

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC. and
PORSCHE CARS NORTH AMERICA, INC.,
Petitioner,

v.

YECHEZKAL EVAN SPERO,
Patent Owner.

IPR2022-01586*
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 Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Dismissing Petitioner's Motion to Exclude Evidence
37 C.F.R. § 42.64(c)

* Porsche Cars North America, Inc, which filed a petition in IPR2023-01122,
has been joined as a party to this proceeding.

I. INTRODUCTION

Volkswagen Group of America, Inc. (“Volkswagen”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–33 of U.S. Patent No. 11,208,029 B2 (Ex. 1001, “the ’029 patent”). Yechezkal Evan Spero (“Patent Owner”) filed a Preliminary Response. Paper 6. We instituted review. Paper 7 (“Institution Decision” or “Inst.”). Following institution, Porsche Cars North America, Inc. (“Porsche”), filed a petition for *inter partes* review and a Motion for Joinder in IPR2023-01122, requesting that Porsche be joined as a petitioner to this proceeding. IPR2023-01122, Papers 2, 3. We instituted trial in IPR2023-01122, granted the Motion for Joinder, and added Porsche as a petitioner here. *Id.*, Paper 10. A copy of that decision was entered into the record of this proceeding. Paper 25. Thus, Volkswagen and Porsche are, collectively, “Petitioner” here.

Patent Owner filed a Response (Paper 13, “PO Resp.”), Petitioner filed a Reply (Paper 17, “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 20, “PO Sur-Reply”).

Petitioner filed a Motion to Exclude Evidence (Paper 27, “Mtn. Exclude”), which Patent Owner opposed (Paper 28, “Opp. Mtn. Exclude”), and Petitioner filed a Reply (Paper 29, “Reply Mtn. Exclude”).

We held an oral hearing on February 22, 2024. Paper 32 (“Tr.”).

For the reasons below, we conclude that Petitioner has proven claims 1–8, 10–19, 21–30, 32, and 33 unpatentable but has not proven any of claims 9, 20, and 31 unpatentable.

A. REAL PARTIES IN INTEREST

Petitioner Volkswagen identifies itself as the real party in interest. Pet. 95. Petitioner Porsche identifies itself and its affiliate Dr. Ing. h.c. F.

Porsche Aktiengesellschaft as the real parties in interest. IPR2023-01122 Paper 2, 93. Patent Owner identifies itself as the real party in interest, noting that Torchlight Technologies LLC is the exclusive licensee of the '029 patent. Paper 4, 1 (Patent Owner's Mandatory Notices).

B. RELATED MATTERS

The parties identify the following related litigation: *Torchlight Techs. LLC v. Daimler AG et al.*, Case No. 1:22-cv-00751 (D. Del.); *Torchlight Technologies LLC v. General Motors LLC et al.*, No. 1:22-cv-00752 (D. Del). *See* Pet. 95; Paper 4, 1. They also identify *Unified Patents, LLC v. Torchlight Technologies LLC*, IPR2022-01500 (PTAB Sept. 22, 2022). *See* Pet. 95; Paper 4, 1.¹

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 combined unit is referred to as a Digital Lighting Fixture (DLF). *Id.* at 18:29–33.

The specification further describes transportation vehicle applications. *Id.* at 50:49–57:35. One such application involves a DLF headlamp device that includes a cluster of LEDs to illuminate around a curve. *Id.* at 51:54–63,

¹ Patent Owner further lists matters involving two different patents related to the '029 patent, including several IPRs, a pending reissue, and a completed *ex parte* reexamination. Paper 4, 2.

54:8–15. With LEDs having a variety of aims, the headlamp’s light distribution pattern may be controlled based on a number of factors, including location data from a GPS system, providing information about upcoming curves in the road. *See id.* at 51:54–67, 54:15–22.

D. CHALLENGED CLAIMS

Petitioner challenges all thirty-three claims of the ’029 patent. Pet. 4. Claim 1 is independent and is reproduced below:

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.

² Patent Owner refers to these limitations as the “Predictive Curve Determination Element.” PO Resp. 8.

³ Patent Owner refers to these limitations as the “Predictive Curve Control Element.” PO Resp. 8.

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.

Claim 9, which is reproduced below, depends from claim 8, which depends directly from claim 1. *Id.* at 96:62–97:38.

8. The system of claim 1, further comprising one or more cameras positioned to capture data indicating at least one other vehicle ahead of the motor vehicle;
wherein the instructions include instructions that, when executed by the one or more processors, enable the one or more processors to:
 - 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;
and
 - 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.
9. The system of claim 8, wherein:
 - the first plurality and second plurality of LED light sources include at least one common LED light source;

- the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle;
- the position includes at least one of:
 - a distance associated with the at least one other vehicle,
 - at least one elevation associated with the at least one other vehicle, or
 - a position within image data captured by at least one of the cameras;
- the first data includes data from a non-camera sensor of the motor vehicle;
- either one of the control of the first plurality of LED light sources or control of the second plurality of LED light sources is subsequent to and accommodative of the other;
- the control of the second plurality of LED light sources additionally includes termination of light from at least one LED providing light directed to the area prior to the termination; and
- the light pattern includes at least one of an illumination pattern or an emission pattern of the headlamps.

Id.

E. PRIOR ART AND ASSERTED GROUNDS

Petitioner asserts the following unpatentability grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1-33	103	Beam, ⁴ Kobayashi ⁵
1-33	103	Gotou, ⁶ Karlsson ⁷

⁴ U.S. Patent No. 6,144,158, issued Nov. 7, 2000 (Ex. 1005).

⁵ U.S. Patent No. 6,049,749, issued Apr. 11, 2000 (Ex. 1008).

⁶ U.S. Patent No. 5,588,733, issued Dec. 31, 1996 (Ex. 1012).

⁷ WIPO Patent Publication No. 98/54030, published December 3, 1998 (Ex. 1010).

Pet. 4–5. Petitioner also relies on the Declaration of Dr. Jianzhong Jiao. Ex. 1003.

II. ANALYSIS

A. LEVEL OF ORDINARY SKILL IN THE ART

Petitioner asserts that an ordinarily skilled artisan “would have had a bachelor’s degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, as well as at least 2 years of industry experience in the area of automotive lighting and lighting-control systems” and “may work as part of a team” listing an example. Pet. 10 (citing Ex. 1003 ¶¶ 41–43).

In its Response, Patent Owner “does not dispute Petitioner’s proposed level of ordinary skill.” PO Resp. 21 (citing Pet. 10). Following Petitioner’s assertion in the Reply that Patent Owner’s declarant does not satisfy the agreed level of ordinary skill (*see* Pet. Reply 2–5), Patent Owner relies on Petitioner’s expert’s statement that “a higher level of education or skill might make up for less experience” to argue that the level of skill does not require specific industry experience and instead encompasses work in optics and imaging systems. PO Sur-Reply 1–9 (quoting Ex. 1003 ¶ 42).

We proceed with the agreed level of ordinary skill. We note that the parties’ belated dispute regarding the level of skill does not affect our analysis, as further discussed below regarding Petitioner’s Motion to Exclude.

B. CLAIM CONSTRUCTION

The parties agree that no express claim construction is required. Pet. 10–11; PO Resp. 21–22. Other than two disputes discussed below

regarding dependent claims, we agree that the claims do not require express construction. *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)). As to the two disputes that implicate claim scope, we discuss the relevant issues in context below. *See infra* at 21 (§ II.C.7), 22 (§ II.C.8).

C. OBVIOUSNESS OVER GOTOU AND KARLSSON

Petitioner asserts that claims 1–33 are unpatentable as obvious over Gotou and Karlsson.

1. *Gotou*

Gotou is titled “Head Lamp Device for Vehicle” and is directed to a vehicle headlamp with a left-right adjustable lighting region. Ex. 1012, codes (54), (57). Gotou’s device may adjust the lighting region based on a number of factors, including “direction indicating signal, steering angle signal, map information and information of the present position.” *Id.* at 2:5–7. Gotou describes a “light distributing control ECU 10” that receives information from a variety of sensors and “processes the information[] and signals to determine a requisite optical axis angle θ .” *Id.* at 3:52–63. Gotou’s system uses the optical axis angle to control a motor driver that aims the lamp unit. *Id.* at 3:24–45, 3:63–67. Gotou describes that its controller generates “a curve pre-noticing signal” from map information and adjusts the optical axis angle “when the vehicle reaches the predetermined distance

S before the curve entrance and the light distribution is deflected leftward at a proper timing before the curve.” *Id.* at 7:32–43.

2. Karlsson

Karlsson is titled “A Lighting Device Having a Controllable Lighting Pattern” and is directed to a lighting device that automatically adjusts the lighting pattern and intensity of a vehicle’s headlights to reduce blinding oncoming traffic. Ex. 1010, codes (54), (57). Karlsson’s system uses “a plurality of controllable spotlight beams . . . such as LEDs, which can preferably be controlled either individually or in groups.” *Id.* at 13:24–14:4. “[T]he pattern of the emitted light beam is varied automatically in an efficient manner and with maximum sensitivity in response to at least one control signal delivered by light-sensitive sensor.” *Id.* at 2:30–35. Karlsson sought to improve road safety, noting that “[w]hen taking a bend there is also the problem that the road ahead of the vehicle is insufficiently lit, because the light beam is generally optimized for straight movement (rather than turning movement) of the vehicle.” *Id.* at 1:27–2:1. Karlsson describes using a direction sensor “for determining when the car 56 is taking a bend, so that the light beam 7 can be adapted to prevent the traffic on the other side of the road from being blinded as much as possible.” *Id.* at 20:29–32.

3. Claims 1, 12, and 23

Petitioner groups independent claims 1, 12, and 23 together because they “recite substantially similar elements and concepts; thus, the same prior art disclosures map to corresponding elements.” Pet. 8. Petitioner summarizes the similarities and supplements this analysis with a claim chart corresponding the claims’ limitations. *Id.* at 8–9, Appendix A. Patent Owner

similarly asserts that “[i]ndependent claim 1 is representative of claims 12 and 23.” PO Resp. 24. Thus, those claims stand or fall together.

Petitioner asserts that Gotou discloses a system for a motor vehicle comprising a plurality of headlamps, one or more processors, and the claimed memory storing instructions. Pet. 65–79. Petitioner points out how Gotou concerns “adaptive vehicle headlamp[s]” and that Gotou’s control ECU has the claimed processor⁸ and memory storing instructions that enable the processor to receive map data indicating upcoming road curvature and, before the vehicle reaches the curve, determine the desired optical axis to increase light in the direction of road curvature. *Id.* at 68–78 (citing, e.g., Ex. 1012, 3:52–67, 4:23–25, 8:23–27, 4:36–40). Petitioner submits that “headlamps with LED arrays were well-known,” which is why it would have been obvious “to substitute Karlsson’s known controllable LED arrays to control the headlight shape and/or intensity for Gotou’s” light source. *Id.* at 67–68 (citing Ex. 1010, 13:24–14:4, 2:30–35, 9:18–26). The asserted combination substitutes “Gotou’s moving parts” with “Karlsson’s controllable LEDs.” *Id.* at 60. Petitioner explains how the combination teaches the “control” limitation because it teaches adjusting the LEDs based on the map data and before reaching a road curvature. *Id.* at 78–79.

Patent Owner asserts that Karlsson does not teach “increasing light in a direction of the road curvature” because it provides full-intensity light in

⁸ In the alternative, Petitioner further argues that a person of ordinary skill would have found it obvious to include a processor or Karlsson’s “control means.” Pet. 69–70 (emphasis omitted). Petitioner provides additional alternative arguments throughout the Petition. *See, e.g., id.* at 72, 75, 77.

all areas other than where an oncoming vehicle is detected. PO Resp. 24–30.
We do not agree.

Karlsson's Figure 14 is reproduced below:

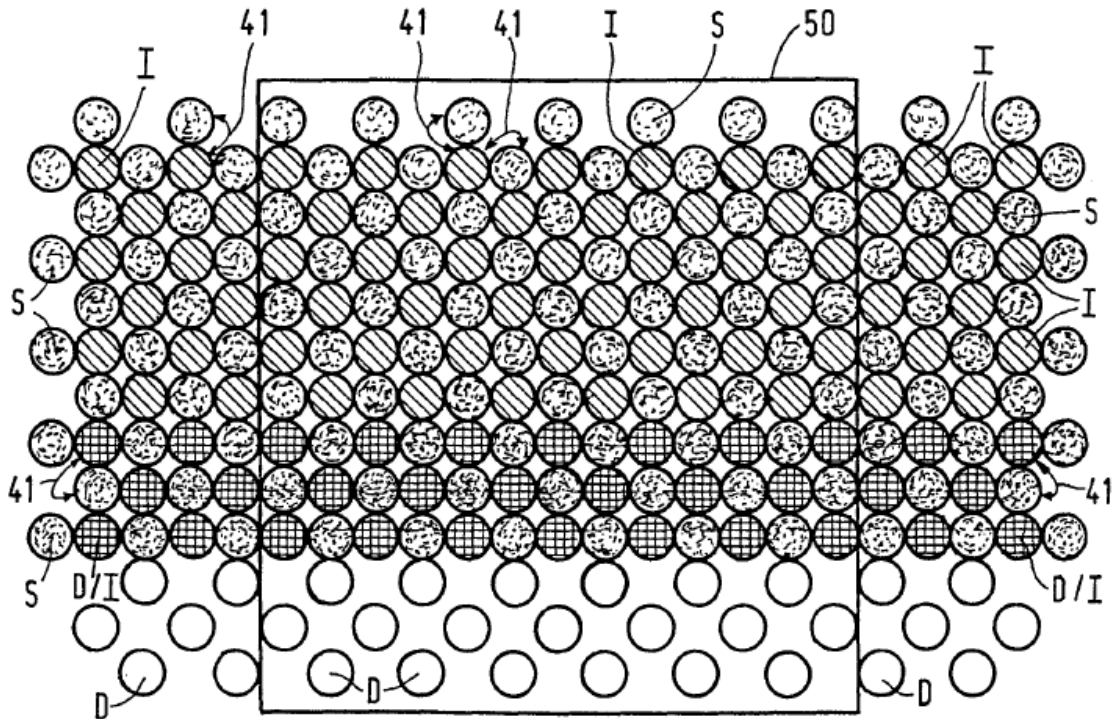


FIG. 14

Figure 14 depicts an embodiment of spotlight sources D, I, and D/I, intermixed with spotlight sensors S. Ex. 1010, 19:18–28. Karlsson discloses that, in Figure 14,

The emitted light beam 50 is represented as a window which can shift in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa, and which may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam.

Id. at 19:29–33. According to Patent Owner, that description supports that emitted light beam 50 would result from dimming the overall beam “to

avoid blinding oncoming drivers.” PO Resp. 25; *accord id.* at 27 (“[W]indow 50 is created by blanking a subset of the overall beam ‘if desired,’ i.e., to reduce potential glare.”). Karlsson’s description of window 50, however, does not support that it is created as a result of dimming the beam for oncoming traffic. The description instead supports that Karlsson may operate its headlight to use a subset of the overall field, regardless of detecting oncoming traffic. To the extent that Karlsson describes shifting its entire beam to prevent glare to oncoming traffic, it is in the context of “a direction sensor 54, which is for example connected to the steering wheel.” Ex. 1010, 20:22–24 (describing Figure 16). Karlsson states that “[t]he direction sensor 54 is in particular intended for determining when the car 56 is taking a bend, so that the light beam 7 can be adapted to prevent the traffic on the other side of the road from being blinded as much as possible.” *Id.* at 20:29–32; *accord id.* at 6:26–33 (describing “direction sensors, for detecting whether a vehicle is taking a bend, for example a direction sensor which is responsive to the steering wheel of a vehicle”). By focusing on the direction sensor as a primary input for steering the headlight beam, Karlsson discloses that its system may generally light the field’s central portion, shifting the light left or right as may be desired to accommodate road curvature.

Patent Owner’s erroneous view of Karlsson would limit Karlsson to disclosing a single approach to controlling its lights. In this manner, Patent Owner relies on Petitioner’s statement regarding Karlsson from a different proceeding, IPR2023-00315. *See* PO Resp. 25–26. There, Petitioner asserted that operating Karlsson’s system in a particular manner—with a full-intensity main beam all around the area of reduced illumination—would

provide a particular benefit—maximizing the fully illuminated area.

Ex. 2008, 67. We do not read that assertion as limiting Karlsson’s system to only one operating mode. Thus, we do not agree with Patent Owner “that Karlsson uses full illumination . . . i.e., use[s] the entire array just as Beam does, except for portions dimmed to avoid glare.” PO Resp. 26 (emphasis omitted).

Considering Karlsson’s statement that its emitted light beam may be produced from a “window which can shift . . . from the left to the right,” we conclude that the record better supports Petitioner’s position. In that regard, we credit Dr. Jiao’s testimony that skilled artisans would understand Karlsson to disclose a device capable of adapting its beam shape to myriad possible situations, rather than a device that illuminates all possible light sources unless detecting an oncoming vehicle. Ex. 1036 ¶¶ 51–64.

Patent Owner further argues that Petitioner has not established a sufficient reason that skilled artisans would have combined Karlsson’s teachings with Gotou’s as asserted. PO Resp. 37–51. As summarized above, Petitioner contends that skilled artisans had reason to use Karlsson’s controllable LEDs as a light source in place of Gotou’s because of the “well-known benefits of LEDs in vehicle headlamps—for example, life expectancy and redundancy, adaptation during unfavorable weather, and low-voltage direct current operation.” Pet. 55–56 (citing Ex. 1003 ¶¶ 231–233, 235–236; Ex. 1009, 12:27–29, 20:9–12, 23:8–12; Ex. 1010, 2:30–35, 4:25–35, 6:1–5, 11:29–32, 13:24–29, 14:1–15, 14:26–30; Ex. 1011, 1:18–2:2, 3:18–26, 10:6–11, 10:21–22; Ex. 1022, 2:22–26, 3:44–47). Petitioner contends also that using Karlsson’s LEDs would have removed “Gotou’s

moving parts (e.g., motors), while also providing expanded beam shaping abilities.” *Id.* (citing Ex. 1003 ¶ 234).

Patent Owner contends that, instead, LEDs did not offer a workable solution for vehicle headlamps because, at the time of invention, LEDs produced output levels far below “typical tungsten halogen” bulbs. PO Resp. 39. Thus, argues Patent Owner, using Karlsson’s LEDs would render Gotou unsuitable for its intended purpose of adjusting illumination direction. *Id.* at 39–40. We do not agree. Most significantly, Karlsson is specifically directed to a motor vehicle headlight capable of varying its emitted beam. *E.g.*, Ex. 1010, 1:3–7. And Karlsson expressly discloses that LEDs are appropriate options for its headlamp. *Id.* at 4:32–5:1, 14:1–4, 19:34–36, 21:13–17. In addition, Petitioner cites to multiple exhibits that support its contention that skilled artisans would have recognized the benefits of LEDs as light sources for headlamps. Pet. 56 (citing Ex. 1005, 4:9–15, 6:9–12, Claims 4 and 5; Ex. 1006 ¶¶ 5, 7, 8, 20, 27; Ex. 1009, 19:27–29, 20:9–12, 23:8–12; Ex. 1010, 4:25–35, 13:24–29, 11:29–32; Ex. 1011, 1:18–2:3, 3:18–26, 8:13–20, 10:6–11, 10:21–22). Patent Owner counters that evidence by pointing to its expert’s declaration and to the industry’s recognition that LEDs provided less illumination than incandescent bulbs. PO Resp. 39 (citing Ex. 2006 ¶¶ 25–38; Ex. 2012, 3). Of course, evidence about an individual LED’s output does not undermine Petitioner’s combination because headlamps using LEDs, such as Karlsson’s, used many individual devices. *E.g.*, Ex. 1010, 13:24–14:4, Fig. 6. We conclude that the weight of evidence establishes that Karlsson’s LED-based light source would have been sufficient to implement a vehicle headlamp, as disclosed in Karlsson.

For the same reasons as illumination level, Patent Owner’s arguments regarding heat management and packaging are not persuasive. *See* PO Resp. 44–45. Because (1) Karlsson discloses a system using LEDs and (2) the challenged claims impose no specific requirements regarding Patent Owner’s asserted characteristics, we conclude that those characteristics would not have counseled against the proposed combination. *See* Ex. 1010, 3:34–35 (“[I]t is furthermore possible to comply with relevant national and international regulations.”).

In addition to LEDs’ output level, Patent Owner relies on the need for an optical system in an implemented system and criticizes Petitioner for inadequately explaining how skilled artisans would configure the proposed combination’s optical system. PO Resp. 43–44. We do not agree with Patent Owner’s arguments. Petitioner asserts that the combination would involve substituting “Karlsson’s directional-controllable LED headlamps” in place of “Gotou’s non-LED light sources” (Pet. 64–65) and asserts that the combination would “result[] in a more compact system with fewer moving parts” (*id.* at 60). It is clear from the Petition that the proposed combination would include Karlsson’s optical system, as that system is used to direct the light from individual LEDs towards the illumination target. Ex. 1010, 8:15–17 (disclosing “lens 6, which forms light 5 into a desired emitted light beam 7”), 13:24–14:4 (disclosing an embodiment for light source 2 using an array of LEDs to form spotlight beams). Moreover, configuring the combined system with an appropriate optical system was well within the ordinary skill at the time, as Karlsson includes an optical system as discussed above, Gotou refers to an “optical axis” (Ex. 1012, 3:31–35), and ordinarily skilled artisans would have had automotive-lighting experience

(*supra* at 7 (§ II.A)). See also *In re ICON Health and Fitness, Inc.*, 496 F.3d 1374, 1382 (Fed. Cir. 2007) (“[W]e do not ignore the modifications that one skilled in the art would make to a device borrowed from the prior art.”). The claims recite no specific requirements for the optical system and we find that skilled artisans would have understood how to achieve the goal of projecting light to specific, controllable areas on the illumination target space.

Patent Owner criticizes Petitioner for proposing a combination that includes “Karlsson’s LED array and control” because, in Patent Owner’s view, that would result in a system with conflicting control strategies. PO Resp. 46–47 (internal quotations omitted). We do not agree, because the proposed combination makes logical sense and the two control systems would work together. Gotou’s system uses a control system to determine the desired optical axis—the lateral direction for illumination relative to the vehicle—based on multiple possible inputs. Ex. 1012, 2:5–8 (“control means for inputting said direction indicating signal, steering angle signal, map information and information of the present position and adjusting the lighting region of said head lamp”), 3:62–63 (“ECU 10 processes the information[] and signals to determine a requisite optical axis angle θ ”). Karlsson’s system uses a control system that accepts inputs and provides outputs “in such a manner that a light beam 7 having a desired pattern and a desired intensity is emitted.” Ex. 1010, 9:15–17. We find that skilled artisans would have understood to use Gotou’s control system to determine the desired pattern and intensity, and to use Karlsson’s control system to produce that desired pattern and intensity with Karlsson’s LED array and optical system.

Patent Owner argues that Karlsson’s controller would not have worked with Gotou’s because LEDs “are controlled differently than conventional light bulbs with respect to the input voltage and waveform.” PO Resp. 48; *accord id.* at 49 (“Gotou’s ECU, with its limited control capability, would not have been capable of providing digital control of Karlsson’s LED array at the correct input voltage.”). As explained above, we find that ordinarily skilled artisans would have understood how to configure the two systems to work together, because they would not simply connect Gotou’s controller to Karlsson’s LED array, but would understand that Gotou’s controller would provide the desired illumination angle, and Karlsson’s controller would implement that desired illumination angle by controlling the individual LEDs in the array. Similar flaws undermine Patent Owner’s argument that skilled artisans making the proposed combination would not have appropriately adapted Karlsson’s optics, resulting in a combination that could not adjust its optical axis. *See id.* at 50–51. As explained above, Karlsson discloses that optics are part of the system used to create a projected light beam from the controllable light source, and skilled artisans would have understood optical design as part of implementing the combination.

We find that skilled artisans would have had reason to combine Karlsson’s teachings with Gotou’s as Petitioner asserts because of known benefits from LEDs in headlamps. *See Pet.* 55–56.

Patent Owner does not otherwise contest Petitioner’s unpatentability assertions regarding the independent claims. *See PO Resp.* 24–30, 37–51. We have considered Petitioner’s contentions in light of the full record and conclude that Petitioner has shown the unpatentability of claims 1, 13, and

23, for the reasons provided in the Petition, Reply, and as discussed above. Pet. 55–79; Pet. Reply 6–17.

4. Claims 5, 16, and 27

Claim 5 depends from claim 1 and further recites that “the increase of light in the direction of the road curvature includes at least an increase of light emitted at a level below high-beam light and directed in the direction of the road curvature.” Ex. 1001, 96:24–27. Claim 16 depends from claim 12 and recites a parallel limitation. Claim 27 depends from claim 23 and refers to a road “shape change” rather than curvature; we agree with Petitioner that a curvature is a type of shape change. Pet. Reply 18 (citing Ex. 1003 ¶¶ 175–176, 302); Pet. 34 n.8.

Petitioner contends that Gotou implements lighting changes in the horizontal direction, by changing the horizontal optical axis, and that the combination using Karlsson’s LED-based illuminator would implement a similar lighting approach, resulting in increased lighting towards a road curve that is below high-beam level because nothing in the control strategy would increase the lateral illumination to a high-beam level. Pet. 84. Patent Owner faults that logic for lacking “any explanation of why Karlsson would mimic Gotou’s incandescent light source output.” PO Resp. 31–34. Patent Owner’s argument is deficient because the combination uses Gotou’s controller to determine the desired lateral optical axis, and then implements that illumination pattern using Karlsson’s LED array and optics, as discussed above. Given Gotou’s illumination pattern, which did not increase high-beam illumination in response to road curvature, there was no need for Petitioner to justify maintaining that approach.

Patent Owner does not otherwise challenge Petitioner's contentions regarding claims 5, 16, and 27. We have considered Petitioner's contentions in light of the full record and conclude that Petitioner has proven claims 5, 16, and 27 are unpatentable for the reasons provided in the Petition, Reply, and as discussed above. Pet. 84; Pet. Reply 18–19.

5. Claims 6, 17, and 28

Claim 6 depends from claim 1 and further recites a capability to determine a second light change to increase light in a direction of a second road curvature and to control a second plurality of LEDs that includes at least one LED different from the first plurality. Ex. 1001, 96:28–45. Claims 17 and 28 depend from claims 12 and 28, respectively, and recite parallel limitations. Petitioner asserts that the claims require “merely a subsequent, repeated step in the continuous, iterative processes of the '029 patent and Gotou-Karlsson system.” Pet. 85.

Patent Owner disputes whether a merely iterative process adequately addresses the requirement that the second plurality of LEDs includes at least one LED different from the first plurality. PO Resp. 34–35. As Petitioner points out, however, the case where a road curves right and then left would require different plurality of LEDs to direct light toward the road curvature as the car proceeds from the right turn to the left turn. Pet. Reply 20. That fact is apparent when considering Patent Owner's expert's view of how Karlsson accommodates such curves. Ex. 2006 ¶¶ 84–86. Although Patent Owner's expert testifies that Karlsson operates with all LEDs illuminated absent a detected road curvature, that does not change that Karlsson invariably uses different subsets when illuminating curves of different directions. We agree with Petitioner that claims 6, 17, and 28 are obvious

over Gotou and Karlsson because the asserted combination would select a different plurality of LEDs for each detected situation, and because Gotou and Karlsson both describe operating on an ongoing basis such that LEDs are repeatedly selected based on detected conditions. Ex. 1036 ¶¶ 94–98.

Patent Owner does not otherwise challenge Petitioner’s contentions regarding claims 6, 17, and 28. We have considered Petitioner’s contentions in light of the full record and conclude that Petitioner has proven claims 6, 17, and 28 are unpatentable for the reasons provided in the Petition, Reply, and as discussed above. Pet. 84–85; Pet. Reply 19–21.

6. Claims 7, 18, and 29

Claim 7 depends from claim 1 and, *inter alia*, further recites that “the increase of light in the direction of the road curvature includes at least one of expansion of the light pattern in the direction of the road curvature or an increase to intensity of light directed in the direction of the road curvature.” Ex. 1001, 96:46–61. Claims 18 and 29 depend from claims 12 and 23, respectively, and recite parallel limitations. Petitioner asserts that the additional limitations recite nothing more than well-known alternatives for increasing light toward the road curvature and are obvious for the same reasons as the independent claims. Pet. 85–86. Petitioner points out that Karlsson discloses effecting a particular illumination pattern by switching LEDs on or off, or by adjusting an LED’s intensity. *Id.* at 85 (citing Ex. 1010, 13:24–14:4, 2:29–35, 9:18–26, Figs. 6, 14).

We agree with Petitioner that Karlsson discloses claim 7’s limitations, because Karlsson discloses that the emitted light beam may be produced from a window of selected LEDs that shifts left or right within the overall array. Ex. 1010, 19:29–33. That disclosure logically applies to the claims at

issue, which require directing light in the direction of road curvature. Karlsson discloses that a desired pattern may be created by switching spotlight beams (as created by LEDs) on or off, or by otherwise changing their intensity. *Id.* at 13:33–36.

Patent Owner does not otherwise challenge Petitioner’s contentions regarding claims 7, 18, and 29. We have considered Petitioner’s contentions in light of the full record and conclude that Petitioner has proven claims 7, 18, and 29 are unpatentable for the reasons provided in the Petition, Reply, and as discussed above. Pet. 85–86; Pet. Reply 21–23.

7. Claims 9, 20, and 31

Claim 9 depends from claim 8, which depends from claim 1. Relevant to the dispute here, claim 1 requires capability to “determine a light change . . . to increase light in a direction of road curvature” and control a first plurality of LEDs “to provide light based at least in part on the determined light change.” Ex. 1001, 95:66–96:8. Claim 8 requires capability to control a second plurality of light sources “to diminish glare to a driver of the other vehicle.” *Id.* at 97:5–14. Claim 9 recites “the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle.” *Id.* at 97:18–20.

Petitioner asserts that “Gotou’s map data is not from a camera sensor” and therefore satisfies claim 9’s language. Pet. 88. Patent Owner disputes that assertion, arguing that claim 9’s control of the second plurality takes its antecedent basis from claim 8, which requires that the control be to diminish glare. PO Resp. 36. Because Gotou’s map data is used to accommodate road curvature, not to diminish glare to oncoming vehicles, Patent Owner submits that Petitioner’s proof is inadequate. *Id.* Petitioner responds that claim 9

recites “*additional* control,” not the same control from claim 8 that is limited in purpose. Pet. Reply 23–24.

We agree with Patent Owner. Claim 9 recites “the control of the second plurality of LED light sources, which naturally and logically refers to claim 8’s “control . . . 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.” Thus, the claim language’s antecedent basis establishes that claim 9’s control must also be “to diminish glare to a driver of the other vehicle.” The Petition does not identify teachings in the prior art that render claim 9’s limitation obvious under the correct claim interpretation. Nor does Petitioner’s Reply explain how the asserted combination satisfies Patent Owner’s construction, which we adopt. *See* Pet. Reply 23–24. Therefore, Petitioner has failed to carry its burden for claims 9, 20, and 31.

8. Claims 21 and 32

Claim 21 depends from claim 19 and recites that the processor is enabled “to utilize one or more optical control elements included in the motor vehicle to control light from” one of the pluralities of LEDs. Ex. 1001, 99:19–24. Claim 32 depends from claim 30 and recites a parallel limitation. Petitioner contends that the Gotou-Karlsson combination includes reflectors and lenses, rendering the additional limitations obvious. Pet. 91. Patent Owner disputes that contention, arguing that the recited elements are “active control elements” because they are “utilized.” PO Resp. 37. We do not agree with Patent Owner.

Patent Owner does not explain its construction other than to point to the word “utilize,” and, in our view, that is an inadequate basis on which to

limit the claims to active optical control elements. Patent Owner's expert testified that "optical control element" in claims 21 and 32 means "elements that control the direction of light through optics" and that the term encompasses lenses and reflectors in the context of those claims. Ex. 1037, 164:9–165:2. We agree with Petitioner that the combination includes Karlsson's optical control elements because "they provide the correct illumination and control for Karlsson's LEDs." Pet. Reply 24; Ex. 1036 ¶ 108. And a processor would "utilize" the lens because the processor must consider how each LED corresponds to a portion of the illuminated target space.

Patent Owner does not otherwise challenge Petitioner's contentions regarding claims 21 and 32. We have considered Petitioner's contentions in light of the full record and conclude that Petitioner has proven that claims 21 and 32 are unpatentable for the reasons provided in the Petition, Reply, and as discussed above. Pet. 91; Pet. Reply 24–25.

9. Uncontested claims

Petitioner provides contentions for claims 2–4, 8, 10, 11, 13–15, 19, 22, 24–26, 30, and 33. Pet. 79–91. Other than as discussed above, Patent Owner does not challenge those contentions in the Patent Owner Response. Any such challenge has been forfeited. *See* Paper 8, 9 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.").

We have considered Petitioner's contentions in light of the full record and conclude that Petitioner has shown the unpatentability of claims 2–4, 8, 10, 11, 13–15, 19, 22, 24–26, 30, and 33 for the reasons provided in the Petition and as discussed above. Pet. 79–91.

D. OBVIOUSNESS OVER BEAM AND KOBAYASHI

Petitioner asserts that claims 1–33 are unpatentable as obvious over Beam in view of Kobayashi.

1. Beam

Beam is titled “Adaptive/Anti-Blinding Headlights” and is directed to a system that automatically adjusts a vehicle’s headlights to avoid blinding oncoming drivers. Ex. 1005, code (54), 1:5–18. Beam describes how its adaptive/anti-blinding headlight (“AABH”) system contains an optical system 106, a sensor 107, a controller 108, and an illuminator 109. Oncoming light enters the system through the optical system. *Id.* at 4:9–25. The sensor detects the light and converts the light into data, which is sent to the controller. *Id.* The controller then uses the data to adjust the output of light from the illuminator so that “[t]he resulting beam is at full intensity except in areas that would dazzle a driver ahead.” *Id.* at 4:32–59.

2. Kobayashi

Kobayashi is titled “Lighting Device for a Vehicle” and is directed “to a lighting device for vehicle use which conducts irradiation control of the lighting device in accordance with a road profile, vehicle operation and vehicle running condition.” Ex. 1008, code (54), 1:5–8. Irradiation is the area of space that light illuminates. *See* Pet. 14; Prelim. Resp. 15–16. Kobayashi discloses that its device includes:

a road profile calculating means 2, vehicle advancing direction predicting means 3, irradiation control means 4 and light device (e.g., headlamp) 5. The irradiating direction and irradiating range of the lighting device 5 are directly controlled by the irradiating control means 4 or indirectly controlled via the drive means 6.

Ex. 1008, 3:11–17. The road profile calculating means 2 can be a “navigation system” or “GPS” that includes details about “the position of the vehicle and road profile (including a taper and radius of curvature of the road).” *Id.* at 3:40–49. Based on how the vehicle is being operated, “the vehicle advancing direction predicting means 3 synthetically predicts a vehicle advancing direction at which the driver aims.” *Id.* at 4:6–8. “[T]he irradiation control means 4 compares the direction data of the road profile calculating means 2 with the direction data of the vehicle advancing direction predicting means 3”—which then changes the irradiation/the light produced from a headlight. *Id.* at 4:60–5:28.

3. Petitioner’s combination

Petitioner asserts that Beam discloses a system for a motor vehicle that uses a processor to control “an array of individual, independently controllable [LEDs].” Pet. 30–32 (citing, *inter alia*, Ex. 1005, 4:10–59, 5:34–36, 8:4–12, claim 4). Petitioner acknowledges that Beam does not expressly teach “receive first data, including at least map data” *Id.* at 34. Based on Beam’s discussions of prior art, Petitioner contends that “a POSA would have modified Beam’s system to include Kobayashi’s map data functions to further control Beam’s directional LEDs, improving driver safety.” *Id.* at 34–36; *see also id.* at 24–30 (describing Petitioner’s full motivation to combine Beam and Kobayashi). Petitioner argues that Beam’s system that uses oncoming light information “to control the intensity, and/or the angular position, of one or more” discloses “determin[ing] a light change” in “intensity and spatial distribution.” *Id.* at 36–37 (citing Ex. 1005, 6:24–27, 5:46–54) (emphasis omitted). As modified with Kobayashi’s map data above, Petitioner asserts that Beam’s determination disclosure would

“‘increase light in a direction of the road curvature ahead of the motor vehicle,’ thus shaping light based in part on the road curvature.” *Id.* at 37–38 (citing Ex. 1008, 17:8–15, 1:21–28, 4:6–21, 15:15–28). Petitioner contends that the implementation of the Beam-Kobayashi determination results in the “control” limitation. *Id.* at 38–39.

4. Redundant challenges

For the independent claims and most dependent claims, we need not address Petitioner’s challenges based on Beam and Kobayashi, because we have already determined the claims are unpatentable over Gotou and Karlsson. Accordingly, we do not reach the redundant challenges.

5. Claims 9, 20, and 31

As discussed above, we conclude that Petitioner has not proven claims 9, 20, and 31 are unpatentable over Gotou and Karlsson. *See supra* at 21 (§ II.C.7). Thus, Petitioner’s challenge based on Beam and Kobayashi remains potentially determinant of the outcome here.

For those claims, Petitioner relies on Kobayashi’s map data as “third data received from a non-camera sensor.” Pet. 52. Patent Owner raises the same argument discussed above—that “the control” in claim 9 must be consistent with that term’s antecedent basis in claim 8, requiring control to diminish glare to other drivers. PO Resp. 56. Petitioner takes the same position discussed above—that claim 9 does not restrict the purpose of control based on the non-camera sensor data—and does not address unpatentability under Patent Owner’s construction. Pet. Reply 31–32. For the reasons discussed above, we agree with Patent Owner regarding the claim scope, and therefore find that Petitioner has failed to prove claims 9,

20, and 31 are unpatentable over Beam and Kobayashi. *See supra* at 21 (§ II.C.7).

E. PETITIONER’S MOTION TO EXCLUDE

Petitioner seeks to exclude the testimony of Patent Owner’s declarant, Dr. Turk, asserting that he does not meet the agreed level of ordinary skill in the art. Mtn. Exclude 1; *see supra* at 7 (§ II.A). In particular, Petitioner argues that the agreed level of skill requires “at least 2 years of industry experience in the area of automotive lighting and lighting-control systems” whereas Dr. Turk lacks such qualifications. Mtn. Exclude 4–6; *accord* Reply Mtn. Exclude 3–4 (arguing Dr. Turk “has no experience with a vehicle headlamp company, an LED (or any other light source) company, or lighting design, or awards/patents for a vehicle forward lighting system” (citing Opp. Mtn. Exclude 4)).

We determine that granting Petitioner’s Motion to Exclude would not change the outcome here. For the claims on which Patent Owner has prevailed, our determination that Petitioner fails to meet its burden does not depend on Dr. Turk’s testimony, but instead relies on the claim language as compared to Petitioner’s assertions. *See supra* at 21 (§ II.C.7). For the claims on which Petitioner has prevailed, excluding Dr. Turk’s testimony would not change the outcome. Thus, the motion is moot as to Dr. Turk’s declarations.

Petitioner’s Motion to Exclude further seeks to exclude a hyperlink to the ’029 patent’s inventor’s LinkedIn page, which Patent Owner includes in its Sur-Reply. Mtn. Exclude 15; PO Sur-Reply 2. The link is offered to support Patent Owner’s contention that the named inventor “had a bachelor’s engineering degree and industry experience with optics but not

automotive lighting at the relevant time.” PO Sur-Reply 2. Because Patent Owner agreed to the level of ordinary skill in the Patent Owner Response, and we adopt that for this decision, Patent Owner’s additional arguments regarding the level of ordinary skill do not affect our analysis. Granting Petitioner’s motion as to the hyperlink would not change our analysis above.

Accordingly, we dismiss Petitioner’s motion as moot.

III. CONCLUSION⁹

For the reasons discussed above, we conclude Petitioner has proven claims 1–8, 10–19, 21–30, 32, and 33 are unpatentable but has not proven any of claims 9, 20, and 31 unpatentable. Our conclusions are based on the full record. In summary:

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

⁹ 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 notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. §§ 42.8(a)(3), (b)(2).

¹⁰ As noted above, we do not reach this ground for claims 1–8, 10–19, 21–30, 32, and 33 because we determine those claims to be unpatentable over Gotou and Karlsson. See *supra* at 23 (§ II.D.4).

IV. ORDER

Accordingly, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–8, 10–19, 21–30, 32, and 33 of the '029 patent are unpatentable;

FURTHER ORDERED that Petitioner has not shown by a preponderance of the evidence that any of claims 9, 20, and 31 of the '029 patent are unpatentable;

FURTHER ORDERED that Petitioner's Motion to Exclude Evidence is dismissed as moot; 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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