

IN THE 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 IPR2022-01586
U.S. Patent No. 11,208,029

**DECLARATION OF JIANZHONG JIAO, PH.D., IN SUPPORT OF
PETITIONER'S REPLY**

Mail Stop "PATENT BOARD"
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

VWGoA EX1036
U.S. Patent No. 11,208,029

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	LEVEL OF ORDINARY SKILL IN THE ART	3
III.	LEGAL STANDARDS	4
IV.	DR. TURK HAS SHOWN THAT HE IS NEITHER AN EXPERT NOR A POSA IN THE RELEVANT FIELD, AND NEVER HAS BEEN.	4
A.	Dr. Turk acknowledges he does not understand basic concepts related to automotive lighting, and lighting in general, is not aware of major projects and technical events in the relevant art, and separately accepts my knowledge and expertise in the field.	5
1.	Dr. Turk has shown he does not understand basic terms a POSA would have understood within the field of automotive lighting and lighting control.	5
2.	Dr. Turk has shown he is not familiar at all with basic developments in controllable headlamps, including, for example, the major EUREKA project and technical events, etc.	14
3.	Dr. Turk acknowledges my expertise when discussing considerations of a POSA—even though he cites several papers I co-authored he ignores their substance and does not appreciate what a POSA would actually have understood.	16
B.	I am convinced that Dr. Turk’s inadequate, tangential experience related to self-driving systems is not adequately relevant to the subject technology to qualify him as a POSA.	22
V.	DR. TURK’S SUBSTANTIVE ARGUMENTS AGAINST THE GOTOU- KARLSSON COMBINATION ARE INCORRECT, AT LEAST IN PART BASED ON HIS LACK OF UNDERSTANDING OF THE ART.	26
A.	Karlsson does not default to all LEDs “on” as Dr. Turk alleges, and a POSA would understand that this stems from Dr. Turk’s fundamental misunderstanding of “maximum intensity,” and an incorrect importation of that term from Beam into Karlsson.	26
B.	Dr. Turk’s annotated figures of Karlsson are incorrect, however, even they establish that Gotou-Karlsson meets the claims of the ’029 patent.	35

C.	Dr. Turk’s arguments related to the motivation to combine Gotou and Karlsson are further evidence he does not understand the relevant art, and in any event are not relevant to determining whether a POSA would have had motivation to combine Gotou and Karlsson.....	44
D.	Dr. Turk’s arguments related to the dependent claims again show he does not understand the applied art from the viewpoint of a POSA, and he failed to appreciate the particularity with which I pointed to each claimed feature shown in the respective references. .	47
1.	Claims 5, 16, and 27	47
2.	Claims 6, 17, and 28	50
3.	Claims 7, 18, and 29	52
4.	Claims 9, 20, and 31	55
5.	Claims 10, 21, and 32	57
VI.	DR. TURK’S SUBSTANTIVE ARGUMENTS AGAINST THE BEAM-KOBAYASHI COMBINATION ARE INCORRECT, AT LEAST IN PART BASED ON HIS LACK OF UNDERSTANDING OF THE ART.....	59
A.	Dr. Turk’s arguments regarding Beam’s “maximum intensity” are incorrect and reflect a lack of understanding of the art.....	59
B.	Beam discloses to a POSA a system that includes both an LED array and a spatial light modulator, contrary to Dr. Turk’s demonstrably false assertions.....	63
C.	Dr. Turk’s arguments related to the motivation to combine Beam and Kobayashi are further evidence he does not understand the relevant art, and in any event are not relevant to determining whether a POSA would have had motivation to combine Beam and Kobayashi.....	64
D.	Dr. Turk’s arguments related to the dependent claims again show he does not understand the applied art from the point of view of a POSA, and failed to appreciate the particularity with which I pointed to each claimed feature shown in the respective references. .	68
1.	Claims 5, 16, and 27	68
2.	Claims 6, 17, and 28	71
3.	Claims 9, 20, and 31	73

VII. CONCLUSION	76
-----------------------	----

I, Dr. Jianzhong Jiao, hereby declare as follows.

I. INTRODUCTION

1. I have been asked by Volkswagen Group of America, Inc. (“VWGoA” or “Petitioner”) to provide my opinions in the above-captioned *inter partes* review (“IPR”) proceeding involving U.S. Patent No. 11,208,029 (“the ’029 patent,” EX1001). I previously submitted a declaration (EX1003) in support of the Petition for *inter partes* review of the ’029 patent. This declaration is in support of Petitioner’s Reply to Patent Owner’s Response in the same proceeding, IPR2023-01586.

2. I understand that Patent Owner Yechezkal Evan Spero (“Patent Owner”) submitted a Patent Owner Response (“POR,” Paper 13) along with a Second Declaration from Matthew A. Turk, Ph.D. (EX2006) in support of the POR.

3. My background and qualifications were provided in paragraphs 9-20 of my First Declaration, Exhibit 1003, and my CV was submitted as Exhibit 1004. My statements and opinions in my First Declaration regarding my review of the ’029 patent and related materials remain unchanged. In reaching my opinions in this declaration, I reviewed the POR, my First Declaration, and the materials reviewed as part of my First Declaration. EX1003, ¶21 (listing references

considered in my First Declaration). In addition, I reviewed and refer to the following materials:

Paper/Exhibit No.	Description
7	Institution Decision
13	Patent Owner's Response
1037	Transcript of the Deposition of Matthew A. Turk, Ph.D. ("the Turk Deposition")
1038	Leighty, <i>et al.</i> , "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)
1039	Lowrie, <i>et al.</i> , "The Autonomous Land Vehicle (ALV) Preliminary Road-Following Demonstration," <i>Proceedings of SPIE</i> , Vol. 579 Intelligent Robot and Computer Vision, 1985 (accessible at https://home.ttic.edu/~mturk/pubs/ALV-preliminary-SPIE1985.pdf , last accessed October 30, 2023)
1040	U.S. Patent No. 5,426,294 to Kobayashi <i>et al.</i> , issued June 20, 1995
1041	"The International System of Units (SI)," Bureau International des Poids et Mesures, 7 th Edition (1998) (Excerpt)
1042	Surface Vehicle Recommended Practice, Performance Requirement for Motor Vehicle Headlamps, J1383 (May 2018)
1043	"Turk Diagram," (Exhibit A) From the Deposition of Matthew A. Turk PhD, October 17, 2023
1044	49 C.F.R. 571.108, Standard No. 108 (Up To date as of Nov. 3, 2023)
1045	Terminology – Motor Vehicle Lighting, SAE J387 Nov87, The Engineering Society For Advancing Mobility Land Sea Air and Space (Revised Nov. 1987)
2001	First Declaration of Matthew A. Turk, Ph.D. ("the First Turk Declaration")

Paper/Exhibit No.	Description
2006	Second Declaration of Matthew A. Turk, Ph.D. (“the Second Turk Declaration”)

4. I have reviewed all other materials cited herein. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

5. My work in this case is being billed at a rate of \$400 per hour, with reimbursement for actual expenses. My compensation is not contingent upon the outcome of this proceeding.

II. LEVEL OF ORDINARY SKILL IN THE ART

6. I incorporate by reference my opinion of the person of ordinary skill in the art (“POSA”) as set forth in paragraphs 41-43 of First Declaration (EX1003), particularly that “a POSA at the time of the alleged invention would have had a bachelor’s degree (B.S.) in mechanical engineering, electrical engineering, optical engineering, applied physics, or an equivalent field, *as well as at least 2 years of industry experience in the area of automotive lighting and lighting-control systems.*” (emphasis added throughout unless I note otherwise).

7. I understand that Dr. Turk initially had a different opinion as to the

level of ordinary skill (compare EX1003, ¶41 with EX2001, ¶29), but now agrees with my opinion (EX2006, ¶¶48-49; EX1037, 60:7-22).

8. After reviewing the First Turk Declaration (EX2001), the Second Turk Declaration (EX2006), and the transcript of the Turk Deposition (EX1037), I am convinced that Dr. Turk is neither an expert in the relevant art, nor is he a POSA. Rather he has shown through his lack of knowledge (as I explain throughout this declaration) and experience that he has never been an expert, or a POSA, as laid out and accepted by him. EX2006, ¶¶48-49; EX1037, 60:7-61:2. More specifically, Dr. Turk does not have at least 2 years of industry experience in the area of automotive lighting and lighting-control systems, which he acknowledges a POSA would have had. EX2006, ¶¶48-49; EX1037, 60:7-61:2. Accordingly, in my opinion Dr. Turk is not qualified to opine in this matter as an expert or from the perspective of a POSA.

III. LEGAL STANDARDS

9. I incorporate by reference my understanding of the legal principles, including my discussion of claim construction and obviousness, as set forth in my First Declaration. EX1003, ¶¶22-40.

IV. DR. TURK HAS SHOWN THAT HE IS NEITHER AN EXPERT NOR A POSA IN THE RELEVANT FIELD, AND NEVER HAS BEEN.

10. Again, after reviewing the First Turk Declaration (EX2001), the Second Turk Declaration (EX2006), and the transcript reflected in the Turk

Deposition (EX1037), and Dr. Turk's CV (EX2002), each indicates to me that Dr. Turk is neither an expert in the relevant art, nor is he a POSA. Rather he has shown through his lack of knowledge and experience that he has never been an expert, or a POSA, and is not qualified to opine on what a POSA would have understood either in the individual references here, the '029 patent itself, or the proposed obviousness combinations.

A. Dr. Turk acknowledges he does not understand basic concepts related to automotive lighting, and lighting in general, is not aware of major projects and technical events in the relevant art, and separately accepts my knowledge and expertise in the field.

11. In the sections below, I explain several ways in which Dr. Turk has indicated to me that he is not, and never has been, a POSA under the definition that he has agreed with and adopted in this proceeding.

1. Dr. Turk has shown he does not understand basic terms a POSA would have understood within the field of automotive lighting and lighting control.

12. As I previously opined, none of the claim terms require specific construction and should receive their plain and ordinary meaning in the context of the '029 patent specification. EX1003, ¶71. But Dr. Turk repeatedly has indicated that he does not understand the plain an ordinary meanings of several claim terms.

13. Dr. Turk appears to not understand what the term "intensity" means in the context of automotive lighting and lighting control. When asked to define "intensity," as it relates to the '029 patent claims, he answered "[i]ntensity is a

broadly applied word that can mean different things in different contexts.”

EX1037, 62:18-25.

14. When Dr. Turk was asked during his deposition, “What does ‘maximum intensity’ mean in the context of automotive lighting?” he answered “In general, *I don’t know....I think* it means you can’t make it any brighter, any higher in terms of its intensity.” EX1037, 103:13-20. Dr. Turk was asked as a direct follow up: “You said, though, that you don’t know in general what ‘maximum intensity’ means in the context of automotive lighting?” and he answered “Not as a general term in all circumstances, no.” EX1037, 103:22-25.

15. But in the automotive lighting context, a POSA would have readily understood that “intensity” refers to luminous intensity measured in the unit candela (cd) in the International System of Units. EX1041, 18. The candela value is a measurement of luminous flux per unit solid angle emitted by a light source *in a particular (or a given) direction*. It is a quantitative measurable widely known and regularly used by a POSA in the field of lighting including automotive lighting. It is not, contrary to Dr. Turk’s misunderstanding, similar to or synonymous with “brightness,” which is a human perception measurement. *See* EX1037, 62:18-25. Dr. Turk opines that the term “intensity” in the context of the ’029 patent should be interpreted as “what intuitively we think of as brightness.” EX1037, 84:3-6. This is plainly incorrect, and especially in view of his

incomprehensible answer relating to “subtly different implications,” further indicates to me that Dr. Turk is not a POSA in automotive lighting and lighting control. EX1037, 84:7-21.

16. Dr. Turk’s misunderstanding of the term “intensity” is also present in each of the Dr. Turk’s declarations. For example, his paragraphs 33 and 34 in the First Turk Declaration relating to Beam’s “maximum intensity” is now further clarified that he was conflating brightness (perception) and intensity (measured physical and physiological quantity that *includes directionality*). EX2001, ¶¶33-34, citing EX1005, 6:40-44, 3:8-15.

17. Dr. Turk also incorrectly states that “beam pattern” is “related to brightness and darkness of illumination within the shape.” EX1037, 43:2-4. And this is in direct conflict with the Second Turk Declaration (EX2006, ¶26), where he quotes *from an article that I co-authored*, where I explained that “[a]ny automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2010, 237. Such a misunderstanding and contradiction within his same declarations indicates to me that he does not understand the art, relevant literature, regulations, etc., that a POSA would possess. I am convinced he has never had the knowledge of a POSA.

18. Indeed for automotive lighting, specifically for headlamps, beam pattern includes directionality, and a change in beam pattern includes a change in

direction of the light. EX2010, 237; EX1017, FIGS. 1 and 3-5. For example, for headlamps with at least both high beam and low beam functions, a POSA would understand that high beam and low beam are aimed in *different* directions.

EX2010, 237; EX2012, 8, FIGS. 11A, 11B; EX2013, 7. That is, high beam and low beams have different “maximum intensities,” and such “maximum intensities” must be understood also with regard to the change in beam pattern and direction.

Dr. Turk has acknowledged that he does not understand such beam patterns, or their foundation in the FMVSS that he cites (without any understanding, much less that of a POSA in automotive lighting and lighting control). *See* EX1037, 42:23-43:6.

19. I previously explained the concept of beam pattern in my First Declaration, for example, in the context of adaptive headlamps and adaptive front lighting systems. EX1003, ¶¶46-52. As an example, I previously explained with reference to background art Hogrefe at paragraph 50 of my First Declaration (EX1003) that as an example, Hogrefe shows how known adapted light patterns can increase safety on curved roads, at high speeds, and within cities, for example, by varying improved lateral illuminance (shaping light around curves), increasing length of the beam to improve visibility, and expanding the beam shape to capture a wider angle, for example. And as Hogrefe’s Figure 3 explains, “the individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern.”

EX1017, FIG. 3 (emphasis in original).

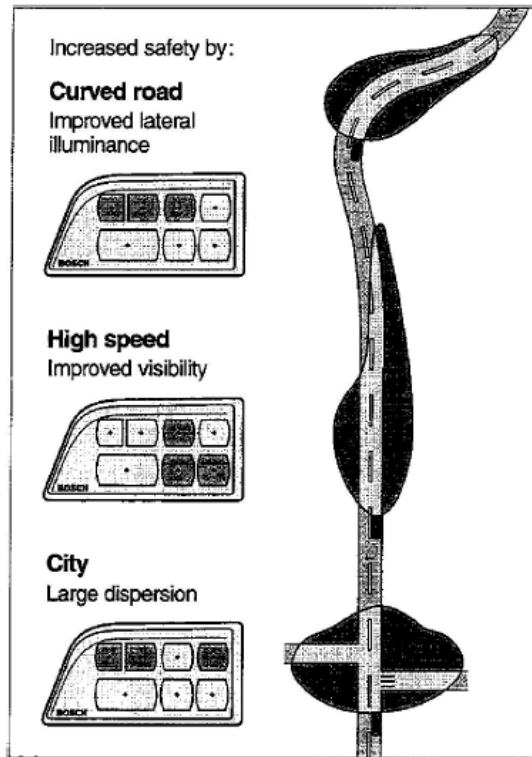


Fig. 1: Three standard driving situations with adapted light pattern seen from the bird eye's view.

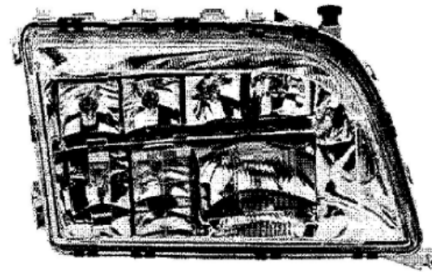
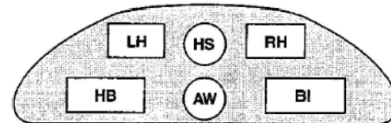


Fig 4: ALP headlamp sample



Single components:

LH Left hand bend BI Basic illumination
RH Right hand bend AW Adverse weather illumination
HB High beam HS Hot spot

Fig. 5: Advanced ALP sample layout

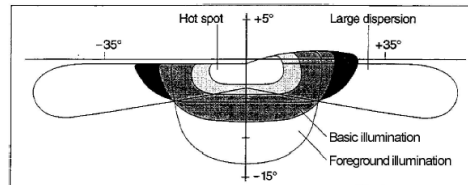


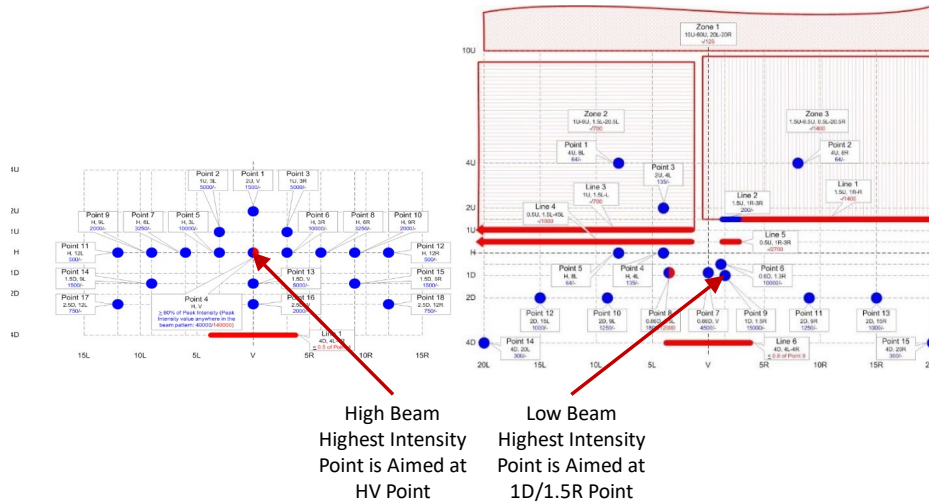
Fig. 3: Light pattern of multiple beam headlamp (Isolux curves in wall projection). The individual light pattern of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

20. As shown above, the headlamp beam pattern includes variation in light direction and projected length and width on the road from a bird's eye view (in EX1017, FIG. 1) or driver's view, with intensity points along a projected distance (in EX1017, FIG. 3). Known patterns include large dispersion, curved-road light, and high speed long reaching beams as shown above.

21. A POSA would also have understood, for example, that high beams' hotspot, the highest light intensity point is aimed at the so called "HV point" – the center of the vehicle; while low beams' hotspot, the highest light intensity point is

aimed in a different direction (specifically, aimed at 1-degree down and 1.5-degree right point), per U.S. regulation FMVSS 108 as well as industry standard SAE J1383) – not the center of the vehicle but toward the right-hand side, for right-hand side drive as in the U.S., as I have illustrated in Figure 1 below:



EX1042, FIG. 1 (Headlamp Beam Pattern Comparison of the U.S.
High Beam and Low Beam, annotated).

22. A POSA also would have understood that the automotive lamp features or functions can be “optically combined,” within the applicable regulations contrary to Dr. Turk’s misstatement that “a POSA would not have considered combining features from lamps having different functions..., fog lamp, cornering lamp,” (EX1026, ¶26), because such combination has always been allowed and practiced. *See, e.g.*, EX1044, 4, (noting in its definitions that “[o]ptically combined means a lamp having a single or two filament light source or two or more separate light sources that operate in different ways, and has its

optically functional lens area wholly or partially common to two or more lamp functions.”); *see also* EX1045, 5.

23. Optically combined headlamps *must* be able to change direction in order to achieve at least the high beam and low beam functions. And the above diagram shows such directional change for both beams. In the above Figure 1, H denoting the horizontal line, V denoting the vertical line. This is the angular coordinate system for all automotive lighting light intensity, or candela value, measurements. Numbers listed in the diagram above on the coordinates are the FMVSS 108 and SAE J1383 (EX1042) required candela values, color blue is for the minimum, and color red is for the maximum allowed. More simply put, the high beam is a narrow-spread beam that is aimed for far-distance illumination (preferably 140 meters or farther). To be sure, in regulatory terms, FMVSS 108 requires at 12-degree left and right measured at H (0-degree) for 1500 cd and 2.5-degree down for 1000 cd min, and HV for 40000 cd min. Low beam has wider spread. FMVSS 108 requires at 20-degree left and right measured at 4-degree down for 300 cd min. Dr. Turk acknowledged that he did not know how intensity would be measured for automotive headlamps when asked during his deposition. EX1037, 10-15.

24. Based in my work in the field, a POSA would also have understood that OEMs often add further specifications for wider low beam spread measured up

to 40-degree left and right with certain candela values. I previously worked for 4 years on automotive lighting including technology development, product design, testing, and compliance for standards and regulations for General Motors before transitioning to North American Lighting, where I implemented adaptive front-lighting system and other lighting technologies for 14 years. EX1003, ¶¶11-12. I then worked at OSRAM Opto-Semiconductors on automotive lighting for an additional 8 years of industry experience with continuation in automotive and other lighting applications. EX1003, ¶13. In my experience, a POSA would have appreciated that for commercial applications in the U.S., high beam only has one maximum intensity point at HV, and would have appreciated that there is no maximum intensity requirement for other angles. As above, this shows that a POSA would have understood that such beam pattern *always includes direction*. Again, unsurprisingly, Dr. Turk acknowledged that he would not know which standards a POSA would look to, e.g., to know the standard methodology for measuring high-beam light output (headlamp with high beam and low beam functions is a highly regulated and consistently enforced automotive lighting device in the U.S. and rest of the world). EX1037, 154:20-155:15.

25. Dr. Turk also incorrectly states that “spatial distribution” in the context of the ’029 patent should mean “a possible change in the brightness levels at various points of the light shape that’s coming out of the headlamp.” EX1037,

83:12-19. In reality relating to the art, such spatial distribution is simply that, the intensity distribution across space (measured in angles) in front of the headlamp. Such spatial distribution, like beam pattern, must include directionality (e.g., angular intensity distribution).

26. These incorrect statements and understandings in Dr. Turk's declarations and deposition, along with the dearth of experience in the field reflected on his CV, convince me that he is not a POSA, and does not understand fundamentals in automotive lighting and lighting control with no knowledge of basic concepts, lighting principles, lighting metrics and measurements, lighting regulations and standards, which a POSA would have. The examples include the basic terms of "intensity," "brightness," "spatial distribution," high beam, low beam, and other automotive lighting devices and their well-defined functions and requirements, how those lighting devices are optically combined, and other basic and commonly used terms that a POSA would readily understand. He does not understand how a POSA would go about measuring such lighting quantities (e.g., in development or under certain regulations, EX1037, 103:22-108:14, 150:23-156:3), or what a POSA would have found obvious to combine with respect to the applied references discussed here and in my First Declaration, EX1003.

2. **Dr. Turk has shown he is not familiar at all with basic developments in controllable headlamps, including, for example, the major EUREKA project and technical events, etc.**

27. I was shocked that Dr. Turk was not aware of the EUREKA project, one of the most well-known, major projects that involved internationally joint research that included developing adaptive front lighting systems (AFS) and legislative proposals related to automotive lighting and lighting control standardization. EX1037, 149:17-18 (“Q: Doctor, are you familiar with the EUREKA Project? A: It does not ring a bell at the moment.”). He also acknowledged that he is not familiar with the Progress in Automobile Lighting conference, which revolved around developments in automotive lighting and lighting control, in the technological, design, testing, and regulation aspects. EX1037, 149:19-20 (“Q: Are you familiar with the Progress in Automobile Lighting Conference, also referred to as PAL?....A: I don’t recall that conference at the moment, no.”).

28. A POSA certainly would have been familiar with the EUREKA project and technical events such as PAL, especially with reference to adaptive front lighting systems. And as I noted in my First Declaration, several of the background references are articles from conference proceedings of PAL, a well-known, well-attended, bi-annual international conference. EX1003, FN 3. Members of the companies and organizations that participated in the EUREKA

Project often attended the PAL Symposium and contributed technical papers.

EX1003. I personally attended the PAL Symposium in both 1995 and 1997, and my technical papers were published in both Proceedings. EX1003. This major project and conference/proceedings would readily be recalled by a POSA, and Dr. Turk's lack of knowledge of even their existence shows he is not a POSA.

29. Relatedly, while the EUREKA project and PAL both show that the adaptive front lighting systems were well-known many years ahead of the '029 patent's earliest possible priority date, I also note that Dr. Turk references "Adaptive Frontal-lighting Systems" in a way that makes it seem he thinks that the '029 patent purports to invent such systems (EX2006, ¶46) and does not appreciate that such systems were well known prior to the '029 patent. EX1037, 73:2-4 ("Q: Do you know if adaptive frontal lighting systems were known prior to the '029 patent? A: I don't know offhand.").

30. But a POSA would know that such systems were developed long before the '029 patent's earliest possible filing date, as I explained in the background of my First Declaration. EX1003, ¶¶47-48. Indeed, I explained at length in my First Declaration, the development of such systems. *See, e.g.*, EX1003, ¶¶47-52, 57-58.

- 3. Dr. Turk acknowledges my expertise when discussing considerations of a POSA—even though he cites several papers I co-authored he ignores their substance and does not appreciate what a POSA would actually have understood.**

31. As explained above, Dr. Turk also incorrectly states that “beam pattern” is “related to brightness and darkness of illumination within the shape.” EX1037, 43:2-4. And this is in direct conflict with the Second Turk Declaration’s paragraph 26, where he quotes *from an article that I co-authored*, explaining that “Any automotive headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2010, 237. This misunderstanding and conflicting testimony indicates to me that he does not understand the art – his misunderstanding during deposition should have at least been consistent with documents he himself quotes and relies on. Such an inconsistency and demonstrated lack of understanding calls into question, in my mind, whether he actually read my co-authored articles in order to attempt to form an opinion on them.

32. Further, in the Second Turk Declaration, Dr. Turk even acknowledges *my* expertise and qualifications to opine on what a POSA would have understood in vehicle forward lighting, including automotive lighting and lighting control. EX2006, ¶¶30-38, quoting various articles that I co-authored, for example, EX2010, EX2012, EX2013, EX2014, EX2015. He also acknowledged this during

his deposition that I am expert in vehicle forward lighting and LED headlamps and that he has “no reasons to disagree” with me. EX1037, 58:9-19, 59:16-19.

33. I have reviewed the other articles Dr. Turk cites that I co-authored, along with others, and *none* support his arguments that a POSA would have found challenges in automotive lighting related to LEDs, regulations, design tradeoffs, hardware, optical systems, heat management, packaging, or cost to suggest any of the claims of the '029 patent are patentable. EX2006, ¶¶30-38. Rather, his disjointed citations indicate to me that he does not understand the subject matter of those articles, and further indicates to me that he is unaware that the '029 patent does not purport to *solve any* such issues. And he acknowledges that the '029 patent expressly states that it includes technologies that are either “feasible... or will become feasible in the future.” EX1037, 64:25-73:16; EX1001, 19:64-20-2.

34. While LED lighting had progress to make before wide commercial adoption, and certain regulatory restrictions limited commercial implementation of, for example, LED headlamps, AFS, and ADB systems, it is *not* the case that such developments are purported to be solved by the '029 patent or its claims. Nor would such progress required to be commercially viable be a deterrent for a POSA to seek to improve known systems via modification or adoption of other known systems. Indeed, when asked whether he agreed that “before the '029 patent, there were prior art references that disclosed to use LEDs in vehicle headlamps,” Dr.

Turk answered in the affirmative. EX1037, 52:9-12.

35. Rather, I gave several examples of the known state of the art in my First Declaration. *See, e.g.*, EX1003, ¶¶231, 232, 257, 258. Specifically, in paragraphs 257 and 258, I explained citing extensive background literature, that a POSA would have understood that:

Using LEDs in headlamps was not novel—LED arrays were well known years before the '029 patent's earliest possible priority date. *See, e.g.*, EX1005, 4:9-15, 6:9-12, 8:4-17; EX1006, ¶¶5, 7, 8, 20, 27; EX1009, 19:27-29, 20:9-12, 23:8-12; EX1010, 4:25-35, 13:24-29, 11:29-32; EX1011, 1:18-2:3, 3:18-26, 8:13-20, 10:6-11, 10:21-22.

And advantages of using LEDs as emitters were also known, such as an array of LEDs meets the standard of luminous flux; there is no appreciable size difference in the overall headlamp packaging using such LEDs; the service life of LEDs is very long compared to conventional light sources.

EX1011, 3:18-26. Beyond that, the art recognized that LEDs may be adapted under unfavorable weather (EX1011, 10:6-11) and function at a low-voltage direct current (EX1011, 10:21-22). *See also* EX1029, 987, 991 (“LED’s are offering a unique set of benefits such as lower power consumption, Long operating life, compact size, increased reliability and very low maintenance requirements depending on the application;” “the probably biggest potential

for LED's in Automotive is in Headlamps."). Thus, the evolution from prior "conventional lamps" to LEDs as headlamp light sources would have been apparent to a POSA.

36. With respect to AFS, I gave several examples of the known state of the art in my First Declaration with respect to *directional* control. See, e.g., EX1003, ¶57:

....By 1999, there were AFS headlamps "controlled by path prediction based on a vehicle's dynamics and navigation data." EX1025, 186. Although live data could be used by vehicle sensors, it was well known that GPS navigation system gave additional advantages by providing more accurate information on driving regions. EX1026, 461-462 ("To obtain more accurate information on driving regions, it is advantageous to use data from a GPS navigation system."); EX1024, 815-816. The increased accuracy of navigation systems at that time made it possible to anticipate the light distribution needed during critical driving conditions, such as curves and crossings. EX1023, 525 ("This predictive system would make possible to anticipate the needed light distribution avoiding dangerous changes in the beam during critical driving conditions such as curves and crossing."); EX1027, Abstract.

37. Also with respect to AFS, I gave several examples of the known state

of the art in my First Declaration with respect to *glare* control. *See, e.g.*, EX1003,

¶¶47-52. For brevity, I reproduce only the text of paragraph 52 of my First

Declaration, which summarizes my conclusions:

By 2000, adaptive headlamp systems with multiple directional light beams were developed with various means of sensors to detect surroundings while driving and resulted in glare reduction for oncoming and preceding vehicle drivers. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-26, 9:18-26, 20:29-32; *see also* EX1015, 6-18, 21; EX1016, 1-19 (“[A]ll GRE experts acknowledge the experience with the new technology of front lighting, designed to improve the illumination and to adapt it to various driving situations, whilst reducing glare.”); EX1009, 6:4-7; 16:6-25, 20:15-33 (“According to an aspect of some embodiments of the present invention, the pattern recognition application identifies oncoming vehicles and automatically adjusts illumination provided by the luxels to prevent glare from light provided by the luxels from blinding a driver of the oncoming vehicle.”). Further, arrays of independently controlled narrow-beam directional light sources, for example, light-emitting diode (LED) arrays, were developed with sufficient illuminance, directionality, and dynamic control as an alternative to traditional incandescent and gas discharge bulbs to provide adaptive light patterns and real-time feedback. EX1005, 1:5-3:44, 4:9-59; EX1010, 1:10-

26, 9:18-26, 20:29-32; EX1015, 6-18, 21; EX1009, 16:6-25, 20:15-33.

38. A POSA would have been familiar with these developments and state of the art, and Dr. Turk's lack of understanding of automotive lighting and lighting control makes clear that he is not a POSA, and never has been.

39. Moreover, because Dr. Turk ignores this well-known information that a POSA would have appreciated—even after I provided a detailed discussion of what a POSA would have appreciated with regard to automotive lighting and lighting control—his entire analysis presented in each of his declarations is flawed such that he *could not* have taken into account the knowledge of a POSA in his observations.

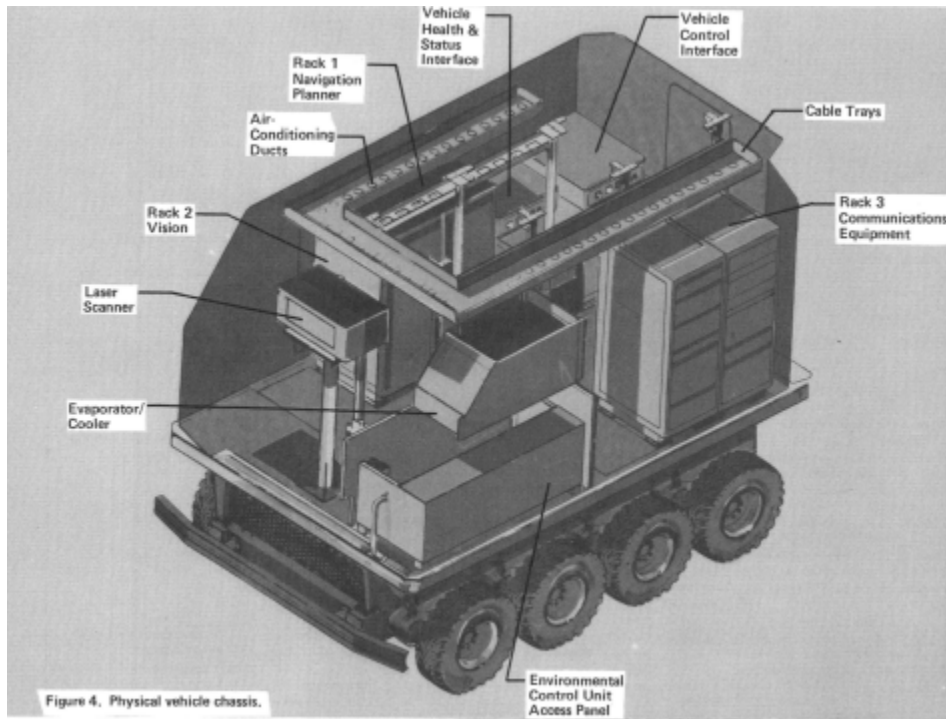
40. Notwithstanding his lack of knowledge of the relevant field and ignoring the knowledge of *others* in the field, Dr. Turk did ultimately acknowledge that the '029 patent is not so limited in regards to compliance with government rules or regulations, particular intensities, packaging size, beam pattern, new hardware, new LEDs or improvements thereof, heat management, etc. (all things he argues would be challenging for a POSA or would detract from the motivation to combine the references in the Grounds, EX2006, ¶¶25-38, 135, 155, 160, 166, 169, 170, etc.), and acknowledges that the '029 patent is not limiting to technologies that are either “feasible... or will become feasible in the future.” EX1037, 64:25-73:16; EX1001, 19:64-20-2.

B. I am convinced that Dr. Turk's inadequate, tangential experience related to self-driving systems is not adequately relevant to the subject technology to qualify him as a POSA.

41. In reviewing his deposition transcript, I note that Dr. Turk points to just one experience he finds “a bit” relevant to his experience as an alleged POSA, specifically, work related to autonomous vehicles at Martin Marietta Denver Aerospace. EX1037, 53:4-25. After reviewing that experience and public records documenting that project related to autonomous vehicles, I confirm that this experience does not adequate to establish that Dr. Turk is a POSA.

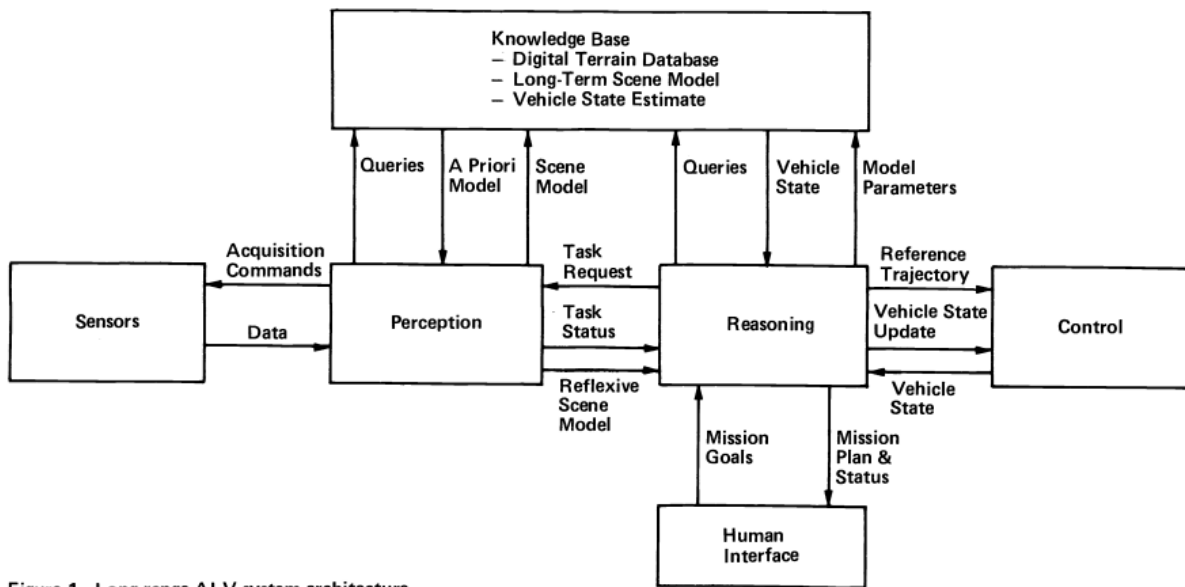
42. This project, known as the “Autonomous Land Vehicle” or “ALV” project, utilized standard testbeds with a known vehicle chassis that included the headlamps of those vehicles. EX1038, 10-12 (Section titled “Demonstration Plan”, noting that General Dynamics and/or FMC provided the chasses, which has no relevance to the art of passenger vehicle's headlamp system disclosed in the '029 patent).

43. Indeed, a paper co-authored by Dr. Turk shows a figure of the project installed over “a drive chassis supplied by Standard Manufacturing,” and notes that “[t]his physical platform is considered to be sufficient to support the electronics for all projected demonstrations and experiments.” EX1039, 338.



EX1039, FIG. 4.

44. The same paper co-authored by Dr. Turk, includes a figure of the “Long-range ALV system architecture”:



EX1039, FIG. 1.

45. The system architecture of what Dr. Turk considers to be his most relevant experience with automotive lighting and lighting control does not even include any mention of either automotive lighting or lighting control. EX1039. The system architecture of the ALV makes no mention of any lighting parameters, characteristics, inputs, outputs, considerations, etc.

46. Last, to be clear, I understand that in developing self-driving systems, lighting may be included, for example, as developed by the makers of the *standard chassis*. However, such experience is tangential at best, and bears no resemblance to work an actual POSA would be involved in under the umbrella of automotive lighting, much less adaptive headlamps with lighting control such as the subject of the '029 patent.

47. Assuming the ALV had headlamps, they were part of a standard, pre-manufactured chassis or subsystems that did not require any additional work or design, or any automotive lighting and lighting control that is the subject of the '029 patent. This further indicates to me that Dr. Turk has no relevant experience in the field of automotive lighting or lighting control, and he does not qualify as a POSA under his accepted definition.

48. Dr. Turk acknowledges that he has no experience in the field of automotive lighting, lighting control, general lighting, light measurements, and lighting device development, design, process, testing, standard and regulation

compliance. He never worked for a vehicle headlamp company, has never worked for an LED (or any other light source) company, has never worked for a general lighting company, has not designed a vehicle forward lighting system, has no patents for any vehicle forward lighting, has never won any awards for vehicle forward lighting, and has no papers on vehicle forward lighting. EX1037, 52:18-53:1, 54:24-56:12. Without any such experience, I fail to see how Dr. Turk can hold himself out as a POSA under his accepted definition, much less an expert qualified to opine on what a POSA would have understood. Dr. Turk has not participated in any lighting professional associations' activities, is not a member of the Society of Automotive Engineers (SAE International), International Society for Optical Engineering (SPIE), or Illuminating Engineering Society (IES), EX1037, 57:9-17 (a few major lighting professional organizations), which is further indicative of a lack of any focus or even awareness on automotive lighting and lighting control—his lack of participation in SAE International, in particular, even suggests a lack of focus on automotive engineering in general.

49. As I understand it from his CV, declarations, and deposition testimony, Dr. Turk's *industry experience* relates to "computer vision methods for recognizing human faces, gestures, and activity." EX2006, ¶12 (defining Dr. Turk's "industry experience"). Even if Dr. Turk is an expert in "computer vision,... concerning automatic face recognition," EX2001, ¶¶7, 10, 12, 15-16

(detailing Dr. Turk’s experience with facial recognition technologies); EX2006, ¶¶9-10, 12, 14, 17-20 (same), EX1037, 22:15-17, 22-24 (same), this is *not a case about automatic facial recognition*. The closest experience in Dr. Turk’s CV, appears to be his work at Martin Marietta Denver Aerospace, working on “computer vision for autonomous vehicle *navigation*,” not automotive lighting and lighting control or even “lighting technology” as Dr. Turk agrees is the area of the ’029 patent (EX1037, 36:2-4). The patent claims at issue concern automotive lighting and lighting control, as Dr. Turk agrees, and he has not indicated that he has any requisite “industry experience in the area of automotive lighting and lighting-control systems” required to be a POSA.

V. DR. TURK’S SUBSTANTIVE ARGUMENTS AGAINST THE GOTOU-KARLSSON COMBINATION ARE INCORRECT, AT LEAST IN PART BASED ON HIS LACK OF UNDERSTANDING OF THE ART.

50. Dr. Turk’s substantive arguments against the Gotou-Karlsson combination are not correct, and I believe they are based upon his fundamental misunderstandings of the art as I have laid out above.

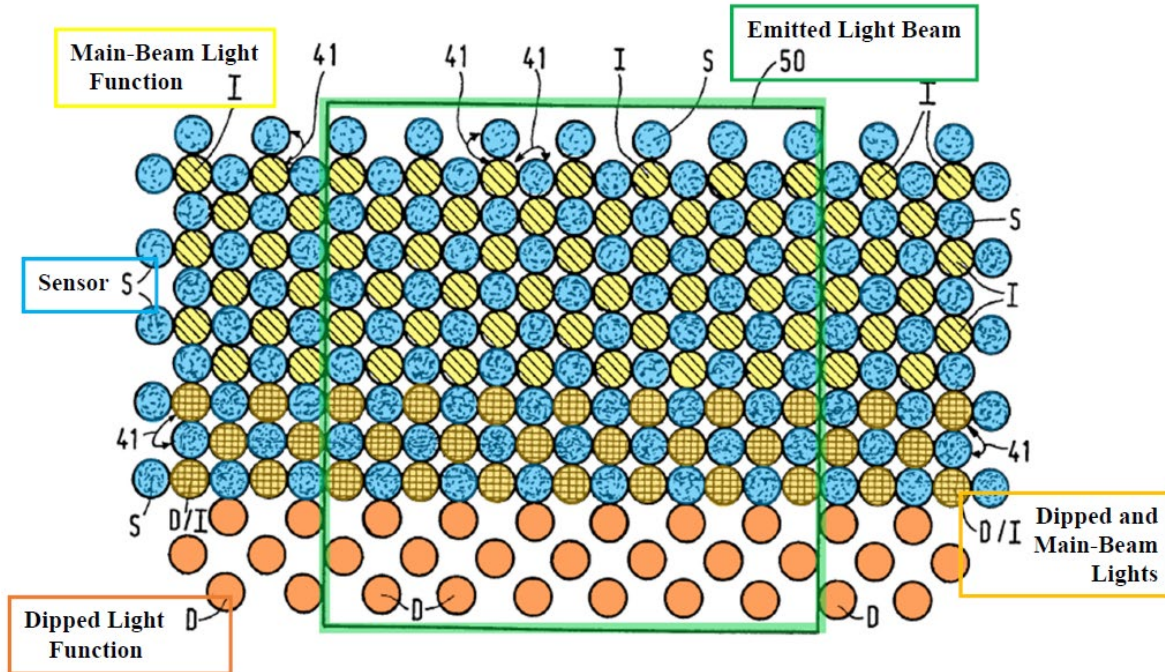
A. Karlsson does not default to all LEDs “on” as Dr. Turk alleges, and a POSA would understand that this stems from Dr. Turk’s fundamental misunderstanding of “maximum intensity,” and an incorrect importation of that term from Beam into Karlsson.

51. Dr. Turk draws an unreasonable and incorrect conclusion that Karlsson forms emitted beam 7 by “using 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.” EX2006, ¶76.

52. In paragraph 76 of the Second Turk Declaration (EX2006), Dr. Turk states that “Karlsson, like Beam, forms emitted beam 7 (Fig. 1) by using 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.” This is a gross misstatement of Karlsson. Karlsson does not disclose full or maximum intensity.

53. As I previously explained, for example in EX1003, ¶242, Karlsson’s “emitted light beam 50 is represented as a window that shifts in the plane from left to right and from top to bottom, based on the data from inputs to Karlsson’s controller. EX1010, 19:18-20:3.” I included the below annotated figure in the same paragraph:



EX1010, FIG. 14 (annotated).

54. Simply put, in direct contradiction to Dr. Turk’s mischaracterization above and his misstatement in EX2006, ¶134 that “There is nothing in Karlsson to suggest that window 50 is the actual beam that would be used for driving,” Karlsson expressly states that “The *emitted light beam 50 is represented as a window* which can *shift* in the plane of the drawings *from the left to the right* and *from the top to the bottom*, if desired, and vice versa, and which may *vary as regards its shape and dimension* in dependence on the *desired pattern and direction of the beam*.” EX1010, 19:29-34. A POSA would not find anything unclear about this statement in Karlsson. Below, I illustrate several beam patterns that Karlsson would create via its emitted light beam based in part on the section quoted above from Karlsson’s beam (supporting that Karlsson discloses an

adaptable beam):

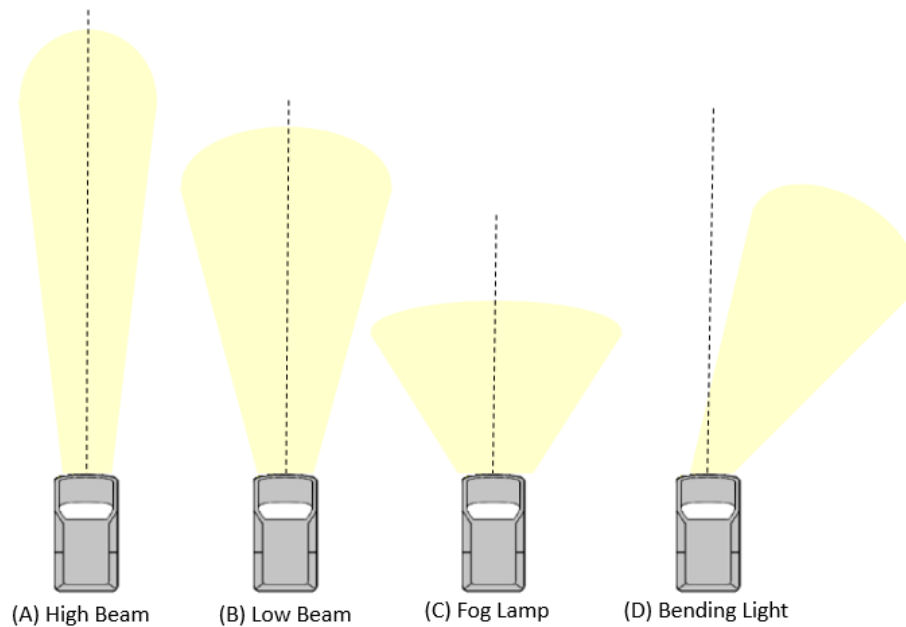


FIG. 1 Examples of Karlsson's "Desired Beam Pattern."

55. The left-most figure shows a schematic of a high-beam pattern which is long with a narrower angle of beam spread. The figure next to that shows a low beam pattern—still relatively long, and wider spread. The third-from-left figure illustrates a fog lamp beam pattern—low and wider still, ideal to increase short-range visibility and safety. Finally, the right-most figure shows a beam aimed towards the right, for example, towards a right-handed curve when using Gotou's control strategy to aim light in the direction towards a curve prior to entering the curve.

56. Karlsson's "spotlight beams 34 can be obtained, for example, by using a light source 2 which is composed of a grid of separate light sources, such as

LEDs, which can preferably be *controlled either individually or in groups.*”

EX1010, 14:1-4. Dr. Turk acknowledged that Karlsson uses LEDs for headlamps, and that those LEDs can be controlled individually or in groups. EX1037, 129:19-130:1. Even Dr. Turk notes (EX2006, ¶78) that Karlsson discloses multiple beam patterns “‘spotlight sources indicated at D provide the dipped light [low-beam] function in accordance with existing vehicle headlights,’ and ‘sources indicated at I provide the main-beam light function of existing vehicle headlights.’” (EX1010, 19:22-28). He also acknowledges that Karlsson discloses that the “‘spotlight sources indicated at D/I are both operative as dipped and main beam lights.’” EX2006, ¶78.

57. And, when asked during deposition, Dr. Turk ultimately correctly acknowledged that Karlsson discloses that its beam 50 can (1) vary as regards to its shape and dimension, (2) vary depending on the desired pattern and direction of the beam, and (3) its dimension can vary depending on the desired pattern and direction of the beam. EX1037, 132:15-25, 133:6-7, 134:2-7, 134:13-15.

58. In the Second Turk Declaration at EX2006, ¶129, Dr. Turk mischaracterizes my testimony in my First Declaration for a separate IPR (EX2006, ¶129, citing my First Declaration in that case at ¶¶281-282) where I discuss Karlsson. There, he cites testimony related to my opinion regarding a specific *surrounding area* of Karlsson’s reduced illumination with respect to glare

control. The area I discuss there is the area *around* the reduced illumination area—this “maximizes” the area illuminated *around* a vehicle that Karlsson avoids providing glare to while simultaneously allowing the driver of the vehicle with Karlsson’s system to fully see the area *around* the reduced illumination area—providing a type of “optimum lighting effect.” EX2008, 67, citing my First Declaration in that case, EX1003 at ¶¶281-282. But this is not inconsistent with my testimony here, explaining Karlsson’s directionality and intensity control—that testimony in the other case does *not* suggest that Karlsson’s maximized area *around the glare control region* means that all of Karlsson’s LEDs spotlight beams are illuminated, much less illuminated to their highest degree. Dr. Turk confirms his misunderstanding in his statements in EX2006, ¶130 that conflate Beam with Karlsson. A POSA would not be confused or mistakenly conflate these disclosures of different systems.

59. Moreover, Dr. Turk further confirms that the ’029 patent’s “*optimal operating regime*” (EX1001, 52:2) is “how a device should be operating ideally,” (EX1037, 73:5-16). Indeed, the ’029 patent’s disclosure of GPS systems used in AFS systems providing such an “optimal mode” (EX1001, 51:63-67) is similar to Karlsson’s optimally adapted intensity of its beam. Dr. Turk even acknowledges that Karlsson expressly discloses that its average intensity of the light emitted by the lighting means is controlled such to provide a light beam, the intensity of which

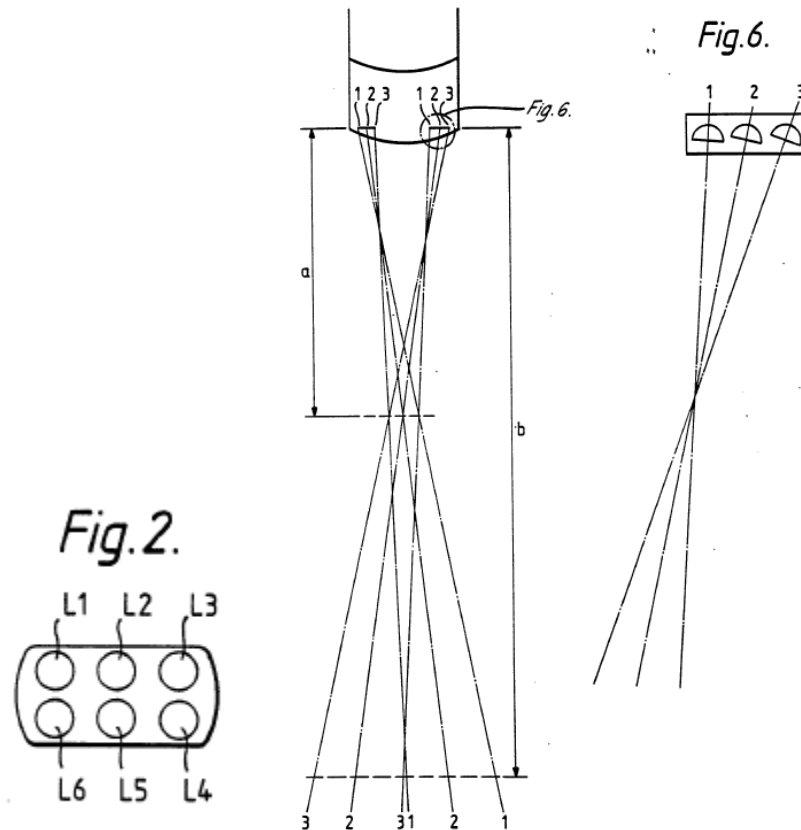
is *optimally* adapted to the road and to the ambient light, thereby increasing the driving comfort and road safety. EX1037, 130:7-131:7. And nothing suggests to a POSA that Karlsson operates with all of its LED spotlight beams active except for situations where it implements its glare control function—such an incorrect reading ignores Karlsson’s optimally adapted system with individually and group controllable LEDs resulting in emitted light beam 50 is represented as a window that shifts in the plane from left to right and from top to bottom, based on the data from inputs to Karlsson’s controller. EX1010, 19:18-20:3.

60. I note that Dr. Turk also characterizes Flaaten’s disclosure, in that it aims for an “*optimum* lighting effect.” EX2006, ¶134, citing EX2017 at 1; *see also* EX2006, ¶89, stating that Flaaten provides an “optimum lighting effect for the driver of the vehicle,” citing EX1010, 2:2-9. Indeed, Flaaten describes controlling “the light distribution pattern of the headlights,” with “intersecting directions of the axes of light beams,” to efficiently dim the light “selectively in the areas where there are other vehicles, persons, or sources of light, whereas a maximum *satisfactory* illumination is maintained of the roadway in front of the vehicle.” EX2017, Abstract. Maximum *satisfactory illumination* does not mean *all of Flaaten’s light sources are on at all times*. Nor does Flaaten’s statement that removing only the portion of the light that would inconvenience the driver of meeting cars support Dr. Turk’s conclusion that there should be “full illumination

to the ‘greatest extent possible,’” (EX2006, ¶90). Rather, a POSA would understand that Flaaten expressly acknowledges that “satisfactory illumination is maintained of the roadway in front of the vehicle,” for example, including ahead in curves. EX2017, Abstract.

61. Further, to the extent that Dr. Turk thinks Karlsson is an evolution of Flaaten, such a position shows that the evolution from incandescent bulbs to LEDs was obvious—Flaaten shows an array of bulbs in FIGS. 1 and 2, and gives an example of directional light sources in its arrays in FIGS. 5 and 6, also including intersecting, combined, optical axes, that together provide light sources “in each headlight [that] have directions of light that provide the *best possible illumination* in a *desired predetermined area* in front of the vehicle.” EX2017, 3:12-15.

Flaaten’s FIGS. 2, 5, and 6 are shown for reference:



EX2017, FIGS. 2, 5, 6.

62. Flaaten's sources L1-L6 are described to be turned off and on, or "dimmed gradually, one at a time." EX2017, 3:34-36. And Flaaten's sources may include an angular setting that is adjustable *automatically*. EX2017, 5:27-31.

63. Thus, to the extent that Dr. Turk considers Karlsson to be an improvement of a type of device of Flaaten (EX2006, ¶89) or "Karlsson's base device," he appears to thus acknowledge Karlsson's directionality and aiming of its spotlight beams from its LEDs. This is because Flaaten provides that the roadway, the edges of the road, *curves*, etc. be *satisfactorily* illuminated. EX2017, 2:2-6. Flaaten also teaches that its system of "intersecting head light beams will also be

advantageous when driving in *curves*, since the light beam from left head light will not inconvenience oncoming vehicles, and total dimming of both headlights can be avoided,” (EX2017, 2:22-26) by way of “several directional separate headlights in groups,” that are “individually di[m]mable” (EX2017, claim 3). This actually supports Karlsson’s directional aiming of its LED spotlight beams.

64. Moreover, the system implemented in Karlsson would not result in Dr. Turk’s created diagrams, rather, Flaaten would suggest that Karlsson’s LEDs may be aimed to light the *opposite side of the road*, such that Dr. Turk’s cornering diagrams would illuminate towards the curve. I now discuss Dr. Turk’s annotated figures in the Dr. Turk’s declarations and explain their deficiencies.

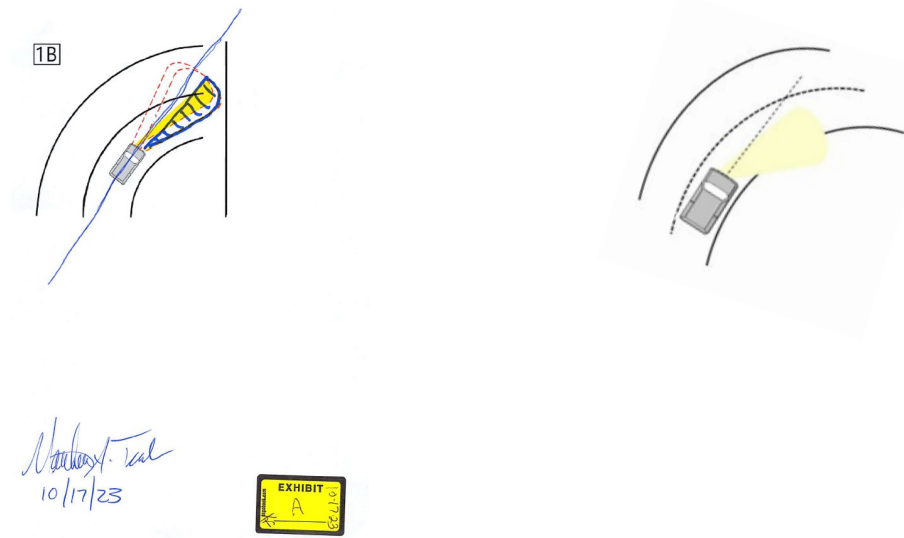
B. Dr. Turk’s annotated figures of Karlsson are incorrect, however, even they establish that Gotou-Karlsson meets the claims of the ’029 patent.

65. Dr. Turk creates several new, misrepresentative figures in EX2006, showing his interpretation of Karlsson’s “Reduction Control Strategy,” where he shows “window 50” and how he estimates it would look if a vehicle equipped with Karlsson’s system were to take a curve. EX2006, Turk-created FIGS. 1A, 2A, 1B, 2B, 1C. A POSA would immediately understand that Dr. Turk’s diagrams are completely incorrect. Karlsson discloses “The emitted light beam 50 is represented as a window which can shift in the plane of the drawings from the left to the right and from the top to the bottom, if desired, and vice versa, and which may vary as

regards its shape and dimension in dependence on the desired pattern and direction of the beam.” EX1010, 19:29-33. A POSA would have clearly understood that Karlsson’s beam 50 is a representation of grouping the individually controllable spotlight beams with a flexibility of grouping’s location, shape, and size to achieve “the desired pattern and direction of the beam.” A beam pattern and direction is defined for a known forward illumination lighting device or lamp light intensity angular distribution with examples of high beam, low beam, fog lamp, bending lighting (illustrated in my Fig. 1, above) and other “desired” possibilities. However, a POSA would not be confused that light from “window 50” could form a partial beam or a part of a beam, shown in Dr. Turk’s created FIG. 1B). This demonstrates that Dr. Turk lacks basic knowledge of a POSA.

66. However, even Dr. Turk’s figure establishes that Karlsson’s beam 50 shifts from left to right. So, when applied to Gotou’s system that controls for road curvature via map data as the Ground proposes, the beam would do the same in the direction of the curve (as it is desired) while also still accounting for “a variety of possible glare situations” as Dr. Turk acknowledges (EX2006, ¶88), and it would not be a partial beam or a part of a beam. Gotou-Karlsson would *not include* empty, unlit space. During deposition, I understand that Dr. Turk was asked to annotate a version of his created FIG. 1A, with an added second red dotted line for a potential beam pattern for the right headlamp, copying over what Dr. Turk had

drawn as the outline for his left headlamp. EX1037, 142:16-145:25. He shaded similarly, but “shifted over into the right headlamp and perhaps oriented a little more towards the centerline ahead,” which he characterized as “[t]he imaginary line that goes through the center of the car from behind to forward.” EX1037, 142:16-145:25. Below is a screen capture of his annotation he provided on the left (see EX1037, 142:6-15, 142:21-145:15 for the entire exchange), compared to an illustration on the right that I have created which corrects Dr. Turk’s misunderstanding:



EX1043, 1 Dr. Turk’s incorrect annotations

FIG. 2 Corrected Illustration

67. My corrected illustration on the right, above, shows where Karlsson’s beam would project light towards right when taking a right-hand curve, e.g., as a result of Karlsson’s “direction sensor 54,” such as a steering wheel sensor, or Gotou-Karlsson’s beam would project light towards right when taking a right hand

curve, using Gotou's map data. Unsurprisingly, Dr. Turk stated that "I don't know exactly what it would do, and again, it's not meant to be technically precise[.]"
EX1037, 144:13-15.

68. Dr. Turk's figures created in the Second Turk Declaration follow created figures present in the First Turk Declaration, about which the Board already acknowledged that such a shifting towards a curve based on which LEDs are active, for example, and acknowledged that: "Karlsson's description of Figure 14 notes that its light beam 50 'can shift...which may vary as regards its shape and dimension in dependence on the desired pattern and direction of the beam,'" and that Karlsson contemplates adjusting its LEDs "'when the car [] is taking a bend.'" Paper 7, 12-13. It is also worthy to point out that actually none of automotive lighting devices or lamps could produce a partial light output pattern drawn by Dr. Turk, simply because of the nature of optical design for the device. His drawings are another demonstration that he is not a POSA in the field.

69. Moreover, a POSA would have understood that Karlsson's spotlight beams are for at least *both* high beam and low beam functions. High beam and low beam are aimed in *different* directions as I discussed above (FIG. 1). Karlsson's spotlight beams *must* be able to change direction in order to achieve at least the high beam and low beam functions, as shown below with a simplified schematic showing a generic high beam pattern on the left and a generic low beam pattern on

the right:

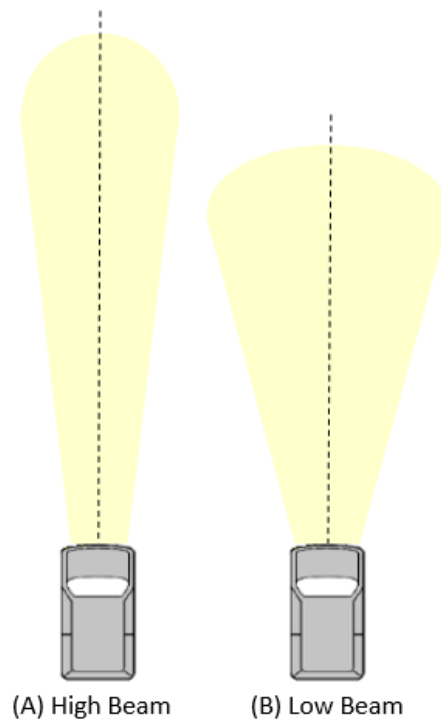


FIG. 3 High Beam vs. Low Beam Beam Patterns

70. Karlsson's description that light beam 50 "can shift...which may vary as regards to its shape and dimension in dependence on the desired pattern and direction of the beam," and that Karlsson contemplates adjusting its LEDs "when the car [] is taking a bend," supports the conclusion that the Gotou-Karlsson combination would result in a beam in the direction of a right hand curve as I show below:

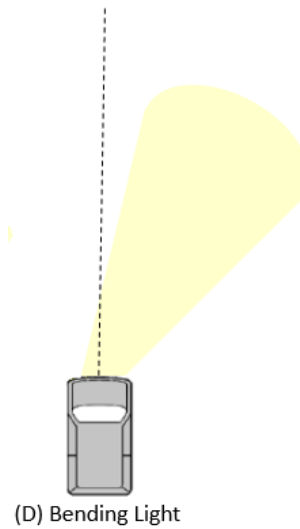


FIG. 4 Bending Light Beam Pattern

71. In reality, a POSA would have understood that the Gotou-Karlsson combination would result in a large set of “desired” beam patterns, acknowledged by Dr. Turk in Flaaten, or, for example, like those already known in AFS systems. As an example, I described in my First Declaration Hogrefe’s Figure 3, which explains that “the individual light *pattern* of multiple sub-units sum up to the total adaptive light pattern.” EX1017, FIG. 3 (emphasis in original).

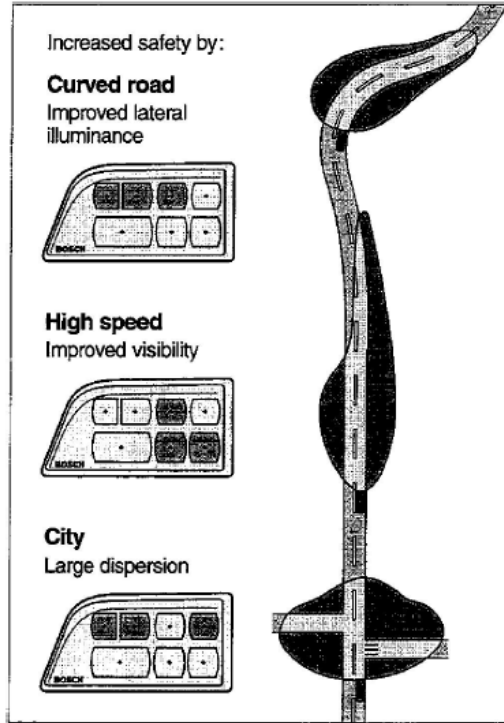


Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.

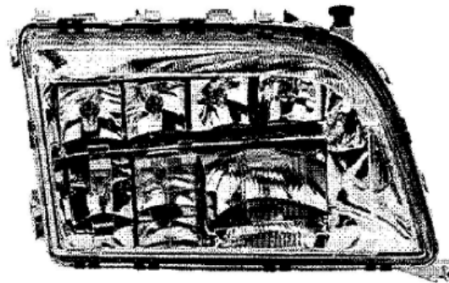
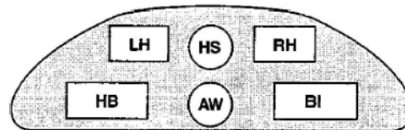


Fig 4: ALP headlamp sample



Single components:

LH Left hand bend
RH Right hand bend
HB High beam
BI Basic illumination
AW Adverse weather illumination
HS Hot spot

Fig. 5: Advanced ALP sample layout

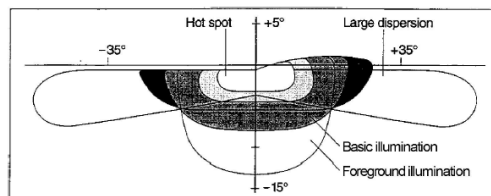


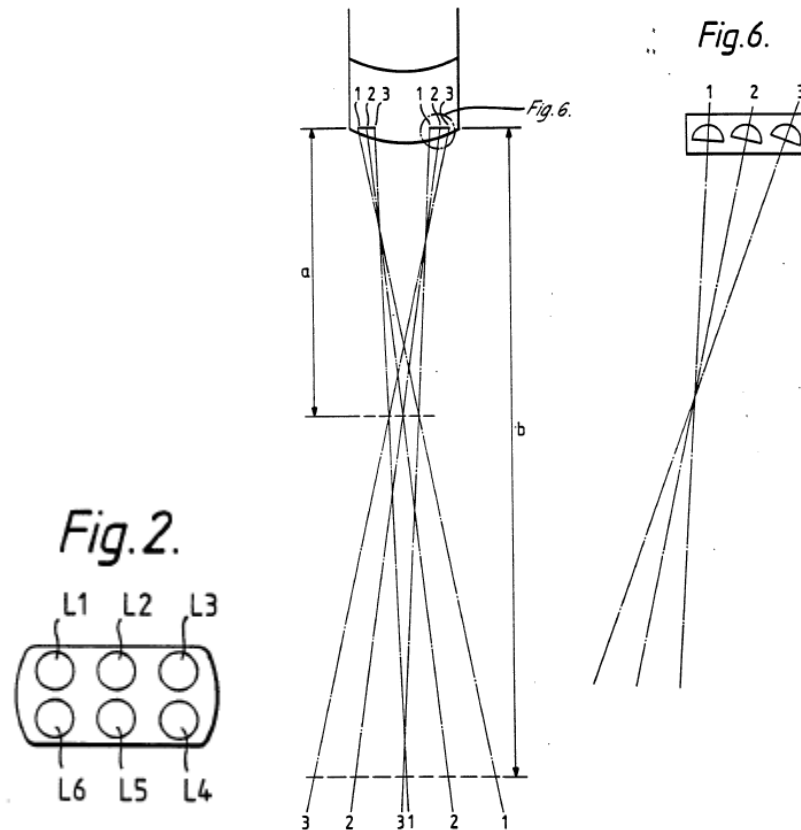
Fig. 3: Light pattern of multiple beam headlamp (Isolux curves in wall projection). The individual light pattern of multiple sub-units sum up to the total adaptive light pattern

EX1017, FIGS. 1 and 3-5.

72. A POSA would have understood that Gotou-Karlsson beam patterns—like known adaptive beam patterns at the time—would include variation in direction and length and width (angular distribution) from a bird’s eye view, or driver’s view with variation in intensity points along a projected distance. Known patterns shown above include large dispersion, curved-road light (bending light, increased lateral illuminance for curves), and high speed long reaching beams as shown above.

73. This directly refutes Dr. Turk’s unsupported and misinformed arguments that Gotou-Karlsson does not teach “increasing light in a direction of the road curvature,” as laid out in the First Turk Declaration, EX2006, ¶¶127-136.

74. Further, to the extent that Dr. Turk thinks Karlsson is an evolution of Flaaten, I have explained above that Flaaten shows an array of bulbs in FIGS. 1 and 2, and gives an example of directional light sources in its arrays in FIGS. 5 and 6, also including intersecting, combined, optical axes, that together provide light sources “in each headlight [that] have directions of light that provide the *best possible illumination* in a *desired predetermined area* in front of the vehicle” EX2017, 3:8-14. Flaaten’s FIGS. 2, 5, and 6 are shown for reference:



EX2017, FIGS 2, 5, and 6.

75. Flaaten’s sources L1-L6 are described to be turned off and on, or “dimmed gradually, one at a time.” EX2017, 3:34-36. And Flaaten’s sources may include an angular setting that is adjustable *automatically*. EX2017, 5:27-31.

76. Thus, to the extent that Dr. Turk considers Karlsson to be an improvement of a type of device of Flaaten (EX2006, ¶89) or “Karlsson’s base device,” he appears to acknowledge Karlsson’s directionality and aiming of its spotlight beams from its LEDs—indeed Flaaten itself provides that the roadway, the edges of the road, *curves*, etc. are *satisfactorily* illuminated (EX2017, 2:2-6) and that its system of “intersecting head light beams will also be advantageous

when driving in *curves*, since the light beam from left head light will not inconvenience oncoming vehicles, and total dimming of both headlights can be avoided,” (EX2017, 2:22-26) by way of “several directional separate headlights in groups,” that are “individually dim[m]able” (EX2017, claim 3).

77. Again, such a system implemented in Karlsson would not result in Dr. Turk’s created diagrams, rather, Flaaten would suggest that Karlsson’s LED spotlight beams may be aimed to light the *side of the curved road*, such that Dr. Turk’s cornering diagrams (Figure 1B) would illuminate towards the curve instead.

C. Dr. Turk’s arguments related to the motivation to combine Gotou and Karlsson are further evidence he does not understand the relevant art, and in any event are not relevant to determining whether a POSA would have had motivation to combine Gotou and Karlsson.

78. Dr. Turk focuses on Karlsson while ignoring that Gotou is the primary reference and how a POSA would have understood the Gotou-Karlsson *combination*. Furthermore, I explained at length and with particularity why a POSA would have been motivated to combine the references and with a reasonable expectation of success in my First Declaration. EX1003, ¶¶229-252.

79. Dr. Turk’s main criticism of Gotou is his factually incorrect statement that Gotou does not “contemplate turning lamp unit 4 on/off or otherwise changing its intensity.” EX2006, ¶71. This is wrong for at least two reasons.

80. First, as described above, even if Gotou only changed the direction of

its headlamp beam pattern, the headlamp beam pattern directional change will result in the light intensity angular distribution change. But Dr. Turk's misunderstanding of a POSA's perspective of "intensity" being synonymous with "brightness" undergirds his entire analysis. A change in direction reflects a change in intensity and certainly an "increase of light in a direction," as stated in the '029 patent's claims.

81. Second, Gotou expressly describes at 8:16-19 that its system contemplates plural bulbs, which I highlighted in my First Declaration. EX1003, ¶239 (Gotou "*describe[s] that plural bulbs may be installed in one head light and the light distribution is changed by 'separately using one bulb illumination and two-bulb illumination, respectively.'*" EX1012, 8:15-19."). Correctly, Dr. Turk acknowledged this during his deposition (EX1037, 125:4-6, 127:6-13), as well as the premise that with two bulbs where "one is lit and one is off and then you light the second one,...that would increase light in a certain direction." EX1037, 128:8-20.

82. So Dr. Turk's conclusion that Gotou does not disclose "headlamps with multiple light sources with corresponding multiple optical axes" is demonstrably false. EX2006, ¶74. Additionally, his statement that Gotou does not disclose LEDs, non-moveable light sources, light sensors, or glare prevention features is not controversial (EX2006, ¶74)—Karlsson does, which is why the

combination of Karlsson with Gotou renders the claims obvious, as I previously described. EX1003, ¶¶229-352.

83. Dr. Turk again argues that various potential challenges in creating a commercial LED headlamp array (*e.g.*, EX2006, ¶135), but ultimately acknowledged during deposition that the '029 patent is not so limited by regulations, design tradeoffs, hardware, optical systems, heat management, packaging, or cost to suggest any of the claims of the '029 patent would be patentable. He also correctly acknowledged that the '029 patent is not limiting to technologies that are either “feasible... or will become feasible in the future.” EX1037, 64:25-73:16; EX1001, 19:64-20-2.

84. Dr. Turk’s conclusion at paragraph 179 of EX2006 states that “substituting an LED array for a conventional light source to make a forward lighting system that meets applicable regulations and standards would be beyond routine for a POSA and there would be no reasonable expectation of success for the resulting forward lighting system.” But, even Karlsson—the target of Dr. Turk’s misplaced criticism—acknowledges that its light beam 7 emitted with LEDs “*is adapted to the respective regulations at all times,*” (EX1010, 20:26-27) and improves upon a device that does not include LEDs (EX2017). And while Dr. Turk opined in the First Turk Declaration that “Some systems cannot be adapted to the regulations at the time,” (EX1037, 147:4-6) I do not believe that a POSA

would consider that to be determinative of whether a POSA would have found claims obvious, where the claims do not require compliance with a particular regulation.

85. These admissions from Dr. Turk that the '029 patent is not so limited by regulations, design tradeoffs, hardware, optical systems, heat management, packaging, or cost contradicts his arguments against the combination of Gotou-Karlsson, and confirms my previous explanation of why a POSA would have been motivated to combine Gotou with Karlsson with a reasonable expectation of success in my First Declaration. EX1003, ¶¶229-252. Gotou's plural bulb control and Karlsson's acknowledgement of adapting its light beam to "respective regulations" also cuts against Dr. Turk's uninformed arguments against the *combination*.

D. Dr. Turk's arguments related to the dependent claims again show he does not understand the applied art from the viewpoint of a POSA, and he failed to appreciate the particularity with which I pointed to each claimed feature shown in the respective references.

1. Claims 5, 16, and 27

86. Dr. Turk groups claims 5, 16, and 27 (EX2006, ¶¶137-141), and argues that Gotou-Karlsson does not disclose these features. This is incorrect.

87. As I explained in my First Declaration (*e.g.*, at EX1003, ¶299), these features recite increasing any light (other than high-beam intensity) in the direction

of the road curvature. And as I previously explained, “Gotou’s variation of high-beam and low-beam is generally in a vertical direction and not affected by horizontal movement—rather, when the vehicle runs along a curved corner or turns right or left,” e.g., along a curve, “[] the lamp optical axes are moved in a turning direction to deflect the lighting region at the curve, thereby improving visibility. EX1012, 1:10-20; *see also* EX1012, 3:52-67, 4:1-29, FIG. 4, 4:36-40, 5:8-7:4, FIGS. 8-9.” EX1003, ¶300.

88. And I have explained above, a POSA would have understood that Karlsson relates to *at least both low beam and high beam light*. It is not clear what Dr. Turk takes issue with, in my previous conclusion (EX1003, ¶¶299-302, ¶302 specifically) that “Thus, the increase of lighting toward the curve of the combined Gotou-Karlsson system is emitted at a level below high-beam light, unless manually changed by the driver, resulting in the increase of light in the direction of the road curvature being ‘an increase of light emitted at a level below high-beam light.’ *See* EX1012, 1:10-20. The increased lighting toward the curve of the combined Gotou-Karlsson system (using Karlsson’s LEDs) would be at a level below high-beam light (i.e., Karlsson’s LEDs would implement the same type of light level toward the curve),” thereby increasing light (other than high-beam intensity) in the direction of the road curvature. EX1003, ¶302.

89. Additionally, Dr. Turk apparently takes issue with the “road

curvature” or “shape change” language difference in comparing claims 5 and 27, but I fail to see any patentable distinction, as I described in my First Declaration. EX1003, ¶95 (where I explain phrases that vary slightly between the independent claim elements and concluding that such changes do not confer any patentable difference between those limitations). And accounting for “road curvature” is a type of “shape change.” EX1003, ¶95. When asked during deposition whether “road curvature in claim 5 [is] analogous to a shape change in claim 27,” Dr. Turk was unable to provide any difference between the terms and answered: “Again, I have not compared those claims and the language in them, so I can’t really comment or don’t have an opinion at the moment of whether those two are associated or not or how they’re associated.” EX1037, 158:15-159:9 (see EX1037, 156-15-159:9 for the entire exchange).

90. Dr. Turk also incorrectly ignores claim 27’s plain language that “the increase of light *in the direction associated with the shape change* includes at least light output that *increases light emitted at a level below high-beam light and directed in the direction associated with shape change.*”

91. Even under his interpretation that an “emitting LED has its illumination increased” is required (EX2006, ¶142) (which it is not), Gotou’s disclosure of plural bulb control for controlling increase of light in the direction associated with the shape change includes at least light output that *increases light*

emitted at a level below high-beam light and directed in the direction associated with shape change. EX1012, 8:15-19, as I described in my First Declaration (EX1003, ¶239). Similarly, Karlsson, too, controls illumination level of its LEDs individually and in groups (EX1010, 14:1-4), such that the Gotou-Karlsson combination renders the claim obvious.

92. Indeed, by Dr. Turk’s own admission, Karlsson’s LEDs may be “freshly lit, having never been previously illuminated.” EX2006, ¶145. This would be an increase in “intensity” even under Dr. Turk’s incorrect understanding that does not include direction, namely zero “brightness” increased to non-zero “brightness.” This would also include *at least light output that increases light emitted at a level below high-beam light and directed in the direction of the curvature or associated with shape change.*

2. Claims 6, 17, and 28

93. Dr. Turk groups claims 6, 17, and 28 (EX2006, ¶147), and states that the control would not have included “at least one LED light source different from the first plurality of LED light sources,” in the context of a second road curvature or shape change. But that is simply not correct.

94. As I explained in my First Declaration, (EX1003, ¶¶304-315), the Gotou-Karlsson combined system is iterative, and determines any number of future light changes—there are several instances that at least one LED light source would

be different from the first plurality of LED light sources.

95. I previously explained that a POSA would have understood that the claim elements are a verbose way of reciting that the system (including instructions [6.1]/[17.1]/[28.1]) (1) determines a second light change for a second (i.e., next) road curvature [6.2]/[17.2]/[28.2], and (2) controls the LEDs to provide light toward the second road curvature (i.e., “shaping light”) based on map data [6.3]/[17.3]/[28.3], and as combined, claims 6, 17, and 28 are rendered obvious by the Gotou-Karlsson combination.

96. Indeed, as I explained in my First Declaration at EX1003, ¶305, the Gotou-Karlsson combination discloses this function for the same reasons as in, EX1003, Sections XI.A.1, XI.A.7, XI.A.8, XI.B.2, XI.B.3. *See, e.g.*, EX1008, 13:67-14:13, 14:26-30, 2:30-35, 6:1-5; EX1012, Abstract, 1:35-40, 2:8-26, 3:24-62, 4:45-49, 6:4-61, 7:32-43, 8:28-35, FIGS. 1-3 and 8-10. This is nothing more than a subsequent, repeated step in the continuous, iterative processes of the '029 patent and Gotou-Karlsson systems, and a POSA would have readily understood that it would involve different permutations of LEDs.

97. Even Dr. Turk’s own annotations showing shifting LEDs towards a right hand curve in his FIG. 1B (EX2006, ¶84) and the addition of other LEDs to the left when taking a left hand curve in his FIG. 1C (EX2006, ¶¶85) show that this claim feature is obvious, and confirm Karlsson uses “at least one LED light source

different from the first plurality of LED light sources,” in the context of a second road curvature or shape change. This directly contradicts his argument in EX2006, ¶147 that it does not.

98. Dr. Turk does not criticize my opinions provided regarding claims 4, 15, and 26 (EX1003, ¶¶295-298), which are similar to claims 6, 17, and 28 in that they relate to reshaping the light, that is, selecting one of the first plurality of LED’s or some second plurality of LEDs with one different LED from the first to provide *reshaped* light. EX1003, ¶295. Just like claims 6, 17, and 28, a POSA would have understood this to have been obvious, at least because *reshaping* the combined system’s light in any sense would have required taking some action with *at least one* of Gotou’s modified headlamps utilizing Karlsson’s LEDs (e.g., rather than relying on the instant forward direction of travel of the vehicle). EX1003, ¶295.

3. Claims 7, 18, and 29

99. Dr. Turk groups claims 7, 18, and 29 (EX2006, ¶¶148-150). His discussion ignores my previous explanation of the Gotou-Karlsson combination. A POSA would have understood that Gotou-Karlsson indeed increases light via an increase of intensity of light directed in the direction of the road curvature, and also an expansion of the light pattern (towards the curve). EX1003, ¶¶316-320.

100. Indeed, I explained at EX1003, ¶¶316-317, these elements are simply

a way of reciting well known alternatives for increasing the light toward the road curvature [7.1]/[18.1]/[29.1], [7.2]/[18.2]/[29.2]. The light can be increased by (1) increasing the intensity of the lights [7.3]/[18.3], or (2) increasing the number of lights that are “on” that are directed toward the road curvature [7.4]/[18.4]/[29.2]. These basic alternatives are disclosed by the Gotou-Karlsson combination. And the obviousness of this feature is shown by the same disclosures and rationales as the independent claims. EX1003, ¶317, citing EX1003, Section XI.A.

101. As one example, Gotou’s light distribution which controls around curves can be changed by “separately using one bulb illumination and two-bulb illumination, respectively” EX1012, 8:15-19. Dr. Turk’s acceptance that with two bulbs where “one is lit and one is off and then you light the second one,...that would increase light in a certain direction.” EX1037, 127:9-128:11. This is an expansion of the light pattern by increasing the number of lights that are on (and controlling intensity thereof since intensity includes direction) that are directed toward the road curvature.

102. As another example, Karlsson expressly states that “The *emitted light beam 50 is represented as a window* which can *shift* in the plane of the drawings *from the left to the right* and *from the top to the bottom*, if desired, and vice versa, and which may *vary as regards its shape and dimension* in dependence on the *desired pattern and direction of the beam*.” EX1010, 19:29-34. This is also an

expansion of the light pattern by increasing the number of lights (spotlight beams) that are on that are directed toward the road curvature (and controlling intensity thereof since intensity includes direction) and would result in expanded beam patterns, e.g., in the direction of the curve as shown in my annotated figures, as well as figures of other known art such as Hogrefe's FIG. 1:

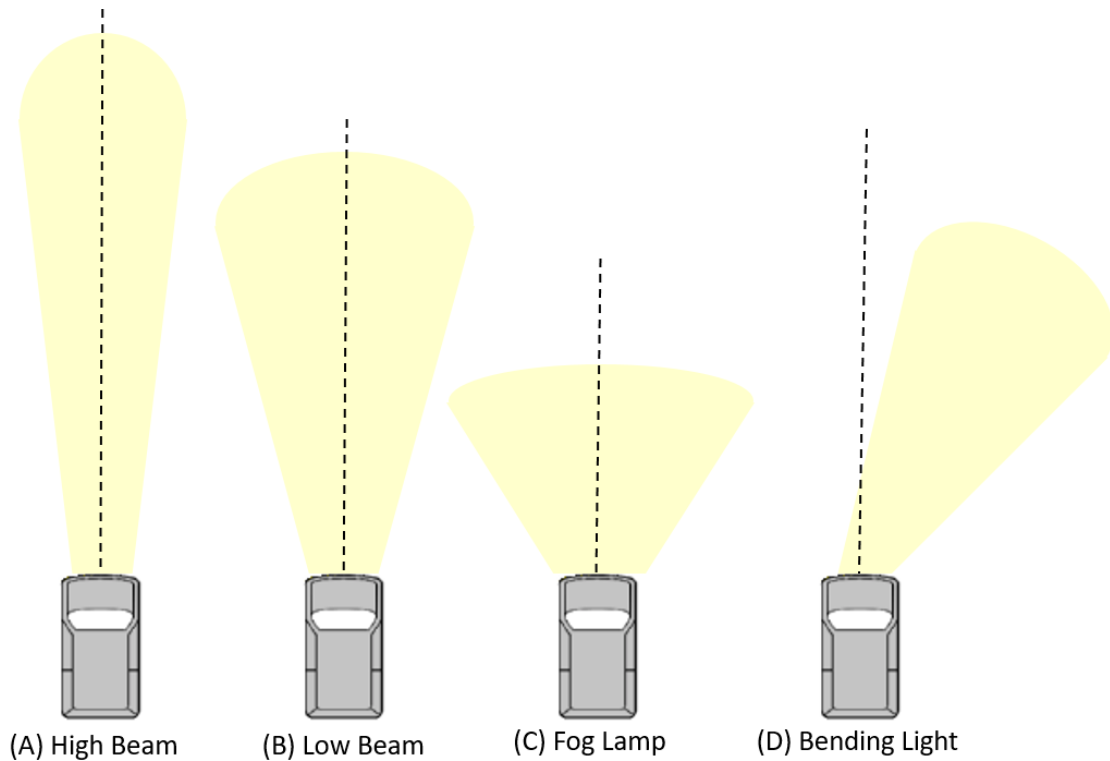


FIG. 1 Examples of Karlsson's "Desired Beam Pattern"

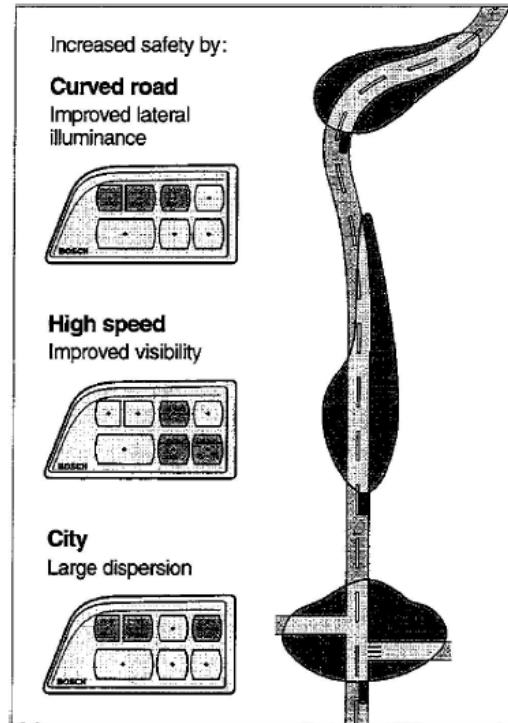


Fig.1: Three standard driving situations with adapted light pattern seen from the bird eye's view.

EX1017, FIG. 1.

4. Claims 9, 20, and 31

103. Dr. Turk groups claims 9, 20, and 31 (EX2006, ¶¶151-153), and suggests that “map data” cannot be used to “control the second plurality of LED light sources” to diminish glare to a driver of the other vehicle. But this is incorrect or irrelevant for at least two reasons.

104. First, as I explained in my First Declaration (EX1003, ¶329), these claims simply recite, among other things, that the second plurality of LEDs is controlled based at least in part on third data received from a *non-camera sensor* [9.3]/[20.3]/[31.3]; and the first data includes data from a *non-camera sensor*

[9.5]/[20.5]/[31.5]. In paragraph 330 of my First Declaration, I explain that Gotou's map data is not from a camera sensor (among other examples in both Gotou and Karlsson), and thus in combination with Karlsson meets this portion of the feature related to both first and third data not from a camera sensor [9.3]/[20.3]/[31.3], [9.5]/[20.5]/[31.5]. EX1012, 3:52-67, 4:1-29, 5:8-6:3, 6:18-7:4, FIGS. 4, 7.

105. Second, there is no requirement in the claims that such non-camera sensor data is the *sole* control of the claimed "second plurality of LEDs," or that the "second plurality of LEDs" is *solely* controlled to "diminish glare to a driver of the other vehicle." Indeed, claim 8 for example, from which claim 9 depends, clarifies that there is "control, *based at least in part* on the position [of a vehicle determined with a camera]" as in Karlsson, of "a second plurality of LED light sources...to diminish glare." I explained in my First Declaration in paragraphs 329-340 the obviousness of this claim along with similar claims 19 and 30 with reference to the Gotou-Karlsson combination. But [9.3] only recites that "the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle;" and does *not* require that such control be "to diminish glare," as the partial control of the second plurality of LED light sources based at least in part on the position of a vehicle. Rather, the *additional* control in [9.3] is not limited in its purpose at all, just that it

is based “at least in part on third data received from a non-camera sensor of the motor vehicle.”

106. Dr. Turk acknowledged that GPS, speed sensor, rain sensors, radar, steering angle sensors, range sensors, elevation sensors (all sensor examples from Gotou/Karlson/Beam/Kobayashi that are inputs into beam control) are non-camera sensors. EX1037, 162:2-24. Nonetheless, Dr. Turk ignores that in the Gotou-Karlsson combination, such control of the LEDs would include both the glare control inputs *and* map data inputs, as I explained in detail in my First Declaration. EX1003, ¶¶329-340.

5. Claims 10, 21, and 32

107. Dr. Turk groups claims 10, 21, and 32 together (EX2006, ¶154), and states that “Petitioner does not identify which optics it is relying on for this combination.” The feature recited here is merely “one or more optical control elements for controlling light from one or more of the LED light sources,” and both Gotou and Karlsson individually and together disclose myriad optical control elements.

108. As I previously explained in my First Declaration (EX1003, ¶¶341-349), Gotou discloses optical control elements by using reflectors/sub-reflectors to change light distribution (EX1012, 8:20-22), and Karlsson also discloses optical control elements such as reflectors and lenses throughout. *See, e.g.*, EX1010, 14:1-

15, 5:4-10, 10:26-31. These are all optical control elements for controlling the LED light. *See also* EX1010, 11:3-25 (discussing “light modulator means), and thus as combined they are rendered obvious by the Gotou-Karlsson combination. Of course, a POSA would have understood that Karlsson’s optical control elements (or optics as Dr. Turk calls them) would have been used in the combined Gotou-Karlsson system, as together they provide the correct illumination and controls Karlsson’s LED light. EX1003, ¶¶341-349. Dr. Turk acknowledged that such components like Karlsson’s lenses and reflectors are “optical control elements.” EX1037, 164:12-165:2. Clearly, Dr. Turk may not understand the concept of “optical control elements” taught in both Gotou and Karlsson due to his lack of knowledge in automotive lighting applications. These two references are not conflicting but additive. Overall, a POSA would have understood that the Gotou-Karlsson combination is relatively easy to achieve and to meet the ’029 patent claim elements. FIG. 5 below is an illustration of Gotou-Karlsson combination, in which Gotou’s light sources and optical control elements are replaced by Karlsson’s, and Gotou’s ECU 10 is integrated with Karlson’s control means 14 with GPS data.

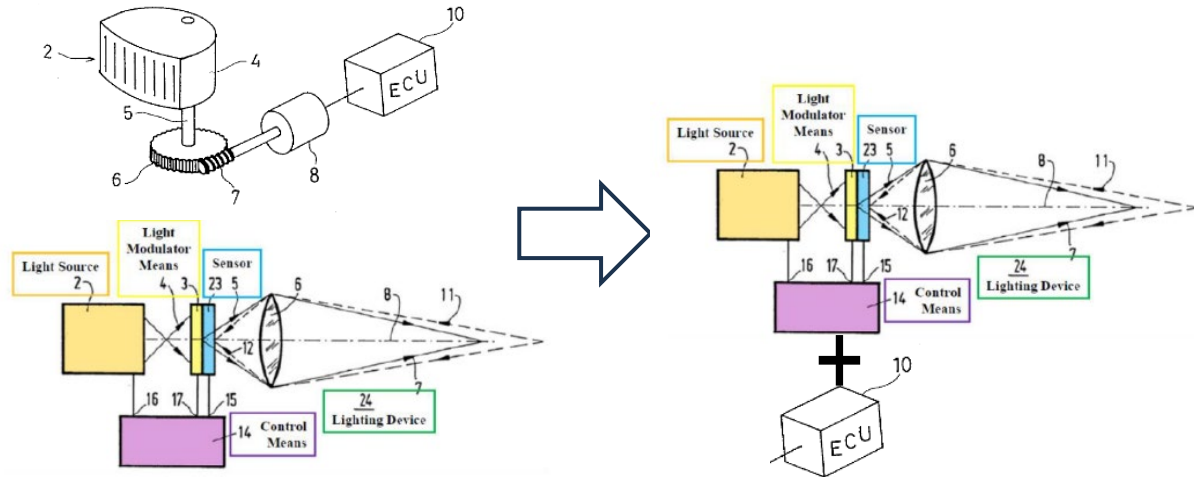


FIG. 5 Illustration for Gotou-Karlsson combination

VI. DR. TURK’S SUBSTANTIVE ARGUMENTS AGAINST THE BEAM-KOBAYASHI COMBINATION ARE INCORRECT, AT LEAST IN PART BASED ON HIS LACK OF UNDERSTANDING OF THE ART.

109. Again, Dr. Turk’s substantive arguments against the Beam-Kobayashi combination are not correct, and I believe they are based upon his fundamental misunderstandings of the art as I have laid out above.

A. Dr. Turk’s arguments regarding Beam’s “maximum intensity” are incorrect and reflect a lack of understanding of the art.

110. Beam thus explains that it *controls intensity including angular position* to a maximum desired in a given direction, and does not default (using a colloquialism) “full blast” everywhere at all times as Dr. Turk seems to suggest based on his misunderstanding of “intensity.”

111. Dr. Turk’s misunderstands what Beam discloses to a POSA. Beam’s discloses a system that includes at least *both* low beam and high beam achieved by its microbeams. And as I have explained, high beam and low beam are aimed in

different directions. Beam’s microbeams *must* be able to change direction in order to achieve at least the high beam and low beam functions that a POSA would have understood. Beam does not, however, disclose to a POSA that it is unable to *increase light in a direction* by virtue of its “maximum intensity”—which is not “maximum brightness.” A POSA would have well understood that term of maximum intensity is commonly relating to the light intensity level in different angles for different lamp functions.

112. And as I previously explained at paragraph 119 in my First Declaration, Beam discloses a plurality of headlamps, each comprising a plurality of LED light sources, that may be configured as “an array of individual, independently controllable microbeam sources.” EX1005, 8:4-17. Beam expressly discloses in claims 4 and 5 that the light source as referred to as comprising microbeams may be configured as an array of *individual, independently controllable LEDs*. EX1005, 2:53-3:3, 4:9-59, 8:4-17.

113. Additionally, I explained in paragraph 137 of my First Declaration that Beam’s system “us[es] that information to *control the intensity, and/or the angular position*, of one or more” LEDs. *See* EX1005, Abstract. Beam thus explains that it *controls intensity including angular position* to a maximum desired in a given direction, and does not default (using a colloquialism) “full blast” everywhere at all times as Dr. Turk seems to suggest based on his

misunderstanding of “intensity.” Further, Beam’s control is “*dynamically varying* in position and in size,” in response to the control input. EX1005, 5:46-54, 6:24-27. So, what Beam discloses to a POSA is that Beam “determines a light change,” and adapts the headlamps’ light pattern in both intensity *and* spatial (angular) distribution as in the ’029 patent’s claims.

114. I note that Dr. Turk, incorrectly, stated that Beam could not “light outside of [its] field of view to light a curve,” in his deposition (EX1037, 119:19-120:6) but at least ultimately acknowledged that Beam could be modified to light outside of that field of view (EX1037, 119:19-120:6).

115. As I explained above with reference to Dr. Turk’s lack of POSA qualifications, he appears to not understand what the term “intensity” means in the context of vehicle headlamps. It is not, contrary to Dr. Turk’s misunderstanding, similar to or synonymous with “brightness,” which is a human perception measurement. *See* EX1037, 62:18-25. Dr. Turk opines that the term “intensity” in the context of the ’029 patent should be interpreted as “what intuitively we think of as brightness.” EX1037, 84:3-6.

116. Dr. Turk also incorrectly states that “beam pattern” is “related to brightness and darkness of illumination within the shape.” EX1037, 43:2-4. And this is in direct conflict with the Second Turk Declaration’s paragraph 26, where he quotes *from an article that I co-authored*, explaining that “[a]ny automotive

headlamp beam pattern, either high-beam or low-beam, is a light luminous intensity (candela) angular distribution.” EX2010, 237. Thus, a POSA would understand that such beam patterns relate to intensity with angular distribution.

117. As a POSA would understand, Beam’s beam pattern includes directionality, and a change in beam pattern includes a change in direction of the light. It is apparent to me that Dr. Turk does not understand Beam’s disclosure from the perspective of a POSA. At paragraphs 54 and 56 of EX2006, he states that Beam does not “disclose or teach changing direction of any microbeams,” but this is fundamentally wrong. Beam expressly states that the *angular position* or *attenuation* (e.g., decrease as understood by Dr. Turk, EX1037, 95:12-23) “of each of these microbeams is independently set by controller 108,” which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-54. In a particular example of Beam’s teaching shown in EX1005 FIG. 1, the detected oncoming and preceding vehicles where the sections of AABH are dimmed to avoid glare are the moving targets. Thus, the microbeams must be able to constantly change directions in order to follow the moving targets.

118. Thus, Beam does not, contrary to Dr. Turk’s opinion, disclose to a POSA that it is unable to *increase light in a direction* by virtue of its “maximum intensity.”

B. Beam discloses to a POSA a system that includes both an LED array and a spatial light modulator, contrary to Dr. Turk's demonstrably false assertions.

119. Dr. Turk opines that Beam's LED array renders its "spatial light modulator....superfluous." EX2006, ¶¶58-59. Moreover, Dr. Turk takes the incredible position that "A POSA would never interpret the SLM as being included in the LED embodiment because the functionality of the two components is redundant, and thus unnecessary." EX2006, ¶61. But this is demonstrably false, as exemplified by Beam's claim 4. Indeed, I note that when confronted during his deposition, Dr. Turk acknowledged that, for example, Beam's claim 4 does, in fact, expressly disclose a system that includes both an array of LEDs and a spatial light modulator. EX1037, 89:21-90:9, 90:17-91:8.

120. Such a disclosure is not superfluous. Beam's disclosure includes a beam pattern comprising many—on the order of 300,000—individual, narrow angle microbeams, which may come from LED sources. EX1005, 4:41-44. Of course, Dr. Turk acknowledged that Beam would not include 300,000 LEDs, rather, a spatial light modulator would be included. EX1037, 101:4-102:15. Beam's microbeams are "diverted or attenuated" (EX1005, 5:65-66) which a POSA would understand means, for example changed direction or dimmed. A POSA would not conflate these concepts as Dr. Turk did during his deposition where in responding to a question that asked whether his understanding of Beam is

that the term “angular position” is the same thing as “attenuation,” he responded that “...the angular position of each microbeam is equated to the attenuation of each microbeam.” EX1037, 94:21-96:12.

121. Nonetheless, Dr. Turk ultimately acknowledge that each of Beam’s microbeams can be directed. EX1037, 100:23-24.

C. Dr. Turk’s arguments related to the motivation to combine Beam and Kobayashi are further evidence he does not understand the relevant art, and in any event are not relevant to determining whether a POSA would have had motivation to combine Beam and Kobayashi.

122. I provided very detailed, specific explanations in my First Declaration about the motivation to combine Beam and Kobayashi from the perspective of a POSA, for example, at EX1003, ¶¶96-115.

123. Dr. Turk argues that adding Kobayashi’s map data to Beam would render “Beam’s AABH system inoperative or unsatisfactory for its stated purpose.” EX2006, ¶112. But this is based on a fundamental misunderstanding of what a POSA would understand “intensity” means, as I have repeatedly explained in this declaration. Dr. Turk also ignores that Beam’s system *does* change the direction of light from headlamps, and such a combination that changes direction in view of Kobayashi’s map data *would* improve driver safety. EX2006, ¶112.

124. Indeed, Dr. Turk repeatedly truncates the ’029 patent’s claim language “increase light” (the Turk Second Declaration paragraphs 96, 113, 123,

136, 137, 171) where the full phrase is “increase light in a direction,” (claims 1, 5, 11, 16) further demonstrates Dr. Turk’s lack of understanding of fundamental concept of the automotive headlamps’ functionality. The ’029 patent claim language of “increase light in a direction,” per POSA’s understanding, is a light intensity change that includes spatial distribution or directionality. Changing or increasing light in a direction is a headlamp beam pattern’s spatial distribution change that includes intensity change or increase in certain direction, which results in a light intensity angular distribution qualities change. It is not “increase light” for overall beam pattern. This also further explains why Dr. Turk’s interpretation of Beam’s “maximum intensity” statements as something that does not include direction and is synonymous with “brightness” is incorrect as I described above and a POSA would understand that he is incorrect.

125. Nonetheless, I note that Dr. Turk acknowledged during deposition that “increase light in a direction” as used in the ’029 patent “means what it says, to increase the amount of light in a certain direction,” and that any of “a change in color or change in intensity or change in spatial distribution,” “can cause increase in light and direction.” EX1037, 85:24-86:17.

126. Again, at paragraphs 54 and 56 of EX2006, Dr. Turk states that Beam does not “disclose or teach changing direction of any microbeams,” but this is fundamentally wrong. Beam expressly states that the *angular position* or

attenuation (e.g., decrease as understood by Dr. Turk, EX1037, 95:12-23) “of each of these microbeams is independently set by controller 108,” which is controlled in a dynamic environment of moving vehicles. EX1005, 4:46-54.

127. Dr. Turk further states that Beam is not “capable of pointing or otherwise changing direction of microbeams,” at paragraph 119 for example, but that is also incorrect. A POSA would have understood that Beam expressly discloses that it *is* capable of pointing or otherwise changing direction of microbeams (and it does so). Indeed, as I explained in my First Declaration (EX1003, ¶208), Beam’s AABH unit explicitly discloses “[t]he angular position or attenuation of each of these microbeams is independently set by the controller 108.” EX1005, 4:46-48. And a POSA would have understood the angular position (e.g., direction) of one or more narrow *microbeams* from Beam’s *light-emitting diodes (LEDs)* are controllable. EX1003, ¶74, citing EX1005, Abstract, 8:4-17. And as I described in paragraph 103 of my First Declaration “[s]uch control is ‘*dynamically varying* in position and in size,’” in response to the control input. EX1005, 5:46-54. Thus, Beam confirms that its control is not limited only to reducing glare, and confirms that its light is controllable in direction, intensity, angular position, etc.

128. In attacking the references individually, Dr. Turk’s observation that Kobayashi (EX1008) does not disclose LEDs, specific light sensors, or glare

prevention is not surprising (EX2006, ¶68). Kobayashi is not relied upon for such features—Beam is (for example, EX1003, ¶¶96-115, 199-206).

129. However, I also note that the inventor Kobayashi had, almost 5 years prior to the issuance of EX1008, an entire patent dedicated to glare sensors for vehicles and automatic control of headlamps issued as U.S. Pat. No. 5,426,294, (EX1040) which is cited on the face of EX1008. This further confirms to a POSA that the modification of Beam adding Kobayashi’s map data disclosed in EX1008 would *not conflict at all* with Beam’s glare control features.

130. As I explained in detail in my First Declaration, while Beam does not specifically disclose using map data, such as from GPS or navigation beacons, as an input to control the intensity and/or angular position of the LEDs (or their resultant beam) of its system, it would have been obvious to a POSA to do so. EX1003, ¶105. This would have made Beam’s system even more active and sophisticated than prior systems, as Beam seeks to do (*see* EX1005, 2:15-22), and further achieves Beam’s purpose of improving driver safety by directing or adding light where it is needed. EX1005, 3:8-44; 6:53-7:13. Beam *is able* to “illuminate both lanes of the roadway,” and includes the left shoulder, right shoulder, *and* “the upcoming curve,” as acknowledged by Dr. Turk. EX2006, ¶126.

131. Kobayashi further confirms that controlling the shape of the light to correspond with the driver’s changing line of sight (ahead of a curve on a *curved*

road) enhances safety. EX1008, 15:6-28. This was all described in my First Declaration (for example, EX1003, ¶¶96-115), and directly refutes Dr. Turk's arguments regarding how the Beam-Kobayashi system would work, e.g., at EX2006, ¶¶122-126.

D. Dr. Turk's arguments related to the dependent claims again show he does not understand the applied art from the point of view of a POSA, and failed to appreciate the particularity with which I pointed to each claimed feature shown in the respective references.

1. Claims 5, 16, and 27

132. Dr. Turk groups claims 5, 16, and 27 (EX2006, ¶¶98-105), and argues that these claims do not simply “amount to merely directing any light (other than high-beam) in the direction of the road curvature.” EX2006, ¶100. He points to Beam's default of low-beam illumination (EX1005, 6:30-33), but as I have explained above, a POSA would have understood that Beam relates to *at least both low beam and high beam light*.

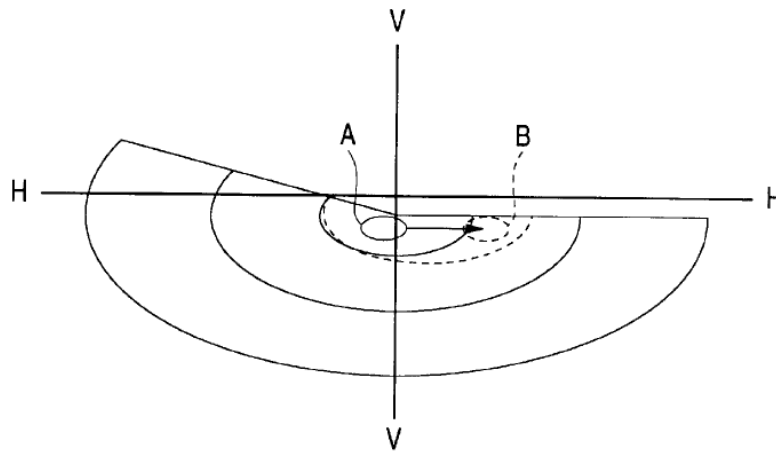
133. Dr. Turk apparently takes issue with the “road curvature” or “shape change” language difference in comparing claims 5 and 27, but I fail to see any patentable distinction, as I described in my First Declaration. EX1003, ¶95 (where I explain phrases that vary slightly between the independent claim elements and concluding that such changes do not confer any patentable difference between those limitations). Dr. Turk also incorrectly ignores claim 27's plain language that “the

increase of light *in the direction associated with the shape change* includes at least light output that *increases light emitted at a level below high-beam light and directed in the direction associated with shape change.*”

134. “Road curvature” is a type of “shape change.” EX1003, ¶95. When asked during deposition whether “road curvature in claim 5 [is] analogous to a shape change in [claim] 27,” Dr. Turk was unable to provide any difference between the terms and answered: “Again, I have not compared those claims and the language in them, so I can’t really comment or don’t have an opinion at the moment of whether those two are associated or not or how they’re associated.” EX1037, 158:15-159:9.

135. As explained in my First Declaration (EX1003, ¶¶171-177), in the Beam-Kobayashi combination, Kobayashi explains increasing light emitted at a *level below high-beam light and directed in the direction of the road curvature*, for example, with reference to Figure 8.

FIG. 8



EX1008, FIG. 8.

136. The light distribution pattern of a low beam (in EX1008, FIG. 8, commonly named as an iso-candela plot by a POSA) shows the center portion with higher intensity (hotspot) is moved from section A to section B, so that the luminous intensity distribution can be changed towards a curved road, e.g., as shown by a broken line in the drawing. EX1008, 11:14-33. In Figure 8, lines “H—H” and “V—V” are reference lines on a screen located in the front of the vehicle by a predetermined distance (light distribution in an angular coordinate), and line “H—H” is a horizontal line, and line “V—V” is a vertical line. EX1008, 11:14-33.¹

¹ Of course, controlling direction and range may also be conducted on a main beam. EX1008, 11:23-33. Also, the entire range may be directed to a desired

2. Claims 6, 17, and 28

137. Dr. Turk groups claims 6, 17, and 28 (EX2006, ¶106), and says that the control would not have included “at least one LED light source different from the first plurality of LED light sources.” That is not correct. As I explained in my First Declaration, there are several instances that at least one LED light source would be different from the first plurality of LED light sources. The Beam-Kobayashi combined system is iterative and determines any number of future light changes, and I described in detail such functions (EX1003, ¶¶179-186).

138. For example, I explained (EX1003, ¶179) that Beam’s control is “*dynamically varying* in position and in size,” in response to the control input. EX1005, 5:46-54, 6:24-27.

139. And, as I explained in EX1003, ¶180, “as modified with Kobayashi’s ECU 10, the combined system receives signals sent from GPS navigation device 29 among others, and applies an iterative control scheme. *See, e.g.,* EX1008, 17:8-15, 17:41-50.” “Such an iterative control scheme, applying map data from a GPS system, beacon, etc., allows for directional light control on curved roads r1, R1, etc., in accordance with the driver’s line of sight to improve safety by adapting the light pattern in intensity and spatial distribution, shaping and reshaping light based at least in part on road curvature—*no matter how many curves the vehicle* direction. EX1008, 11:23-33.

encounters on its travels.” EX1003, ¶180 (emphasis in original).

140. Dr. Turk does not criticize my opinions provided regarding claims 4, 15, and 26 (EX1003, ¶¶165-170), which are similar to claims 6, 17, and 28 in that they relate to reshaping the light, that is, selecting one of the first plurality of LED’s or some second plurality of LEDs with one different LED from the first to provide *reshaped* light (a different light intensity angular distribution). EX1003, ¶165. Just like claims 6, 17, and 28, a POSA would have understood this to have been obvious, at least because *reshaping* the combined system’s light in any sense would have required taking some action with *at least one* of Beam’s AABH LEDs (e.g., rather than relying on the instant forward direction of travel of the vehicle). EX1003, ¶165.

141. I explained in paragraph 166 of my First Declaration that Beam’s processor 1105 (*see* EX1005, 5:34-36) as used in controller 108 uses appropriate algorithms on the incoming data to determine the LEDs to be controlled, e.g., blanked, thus making it clear that a specific LED is used in one situation (e.g., Figure 1C) but not in another situation (e.g., Figure 1D, having an enlarged blanked area, especially when both oncoming and preceding vehicles driving in different lanes are detected). EX1005, 5:33-54, FIG. 7. Such control is “*dynamically varying* in position and in size,” in response to the control input. EX1005, 5:46-54.

142. To be sure, Kobayashi also expressly describes reshaping the light based on road curvature, which would be implemented with Beam's controller 108. EX1008, 14:53-15:28, FIG. 10, FIG. 12; EX1003, ¶167.

3. Claims 9, 20, and 31

143. Dr. Turk groups claims 9, 20, and 31 (EX2006, ¶107), and suggests that “map data” cannot be used to “control the second plurality of LED light sources” to diminish glare to a driver of the other vehicle. Again, this is incorrect or irrelevant for at least two reasons.

144. First, as I explained in my First Declaration (EX1003, ¶207), these claims simply recite, among other things, that the second plurality of LEDs is controlled based at least in part on third data received from a *non-camera sensor* [9.3]/[20.3]/[31.3]; and the first data includes data from a *non-camera sensor* [9.5]/[20.5]/[31.5]. In paragraph 330 of my First Declaration, I explain that Kobayashi's map data is *not* from a camera sensor (among other examples in both Beam and Kobayashi), and thus in combination with Beam meets this portion of the feature related to both first and third data from a *non-camera sensor*. *See, e.g.*, EX1008, Abstract, 1:10-63; EX1005, Abstract, 5:33-54, 4:46-48.

145. Second, there is no requirement in the claim that such non-camera sensor data is the *sole* control of the claimed “second plurality of LEDs,” or that the “second plurality of LEDs,” is *solely* controlled to “diminish glare to a driver of

the other vehicle.” Indeed, claim 8 for example, from which claim 9 depends, clarifies that there is “control, *based at least in part* on the position [of a vehicle determined with a camera]” as in Beam, of “a second plurality of LED light sources...to diminish glare.” I explained in EX1003, ¶¶198-206 the obviousness of this claim along with similar claims 19 and 30 with reference to the Beam-Kobayashi combination. But [9.3] only recites that “the control of the second plurality of LED light sources is based at least in part on third data received from a non-camera sensor of the motor vehicle;” and does *not* require that such control be “to diminish glare,” as the partial control of the second plurality of LED light sources based at least in part on the position of a vehicle. Rather, the *additional* control in [9.3] is not limited in its purpose at all, just that it is based “at least in part on third data received from a non-camera sensor of the motor vehicle.”

146. Dr. Turk acknowledged that GPS, speed sensor, rain sensors, radar, steering angle sensors, range sensors, elevation sensors (all sensor examples from Gotou/Karlson/Beam/Kobayashi that are inputs into beam control) are non-camera sensors. EX1037, 162:2-24.

147. As previously described in my First Declaration, in the Beam-Kobayashi combination, such control of the LEDs would include both the glare control inputs *and* map data inputs, as I explained in detail in my First Declaration. *See, e.g.*, EX1003, ¶207; EX1008, Abstract, 1:10-63; EX1005, Abstract, 5:33-54,

4:46-48. Kobayashi's map data is *not* from a camera sensor (among other examples in both Beam and Kobayashi), and thus in combination with Beam meets this portion of the feature related to both first and third data from a *non-camera* sensor.

VII. CONCLUSION

148. For at least these reasons, I reach the same conclusions as in my First Declaration—each of the Grounds of unpatentability render all claims of the '029 patent unpatentable as obvious.

149. In signing this declaration, I recognize that the declaration will be filed as evidence in an *inter partes* review before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on this 8th day of November 2023, in Louisville, Kentucky.



Dr. Jianzhong Jiao