

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

Case IPR2023-00197
U.S. Patent No. 10,894,503 B2

**PETITIONER VOLKSWAGEN GROUP OF AMERICA, INC.’S REPLY TO
PATENT OWNER RESPONSE**

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PETITIONER’S UPDATED EXHIBIT LIST

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1001	U.S. Patent No. 10,894,503 B2 to Spero (“the ’503 patent”)
1002	File History of U.S. Patent No. 10,894,503 B2 (“Prosecution History”)
1003	Declaration of Dr. Jianzhong Jiao (“Jiao Decl.”) in support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,894,503
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1005	U.S. Patent No. 6,144,158 to Beam
1006	U.S. Patent Publication No. 2001/0019486 to Thominet
1007	WIPO Patent Publication No. 2001/070538 to Stam <i>et al.</i>
1008	U.S. Patent No. 6,049,749 to Kobayashi
1009	WIPO Patent Publication No. 2002/004247 to Braun <i>et al.</i>
1010	WIPO Patent Publication No. 1998/054030 to Karlsson
1011	WIPO Patent Publication No. 2001/001038 to Harbers <i>et al.</i>
1012	U.S. Patent No. 5,588,733 to Gotou
1013	WIPO Patent Publication No. 1986/005147 to Flaaten
1014	U.S. Patent No. 5,707,129 to Kobayashi
1015	Westermann, “History and Scientific Back-up,” 48 th Session of GRE, EUREKA Project 1403, Informal Document No. 30, April 30, 2002
1016	“Adaptive Front Lighting Systems (AFS),” 48 th Session of GRE, EUREKA Project 1403, Informal Document No. 28, April 12, 2002
1017	Hogrefe <i>et al.</i> , “Adaptive Light Pattern – A New Way to Improve Light Quality,” SAE Transactions, Vol. 106, No. 6, pp. 1-10, February 27, 1997
1018	Löwenau <i>et al.</i> , “Adaptive Light Control – A New Light Concept Controlled by Vehicle Dynamics and Navigation, SAE Transactions, Vol. 107, No. 6, pp. 31-36, February 26, 1998
1019	Manassero <i>et al.</i> , “Adaptive Headlamp: A contribution for Design and Development of Motorway Light,” SAE Transactions, Vol. 107, No. 6, pp. 1-6, February 26, 1998
1020	Michael Hamm, “System Strategies for Adaptive Lighting Systems,” 2001 Symposium: Progress in Automobile Lighting (PAL), pp. 368-380, September 26, 2001
1021	U.S. Patent Publication No. 2013/0258688 to Kalapodas
1022	<i>Intentionally Left Blank</i>

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1023	Manassero et al., Adaptive Lighting Systems: Technical Solutions and Methodological Approach for Photometric Specifications, Progress in Automotive Lighting Vol. 6, pp. 514-525 (1999).
1024	Hanno Westermann, Lighting Performance Requirements in Vehicle Lighting Exemplified by System Requirements for AFS, Progress in Automotive Lighting Vol. 6, pp. 807-820 (1999).
1025	Diem et al., Analysis of the Eye-Movement Behaviour During Use Moveable Headlamps, Progress in Automotive Lighting Vol. 5, pp. 185-207 (1999).
1026	Kobayashi & Sugimoto, Development of the Phase-I AFS Front Lighting System, Progress in Automotive Lighting Vol. 5, pp. 449-464 (1999).
1027	<i>Intentionally Left Blank</i>
1028	Bernhard Wörner, Adaptive Frontlighting – Experimental System, Development and Functional Evaluation, Progress in Automotive Lighting Vol. 6, pp. 844-853 (1999).
1029	<i>Intentionally Left Blank</i>
1030	Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005)
1031	<i>Intentionally Left Blank</i>
1032	First Amended Complaint, Torchlight Techs. LLC v. Daimler AG, et al., Civil Action No. 1:22-cv-00751 (D. Del.), filed August 26, 2022 (ECF No. 24)
1033	File History of Ex Parte Reexamination of U.S. Patent No. 9,955,551, Control No. 90/014,815
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1035	United States District Courts – National Judicial Caseload Profile, June 2022
1036	U.S. Patent No. 5,523,193 to Nelson
1037	U.S. Patent No. 5,537,433 to Watanabe
1038	U.S. Patent No. 4,662,746 to Hornbeck
1039	U.S. Patent No. 5,061,049 to Hornbeck
1040	U.S. Patent No. 5,933,183 to Enomoto <i>et al.</i>
1041	<i>Intentionally Left Blank</i>
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1051	Supplemental Declaration of Dr. Jianzhong Jiao
1052	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2023-00197 regarding U.S. Patent No. 10,894,503
1053	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2023-00315 regarding U.S. Patent No. 9,955,551
1054	Transcript of the Deposition of Matthew A. Turk, Ph.D., in IPR2022-01586 regarding U.S. Patent No. 11,208,029
1055	<i>Intentionally Left blank</i>
1056	Moddel, G., Spatial Light Modulators: Processing Light in Real Time, <i>Optics and Photonics News</i> , pp. 17-21 (March 1997)
1057	U.S. Patent No. 6,132,072 to Turnbull et al.
1058	U.S. Patent No. 5,754,217 to Allen
1059	U.S. Patent No. 6,195,136 to Handschy et al.
1060	<i>Intentionally Left blank</i>
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1062	U.S. Patent No. 4,907,044 to Schellhorn et al.
1063	Leighty, et al., “Developing Technologies for Army Autonomous Land Vehicles (U),” Army Engineer Topographic Labs, Fort Belvoir, October 1985 (accessible online at https://apps.dtic.mil/sti/tr/pdf/ADA187972.pdf , last accessed October 30, 2023)
1064	Lowrie, et al., “The Autonomous Land Vehicle (ALV) Preliminary Road-Following Demonstration,” Proceedings of SPIE, Vol. 579 Intelligent Robot and Computer Vision, 1985 (accessible at https://home.ttic.edu/~mturk/pubs/ALVpreliminary-SPIE1985.pdf , last accessed October 30, 2023)
1065	Surface Vehicle Recommended Practice, SAE International, J1383, May 2018
1066	Standard No. 108; Lamps, reflective devices, and associated equipment, 49 C.F.R. § 571.108 (November 3, 2023)

Exhibit #	Description
1067	Terminology: Motor Vehicle Lighting, SAE J387, November 1987
1068	“The International System of Units (SI),” Bureau International des Poids et Mesures, 7th Edition (1998) (Excerpt)
1069	Surface Vehicle Standard: Color Specification, SAE International, J578, February 2019
1070	Second Declaration of Matthew A. Turk, Ph.D. in IPR2023-00315 regarding U.S. Patent No. 9,955,551

I. INTRODUCTION

Petitioner’s clear, compelling prior art combinations presented in the Petition and confirmed by undisputed expert Dr. Jiao showed all challenged claims are unpatentable. Patent Owner’s (“PO”) Response relies on unsound, uninformed testimony from Dr. Turk—who is not even a person of ordinary skill in the art (“POSA”)—manufacturing shortcomings that do not exist in the art or combinations. It is not difficult to see through PO’s attempt to muddy the waters.

First, alleging “particularity” deficiencies in the Petition that the Board already dismissed, DI, 21-22, PO’s arguments distract from the grounds presented clearly on the record. Second, PO’s scattershot technical arguments mischaracterize the art, misinterpret claim language, and misunderstand what a POSA would have understood. PO’s reliance on their non-expert, non-POSA declarant, Dr. Turk, compounds these errors. PO relies, without additional support, on Dr. Turk’s fundamental misunderstandings of and lack of knowledge of the relevant headlight technology that the parties agree applies here.

All of PO’s arguments fail. Indeed, contrary to PO’s assertions, the Beam-Thominet and Karlsson-Harbers grounds disclose directional light sources aimed at different angles. And it would have been plainly obvious to a POSA to make the simple substitution of a curved light/LED substrate for a flat substrate for the reasons in the Petition. Moreover, unsurprisingly, each adaptive headlight

combination determines illumination for first and second subsections relative to a predefined illuminance, as the Petition comprehensively explained. Finally, the combination of Kobayashi and Gotou in the Beam-Thominet and Karlsson-Harbers grounds, respectively, renders the road curvature dependent claims obvious.

II. DR. TURK IS NOT AN EXPERT AND HIS TESTIMONY SHOULD HAVE NO WEIGHT.

Dr. Turk's declarations (EX2001, EX2006) should be excluded or accorded no weight because he is not a POSA. The parties agree, and the Board accepted, that a POSA here would have *two years of industry experience in the area of automotive lighting and lighting-control systems*. DI, 7; Pet., 9; POR, 9; EX1051, ¶¶6-8. Dr. Turk accepted this definition (EX1052, 23:7-19), but does not meet it (and never has).

Only qualified experts can testify about issues of claim construction and validity. *HVLPO2, LLC v. Oxygen Frog, LLC*, 949 F.3d 685, 689 (Fed. Cir. 2020); *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1361 and n.3 (Fed. Cir. 2008). This requirement extends to “ultimate conclusions” on those issues and to “underlying technical” determinations. *HVLOP2*, 949 F.3d, 689; *Sundance*, 550 F.3d, 1363 (“it is an abuse of discretion to permit a witness to testify as an expert on the issues” from the perspective of a POSA “unless that witness is qualified as an expert in the pertinent art”).

“To offer expert testimony from the perspective of a skilled artisan in a

patent case—like for claim construction, validity, or infringement—*a witness must at least have ordinary skill in the art*. Without that skill, the witness’ opinions are neither relevant nor reliable.”¹ *Kyocera Senco Indus. Tools v. Int’l Trade Comm’n*, 22 F.4th 1369, 1375-77 (Fed. Cir. 2022); *see Sundance* 550 F.3d, 1363-1364.

Dr. Turk is not a POSA (EX1051, ¶10) and cannot testify on issues of claim construction or validity. There is no genuine dispute that Dr. Turk lacks “2 years of industry experience in the area of automotive lighting and lighting-control systems.” Pet., 9. Dr. Turk’s industry experience relates to “computer vision methods for recognizing human faces, gestures, and activity.” EX2006, ¶12. The closest “bit” of relevant experience Dr. Turk identified was at Martin Marietta (EX1054, 53:4–25), working on “computer vision for autonomous vehicle navigation,” not automotive lighting and lighting-control. EX2006, ¶12; EX1051, ¶¶41-49. Dr. Turk did not work on any type of headlight control, much less adaptive headlight control as claimed here. There is no evidence that Dr. Turk has any requisite “industry experience in the area of automotive lighting and lighting-control systems” required of a POSA. Pet., 9; EX1051, ¶¶48-49.

Petitioner’s expert, Dr. Jiao’s, industry experience stands in stark contrast to Dr. Turk’s. EX1051, ¶¶25, 32-40; EX1003, ¶¶9-11 (discussing Dr. Jiao’s decades of experience in “adaptive front-lighting system (AFS) technologies”). As an

¹ Emphasis added unless noted.

unquestioned expert in the field—confirmed by PO’s Dr. Turk (EX1054, 58:9-19, 59:16-19)— Dr. Jiao opines that Dr. Turk lacks the requisite industry experience required of a POSA. EX1051, ¶¶11-31. For example, Dr. Jiao testified that a POSA would know that “intensity,” in the context of automotive lighting, includes direction and is not synonymous with “brightness,” which Dr. Turk does not understand. EX1051, ¶¶13-16; EX1054, 62:18-25. Dr. Jiao also confirms that Dr. Turk does not understand other concepts readily known to a POSA including: basic terms (such as “beam pattern”), glare reduction standards, using zero emission light to reduce glare, and other concepts. EX1051, ¶¶17-20. Dr. Turk does not understand how a POSA would measure, e.g., intensity (in development or under certain regulations) and is not familiar with leading consortiums or conferences. EX1051, ¶¶21-27.

Notably, Dr. Turk has never worked for a vehicle headlight company, an LED (or other light source) company, or a general lighting company; never designed a vehicle forward lighting system; and has no patents, awards, or papers for vehicle forward lighting. EX1054, 52:18-53:1, 54:24-56:12; EX1051, ¶¶28, 48-49.

Dr. Turk was also unable to answer straightforward questions—that a POSA would have readily been able to answer—about adjusting headlight beam patterns according to different driving conditions. For example, when asked: “Would a

person skilled in the art want to adapt the light intensity of the headlamp on an illuminated urban road differently from an unilluminated country road,” Dr. Turk replied, “[i]n general, *I don’t know what a person of ordinary skill in the art wants to do.*” EX1052, 126:6-15, 108:5-11, 114:24-115:7.

PO may try to rehabilitate Dr. Turk’s qualifications, but the law dictates that he cannot meet the POSA requirement. His industry experience “in the area of automotive lighting and lighting-control systems,” Pet., 9, if any, amounts to nothing more than “vague reference[s]” that “fall[] short of establishing two years of...work experience” and should be “given no weight,” *Avail Medsystems, Inc. v. Teladoc Health, Inc.*, IPR2022-00444, Paper 10, 24, 26 (P.T.A.B. July 21, 2022); *id.*, 24–26 (citing *Kyocera*, 22 F.4th, 1375–78).

III. PO’S “PARTICULARITY” ARGUMENT IS MERITLESS.

PO backed itself into a corner by choosing an unqualified expert. Having no credible missing element arguments and in the face of the reference-supported rationales that a POSA would have to combine conventional prior art elements, PO attempts to re-cast Petitioner’s simple case of unpatentability as unclear.

There are only two sets of grounds here: (1) based on Beam-Thominet, and (2) based on Karlsson-Harbers. Pet., 4. The Board should confirm its finding of sufficient particularity. DI, 21-22.

Despite the Board’s understanding of the asserted combinations, PO doubles

down on its theory that the Petition provided numerous “alternative positions.”

POR, 24-25. Distracting from the merits, PO artificially creates forty-one “Sub-Grounds.” POR, 15. In doing so, PO conflates independent reasons—*from the prior art*—why the ’503 patent claims are unpatentable.

IV. THE PRIOR ART DISCLOSED DIRECTIONAL LIGHT SOURCES AIMED AT DIFFERENT ANGLES [20.2]/[59.2].

A. Beam-Thominet and Beam-Thominet-Stam disclose [20.2]/[59.2].

1. Beam’s microbeam sources are “directional light sources.”

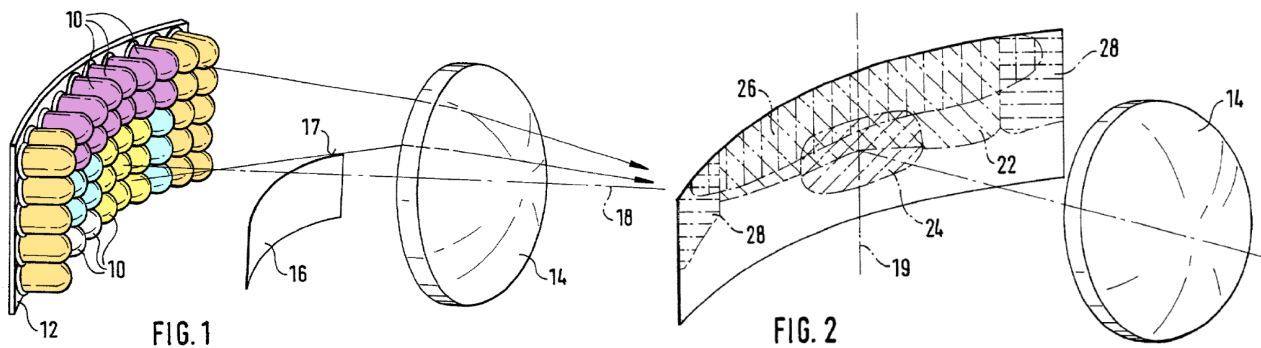
Beam’s headlight includes three directional light sources aimed at different angles with its lamp 202/LEDs 401 (emitter) and spatial-light-modulator (SLM) 203. EX1005, 4:26-59, 5:28-31, 5:61-65, 8:4-12; Pet., 23-25; EX1003, ¶¶70, 147; EX1051, ¶¶50-57, 61-63; EX2025, 21:13-21 (“[M]icrobeam includes emitter, whether it’s lamp or LEDs, and spatial light modulator, which is [an] optical element.”). Emitters for “directional” light sources include an optical element—otherwise, light emission is omnidirectional. EX1051, ¶¶61-66. Because Beam’s emitter/SLM controls the “angular position” of “narrow-angle microbeams” independently, Beam’s lamp/LEDs/SLM are “directional light sources aimed at different angles.” EX1003, ¶147; EX1051, ¶67; EX1052, 31:16-32:1.

Beam’s microbeam sources also meet the Board’s definition—lamp/LED-array and SLM receive an electrical signal from Beam’s controller, thereby producing multiple-angled microbeams. DI, 7-8; EX1005, 4:26-59, 5:28-31, 5:61-

65, 8:4-12; 17:10-15; EX1051, ¶68. Indeed, a POSA would understand that Beam's lamp/LEDs plus SLM are "other such systems" that are "light sources" according to the '503 patent. EX1005, 17:10-15; EX1051, ¶68.

2. Thominet's curved substrate includes "at least three directional light sources aimed at different angles."

PO does not allege Beam-Thominet is missing element [20.2]/[59.2]. Rather, PO/Dr. Turk merely contest the motivation to combine. *Infra* §V; Pet., 25-33. Thominet's curved-substrate LED array shows this. DI, 15; EX1006, ¶18; Pet., 35; EX1003, ¶¶150-151, EX1051, ¶¶69-70. And Beam-Thominet confirms physically "directional light sources" were known and obvious. Pet., 25-32; EX1003, ¶¶123-141, 153-170.



EX1006, FIGS. 1-2 (annotations from Pet. 36).

B. Karlsson-Harbers discloses [20.2]/[59.2].

1. Karlsson’s spotlight beam sources are “directional light sources.”

Karlsson’s headlight discloses this feature with its “spotlight beams.”

EX1010, 4:25-31, 14:5-15, FIGS. 3, 6; 11:25-28, 14:1-4, 19:29-33, FIG. 14; Pet. 77; EX1003, ¶¶368-369; EX1051, ¶¶130-132. Karlsson’s spotlight beams include “a plurality of light sources and/or light modulators,” independently aimed. EX1010, 21:12-16; Pet., 77; EX1003, ¶333.

Contrary to PO’s assertions (POR, 66-67), Karlsson’s modulators aim spotlight beams via reflection. EX1010, 14:5-9 (modulators individually “transmit light, [] block light and/or [] *reflect* light.”); EX1003, ¶¶368-369; EX1051, ¶¶133-134. The Board overlooked that Karlsson’s modulators are “controlled to transmit light to a specified degree, so that a desired light intensity can be adjusted for each individual spotlight beam 34.” EX1010, 4:1-15; DI, 14; Pet., 77; EX1003, ¶¶333-334; EX1051, ¶¶132-135.

2. Harbers’s curved substrate includes “at least three directional light sources aimed at different angles.”

Harbers’s independently controllable opto-electronic elements are arranged on a curved substrate—directional light sources aimed at different angles. EX1011, 7:27-32; EX1003, ¶371; Pet., 80-87; EX1003, ¶¶343-359; EX1051, ¶¶136-138.

PO does not allege that Karlsson-Harbers lacks [20.2]/[59.2]. Again, PO/Dr. Turk only contest the clear motivation to combine. *Infra* §V.

V. A POSA WOULD HAVE BEEN MOTIVATED TO COMBINE THOMINET’S/HARBERS’S CURVED SUBSTRATE WITH BEAM’S/KARLSSON’S HEADLIGHT LED ARRAY TO IMPROVE DRIVER VISIBILITY.

The Board invited the parties to address: (1) whether Petitioner’s rationale for combining Thominet’s/Harbers’s curved substrates with Beam’s/Karlsson’s headlights is sufficient (it is), and (2) whether the law requires a specific, additional motivation to include an “optional” aspect of the secondary reference with the primary reference (it does not). DI, 19-20.

A. Implementing a curved substrate with Beam’s/Karlsson’s headlights would improve driver visibility.

To the extent that the claims require light sources *physically aimed at different angles*, Thominet and Harbers show substituting a curved LED array for a flat LED array was obvious. EX1006, 18; EX1011, 7:27-32; Pet., 30-32, 85-87; EX1003, ¶¶138, 356; EX1051, ¶¶84-85, 146-148. Arranging Beam’s/Karlsson’s LEDs on a curved surface, as in Thominet/Harbers, would have “provid[ed] different spatial distributions for different driving situations.” Pet., 30-32, 85-87; EX1003, ¶¶138, 356. Thus, Beam-Thominet’s/Karlsson-Harbers’s headlight systems would “improve[e] visibility and thereby safety.” Pet., 30-31, 85-86; EX1003, ¶¶135-141, 164-170, ¶¶354-359, 384-389; EX1051, ¶¶85-86, 148-149.

In response to Dr. Turk’s unsupported argument (EX2006, ¶¶142-147, 206), a POSA seeking to improve driver visibility by modifying headlights—as

explained in Dr. Jiao’s First Declaration (EX1003, ¶¶135-141, 164-170, 354-359, 384-389)—would have known that curved substrates enhance a headlight’s optical performance, for example, by minimizing distortion. EX1051, ¶¶87, 150.

B. No “additional” motivation is required in this case.

The Petition provided multiple rationales—no “additional” rationale is required. Pet., 30-33, 85-87.

Instructively, in *Intel Corp. v. PACT XPP Schweiz AG*, the Federal Circuit explained that when two known techniques “address the same problem,” replacing one for the other requires no “‘improvement’ in a categorical sense.” 61 F.4th 1373, 1380-1381 (Fed. Cir. 2023). There is no need for “an obvious improvement” to the primary reference. *Id.*, 1380. Rather, so long as the known technique is a “suitable option” for addressing the same problem, “then there is a motivation to combine.” *Id.*

Here, Thominet and Harbers each described two known techniques—flat/curved substrate—for generating headlight beams with different spatial distributions. Because Thominet’s/Harbers’s curved substrates are both suitable options, the Petition’s explanation is sufficient. Pet., 30-33, 85-87; EX1003, ¶¶135-141, 164-170, 354-359, 384-389; EX1051, ¶¶84, 146.

Intel is not “inapposite” as PO alleges. POR, 43. Neither Thominet nor Harbers discourages a POSA from using a curved substrate with an anti-glare

headlight system. EX1051, ¶¶85, 147.

Why PO thinks *Ethicon* (No. 2020-1528, 2021 WL 3716397, *7 (Fed. Cir. Aug. 23, 2021)) aids its argument is unclear. POR, 40-41. There, the Federal Circuit *reversed* the Board’s finding of no motivation to combine. *Ethicon*, 7. Like here, there was no dispute that the “prior art teaches each and every limitation of all the challenged claims.” *Id.*, 5. Indeed, the Federal Circuit held that the Board erred in finding that a POSA would have not had motivation to use a component of one reference in another because it was allegedly “unnecessary,” and confirmed the petitioner’s rationales. *Id.*, 6; *see also Ethicon v. Intuitive* (Nos. 2021-1995, 2021-1997, 2022 WL 1613188) (discrediting PO’s declarant’s testimony for speculating against Petitioner’s motivation rationales and being “based on little evidentiary support in the record.”). *Intel* and *Ethicon* both support Petitioner’s motivation to combine.

C. A POSA would have had no issue in implementing Harbers’s curved substrate with Karlsson’s interspersed sensors.

Thominet and Harbers both disclose LEDs mounted on curved substrates. EX1051, ¶¶136-138; EX1006, ¶¶17-19, 28; EX1011, 7:27-32. Even Dr. Turk acknowledges this. EX1052, 101:13-22 (“Q ... [W]ould a [POSA] have understood how to implement light sources on a curved substrate[,] such as shown in Thominet? ... A: “I think a [POSA] would know how to mount them and probably connect them electronically and some other things you would want to

do.”) Mounting other types of semiconductors, such as photodiodes, with LED chips on a curved substrate was well within the level of ordinary skill in the art. EX1051, ¶138.

VI. A POSA WOULD HAVE BEEN MOTIVATED TO COMBINE THOMINET’S/HARBERS’S MULTI-FUNCTION BEAM SEGMENTS WITH BEAM’S/KARLSSON’S ADAPTIVE HEADLIGHTS TO IMPROVE DRIVER VISIBILITY.

A. Thominet is fully compatible with Beam.

PO incorrectly alleges Thominet would: (1) conflict with Beam’s anti-glare objective, (2) diminish Beam’s forward illumination, and (3) clash with Beam’s system. POR, 37-39, 43-47; EX1051, ¶¶88-98.

1. Beam’s and Thominet’s headlight control systems are fully compatible.

Beam does not suggest to a POSA that it *cannot increase light in a direction* by emitting a “beam [that] is at full intensity except in [the] areas that would dazzle a driver ahead.” EX1005, 4:57-59; EX1051, ¶90. PO/Dr. Turk rely on a misunderstanding of Beam to reach their illogical conclusion that Thominet’s multiple directional beam regions conflict with Beam’s anti-glare operation. EX2006, ¶155; POR, 46; EX1051, ¶¶13-28.

Dr. Jiao confirms that Beam’s system includes at least *both* low and high-beams achieved by its microbeams. EX1051, ¶¶91-92. And a POSA would have understood that Beam’s microbeams *must* be able to change direction to achieve these beam patterns, which by definition are *aimed in different directions*. EX1051,

¶¶91-92; EX2010, 237; EX2012, 8, FIGS. 11A, 11B; EX2013, 7. A POSA would thus understand that Beam *controls intensity including angular position* to a maximum desired in a given direction—not “full blast” everywhere at all times. EX1051, ¶¶93-94.

Beam “*control[s] the intensity, and/or the angular position,*” of its LEDs, configured as “an array of individual, independently controllable microbeam sources.” EX1005, Abstract 8:4-17, 2:53-3:3, 4:9-59, claims 4 and 5; EX1003, ¶¶74-82. This control is “*dynamically varying* in position and in size,” in response to the control input. EX1005, 6:24-27, 5:46-54. Beam adapts the headlights’ light pattern in both intensity *and* spatial distribution. Pet., 36-37; EX1003, ¶129; EX1051, ¶¶95-96. Thus, Beam’s beam pattern includes *directionality*. EX1051, ¶¶93-97.

Accordingly, Beam-Thominet provides a more direct, active, light beam “specifically aimed for different functions.” EX1003, ¶128; Pet., 25-29; EX1051, ¶98.

2. Beam-Thominet’s headlight provides sufficient forward illumination by actively directing beam segments for particular driving functions.

PO’s assertion that Thominet would “compromise” Beam’s headlight from providing “sufficient forward illumination” is wrong. POR, 44-45; EX1051, ¶99.

Dr. Jiao explained that employing “multiple directional beam regions with

different angles/aimings in Beam's system, as in Thominet," would "provide different spatial distributions for improved visibility in different driving situations." EX1003, ¶123. This system is "more direct, or active, or specifically aimed for different functions." EX1003, ¶128. Thus, Beam-Thominet's headlight distributes light to where illumination is desired according to the particular driving function—not somehow made worse for no reason as PO/Dr. Turk contend. POR, 44-45; EX1003, ¶128; EX1051, ¶¶100-104. Indeed, Beam itself describes adjusting the beam's spatial distribution "for conditions like rain, snow, or fog," as Dr. Jiao explained in his First Declaration. EX1005, 3:29-36; EX1003, ¶128; EX1051, ¶103.

3. Beam-Thominet's lamp/LED/SLM controls the angular position of each microbeam to achieve different light beam patterns.

Again, Beam's SLM adjusts the angular position of its microbeams, contrary to PO/Dr. Turk's position. POR, 36-37, 43-44; EX2006, ¶¶65-66; EX1051, ¶105. Beam's SLM controls the microbeams' angular positions/intensities via command signals. EX1051, ¶106; EX1005, 4:45-57. And Dr. Jiao confirmed that a POSA would have understood to "simply modify[] software instructions in memory of Beam's controller/processor to organize Beam's array of microbeams into multiple direction regions" taught by Thominet. Pet., 29-30; EX1003, ¶133; EX1051, ¶¶106-107.

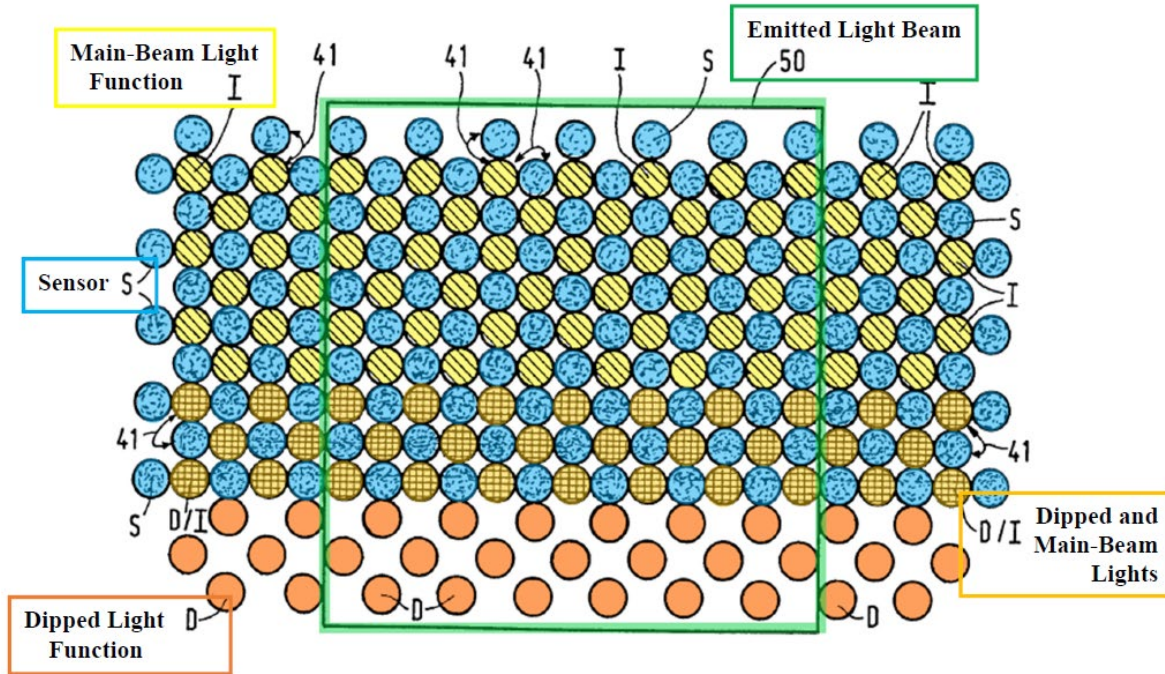
B. Harbers's beam segments are compatible with Karlsson's headlights.

Combining Harbers's multiple directional beam segments with Karlsson provides "different spatial/angular distributions for different driving situations, thereby improving driver safety." EX1003, ¶¶354-359, 384-389; Pet., 80-87; EX1051, ¶151.

PO mischaracterizes Karlsson's "optimally adapted" (EX1010, 9:25) beam based on Dr. Turk's uninformed opinion. POR, 12, 62-65; EX2006, ¶88; EX1051, ¶¶152-153, 166-168.

1. PO mischaracterizes Karlsson's "optimally adapted" beam.

PO/Dr. Turk wrongly conclude that Karlsson's emitted beam "us[es] the entire beam array at full intensity, except when avoiding glare, at which point, window 50, of reduced illumination (Fig. 14) is created to address glare situations." POR, 12; EX2006, ¶88; EX1051, ¶154. But Karlsson's actual emitted light beam 50 is represented as a window that shifts in the plane from left-to-right and from top-to-bottom (varying in shape, dimension etc.), based on inputs to Karlsson's controller. EX1010, 19:18-20:3; EX1003, ¶¶100-105; EX1051, ¶155.



EX1010, FIG. 14 (annotated).

Window 50 is a subset of the LEDs available. EX1052, ¶¶172-173; EX1051, ¶156; EX1010, 19:29-34; EX1003, ¶¶90-92; Pet., 13-14. And even Dr. Turk agreed that Karlsson’s beam “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.” EX1010, 19:29-34; EX1054, 132:15-25, 133:6-7, 134:2-7, 134:13-15.

Nothing suggests to a POSA that Karlsson operates with all of its LEDs active except to implement glare control. EX1010, 19:29-34; Pet., 18-20, 81; EX1003, ¶346; EX1051, ¶¶157-160. Rather, Karlsson’s optimally adapted system with individually and group controllable LEDs produces beam patterns based on

the data from inputs to Karlsson's controller. EX1010, 19:18-20:3; Pet., 18-20; EX1003, ¶¶99-104. Thus, Karlsson's optimum light effect is adapted for the driving condition consistent with Harbers. Pet., 80-87; EX1003, ¶¶344-358; EX1051, ¶161.

2. Harbers's colored LEDs are compatible with Karlsson.

Dr. Turk's new, baseless assertion that Karlsson's system "creates a color-shifting problem" demonstrates his lack of understanding of the claimed headlight technology. EX2006, ¶206; EX1051, ¶¶58-60, 162.

A POSA would have understood how to implement Harbers's colored-LEDs in Karlsson's headlight system to provide a dynamic light beam with desirable color output. EX1010, 4:10-14, 8:31-34, 10:6-10, 10:26-28; EX1051, ¶163; EX1003, ¶¶52, 357-358. Specifically, a POSA would have understood how to arrange the different color-LEDs in Karlsson's headlights to reduce "possible color effects [] for an observer looking into the light emitted by the vehicle headlamp." EX1011, 8:30-33; EX1051, ¶163. A POSA would have also understood how to configure the optical system in Karlsson-Harbers's system to "effectively mix the colors originating from the LEDs" to prevent any undesirable color-shifts. EX1011, 8:32-34; *see also* EX1006, ¶5 ("[L]ight of different colors is emitted and the partial quantities of the semiconductor light sources are operatable for producing a predetermined color of the light beam exiting the illumination

device.”); EX1051, ¶163.

A POSA also would have understood that forward illumination of Karlsson’s/Harbers’s headlights would be within a range of white color that would not result in “undesirable color shifts” purported by Dr. Turk. EX2006, ¶238; EX1051, ¶164; EX1069, 5-6. While Harbers discloses different colored-LEDs, the light beams generated from each colored light source have “a more or less ‘white’ appearance,” not the concocted rainbow spectrum Dr. Turk alleges. EX1011, 5:27-29; EX1051, ¶¶164-165.

VII. THE COMBINATIONS DISCLOSE A HEADLIGHT SYSTEM WITH A PROCESSOR DETERMINING ILLUMINATION FOR THE FIRST AND SECOND SUBSECTIONS OF CLAIMS 20 AND 59.

- A. Beam-Thominet and Beam-Thominet-Stam disclose a headlight system with a processor determining illumination for the first and second subsections.**
- 1. Beam’s headlight system includes a processor determining the “first subsection” [20.9]/[59.7].**

PO/Dr. Turk impermissibly add limitations absent from the ’503 patent claims, arguing that “Beam lacks any specific way to differentiate between different sources of incoming light.” POR, 49; EX2006, ¶163. This is not required (EX1051, ¶¶71-74), as Dr. Turk acknowledged. EX1001, 98:10:-14; EX1052, 40:12-13 (“I don’t think there’s anything in this claim that specifies how that vehicle was detected.”).

Beam’s headlight system includes a processor using sensor data to

determine, within a field-of-view, a first subsection including a detected vehicle.

DI, 20; EX1005, 6:14-19, 8:18-28; Pet., 43-45; EX1003, ¶¶184-185; EX1051, ¶¶71-74. Thus, Beam’s sensor detecting vehicle headlights, which are part of a vehicle, meets the claims’ plain language. EX1051, ¶74.

Furthermore, PO’s/Dr. Turk’s imparted reading—using pattern recognition to detect vehicles for anti-glare control—is not commensurate with the vehicle detection methods described in the ’503 patent for anti-glare control. POR, 48; EX2006, ¶¶159-163; EX1001, 50:35-58, 52:66-53:2. The ’503 patent describes determining vehicle presence via detecting headlights—the *same* approach as Beam. EX1001, 52:66-53:2 (“a detector or an imaging system of the oncoming vehicle position (*using its headlights* for example) can be used to determine which exact aiming ... for any given traffic situation.”); EX1051, ¶¶75-76.

Finally, Beam meets even PO’s/Dr. Turk’s re-written claim language. Dr. Jiao confirms that a POSA would have understood Beam’s controller *does distinguish* between light sources, filtering weak signals. EX1005, 5:34-36 (explaining spatial scene data is “thresholded” to eliminate weak signals and becomes the processor input); EX1051, ¶77. Beam’s filtering technique separates lights detected by the sensor into two classes: those that reflect/emit light above the threshold, and those that do not reflect/emit sufficient light. *See* Pet., 43; EX1051, ¶77. Beam’s controller thus distinguishes between stronger light sources

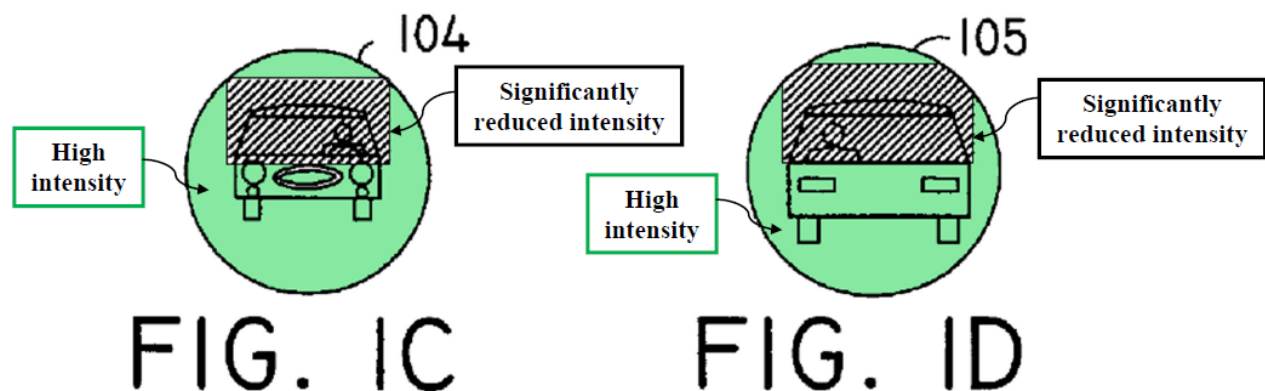
(headlights) and ambient light sources (street sign reflections). EX1051, ¶77.

2. Beam's headlight system includes a processor determining the "second subsection" [20.10].

Claim 20 recites a "second subsection not including the detecting vehicle," without specifying any boundary of the second subsection relative to the first.

EX1001, 98:10-14. So, the "second subsection" is not coextensive with the remaining area of the field of view outside of the "first subsection." EX1051, ¶78.

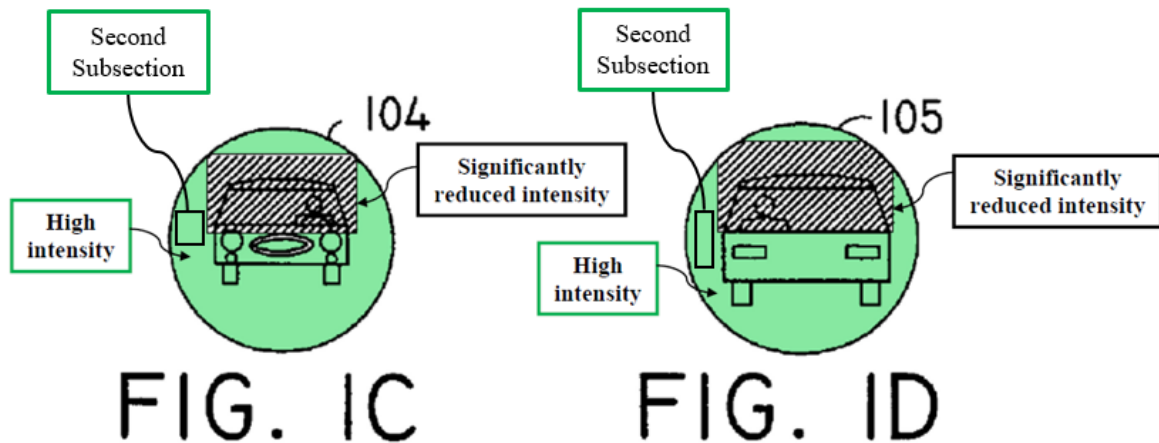
But PO/Dr. Turk surprisingly contend that Petitioner's proof for the "second subsection" fails because the green-highlighted "[h]igh intensity" section of Petitioner's annotated Figures 1C-1D—corresponding to the remainder of the field of view—includes part of the vehicle. EX2006, ¶¶173-174; POR, 53. Petitioner's annotated Figures 1C-1D of Beam, however, show areas outside of the "reduced intensity" subsection (the first subsection) that do *not* include the vehicle. EX1051, ¶¶79-81.



EX1005, FIGS. 1C, 1D (annotations from EX1003, ¶186).

PO/Dr. Turk ignore the areas in Beam's Figures 1C-1D that *do not include a*

vehicle, as explained in the Petition. Compare EX2006, ¶¶173-174; POR, 53 with Pet., 45-46; EX1003, ¶186; EX1005, 6:12-27. That is, any area *within* the green-highlighted section of Beam’s Figures 1C-1D that does *not* include a vehicle corresponds to the “second subsection.” EX1051, ¶¶82-83.



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

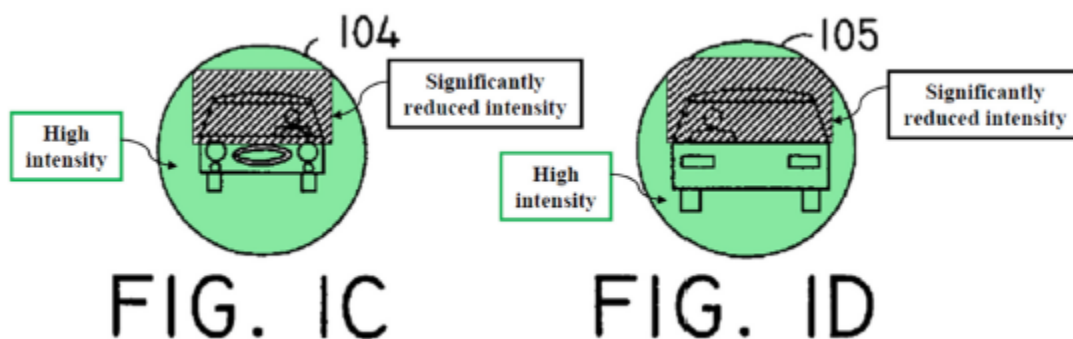
3. **Beam’s headlight system includes a processor determining a light output to illuminate a first subsection below a predefined illuminance [59.8-59.9].**

PO/Dr. Turk allege that Beam “determines whether to blank the light source, which is distinct from determining illumination.” POR 52; EX2006, ¶172. This is wrong. EX1051, ¶¶114-115.

When dimming an area that includes the detected vehicle (the first subsection), Beam’s controller determines light output for the first subsection. EX1005, 5:33-6:9; 2:66-3:1; Pet., 58-61; EX1003, ¶¶253-254. Specifically,

Beam's controller determines to illuminate the first subsection at a level significantly less than low-beams. EX1005, 2:66-3:1; Pet., 58-61. After determining what area should be dimmed based on sensor data, Beam's controller determines individual microbeams to attenuate to illuminate the first subsection at the lower level. EX1005, 4:16-19; Pet., 58-61. A POSA would have understood that Beam's attenuation/dimming to reduce glare includes the preceding processing steps of detecting vehicles and determining an area to be illuminated below the predefined illuminance. EX1051, ¶115; Pet., 58-61.

Dr. Turk believes that Beam's "provides no illumination directed at the 'blanked area.'" EX2006, ¶188; POR, 57. But Beam's area corresponding to the detected vehicles is *still illuminated*, but at a level "reduced significantly" compared to remaining areas of the headlights' field-of-view. EX1005, 4:19-25; EX1051, ¶116. Beam describes that "the area of the beam that would dazzle the driver will be darkened," but it is not completely dark. EX1005, 2:60-61.



EX1005, FIGS. 1C-1D (annotations from Pet., 58).

4. Stam's predefined illuminance level is compatible with Beam-Thominet.

Stam discloses a “predefined illuminance” by its specific dimmed illuminance value to reduce glare. EX1007, 1:14-31, 1:25-27; Pet., 53. A POSA would have been motivated to include a quantitative predefined dimmed (low beam) illuminance level in the combined Beam-Thominet system, as in Stam, to precisely control Beam's directional microbeams, furthering the purpose of improving driver safety. Pet., 53-55; EX1003, ¶¶203-210, 261-270, 280-288; EX1051, ¶¶111-113, 117.

PO's/Dr. Turk's assertion that Beam's strategy eliminates the need for Stam's predefined illuminance is premised on a misunderstanding that Beam does not determine illumination for dimmed sections. POR, 56; EX2006, ¶185. Dr. Jiao explained Beam's attenuation of microbeams to reduce glare toward drivers *includes the preceding processing steps of detecting vehicles and determining an area to be illuminated below low beam*. Pet., 40-45; EX1003, ¶¶182-187; EX1051, ¶112. A POSA would have understood that implementing a quantitative predefined dimmed illuminance level in the combined Beam-Thominet system, as in Stam, would provide light output that remains lower, furthering Beam's goal of reducing glare. Pet., 53-55; EX1051, ¶117.

B. Karlsson’s headlight system includes a processor determining the “first subsection” [20.9]/[59.7].

PO again relies on an unclaimed feature—a processor differentiating between types of light sources—attempting to distinguish over Karlsson. POR, 70 (alleging Karlsson’s controller “is agnostic to the source of the incoming light.”); EX2006, ¶227. As explained in §VI.A.1 and even acknowledged by Dr. Turk, the ’503 patent’s claims do not specify how the processor determines the presence of a vehicle. EX1051, ¶¶139-144.

Karlsson’s headlight controller detects vehicles using a light-sensitive sensor to detect vehicle headlights, which are part of a vehicle. EX1010, 9:9-25, 14:1-15; Pet., 99-100; EX1003, ¶¶408-409; DI, 20. Karlsson’s controller “automatically and dynamically adapt[s]” the “pattern of the light beam being emitted by the lighting device...in dependence on the intensity and the direction of the light being detected” such that “part of the light beam which might cause inconvenience to oncoming traffic is automatically suppressed.” EX1010, 2:4-9; EX1051, ¶¶139-141.

PO’s unsupported imparting of pattern recognition to detect vehicles for anti-glare control is not commensurate with the vehicle detection methods described in ’503 patent for anti-glare control. POR, 70; EX2006, ¶227; EX1001, 50:35-58, 52:66-53:2; EX1051, ¶¶141-142. Karlsson’s detection of vehicle headlights to determine the position of an oncoming vehicle relative to the

headlight is consistent with the methods described in the '503 patent. *Compare* EX1001, 50:53-58, 52:66-53:2 *with* EX1010, 9:9-25.

Finally, a POSA would have understood Karlsson distinguishes between light sources when determining the presence of a vehicle relative to the headlights by distinguishing vehicle lights from ambient light. EX1051, ¶¶143-144; EX1010, 5:16-18. Thus, Karlsson even discloses PO's/Dr. Turk's unsupported claim requirements. EX1051, ¶145.

VIII. BEAM-THOMINET-KOBAYASHI AND BEAM-THOMINET-STAM-KOBAYASHI RENDER OBVIOUS THE ROAD CURVATURE DEPENDENT CLAIMS 21-23 AND 60-62.

PO/Dr. Turk base their arguments against Beam-Thominet-Kobayashi on the same misunderstanding (*see supra* §VI.A.1) that Beam's "maximum intensity" does not include direction. POR, 59-60; EX2006, ¶¶194-198. Accordingly, PO/Dr. Turk incorrectly conclude that "the presented combination can do nothing with Kobayashi's map data," including increasing illumination in a direction of road curvature. EX2006, ¶198. As Dr. Jiao explains, PO's/Dr. Turk's understanding of Beam is wrong. EX1051, ¶¶120-123.

Beam expressly states that the *angular position* or *attenuation* "of each of these microbeams is independently set by controller 108," which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-52; EX1051, ¶¶123-125; EX1003, ¶70; Pet., 34, 47. Beam's "[c]ontrol is '*dynamically varying* in position

and in size,’ in response to the control input.” Pet., 65 (citing EX1005, 5:46-54, 6:24-27); *see also*; EX1003, ¶¶303-317; EX1051, ¶¶124-125. Thus, Beam’s headlights change direction of microbeams to form beam patterns. EX1051, ¶¶125-126. And a POSA would have been motivated to modify Beam-Thominet to adjust the directional light sources to increase illumination of a road curvature (e.g., thereby “increase[ing] illumination in a direction of the road curvature” as in claim 21) using map data, as in Kobayashi, to improve driver safety. Pet., 64-76; EX1003, ¶¶303-317; EX1008, 14:53-15:28; EX1051, ¶127.

IX. KARLSSON-HARBERS-GOTOU RENDERS OBVIOUS THE ROAD CURVATURE DEPENDENT CLAIMS 21-23 AND 60-62.

A. Karlsson’s spotlight beams are directional.

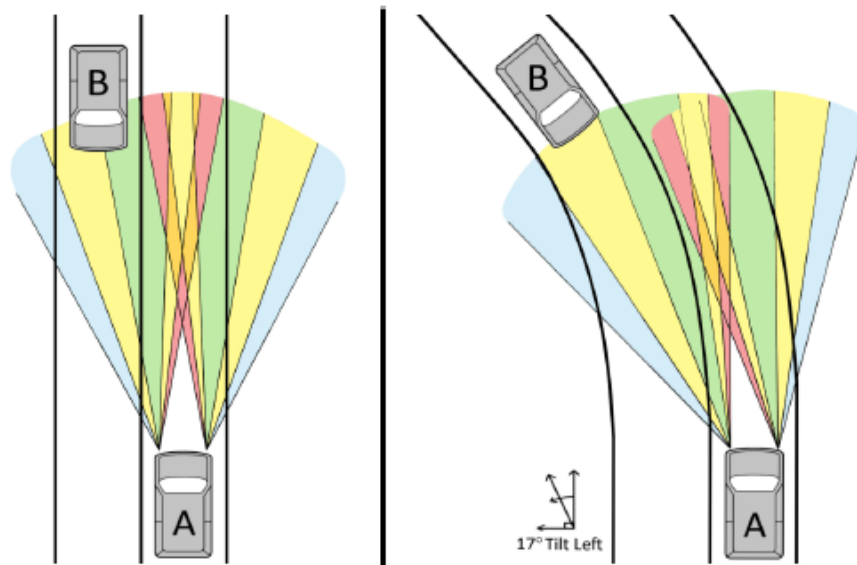
PO/Dr. Turk incorrectly allege that Karlsson’s headlight “lack[s] directional control.” POR, 73; EX2006, ¶237; EX1051, ¶¶170-172.

As explained in §VI.B.1, Karlsson’s beam 50 “shift[s] in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa, which may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam.” EX1010, 19:29-34; EX1051, ¶¶173-174. A POSA would have understood that Karlsson-Harbers-Gotou beam patterns—like known adaptive beam patterns at the time—would vary in direction, length, and width (angular distribution) from a bird’s eye view, or driver’s view with varying intensity points along a projected distance. EX1051, ¶¶156-157;

EX1003, ¶452. Because Karlsson's headlights control beam directionality, the angular position of Karlsson's emitted beam would be adjusted according to Gotou's techniques, without any conflicts. EX1051, ¶¶174-178. And a POSA would have been motivated to modify Karlsson-Harbers to adjust the directional light sources to increase illumination of a road curvature using map data, as in Gotou, to improve driver safety. EX1003, ¶¶443-460; EX1051, ¶¶174-178.

B. Karlsson-Harbers-Gotou would not have color-shifting issues.

Dr. Turk's rendering of Karlsson's color-segmented beam and assertion that the light beam outputted from the Karlsson-Harbers-Gotou combination would create undesirable color shifts show his lack of understanding of the art. EX2006, ¶¶238-239; POR, 72-73; EX1051, ¶179.



EX2006, ¶238: Dr. Turk's Schematic of Karlsson's Color-segmented Beam.

As explained in §VI.B.2, a POSA would have understood how to combine different colored LEDs in a headlight to emit a light beam having “a more or less ‘white’ appearance,” as demonstrated in Harbers and Thominet. EX1011, 5:27-28, 8:31-34, 10:6-10, 10:26-28; EX1006, ¶¶2, 5. While there may be subtle variations of illuminated color between the beam segments, the color of Karlsson-Thominet-Gotou’s headlight beam would be within a range of white color that would not result in “undesirable color shifts” purported by Dr. Turk. EX2006, ¶238; EX1051, ¶¶180-181; EX1069, 5-6. Dr. Jiao explains that the schematic in paragraph 238 of Dr. Turk’s Second Declaration is wholly incorrect and technically unsound. Dr. Turk’s schematic of Karlsson’s modified headlight beam, above, exaggerates the degree of color difference between beam segments. Karlsson-Thominet-Gotou’s multi-colored beam segments—consisting of various shades of white light—would not provide a rainbow color spectrum as purported by Dr. Turk. Simply put, there would be no color shifts when steering Karlsson-Harbers’s beam in view of Gotou’s map data/road curvature control. EX1051, ¶¶180-181.

X. THE PETITION SHOWED ALL DEPENDENT CLAIM ELEMENTS WERE IN THE PRIOR ART.

A. Claim 25

Beam discloses “reflectors, refractors, or lenses” of claim 25 by its optical system 106 and SLM 203. Pet., 50-51; EX1005, 8:4–12; EX1003, ¶199.

Contrary to PO’s assertions (POR, 53-54), Beam discloses an SLM with

LEDs. Pet., 50-51; EX1003, ¶¶199-201; EX1051, ¶¶50-57, 108-109. Beam specifically states that these elements are present in the same device. EX1005, 8:4-12; EX1051, ¶¶50-57, 108-109.

A POSA would have understood that Beam's optical system 106 redirects input light to form a desired light output distribution. EX1005, 5:17-21; EX1051, ¶110. Thus, Beam's optical system 106 is "usable to alter emitted light" from its light sources. EX1001, 98:39-42; EX1051, ¶110.

B. Claim 64

Petitioner showed that the Beam-Thominet and Harbers-Karlsson combinations disclose "reflectors, refractors, or lenses usable to alter the light emitted from at least one of the light sources" of claim 25. Pet., 50-51, 64, 112. Likewise, the Petition also showed "patentably indistinct" claim 64. Pet., 50-51, 64, 112.

Claim 64 only differs by adding "as part of the instructed adjustment." EX1001, 98:39-42 (claim 25), 102:57-61 (claim 64). As the Petition demonstrated, Beam's SLM includes "digital mirror devices" controlled by Beam's controller to alter light "as part of the instructed adjustment" by Beam's controller. Pet., 50-51; EX1003, ¶¶199-201, 293-295, 433-34; EX1051, ¶¶118-119, 169.

C. Claims 60-62

Petitioner showed that the Beam-Thominet-Kobayashi and Harbers-

Karlsson-Gotou combinations disclose the “increase illumination in a direction of the road curvature” of claims 21-23. Pet., 64-76, 113-126. Likewise, the Petition showed the patentably indistinct “light output that aims illumination in a direction of the road curvature” of claims 60-62. Pet., 64-76, 113-126. A POSA would have also understood that directing control circuitry to increase illumination, as recited in claims 21-23, would include determining a light output to illuminate the road curvature or turn. EX1051, ¶¶128-129, 182; Pet. 76, 123. Thus, Petitioner adequately addressed all limitations of claims 60-62.

Respectfully submitted,

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CERTIFICATE OF WORD COUNT (37 C.F.R. § 42.24(d))

1. This Petitioner's Reply complies with the type-volume limitation of 5,600 words, comprising 5,557 words, excluding the parts exempted by 37 C.F.R. § 42.24(c).

2. This Petitioner's Reply complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman font.

Respectfully submitted,

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CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e))

I certify that the above-captioned **PETITIONER VOLKSWAGEN
GROUP OF AMERICA, INC.'S REPLY TO PATENT OWNER RESPONSE**
and associated Exhibits 1051-1054, 1056-1059, 1062-1070 were served
electronically via e-mail in their entireties on January 5, 2024, upon the following
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