Alden and Beam. See *supra* at 38 (§ II.F.1).

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IV. ORDER

Accordingly, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 48–87 of the '551 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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