

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 IPR2023-00328
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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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
1004	<i>Curriculum Vitae</i> of Dr. Jianzhong Jiao
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
1034	<i>Intentionally Left Blank</i>
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 IPR2023-00328 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>
1061	<i>Intentionally Left Blank</i>
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

Exhibit #	Description
1066	Standard No. 108; Lamps, reflective devices, and associated equipment, 49 C.F.R. § 571.108 (November 3, 2023)
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, 14-15, 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 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 the method steps of determining an illumination for first and second subsections relative to the predefined illuminance. And it would have been obvious to a POSA to make the simple substitution of a curved light/LED substrate for a flat substrate as explained in the

Petition. Moreover, the combination of Kobayashi and Gotou in the Beam-Thominet and Karlsson-Harbers grounds, respectively, renders the road curvature dependent claims obvious. Furthermore, the combination of Braun in the Beam-Thominet and Karlsson-Harbers grounds renders the pattern-recognition dependent claims obvious. Finally, the combination of Harbers with Beam-Thominet and Karlsson renders the multi-colored beam segment 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 and Board agree that a POSA would have *two years of industry experience in the area of automotive lighting and lighting-control systems*. DI, 7-8; Pet., 6; POR, 3. Dr. Turk accepts this definition (EX1053, 23:7-19), but does not meet it.

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 extends to “ultimate conclusions” on those issues and to “underlying technical” determinations. *HVLOP2*, 949 F.3d at 689; *Sundance*, 550 F.3d at 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 at 1363-64.

Dr. Turk is not a POSA (EX1051, ¶¶10-49) 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., 6. 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, ¶49. Dr. Turk did not work on any type of headlight control, much less adaptive headlight control 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., 6; EX1051, ¶49.

¹ Emphasis added unless noted.

Petitioner's expert, Dr. Jiao's, industry experience starkly contrasts Dr. Turk's. EX1051, ¶25; EX1003, ¶¶9-20 (discussing Dr. Jiao's decades of experience in "adaptive front-lighting system (AFS) technologies"). As an 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, ¶¶10-49. 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. Dr. Jiao also confirms that Dr. Turk does not understand other concepts known to a POSA: basic terms (such as "beam pattern"), glare reduction standards, using zero emission light to reduce glare, and other concepts. EX1051, ¶¶12-28. Dr. Turk does not understand how a POSA would measure, e.g., intensity (in development or under regulations) and is not familiar with leading consortiums or conferences. EX1051, ¶¶24, 29-31.

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, ¶48.

Dr. Turk was also unable to answer questions that a POSA would have been able to answer about adjusting headlight 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, *see also* 65:15-25, 66:20-25, 78:18-25, 79:25-80:7, 108:5-11, 114:24-115:7, 141:6-12.

PO may try to rehabilitate Dr. Turk’s qualifications, but the law dictates he cannot meet the POSA requirement. His industry experience “in the area of automotive lighting and lighting-control systems,” Pet., 6, if any, merely amounts to “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 at 24, 26 (P.T.A.B. July 21, 2022); *id.*, 24–26 (citing *Kyocera*, 22 F.4th at 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 facing 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, based on: (1) Beam-Thominet, and (2) Karlsson-Harbers. Pet., 3. The Board should confirm its finding of sufficient particularity. DI, 14-15.

Despite the Board’s understanding of the combinations, PO doubles down on its theory that the Petition provided numerous “alternative sub-grounds.” POR, 7, 17-20. Distracting from the merits, PO artificially creates sixty-one “Sub-Grounds.” POR, 17. In doing so, PO conflates independent reasons—from the *prior art*—why the ’503 patent claims are unpatentable.

IV. THE COMBINATIONS DISCLOSE A HEADLIGHT BEAM GENERATION METHOD INCLUDING DETERMINING ILLUMINATION AS IN CLAIMS 26 AND 65.

The Board should reaffirm its Institution Decision finding and reject PO’s arguments against the Beam-Thominet, Beam-Thominet-Stam, and Karlsson-Harbers combinations, which are substantially similar to the POPR. *Compare* POPR, 30-41, *with* POR, 40-44, 58-63; DI, 10-14. The POR does not cure the flaws of the POPR. EX1051, ¶¶61-190.

A. Beam-Thominet and Beam-Thominet-Stam.

1. Beam *determines* illumination for a first subsection in generating its headlight beam [26.4]/[65.3-65.5].

PO/Dr. Turk allege, wrongly, that Beam “[d]etermin[es] which light to ‘extinguish,’” which “is not determining ‘illumination.’” POR 40; EX2006, ¶¶171-174; EX1051, ¶¶63-65.

When dimming an area that includes the detected vehicle (first subsection), Beam’s controller determines light output for the first subsection. EX1005, 5:33-6:9; 2:66-3:1; Pet., 23-25; EX1003, ¶¶151-153. Specifically, Beam’s controller

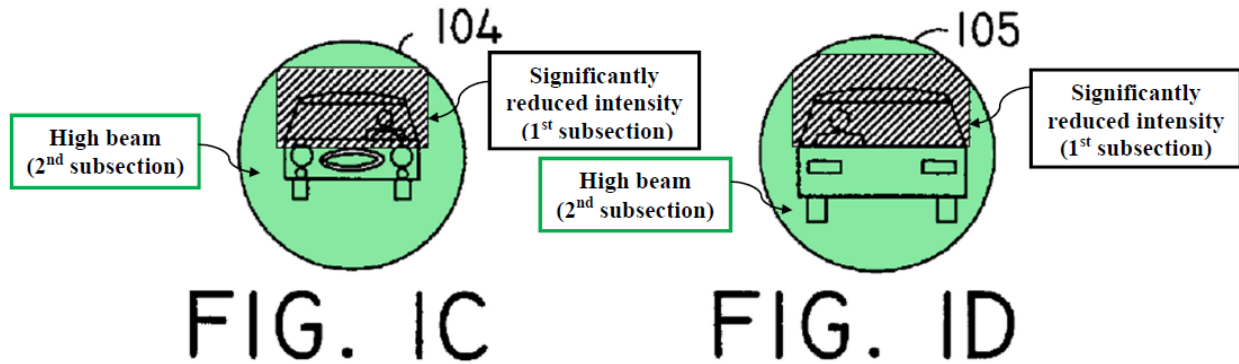
determines to illuminate the first subsection at a level significantly less than low-beams. EX1005, 2:66-3:1; Pet., 44. After determining an area to dim based on sensor data, Beam's controller determines individual microbeams to attenuate to illuminate the first subsection at the lower level. EX1005, 4:16-19; Pet., 23-25. 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, ¶¶63-65; Pet., 23-25.

2. Beam determines illumination for a second subsection not including the other vehicle in generating its headlight beam [26.5].

Claim 26 recites a “second subsection of the field-of-view not including the other vehicle or pedestrian,” without specifying any boundary of the second subsection relative to the first. EX1001, 98:57-58. The “second subsection” is not coextensive with the remaining area of the field-of-view outside of the “first subsection.” EX1051, ¶¶66-71.

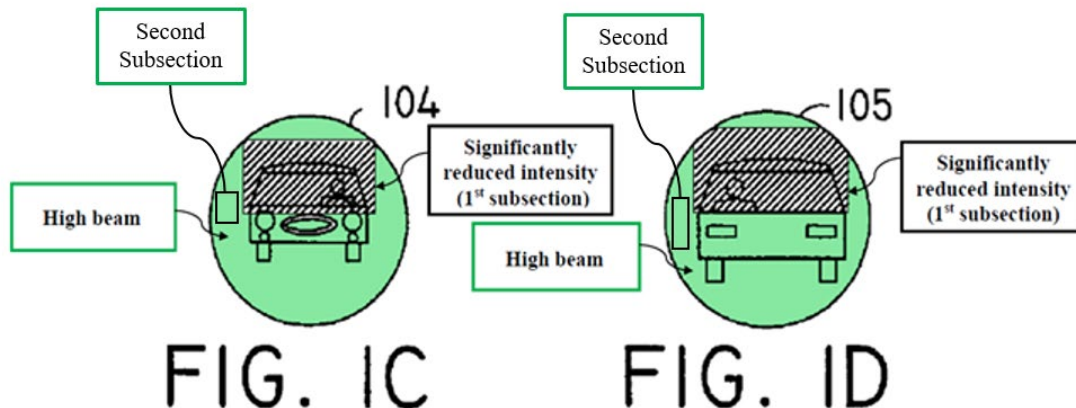
Yet PO/Dr. Turk surprisingly contend that Petitioner's proof for the “second subsection” fails because the green-highlighted “high beam” area of Petitioner's annotated Figures 1C-1D—corresponding to the remainder of the field-of-view—includes part of the vehicle. EX2006, ¶¶175-176; POR, 41. Petitioner's annotated

Figures 1C-1D of Beam, however, show areas outside of the “reduced intensity” area (first subsection) that do *not* include the vehicle. EX1051, ¶68.



EX1005, FIGS. 1C-1D (annotations from EX1003, ¶155).

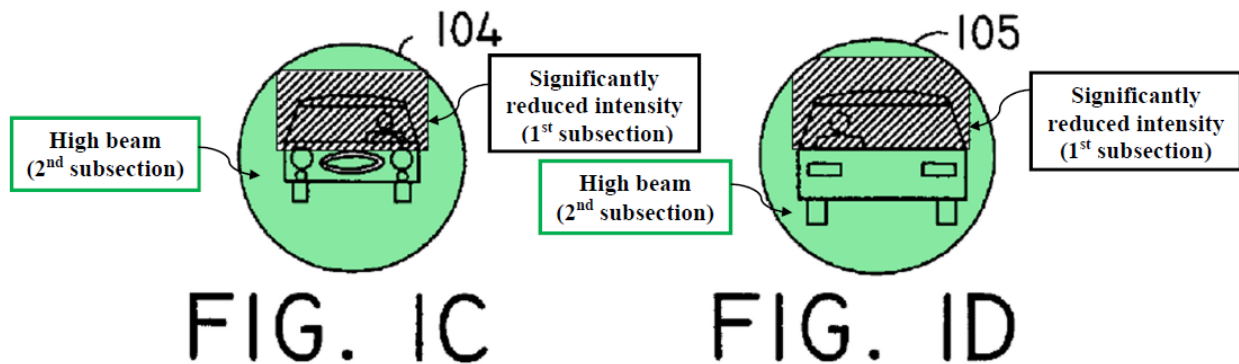
PO/Dr. Turk ignore the areas that *do not include a vehicle*, as explained in the Petition. *Compare* EX2006, ¶¶175-176; POR, 41 *with* Pet., 25-26; EX1003, ¶¶154-156; EX1005, 6:12-27. That is, any area *within* the green-highlighted section that does *not* include a vehicle corresponds to a “second subsection” (examples below). EX1051, ¶71.



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

3. Beam *illuminates* the first subsection below a predefined illuminance in generating its headlight beam [65.5-65.6].

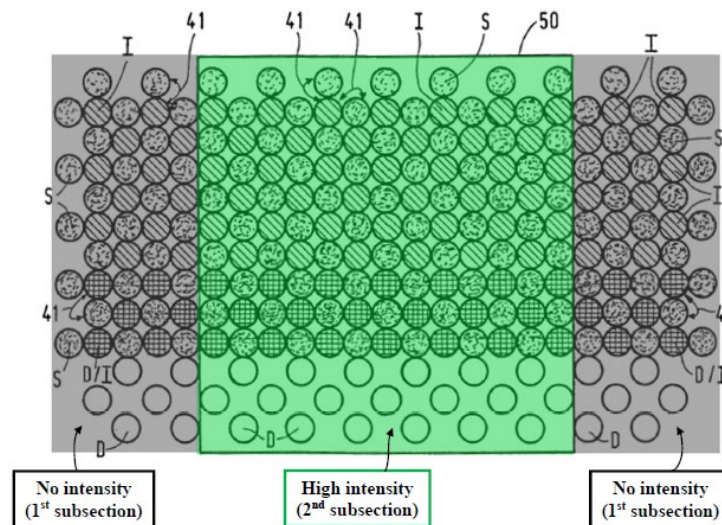
Dr. Turk incorrectly believes that Beam's headlight system "provides no illumination directed at the 'blanked area.'" EX2006, ¶192; POR, 43; EX1005, 6:30-33; Pet., 44-45; EX1003, ¶¶233-239. Beam's area corresponding to the detected vehicles is *still illuminated*, but at a level "reduced significantly" compared to remaining areas of the headlights' field-of-view. EX1005, 4:19-25; EX1051, ¶¶72-74. 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. Regardless, combining Stam's "threshold" for preventing glare with Beam-Thominet would have resulted in *illuminating* Beam's first subsection below a predefined illuminance. Pet., 46; EX1003, ¶¶204-256.



EX1005, FIGS. 1C-1D (annotations from EX1003, ¶125).

B. Karlsson-Harbers determines illumination for a “first subsection” [26.4]/[65.3] and a “second subsection” [26.5]/[65.4] in generating its headlight beam.

PO/Dr. Turk fail to understand Karlsson’s Figure 14, incorrectly concluding that “there is no teaching in Karlsson” showing “Fig. 14 represents control over an array responsive to detected light.” EX2006, ¶266, *see also* ¶¶259-279; POR, 58-64; EX1010, 9:6-26, 14:1-15; Pet., 92-96; EX1003, ¶¶478-487; EX1051, ¶¶124-125.



EX1010, FIG. 14 (annotations from EX1003, ¶481).

Karlsson’s explicit disclosure supports Petitioner’s annotated Figure 14 showing LEDs correspond to a “first subsection” and “second subsection.” Pet., 92-95; EX1003, ¶¶478-487; DI, 12; EX1051, ¶125.

Karlsson’s controller receives inputs from a light-sensitive sensor for detecting “light from oncoming traffic.” EX1010, 5:17, 14:1-15, 9:9-26; Pet., 92-93; EX1003, ¶¶478-480. It then adjusts “the pattern and the intensity of the light

beam” such that “no light at all or light having a low intensity is emitted in those directions from which light is detected by the light-sensitive sensor.” EX1010, 9:18-23. To do so, Karlsson’s controller “switch[es] one or more of the spotlight beams 34 on and/or off” or “adapt[s] the intensity of the light emitted by [the] spotlight beam[s].” EX1010, 13:31-36. The switching/dimming of the spotlight beams allows headlight beam 50 to “shift” and change “shape” according to the “desired pattern and direction.” EX1010, 19:29-34. Using this illumination scheme, Karlsson’s headlight system determines illumination for a “first subsection” and “second subsection.” Pet., 95-102; EX1003, ¶¶483-495; EX1051, ¶¶126-128.

As Dr. Jiao confirmed, Karlsson’s example of dimmed LEDs outside of beam 50 correspond to subsections where vehicle headlights are detected. EX1003, ¶¶478-482; EX1051, ¶128. And, for example, Karlsson’s beam 50 corresponds to a subsection where vehicle headlights are *not* detected. EX1003, ¶¶483-486; EX1051, ¶¶128-129.

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

A. Thominet is fully compatible with Beam.

PO incorrectly alleges that Thominet would: (1) conflict with Beam’s anti-glare objective, (2) diminish Beam’s forward illumination, and (3) clash with Beam’s system. POR, 21-31; EX1051, ¶¶75-76.

1. Beam’s and Thominet’s headlight control methods 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, ¶77. PO/Dr. Turk misunderstand Beam in reaching their illogical conclusion that Thominet’s multiple directional beam regions conflict with Beam’s anti-glare operation. EX2006, ¶¶116-120; POR, 22-24; EX1051, ¶77.

Dr. Jiao confirms that Beam’s system includes at least *both* low and high-beams achieved by its microbeams. EX1051, ¶79. 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*. *Id.*; 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, ¶¶79-83.

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, ¶¶116-117. This control is “*dynamically varying* in position and in size,” in response to control inputs. EX1005, 6:24-27, 5:46-54. Beam adapts the headlights’ light pattern in intensity *and* spatial distribution. Pet., 36-37; EX1003, ¶129; EX1051, ¶81. Thus, Beam’s beam pattern includes *directionality*. EX1051, ¶¶81-85.

Accordingly, Beam-Thominet provides a more direct, active, headlight beam “specifically aimed for different functions.” EX1003, ¶126; Pet., 25-29; EX1051, ¶¶84-85.

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

PO’s assertion that Thominet would “further reduce[]” Beam’s headlight from providing “sufficient forward illumination” is wrong. POR, 28, *see also* 26-29; EX2006, ¶¶127-132; EX1051, ¶¶86-92.

Dr. Jiao explained that employing “multiple directional beam regions” in Beam’s system, as in Thominet, would “have added more control methods for different functions to Beam’s visibility for different driving situations.” EX1003, ¶124. This system is “more direct, or active, or specifically aimed for different

functions.” EX1003, ¶126. Thus, Beam-Thominet’s headlight distributes light to where illumination is desired according to the particular driving function—not somehow made worse as PO/Dr. Turk contend. POR, 26-29; EX2006, ¶¶127-132; EX1003, ¶126; EX1051, ¶¶86-92. Indeed, Beam itself describes adjusting the beam’s spatial distribution “for conditions like rain, snow, or fog,” as Dr. Jiao’s First Declaration explained. EX1005, 3:29-36; EX1003, ¶122 (“automating some of Beam’s *manual* control methods and improving driver safety”); EX1051, ¶¶89-90.

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

Beam’s SLM adjusts the angular position of its microbeams, contrary to PO/Dr. Turk’s position. POR, 25, 39; EX2006, ¶¶65-66; EX1051, ¶¶93-95. Beam’s SLM controls the microbeams’ angular positions/intensities via command signals. EX1051, ¶94; EX1005, 4:45-57. 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. EX1003, ¶131; Pet., 12-14; EX1051, ¶¶93-95.

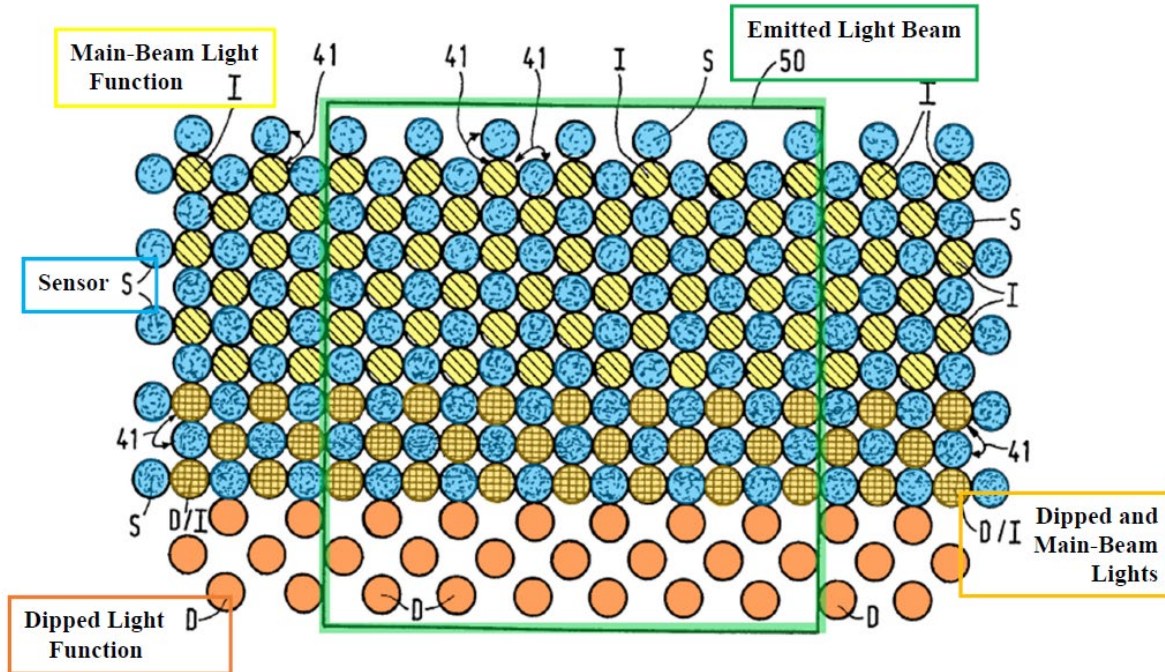
B. Harbers's beam segments are compatible with Karlsson's headlights.

The Petition explained that combining Harbers's multiple directional beam segments with Karlsson provides "different spatial/angular distributions for different driving situations, thereby improving driver safety." EX1003, ¶¶297, 497-513; Pet., 81-86; EX1051, ¶¶135-137, 150-152.

PO mischaracterizes Karlsson's "optimally adapted" (EX1010, 9:25) beam based on Dr. Turk's uninformed opinion. POR, 30-36, 58-59; EX2006, ¶¶139-147; EX1051, ¶¶136-137.

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

PO/Dr. Turk wrongly conclude that Karlsson "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, 59, *see also* 30-33; EX2006, ¶¶88, 139-145; EX1051, ¶138. Karlsson's actual emitted light beam 50 is represented as a window that shifts in the plane from left to right and top to bottom (varying in shape, dimension etc.), based on data inputs to Karlsson's controller. EX1010, 19:18-20:3; EX1003, ¶¶106-111; EX1051, ¶¶139-140.



EX1010, FIG. 14 (annotated).

Window 50 is a subset of the LEDs available. EX1051, ¶¶139-140. Dr. Jiao explained how shifting this window controls headlight beam directionality. EX1051, ¶¶139-141; EX1010, 19:29-34; EX1003, ¶¶90-92; Pet., 95-99. Even Dr. Turk agreed that Karlsson's beam 50 can: (1) vary shape and dimension, (2) vary depending on the desired beam pattern and direction, and (3) its dimension can vary depending on the desired beam pattern and direction. EX1010, 19:29-34; EX1054, 132:15-25, 133:6-7, 134:2-7, 134:13-15; EX1051, ¶¶142-143.

Nothing suggests to a POSA that Karlsson operates with all of its LEDs active except to implement glare control. EX1051, ¶144. Rather, Karlsson's optimally adapted system with individually and group controllable LEDs produces beam patterns based on data inputs to Karlsson's controller. EX1010, 19:18-20:3;

Pet., 78-79, EX1003, ¶¶106-111. Thus, Karlsson’s optimum light effect is adapted for the driving condition, consistent with Harbers. Pet., 86-99; EX1003, ¶¶463-493; EX1051, ¶145.

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

Dr. Turk’s new, baseless assertion that Karlsson’s system’s headlight beam would be “confusingly colored” demonstrates his lack of understanding of the claimed headlight technology. EX2006, ¶152; EX1051, ¶146.

A POSA would have understood how to implement Harbers’s colored-LEDs in Karlsson’s headlight system to provide a dynamic headlight beam with desirable color output. EX1010, 4:10-14, 8:31-34, 10:6-10, 10:26-28; EX1051, ¶147; EX1003, ¶¶575-587. Specifically, a POSA would have understood how to arrange 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, ¶147. A POSA would have also understood how to configure Karlsson-Harbers’s optical 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, ¶147.

A POSA also would have understood that forward illumination from Karlsson's/Harbers's headlights would be within a range of white color that would not result in "extremely confusingly color[]" purported by Dr. Turk. EX2006, ¶152; EX1051, ¶148; EX1069, 5-6. While Harbers discloses different colored-LEDs, the beams generated from each colored light source have "a more or less 'white' appearance." EX1011, 5:27-30; EX1051, ¶148.

VI. 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.

As one reason for combination, Petitioner explained that mounting the LED array on a curved substrate—as was known in the art—thereby aiming light clusters at different angles, would "improve[e] visibility and thereby safety." Pet., 14, 84-85; EX1003, ¶¶133-139, 455-460. Dr. Turk contests the motivation to combine a curved substrate with Beam's/Karlsson's headlights because the segment control functionality described in Thominet/Harbers can be achieved with flat substrates. EX2006, ¶¶137, 154.

In response to Dr. Turk's unsupported argument (EX2006, ¶¶137, 154), a POSA seeking to improve driver visibility by modifying headlights—as Dr. Jiao's First Declaration explained(EX1003, ¶¶133-139, 455-460)—would have readily known that curved substrates enhance the headlight's optical performance, for example, by minimizing distortion. EX1051, ¶¶96-99, 130-134.

Furthermore, no “additional” rationale is required. *See Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-1381 (Fed. Cir. 2023) (substituting one known technique for another does not require showing “‘improvement’ in a categorical sense,” so long as the known technique is a “suitable option” for addressing the same problem). 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., 10-17, 81-86; EX1003, ¶¶133-139, 455-460; EX1051, ¶¶96-99, 130-134; *see also Ethicon LLC v. Intuitive Surgical, Inc.*, No. 2020-1528, 2021 WL 3716397, at *7 (Fed. Cir. Aug. 23, 2021); *Ethicon LLC v. Intuitive Surgical, Inc.*, Nos. 2021-1995, 2021-1997, 2022 WL 1613188 (Fed. Cir. May 23, 2022).

VII. THE ASSERTED COMBINATIONS RENDER OBVIOUS THE ROAD CURVATURE DEPENDENT CLAIMS [32-36 AND 70].

A. Beam-Thominet-Kobayashi and Beam-Thominet-Stam-Kobayashi render obvious the road curvature dependent claims 32-36 and 70.

1. Beam’s headlight beams are directional to increase illumination of an upcoming turn/curve.

PO/Dr. Turk base their arguments against Beam-Thominet-Kobayashi/Beam-Thominet-Stam-Kobayashi on the same misunderstanding (*supra* §V.A) that Beam’s “maximum intensity” does not include direction. POR, 46-47, 49-50; EX2006, ¶¶206-211. Accordingly, PO/Dr. Turk incorrectly conclude that

“the presented combination can do nothing with [Kobayashi’s map] information,” including increasing illumination in a direction of road curvature. EX2006, ¶210. As Dr. Jiao explains, PO’s/Dr. Turk’s understanding of Beam is wrong. EX1051, ¶¶100-101.

Beam expressly states that the *angular position* or *attenuation* “of each of these microbeams is independently set by the controller 108,” which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-52; EX1051, ¶102; EX1003, ¶76; Pet., 8. Beam’s “[c]ontrol is ‘*dynamically varying* in position and in size,’ in response to the control input.” EX1003, ¶315 (citing EX1005, 5:46-54, 6:24-27); EX1051, ¶¶103-104. Thus, Beam’s headlights change direction of microbeams to form beam patterns. EX1051, ¶¶102-105.

A POSA would have been motivated to modify Beam-Thominet/Beam-Thominet-Stam, in view of Kobayashi, to adjust the directional light sources to *increase illumination* of an upcoming turn/curve (e.g., thereby “illuminat[ing] around the curve” claim 32, “increas[ing] illumination of an upcoming turn” claims 34/36, and “increase[ing] illumination of an upcoming curve” claim 70) using map data, as in Kobayashi, to improve driver safety. Pet., 53-61; EX1003, ¶¶310-351; EX1008, 14:53-15:28; EX1051, ¶¶106-107.

2. Beam-Thominet-Stam-Kobayashi disclosed all elements of claim 70

Petitioner showed that the Beam-Thominet-Kobayashi combination discloses “increas[ing] illumination of an upcoming *turn*” (claim 34). Pet., 53-61. Likewise, the Petition showed the patentably indistinct “increas[ing] illumination of an upcoming *curve*” (claim 70). Pet., 62. Contrary to PO’s assertions (POR, 49), a POSA would have understood that a “turn” includes a “curve.” EX1051, ¶¶108-109. Increasing illumination of an “upcoming turn” would in the same way increase illumination of an “upcoming curve.” EX1051, ¶109; Pet., 57-62.

B. Karlsson-Harbers-Gotou renders obvious the road curvature dependent claims 32-36 and 70.

1. Karlsson’s spotlight beams are directional to increase illumination of an upcoming curve/turn.

PO/Dr. Turk incorrectly allege that Karlsson’s headlight has “nothing left to be ‘increased.’” POR, 68-69; EX2006, ¶299; EX1051, ¶¶156-158.

As explained in §V.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, ¶159. 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, ¶159; EX1003, ¶611. 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. EX1003, ¶¶608-622. And a POSA would have been motivated to modify Karlsson-Harbers to adjust the directional light sources to increase illumination of an upcoming curve/turn using map data, as in Gotou, to improve driver safety. Pet., 125-133; EX1003, ¶¶623-649; EX1051, ¶¶158-164.

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

Dr. Turk’s assertion that outputting a directional headlight beam from the Karlsson-Harbers-Gotou combination would “create additional unpredictable usages of colored LEDs” shows his lack of understanding of the art. EX2006, ¶¶296-298; POR, 67-68; EX1051, ¶165.

As explained in §V.B.2, a POSA would have understood how to combine different colored LEDs in a headlight to emit a 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; EX1051, ¶166. 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 “unpredictable usages of colored LEDs” purported by Dr. Turk. EX2006, ¶297; EX1051, ¶167; EX1069, 5-6. Simply put, there would be

no unpredictable color changes when steering Karlsson-Harbers's beam in view of Gotou's map data/road curvature control. EX1051, ¶167.

3. Karlsson-Harbers-Gotou obtains sensor data to indicate an upcoming turn (claims 33/35).

PO/Dr. Turk ignore pertinent sections of the Petition when alleging that Petitioner did not explain how the “intended direction of the driver” or “planned running data” is indicated by sensor data. *See* POR, 71-72; EX2006, ¶308; EX1051, ¶168.

Petitioner explained using Gotou's GPS data—containing map information—as an “additional data source for Karlsson-Harbers's controller/processor.” Pet., 127-129; EX1012, 3:49-67, 4:30-49, 6; EX1003, ¶¶608-649. Gotou's “map information” indicates the “planned running direction,” which allows the headlight system controller to determine “whether the forward curve is directed, rightward or leftward.” EX1012, 6:28-39. Gotou's controller adjusts the direction of the headlight beam based on the degree of the turn, before the steering wheel is turned. EX1003, ¶¶631-632; EX1012, 6:40-44, 4:30-49. Gotou teaches the technique of obtaining the “planned running direction” by its navigation system to direct the headlight in advance of a curve. EX1003, ¶¶631-632. Accordingly, Karlsson-Harbers-Gotou's headlight system obtains sensor data—e.g., Gotou's GPS data—to indicate an upcoming turn/curve. EX1051, ¶¶168-172.

4. Karlsson’s modified headlight increases illumination of an upcoming turn/curve (claims 34/36/70).

Dr. Turk’s misunderstanding of Karlsson infects his and PO’s meritless argument that Karlsson-Harbers-Gotou fails to disclose increased illumination of an upcoming turn/curve. POR, 72-73; EX2006, ¶311; EX1051, ¶173.

First, as explained in §V.B.1, Karlsson does not default to using all LEDs. EX1051, ¶174. Second, because Gotou changes the direction of its beam pattern, it changes its intensity via its angular distribution change. EX1051, ¶175. A change in direction produces a change in intensity, and thus, “increases illumination” of an upcoming turn/curve as recited in claims 34/36/70. EX1051, ¶¶175-176. This is further supported by Gotou’s two-bulb discussion. EX1012, 8:15-19; EX1051, ¶176; EX1003, ¶¶623-649; EX1054, 127:9-128:20. For example, switching a peripheral light source on a multi-source headlight would expand the light pattern further to the periphery of the vehicle, increasing illumination of an upcoming turn/curve located to the periphery of the vehicle. EX1051, ¶176.

VIII. THE COMBINATIONS DISCLOSE HEADLIGHT GENERATION METHODS THAT OBTAIN DATA USED TO DETERMINE ILLUMINATION LEVELS FOR A SUBSECTION INCLUDING A PEDESTRIAN/ROAD-SIGN (CLAIMS 66-67).

A. Beam-Thominet-Stam-Braun renders obvious claims 66-67.

A POSA would have been motivated to modify Beam-Thominet-Stam to adjust the headlight beam based on pattern recognition for identifying pedestrians (claim 66) and signs (claim 67), as in Braun, to illuminate objects more effectively,

thereby improving driver safety. Pet., 62; EX1003, ¶¶355-356; EX1051, ¶¶177-179. Both Dr. Turk and the '503 patent admit such techniques were known. EX1001, 44:67-45:9; EX1053, 84:21-85:3; EX1051, ¶178; EX1052, 75:24-76:5 (“A person would generally know what kind of pattern recognition techniques should be explored or looked at to try to achieve” recognition of a road sign.).

PO’s argument that there would have been no motivation to combine Braun’s pattern recognition techniques with Beam-Thominet-Stam are based on the same misunderstandings of Beam discussed in §V.A.1. POR, 50-51. Specifically, PO mischaracterizes Beam’s system as having “no un-used illumination” to “use to ‘spotlight.’” POR, 50-51. A POSA would have understood that Beam *controls intensity, including angular position*, to a maximum desired intensity in a given direction, not “full blast” everywhere at all times. EX1051, ¶¶180-183.

Contrary to Dr. Turk’s assertions (EX2006, ¶226), a POSA would have understood how to combine Braun’s spotlight technique “in conjunction with” Beam’s anti-glare operation. EX1051, ¶184. Light filtering allows Beam’s controller to distinguish between passive light emission (e.g., light reflected from signs) and active light emission (e.g., headlights). EX1005, 5:34-36; EX1051, ¶184. With this known classification functionality, Beam’s controller would have been able to simultaneously dim areas corresponding to detected vehicles (Beam’s

anti-glare) and direct microbeams at detected signs (Braun's spotlight). EX1051, ¶185; EX1003, ¶¶355-356.

B. Karlsson-Harbers-Braun renders obvious claims 66-67.

Similarly, a POSA would have been motivated to modify Karlsson-Harbers to adjust the headlight beam based on pattern recognition for identifying pedestrians (claim 66) and signs (claim 67), as in Braun, to illuminate objects more effectively, thereby improving driver safety. Pet., 134; EX1003, ¶¶650-61. Again, the '503 patent admits such techniques were known. EX1001, 44:67-45:9; EX1053, 84:21-85:3; EX1051, ¶186.

PO resorts to attacking the references individually, alleging Petitioner failed to show which combined control function would be given "primacy." POR, 75-76; EX2006, ¶¶321-322; EX1051, ¶¶187-88.

But Karlsson's array of individually controlled spotlight sources allows the headlight system to perform two or more control functions simultaneously, as Dr. Jiao confirmed. EX1051, ¶189. Because Karlsson's emitted headlight beam results from many spotlight beam contributors (EX1010, 13:30-14:5), Karlsson's array is configured to direct spotlight beams at a detected object (e.g., a pedestrian or sign), while dimming spotlight beams directed a detected vehicle. Pet., 134-138; EX1003, ¶¶650-656; EX1051, ¶189; EX1010, 14:1-5 (describing "a grid of separate light sources, such as LEDs, which can preferably be controlled either

individually or in groups”), 19:18-34; EX1051, ¶189. Thus, Karlsson’s functionality to optimally adapt the light beam according to road conditions obviates Dr. Turk’s “primacy” concerns. EX2006, ¶322; EX1051, ¶189.

Furthermore, a POSA would have understood how to modify software instructions stored in memory of Karlsson-Harbers’s controller/processor (e.g., an algorithm) to spotlight detected objects in view of Braun’s pattern recognition, without any conflicts. Pet., 134-138; EX1003, ¶¶650-656; EX1051, ¶190. Implementing multiple control functionalities in a headlight controller was a routine task for a skilled artisan, who would have had a reasonable expectation of success in doing so. Pet., 134-138; EX1003, ¶¶650-656; EX1051, ¶190.

IX. THE ASSERTED COMBINATIONS DISCLOSE HEADLIGHT GENERATION METHODS THAT DETERMINE “YELLOWISH”/“BLUEISH” ILLUMINATION (CLAIMS 28-29 AND 68-69).

A. Combining Harbers’s teachings with Beam’s and Karlsson’s modified systems would provide headlights with colored light sources, as was known in the art.

Contrary to PO/Dr. Turk’s arguments (POR, 52-53, 65; EX2006, ¶¶231, 284), Harbers teaches using colored light sources for different functions. EX1011, 8:10-18; *see also* EX1006, ¶5. In combining the teachings of Harbers’s multi-colored beam segments with Beam’s and Karlsson’s modified systems, a POSA would have understood how to use colored light sources to generate the headlight beam. EX1051, ¶¶110-113. Pet., 67-73, 119-121; EX1003, ¶¶379-392, 427, 574-

587. Indeed, Dr. Jiao's First Declaration explained why combining Harbers's colored light sources with Beam's and Karlsson's modified systems to achieve the color segments would have been obvious to a POSA. EX1003, ¶¶385-389, 584. For example, a POSA would understand how to "incorporate known components," such as colored LEDs, and "simply modify[] software instructions in memory of Beam's controller" to direct "Beam's array of microbeams into multiple colored directional beam segments." EX1003, ¶¶384-385.

B. A POSA would have understood that the combinations teach or suggest headlight beam generation methods that "accommodate sensed fog or snow environmental conditions" (claim 29) and "obtain and provide data...indicating fog or snow environmental conditions" (claim 69).

Contrary to PO/Dr. Turk's assertions (POR, 54, 56, 66-67; EX2006, ¶¶235-236), combining Harbers with the prior art, as discussed in the Petition, renders claims 29 and 69 obvious. Pet., 67-78, 122-123; EX1003, ¶¶379-432, 588-602. Claim 29 merely requires that the method "accommodate sensed fog or snow environmental conditions." Harbers does that. EX1011, 2:15-26, 4:15-21, 10:6-14, FIG. 4A; EX1003, ¶¶409-411, 591-592; Pet., 75, 122. Harbers also obtains "data indicating fog or snow environmental conditions," as in claim 69 (which does not even specify further use of the data). EX1011, 2:15-26, 4:15-21, 10:6-14, FIG. 4A; EX1003, ¶¶409-411, 590-591; Pet., 78, 122.

Dr. Jiao's First Declaration confirmed that detecting fog to control headlight beam color was well known. EX1003, ¶410 (citing EX1009, 25:20-25, "headlights 101 and 102 are programmed...to detect *fog* and...provide *light appropriate for driving in fog*."). Given that Harbers actively controls the light sources in response to fog/snow conditions, a POSA would have used a sensor to indicate fog—a well-known technique—with Beam's and Karlsson's modified controllers. EX1011, 10:6-14; EX1051, ¶¶114-117. Indeed, Harbers explains:

Under unfavorable weather conditions, in particular *fog and snow*, when visibility is reduced by backscattering caused by fog or snow particles, both the *configuration and the spectral composition* of the light beams generated by the light source 4; 5 can be *adapted by activating different combinations of LEDs and by changing the output levels* of the various LEDs. As a result of these adaptations, the *spatial and/or spectral distribution of the light is changed*.

EX1011, 10:6-14; EX1003, ¶¶382, 591. Harbers's teachings to "activat[e] different combinations of LEDs" in the presence of "fog" is more than "[m]erely noting that certain beams" be created, as Dr. Turk purports. EX2006, ¶290; EX1051, ¶¶115-117. Rather, a POSA would have understood Harbers expressly obtains "data indicating fog or snow environmental conditions," (claim 69) so that such accommodations would be made. EX1051, ¶¶116-117.

C. Selectively attenuating microbeams would not create color-shifting issues.

PO alleges that Beam's selective attenuating of microbeams, if using colored LEDs, would create a "color-shifting issue." POR, 53-54; EX2006, ¶¶232-233. As explained in §V.B.2, a POSA would have understood how to configure Karlsson-Harbers's optical system to "effectively mix the colors originating from the LEDs" to prevent color-shifts. EX1011, 8:32-34, 10:6-10; EX1006, ¶5; Pet., 67-78; EX1003, ¶¶379-432. While there may be subtle variations of illuminated color between beam segments, the color of Beam-Thominet-Harbers's/Beam-Thominet-Stam-Harbers's headlight beam would be within a range of white color that would not create a "color-shifting issue" purported by Dr. Turk. EX2006, ¶232; EX1051, ¶¶118-121; EX1069, 5-6.

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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 5,555 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.

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

I certify that the above-captioned **PETITIONER VOLKSWAGEN
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parties:

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