

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VOLKSWAGEN GROUP OF AMERICA, INC.,
Petitioner

v.

YECHEZKAL EVAN SPERO,
Patent Owner

Case IPR2023-00336
U.S. Patent No. 9,955,551 B2

**DECLARATION OF E. FRED SCHUBERT, PH.D., IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,955,551**

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TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	SUMMARY OF GROUNDS	2
III.	SUMMARY OF OPINIONS.....	2
IV.	QUALIFICATIONS	3
V.	MATERIALS CONSIDERED	9
VI.	LEGAL STANDARDS	12
	A. My Understanding of Claim Construction.....	13
	B. A Person of Ordinary Skill in the Art	13
	C. My Understanding of Obviousness.....	14
VII.	LEVEL OF ORDINARY SKILL IN THE ART.....	18
VIII.	OVERVIEW OF THE '551 PATENT	19
	A. Technology Background	19
	B. The '551 Patent	23
	C. Prosecution History Summary	27
	D. Claim Construction	29
	1. “lighting fixture” and “light fixture”	30
	2. “light source(s)”	31
IX.	SUMMARY OF THE APPLIED REFERENCES.....	32
	A. Braun	32
	B. Dowling	34
	C. Bailey.....	35
	D. Begemann.....	36
	E. Lee	38
	F. Pederson	40
X.	GROUND 1: BRAUN RENDERS CLAIMS 1-3 OBVIOUS	41
	A. Braun renders independent claim 1 obvious	41
	1. [1.P].....	41
	2. [1.A]	43

3.	[1.B]	45
4.	[1.C]	48
5.	[1.D]	49
6.	[1.E].....	51
7.	[1.F].....	54
8.	[1.G]	56
9.	[1.H]	57
B.	Claim 2	60
C.	Claim 3	61
XI.	GROUND 2: BRAUN, ALONE OR IN VIEW OF DOWLING, RENDERS CLAIMS 4 AND 7 OBVIOUS	63
A.	Motivation to combine Braun and Dowling.....	63
B.	Claim 4	65
1.	[4.A]	65
2.	[4.B]	67
C.	Claim 7	68
1.	[6.P].....	69
2.	[6.A]	69
3.	[6.B]	69
4.	[6.C]	71
5.	[6.D]	72
6.	[6.E].....	74
7.	Claim 7.....	76
XII.	GROUND 3: THE COMBINATION OF BRAUN, DOWLING AND BAILEY RENDERS CLAIMS 8, 10-13 AND 15-18 OBVIOUS.....	77
A.	Motivation to combine Braun, Dowling and Bailey	77
B.	Independent Claim 8	79
1.	[8.P]	79
2.	[8.A]	80
3.	[8.B]	81

4.	[8.C]	85
5.	[8.D]	86
6.	[8.E]	88
7.	[8.F]	90
C.	Claim 10	91
D.	Claim 11	93
E.	Claim 12	93
F.	Claim 13	95
G.	Claim 15	95
H.	Claim 16	99
I.	Claim 17	100
J.	Claim 18	104
XIII.	GROUND 4: BEGEMANN AND LEE RENDER CLAIMS 1-4 OBVIOUS.....	105
A.	Rationale for combining Begemann and Lee.....	105
B.	Begemann, alone or in view of Lee, renders independent claim 1 obvious.	108
1.	[1.P]	108
2.	[1.A]	110
3.	[1.B]	111
4.	[1.C]	114
5.	[1.D]	115
6.	[1.E]	116
7.	[1.F]	119
8.	[1.G]	121
9.	[1.H]	123
C.	Claim 2	125
D.	Claim 3	126
E.	Claim 4	127
1.	[4.A]	127

2.	[4.B]	128
XIV.	GROUND 5: THE COMBINATION OF BEGEMANN, LEE AND PEDERSON RENDERS CLAIMS 8 AND 10-18 OBVIOUS	130
A.	The motivation to combine Begemann, Lee and Pederson.....	130
B.	Independent Claim 8	133
1.	[8.P]	133
2.	[8.A]	134
3.	[8.B]	134
4.	[8.C]	136
5.	[8.D]	136
6.	[8.E].....	137
7.	[8.F].....	140
C.	Claim 10	140
D.	Claim 11	141
E.	Claim 12	142
F.	Claim 13	143
G.	Claim 14	144
H.	Claim 15	145
I.	Claim 16	147
J.	Claim 17	147
K.	Claim 18	148
XV.	OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.	149
XVI.	CONCLUSION.....	152
XVII.	APPENDIX A: THE CHALLENGED CLAIMS	153

I, E. Fred Schubert, Ph.D., declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Volkswagen Group of America, Inc. (“VWGoA” or “Petitioner”) for the above-captioned *inter partes* review proceeding to provide my expert opinions and expert knowledge. I understand that this proceeding involves U.S. Patent No. 9,955,551 (“the ’551 patent”) titled “Detector Controlled Illuminating System,” to Yechezkal Evan Spero, and that Torchlight Technologies, LLC has purported to be the exclusive licensee of the ’551 patent. EX1052, Amended Complaint, 8. I understand that the Petition submitted by Petitioner challenges claims 1-4, 7-8, and 10-18 (“the challenged claims”) of the ’551 patent.

2. The ’551 patent describes, generally, light fixtures with light emitting diodes (“LEDs”). I am familiar with, and have worked on, the technology described in the ’551 patent as of its earliest possible priority date, July 12, 2002.

3. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the ’551 patent and the references that form the basis for the grounds of unpatentability set forth in the Petition for *inter partes* review of the ’551 patent filed by Petitioner.

4. In preparing this declaration, I have reviewed and am familiar with all the documents cited in this declaration. I have reviewed and am familiar with the

'551 patent and its file history. 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. I am being compensated at my customary rate of \$500 per hour for my work on this case. My compensation is not dependent upon my opinions, my testimony, or the outcome of this case.

II. SUMMARY OF GROUNDS

6. I understand that the Petition for *inter partes* review of the '551 patent filed by Petitioner asserts the following Grounds of unpatentability:

Ground	References	Basis	Claims Challenged
1	Braun (EX1005)	§103	1-3
2	Braun, Dowling (EX1027)	§103	4, 7
3	Braun, Dowling, Bailey (EX1035)	§103	8, 10-13, 15-18
4	Begemann (EX1006), Lee (EX1026)	§103	1-4
5	Begemann, Lee, Pederson (EX1011)	§103	8, 10-18

III. SUMMARY OF OPINIONS

7. In my opinion, the challenged claims of the '551 patent would have been obvious to a person of ordinary skill in the art ("POSA") in view of the

combinations of prior art references Petitioner asserts in the context of common knowledge and industry practice at the time of its filing.

IV. QUALIFICATIONS

8. My qualifications for forming the opinions set forth in this report are summarized here and explained in more detail in my curriculum vitae, which is submitted as EX1004 and incorporated herein. My curriculum vitae also includes a list of my publications and the cases in which I have testified at a deposition, hearing, or trial during the past 10 years.

9. I am currently an active, tenured, full professor in the Department of Electrical, Computer and Systems Engineering at Rensselaer Polytechnic Institute (RPI), located in Troy, New York.

10. I received a Master's Degree in Electrical Engineering ("Diploma Degree") from the University of Stuttgart, Germany, in 1981. I received a Ph.D. degree in Electrical Engineering ("Doctorate Degree") from the University of Stuttgart, Germany, in 1986.

11. Starting in 1985, I worked in industry at AT&T Bell Laboratories in Holmdel, New Jersey and Murray Hill, New Jersey, for ten years. For the first two years, I was a Post-Doctoral Member of the Technical Staff, and subsequently became a Principal Investigator and Member of Technical Staff.

12. In 1995, I joined academia. My first position was at Boston University

located in Boston, MA, where I worked as a full professor for seven years. In 2002, I joined Rensselaer Polytechnic Institute (RPI), located in Troy, New York, where I served in several leadership positions. From 2002 to the present time, I have served as an active, tenured, full professor in the Department of Electrical, Computer and Systems Engineering. From 2002 to 2015, I served as Head of the Future Chips Constellation and as a distinguished professor, the Wellfleet Senior Constellation Professor. From 2009 to 2010, I served as the founding Director and Principal Investigator of the Smart Lighting Engineering Research Center that was funded by the U.S. National Science Foundation in the amount of \$40 million over 10 years. From 2002 to 2012, I served as a professor in the Department of Physics, Applied Physics and Astronomy.

13. I am named as a co-inventor on more than 35 U.S. patents, and have co-authored more than 300 publications. I authored the books “Doping in III-V Semiconductors” (1993), “Delta Doping of Semiconductors” (1996) and the first, second and third editions of “Light-Emitting Diodes” (2003, 2006 and 2018); the latter book is known as a standard textbook in the field of LEDs¹, and the book has

¹ In this field, the term “LED” is sometimes used to refer to just the LED chip and is sometimes used to refer to the larger package including the LED chip. The precise meaning is usually apparent from the context.

been translated into Russian, Japanese and Korean. My publications have been well recognized by the technical community, as illustrated by about 40,000 citations received by my publications.

14. I have received several awards for my technical contributions. They include: Senior Member IEEE (1993); Literature Prize of Verein Deutscher Elektrotechniker for my book “Doping in III-V Semiconductors” (1994); Fellow SPIE (1999); Alexander von Humboldt Senior Research Award (1999); Fellow IEEE (1999); Fellow OSA (2000); Boston University Provost In-novation Award (2000); Discover Magazine Award for Technological Innovation (2000); R&D 100 Award for RCLED (2001); Fellow APS (2001); RPI Trustees Award for Faculty Achievement (2002 and 2008); honorary membership in Eta Kappa Nu (2004); 25 Most Innovative Micro- and Nano-Products of the Year Award of R&D Magazine (2007); and Scientific American 50 Award (2007).

15. My general expertise is in the field of electrical engineering and applied physics, including semiconductor materials, processing and devices. My specific expertise is in the field of light-emitting diodes (LEDs), including the structure, packaging and manufacture of LEDs. My work has included the design, growth, fabrication, manufacturing, and testing of semiconductor devices, as well as the employment of these devices in a variety of applications. In addition, I have extensive expertise in LED lighting systems including “smart lighting systems.”

Indeed, I have contributed to establishing the field of smart lighting. A pioneering research article titled “Solid-state light sources getting smart” (Science Magazine, Volume 308, Issue 5726, pages 1274-1278, year 2005), which I co-authored, has been cited more than 3,500 times. Smart lighting recognizes that LED lighting systems allow for new, unprecedented functionalities including changing the color temperature of smart light sources, changing the hue of smart light sources, communicating with lighting sources, and controlling the light polarization of lighting sources. My expertise in LED lighting systems also includes LED drivers, LED controllers, LED power-supply systems, and the reliability of LED lighting systems.

16. I have been working in the field of semiconductor microelectronic and optoelectronic devices, including light-emitting diodes (LEDs), for more than 25 years. I have conducted and directed research in this field, have conducted and directed development in this field and have published numerous papers, patents and books on the topic of LEDs. My research and development activities have related to the packaging, reliability, life-testing, heat-flow, and encapsulation of LEDs. Specific LED-related research topics, on which I have personally worked and published, include the following:

- The roughening, texturing, and patterning of surfaces in GaN LEDs in order to enhance light extraction;

- The encapsulation of LED chips in an LED package using a transparent resin, such as silicone, and the control of the refractive index of the transparent resin by the inclusion of TiO₂ nanoparticles;
- The heat flow and thermal management in LED packages;
- New approaches for the electrostatic discharge protection of packaged LEDs without the use of Zener diodes;
- The optimization of the spatial distribution of phosphor in LED packages, including the analysis of remote-phosphor distributions;
- The reliability of LED packages, including lifetime testing under (i) elevated temperatures, (ii) enhanced humidity and (iii) over-current conditions;
- Delamination effects of optical thin films under stress conditions occurring in optoelectronic packages;
- The design, fabrication and testing of LED packages with particular attention to the spatial phosphor distribution;
- The design and testing of LED packages, with particular attention to the thermal management of packaged LEDs; and
- The occurrence of trapped optical modes inside LED packages.

17. I have made pioneering contributions to the following technical fields:
delta-doping, resonant cavity light-emitting diodes, high electron mobility

transistors, photonic-crystal light-emitting diodes, crystallographic etching of GaN, ohmic contacts (such as delta-doped ohmic contacts and non-alloyed ohmic contacts), omnidirectional reflectors, low-refractive index and low-k materials, high-refractive index and high-k materials, silicon integrated circuit technology, anti-reflection coatings, light-emitting diodes, LEDs with remote phosphors, efficiency droop in LEDs, and solid-state lighting.

18. Furthermore, I pioneered what is now known as the “remote phosphor” distribution in white LEDs; the associated research article (entitled “Strongly enhanced phosphor efficiency in GaInN white light-emitting diodes using remote phosphor configuration and diffuse reflector cup”) has been cited more than 350 times.

19. At RPI, I regularly teach a course on LEDs, which includes extensive discussions on the efficiency of LEDs and the use of LEDs in smart lighting systems. I have guided graduate students and postdoctoral researchers conducting research on LEDs including the packaging of LEDs. My work in industry (at AT&T Bell Laboratories) involved LEDs and lasers, including topics such as minimizing the cost of device-packaging processes.

20. As Director and Principal Investigator of the Smart Lighting Engineering Research Center, funded by the US National Science Foundation, I directed research on LEDs for use in intelligent or “smart” lighting systems. Such

smart lighting systems have functionalities that go beyond lighting and include, for example, the tuning of the color temperature, spatial control of illumination intensity, and communication with lighting sources. Under the Research Center, I started a research effort on traffic lights that not only send visual signals to drivers (red, yellow, and green light) but also digitally communicate their state to approaching cars (stop or go) through the light emitted by the traffic light source. The novel technology may be able to reduce red-light violations, thereby avoiding collisions and fatalities that are still far too common.

V. MATERIALS CONSIDERED

21. In formulating my opinions, I have relied upon my training, knowledge, and experience that are relevant to the '551 patent. Furthermore, I have specifically considered the following documents, in addition to other sources cited in this Declaration:

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 9,955,551 B2 to Spero (“the ’551 patent”)
1002	Prosecution File History of U.S. Patent No. 9,955,551 B2 (“’551 Prosecution History”)
1004	Curriculum Vitae of Dr. E. Fred Schubert
1005	WIPO Patent Publication No. WO 02/04247 to Braun, <i>et al.</i> (“Braun”)
1006	U.S. Patent No. 6,250,774 to Begemann, <i>et al.</i> (“Begemann”)
1007	U.S. Patent No. 6,079,862 to Kawashima, <i>et al.</i> (“Kawashima”)
1008	Ex Parte Reexamination Certificate issued August 19, 2022 for U.S. Patent No. 9,955,551.

<i>Exhibit #</i>	<i>Description</i>
1009	U.S. Patent No. 5,796,094 to Schofield, <i>et al.</i> (“Schofield”)
1010	U.S. Patent No. 6,144,159 to Lopez, <i>et al.</i> (“Lopez”)
1011	U.S. Patent Application Publication No. 2002/0048174 to Pederson (“Pederson”)
1012	File History of <i>Ex Parte</i> Reexamination Request No. 90/014,815 filed on July 30, 2021 for U.S. Patent No. 9,955,551 (“the ’815 reexamination”)
1013	The IESNA Lighting Handbook, Illuminating Engineering Society of North America, 9th Edition, 2000, ISBN 0-87995-150-8 (“IESNA Handbook”)
1014	Schalkoff, Pattern Recognition, statistical, structural and neural approaches, John Wiley and Sons, New York, 1992.
1015	<i>Intentionally left blank</i>
1016	<i>Intentionally left blank</i>
1017	WIPO Patent Publication No. WO 01/70538 (“Stam PCT”)
1018	John Vaglica and Peter Gilmour, “ <i>How to Select a Microcontroller</i> ,” IEEE Spectrum, November 1990. (Accessible at https://ieeexplore.ieee.org/document/62226)
1019	Ata Khan, “ <i>Workhorses of the Electronic Era</i> ,” IEEE Spectrum, October 1996. (Accessible at https://ieeexplore.ieee.org/document/540088)
1020	U.S. Patent No. 6,498,440 to Stam, <i>et al.</i> (“Stam ’440”)
1021	U.S. Patent No. 5,803,579 to Turnbull, <i>et al.</i> (“Turnbull”)
1022	U.S. Patent No. 6,528,954 to Lys, <i>et al.</i> (“Lys”)
1023	U.S. Patent No. 6,681,032 to Bortolussi, <i>et al.</i> (“Bortolussi”)
1024	U.S. Patent No. 5,991,429 to Coffin, <i>et al.</i> (“Coffin”)
1025	U.S. Patent No. 6,856,873 to Breed, <i>et al.</i>
1026	U.S. Patent No. 7,298,871 to Lee, <i>et al.</i> , (“Lee”)
1027	WIPO Patent Publication No. WO 02/25842 to Dowling, <i>et al.</i> (“Dowling”)
1028	<i>Intentionally left blank</i>

<i>Exhibit #</i>	<i>Description</i>
1029	<i>Intentionally left blank</i>
1030	Westermann, “History and Scientific Back-up,” 48th Session of GRE, EUREKA Project 1403, Informal Document No. 30, April 30, 2002 (“Westermann”)
1031	<i>Intentionally left blank</i>
1032	Assessment of Headlamp Glare and Potential Countermeasures, Survey of Advanced Front Lighting System (AFS) Research and Technology, National Highway Traffic Safety Administration (2005) (“NHTSA Survey”)
1033	U.S. Patent No. 6,585,395 to Luk (“Luk”)
1034	U.S. Patent No. 5,181,429 to Sieber (“Sieber”)
1035	U.S. Patent No. 5,752,766 to Bailey, et al. (“Bailey”)
1036	U.S. Patent No. 5,828,485 to Hewlett (“Hewlett”)
1037	U.S. Patent No. 4,712,167 to Gordin, et al. (“Gordin”)
1038	Stephen McKenna and Shaogang Gong, “ <i>Tracking Faces</i> ” Proceedings of the Second International Conference on Automatic Face and Gesture Recognition, Killington, VT, Oct. 14-16, 1996, pp. 271-276 (“McKenna”)
1039	<i>WIPO Patent Publication No. WO 00/19705 (“Iddan”)</i>
1040	<i>Intentionally left blank</i>
1041	<i>Intentionally left blank</i>
1042	U.S. Patent No. 5,038,261 to Kloos (“Kloos”)
1043	U.S. Patent No. 6,501,536 to Fredricks (“Fredricks”)
1044	<i>Intentionally left blank</i>
1045	<i>Intentionally left blank</i>
1046	Handbook of Optics, vol. I. (Michael Bass et al. eds., 2 nd ed. 1995), ISBN 0-07-047740-X (“Optics I”)
1047	Handbook of Optics, vol. III. (Michael Bass et al. eds., 2 nd ed. 2001), ISBN 0-07-135408-5 (“Optics III”)
1048	File History of Reissue Application No. 16/858,342 filed on April 24, 2020 for U.S. Patent No. 9,955,551 (“the ’342 reissue

<i>Exhibit #</i>	<i>Description</i>
	application”)
1049	M. George Craford, “ <i>LEDs Challenge the Incandescents</i> ,” IEEE Circuits and Devices, vol. 8(5), 24-29 (1992) (“Craford”)
1050	<i>Intentionally left blank</i>
1051	Scheduling Order, <i>Torchlight Techs. LLC v. Daimler AG, et al.</i> , Civil Action No. 1:22-cv-00751 (D. Del.), filed August 26, 2022 (ECF No. 24)
1052	First Amended Complaint, <i>Torchlight Techs. LLC v. Daimler AG, et al.</i> , Civil Action No. 1:22-cv-00751 (D. Del.), filed August 26, 2022 (ECF No. 24)

VI. LEGAL STANDARDS

22. I have also relied upon various legal principles (as explained to me by Petitioner’s counsel) in formulating my opinions. My understanding of these principles is summarized below.

23. I have been informed the following legal principles apply to analysis of patentability. I also have been told that, in an *inter partes* review proceeding, a patent claim may be deemed unpatentable if it is shown by a preponderance of evidence that the claim is anticipated by one prior art reference under 35 U.S.C. § 102, or rendered obvious by one or more prior art references under 35 U.S.C. § 103.

24. I understand that documents and materials, such as printed publications or patents, that qualify as prior art can be used to render a patent claim as anticipated or as obvious.

25. I understand that once the claims of a patent have been properly construed, the second step in determining anticipation or obviousness of a patent claim requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis.

A. My Understanding of Claim Construction

26. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art (“POSA”) at the time of the purported priority date. I understand that claim terms are given their ordinary and customary meaning as would be understood by a POSA in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his/her own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

B. A Person of Ordinary Skill in the Art

27. I understand that a POSA is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton.

28. I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the alleged invention was made. In deciding

the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

29. I understand that the relevant time for considering whether a claim would have been obvious to a POSA is at the time of the alleged invention, which I have been told to assume to be July 12, 2002 for the '551 patent.

30. All of my statements and opinions during my technical analysis below are to be understood as based on how a POSA would have understood or read a document at the time of the alleged invention.

C. My Understanding of Obviousness

31. I understand that a patent claim is unpatentable if the claimed invention would have been obvious to a POSA at the time of the alleged invention. I understand that this means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, the claim can still be unpatentable.

32. It is my understanding that to obtain a patent, a claimed invention must have been, as of its earliest possible priority date, non-obvious in view of the prior art in the field. I understand that a patent claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the

subject matter as a whole would have been obvious to a POSA at the time the alleged invention was made.

33. When considering the issues of obviousness, I have been informed that I am to do the following:

- Determine the scope and content of the prior art;
- Ascertain the differences between the prior art and the claims at issue;
- Resolve the level of ordinary skill in the pertinent art; and
- Consider evidence of secondary indicia of non-obviousness (if available).

34. With respect to determining the proper scope of prior art to examine, I understand that in order for a prior art reference to be properly used in an obviousness ground under 35 U.S.C. § 103, the prior art reference must be analogous art to the claimed invention. I have been informed that a reference is analogous art to the claimed invention only if: (1) the reference is from the same field of endeavor as the claimed invention; or (2) the reference is reasonably pertinent to the particular problem solved by the inventor.

35. I understand that factors relevant to determining the proper field of endeavor include the inventor's explanations of the subject matter (including the patent specification), as well as the claimed invention's structure and function. I further understand that to be reasonably pertinent to the particular problem solved

by the inventor, a prior art reference must logically commend itself to the inventor's attention when considering his or her problem.

36. I have been informed that an analogous reference may be modified or combined with other analogous references or with the POSA's own knowledge if the person would have found the modification or combination obvious. I have also been told that a POSA is presumed to know all relevant, analogous prior art, and that the obviousness analysis may take into account the inferences and creative steps that a POSA would employ.

37. In determining whether a prior art reference would have been combined with another prior art reference or other information known to a POSA, I have been informed that the following principles may be considered:

- A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- The simple substitution of one known element for another is likely to be obvious if it yields predictable results;
- The use of a known technique to improve similar devices, products, or methods in the same way is likely to be obvious if it yields predictable results;
- The application of a known technique to a prior art reference that is ready for improvement is likely obvious if it yields predictable results;

- Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- A skilled artisan often will be able to fit the teachings of multiple references together like a puzzle; and
- The proper analysis of obviousness requires a determination of whether a POSA would have a “reasonable expectation of success”—not “absolute predictability” of success—in achieving the claimed invention by combining prior art references.

38. I understand that whether a prior art reference renders a claim unpatentable as obvious is determined from the perspective of a POSA. I have also been told that, while there is no requirement for the prior art to contain an express suggestion to combine known elements to achieve the claimed invention, a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually, as filtered through the knowledge of a POSA. In addition, I have been informed that the inferences and creative steps a POSA would employ are also relevant to the determination of obviousness.

39. I also understand that when a work is available in one field, design alternatives and other market forces can prompt variations of the work, either in the same field or in another. I also have been informed that if a POSA can

implement a predictable variation and would see the benefit of doing so, that variation is likely to be obvious. I have been informed that in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been informed that when there is a design need or market pressure and there are a finite number of predictable solutions, a POSA has good reason to pursue those known options.

40. I have been informed that there is no rigid rule prescribing that a reference (or combination of references) must contain a “teaching, suggestion, or motivation” to combine references. But I also have been informed that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been informed that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

VII. LEVEL OF ORDINARY SKILL IN THE ART

41. In my opinion, a POSA in the context of the '551 patent as of July 12, 2002 (the earliest possible priority date of the '551 patent) 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 lighting and lighting-control systems. The POSA

may work as part of a team, for example, with computer engineers to integrate and program controllers and various inputs to control a given light source.

42. Experience could take the place of some formal training, as domain knowledge may be learned on the job. This description is approximate, and a higher level of education or skill might make up for less experience and vice versa.

43. As a professor teaching in academia, and as an engineer-by-trade conducting research, product design and testing at the time of the '551 patent filing, and having educated and worked with engineers in industry and academia, I feel qualified to determine the level of ordinary skill in the art. I am very familiar with the technology of the '551 patent before and during the July 12, 2002 timeframe. By that date, I had over 10 years of post-doctoral experience working with these technologies. *See* §IV; EX1004.

VIII. OVERVIEW OF THE '551 PATENT

A. Technology Background

44. The '551 patent allegedly provides “[a]n illuminating device coupled with sensors or an image acquisition device and a logical controller allow[ing] illumination intensity and spectrum to be varied according to changing user needs.” EX1001, Abstract. The illuminating device is allegedly “built around a ‘digital’ light source,” e.g., the light emitting diode (LED). EX1001, 16:39.

45. However, LEDs had been widely used long before 2002, the earliest

possible priority date of the '551 patent. By 1992, “[m]ore than 20 billion visible light-emitting diode (LED) chips [had been] produced each year,” for signals, indicators, signs, displays, etc. EX1049, 24; EX1046, 18-24; EX1013, 26, 265-267. Not only were various colored (red, orange, yellow, green, etc.) LEDs available, high flux white LEDs enabled “a viable alternative” to incandescent lamps. EX1049; EX1021. In 1995, LEDs were listed as light sources in the IESNA Handbook and standards had been developed for products containing LEDs. EX1013, 174, 265-267. LEDs were known to be “highly directional,” where intensity can be adjusted by regulating either direct current or the pulse width modulation (PWM) of current. EX1013, 174, 265-267.

46. By the 1990s, lighting controls for specific applications had “become an essential element of good lighting design and an integral part of energy management for lighting of commercial, residential, industrial, and exterior areas,” where “[l]ighting controls for specific applications are described in the various application chapters” of the IESNA Handbook. EX1013, 590-605. Light feedback had been used for automatic control of light sources. For example, “a photocell evaluates the light level and sends a signal to a control unit to dim or switch the electric lights to maintain a preset target level,” e.g., “in response to the amount of available daylight.” EX1013, 590-591, 323-350; EX1020; EX1022, Abstract, 40:52-41:7, FIG. 73. Task tuning had been performed such that “the lighting

system can be adjusted, or tuned, to provide local illumination as needed.”

EX1013, 592.

47. The lighting control system generally includes “a power controller, a logic circuit, and a sensing device,” where the power controller “electrically changes the output of the light source,” and the logic circuit “decides when to supply electric lighting, and how much” by processing information received from the sensing device, such as a photodiodes, an occupancy/motion sensor, or a camera. EX1013, 596, 598. Solid-state detectors, e.g., photodiodes, cameras equipped with a charge-coupled device (CCD) array, were known to detect spectral emission ranging “from the UV to the far IR region,” where CCD cameras “are able to capture and digitize electronic images of visual scenes,” to “determine the luminance at every point in the scene, corresponding to the pixels of the camera’s CCD array.” EX1013, 45, 49, 598; EX1009, Abstract, 3:36-56, FIGs. 3, 9; EX1046, 71-108; EX1047, 14-35.

48. The lighting control system also included processors (and associated memory) that receive input from a sensor, analyze sensor data according to a predetermined set of rules and initiate changes for the lighting system. EX1013, 490, 593-596, 600. Various lighting calculations can be used to determine the desired illumination condition. EX1013, 351-422, 287-289. While “[c]omputational and measurement systems exist to evaluate the potential glare

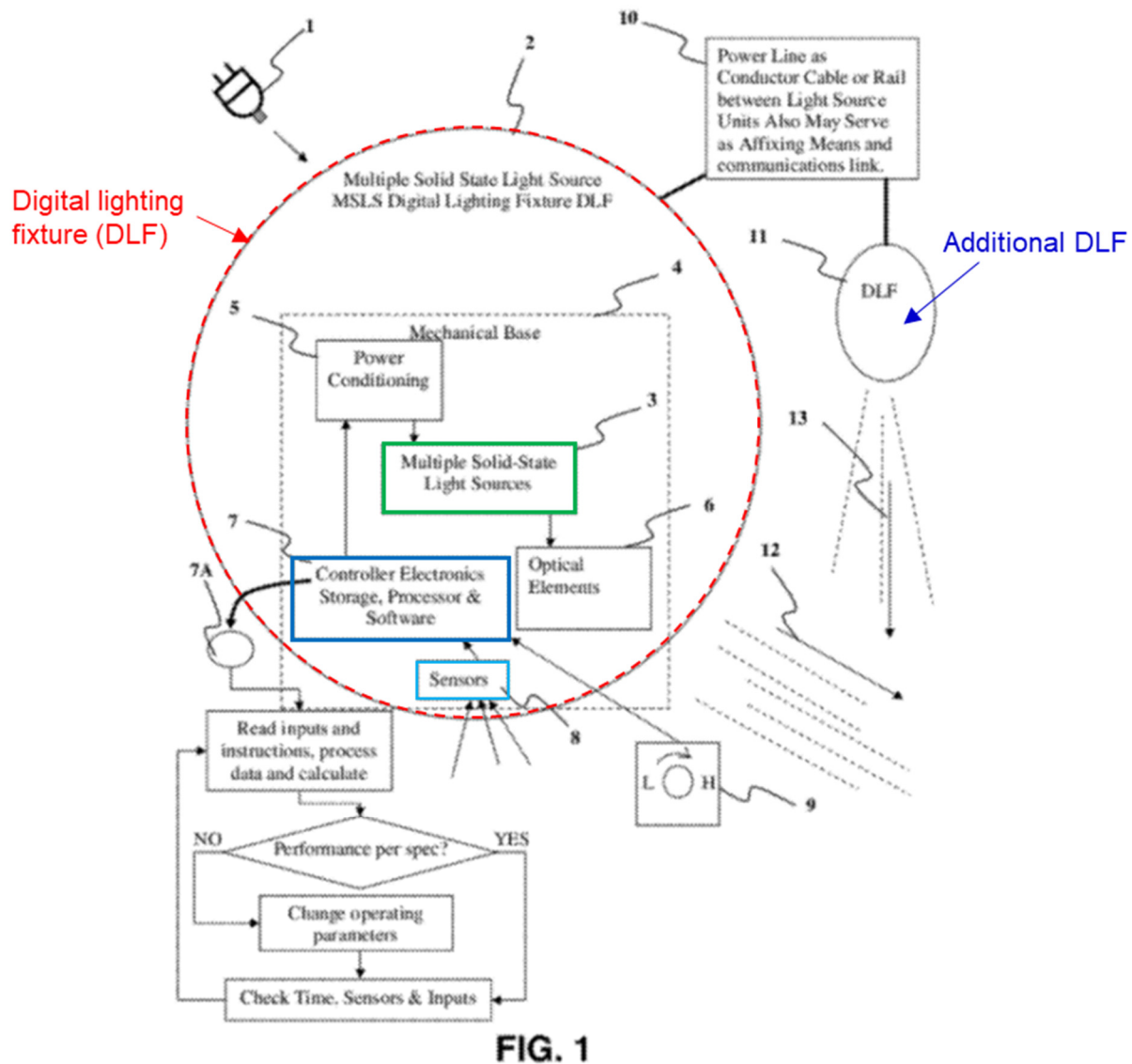
from luminaires,” “cutoff optics or a semi-cutoff optical system [can be used] to control glare.” EX1013, 306, 109-111.

49. In late 1990’s, concepts of smart light bulbs had also emerged, where the LEDs served as the “digitally controlled” light sources, and where the processors controlled the intensity and/or the color of individual LEDs in response to electrical signals from a computer program, a remote control or detectors. EX1022, Abstract, 5:38-45, 6:62-63, 11:43-46, 16:44-64, FIG. 6. The smart light bulbs can have a transmitter and/or receiver to communicate with another device (e.g., another smart light bulb). EX1022, Abstract. Additionally, video analytics (or digital image processing), pattern recognition and artificial intelligence, had been used for data processing and decision making, e.g., for object identification. EX1007, Abstract, FIG. 1; EX1014, 2; EX1036, Abstract. CCD cameras had been used to collect light reflected from the object and provide images to the processors that perform video analytics and/or pattern recognition to determine useful illumination conditions for the identified object. EX1007, 1:7-11; 9:53-10:14, FIG. 1; EX1009, Abstract, FIG. 3; EX1036, Abstract. Specifically, facial recognition has been used to identify individuals. EX1023, 1:66-2:10, Abstract, FIG. 1; EX1024, Abstract, FIG. 6; EX1025, Abstract, 4:8-56; EX1038, Abstract. Using image sensors (e.g., CCD cameras) to “sense[] light in spatially separated regions of a field of view” was also known. EX1009, 2:6-15, 2:22-35, Abstract.

B. The '551 Patent

50. The '551 patent is titled "Detector Controlled Illuminating System" and lists Yechezkal Evan Spero as the sole inventor and assignee. EX1001, (54), (75), (73).

51. The '551 patent allegedly provides "[a]n illuminating device coupled with sensors or an image acquisition device and a logical controller allows illumination intensity and spectrum to be varied according to changing user needs." EX1001, Abstract. The illuminating device is purportedly "built around a 'digital' light source" light emitting diode (LED). EX1001, 16:39. "Detectors, emitters and sensors for light intensity, spectrum, temperature" are allegedly used to "provide data input to the controller, allow feedback and enable recalibration" such that the luminaire is "adapted to the usage and surroundings." EX1001, 13:47-50, 13:61-63. According to the '551 patent, a digital lighting fixture (DLF) "contains logic control electronics unit 7," which "receives input and/or feedback from motion, intensity and/or spectral sensors 8, or from manual control button 9 and increases or decreases or turns on or shuts off the power to one or more of the SLS [solid-state light source] to effect the desired change." EX1001, 25:34-52, FIG. 1.



EX1001, FIG. 1 (annotated).

52. Figures 2B and 12 illustrate the alleged novel DLFs 16/190. EX1001, 28:32-55, 38:37-39, FIGs. 2B, 12. DLF 16 allegedly “provides a complete lighting solution” because sensor 21 “capable of detecting motion, day/night, spectrum, luminance,” inputs data to controller 20. EX1001, 28:18-55, 30:18-28.

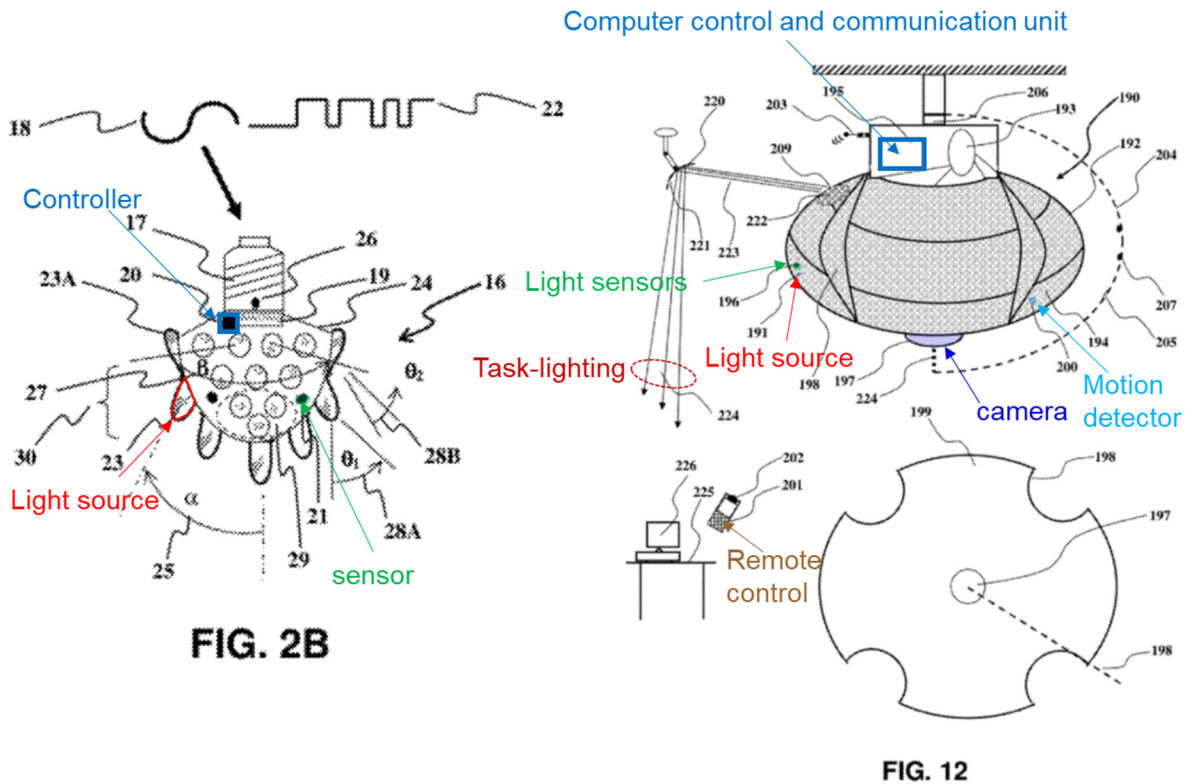
Accordingly to the '551 patent, DLF 190 is equipped with “computer control and

communications unit 195” and “light sensors 196.” EX1001, 38:44-48, FIG. 12.

DLF 190 also has “digital cameras 197” and “[s]patially differentiated motion detectors 200,” where “motion detectors 200, or camera 197, can be used to follow the whereabouts of room occupants.” EX1001, 38:48-51, 38:65-67, 39:7-9, FIG.

12. Controller 195 “has stored look-up-tables, instruction sets and algorithms which it uses to processes the information communicated from the sensors or a camera and in response control the light provided to the illuminated area.”

EX1001, 39:11-14, 41:23-30, FIG. 12. “A section 222 of light sources ... is dedicated to provide sufficient light to the other areas of the room or for specific task lighting applications”, e.g., to provide task-lighting 224. EX1001, 40:52-61, FIG. 12. Remote control unit 201 is “used to operate and program the ADLF [adaptive digital lighting fixture].” EX1001, 39:15-16, FIG. 12.



EX1001, FIGs. 2B, 12 (annotated).

53. However, these alleged novel features of the DLF/ADLF were known before the effective filing date of the '551 patent, as discussed above and further below. *See* §§VIII.A, IX-XV.

54. Additionally, I notice that the '551 patent admits that the claimed features were known in the art. For example, using individually controlled LED as light source was known. EX1001, 5:60-62, 6:13-16, 6:19-24, 6:34-37. 6:55-56, 6:65-7, 7:24-32. Using optics to form directional LED light was known. EX1001, 17:56-63. Packaging LEDs with electronic circuitry into an integrated structure was known. EX1001, 17:67-18:14, 18:46-47. Using sensors for various

measurements and performing data analysis to correct the LED's power level were known. EX1001, 26:7-11. Using photodiodes to detect light intensity, and using optical feedback to produce desired lighting effects were known. EX1001, 7:8-23, 7:33-45, 8:33-39, 9:7-9, 27:15-20. Projecting LEDs at a desired angle was known. EX1001, 30:45-50, 66:64-67, FIG. 2C. Using pattern recognition, artificial intelligence, image processing, or machine vision system to identify objects (e.g., individuals) was known. EX1001, 41:8-11, 44:37-40, 44:63-45:9, 45:15-22, 48:30-32, 63:9-12, 63:29-56, 64:5-9, 64:46-49, 69:25-29, 83:1-5, 94:28-32. Object (e.g., an individual) tracking techniques were known. EX1001, 45:47-20, 45:67-46:6, 57:14-18. Standards related to lighting calculations, design and practice were known. EX1001, 39:33-38, 41:27-30, 41:43-57, 42:16-21, 71:3-6, 72:23-25, 93:66-94:2. Communication connections and protocols were known. EX1001, 47:41-44. Thus, it is unsurprising that the '551 patent does not describe the details of implementation, but rather leaves it to a POSA. In my opinion, the alleged novelty of the '551 patent is simply a collection of known techniques, whose combination would have been obvious and predictable to a POSA.

C. Prosecution History Summary

55. Mr. Spero conducted the prosecution process *pro-se* before the U.S. Patent and Trademark Office ("Office") for the Patent Application No. 13/357,549 ("the '549 application") that issued as the '551 patent. *See generally* EX1002.

56. The '549 application underwent multiple rounds of prosecution. The Office mailed a first non-final action rejecting the claims i) because of insufficient written description, being indefinite and showing insufficient structure, and ii) as being anticipated by US 2004/0105264 to Spero. EX1002, 287-308. Mr. Spero argued that “[t]he structure used to ‘detect’ the age, sex of a person is a digital camera that communicates data to a processor which runs machine learning algorithms that it has stored in a memory device enabling it to perform image recognition using neural networks and other machine learning techniques **known-in-the-art** which after training is able to make a probabilistic guess that the image recognized person is belonging to group of people whose age is a factor in correct lighting practice and recall their data from memory.”² EX1002, 333. Mr. Spero further emphasized the “known-in-the-art” fact by citing Figure 2 from Schalkoff (also cited in the '551 patent). EX1002, 335.

57. In the second non-final action, the Office rejected the claims as being obvious in view of US 2002/0047628 (“Morgan”), US 2002/0047646 (“Lys”) and US 6,379,022 (“Amerson”). EX1002, 365-391. In the reply, Applicant amended claim 7. EX1002, 413-501. The Office mailed a final rejection maintaining the obviousness rejections and pointed out that “the features upon which applicant

² Emphasis added unless noted otherwise.

relies ... are not recited in the rejected claim(s),” and that “amending the claim to add ‘where one or more light sources are directional’ is not novel. Directional lighting is universal.” EX1002, 502-539.

58. After the Request of Continued Examination, the Office allowed independent claim 8 based on US 2012/0287493 to Kuhlman, et al. EX1002, 578-579. In the second non-final action, the Office allowed independent claim 1, stating that US 2004/0052076 (“Mueller”) does not disclose the limitation “*d. a processor for processing the sensed information and determining illumination requirements of the at least one of objects, surfaces and beings using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables and for directing the controller to adjust the light source for that sub-area to meet the specific illumination requirement.*”^{3,4} EX1002, 612. After another office action, the Office issued the Notice of Allowance. EX1002, 666-673.

D. Claim Construction

59. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a POSA at the time of the purported priority date. *See* §VI.A.

³ Claim elements are in italic unless noted otherwise.

⁴ Claim 8 was not examined under Mueller.

60. It is my opinion that none of the claim terms require specific construction and should receive their plain and ordinary meaning in the context of the '551 patent specification. Thus, I would like to clarify my position regarding claim terms "*lighting fixture*," "*light fixture*" and "*light source(s)*."

1. "*lighting fixture*" and "*light fixture*"

61. The '551 patent explains that "[a] Lighting Fixture or luminaire (the terms are used interchangeably) is a device which is constructed around the lamp to provide lighting specific to the application." EX1001, 2:12-16. "A luminaire has apparatus whereby it is attached to the building structure," and provides "a wide scope of applications ... from indoor to outdoor use in residences, factories, stores stadiums and streets." EX1001, 2:35-42, 11:14-18, 13:5-9, 14:25-30, 49:61-67, 65:36-40, FIGs. 1, 2B-2C, 3B, 4, 5, 8, 9, 11, 12, 13A-13C, 18A-18B, 20A-20B, 21, 24, 25A-25B, 26, 27, 28A-28B, 30-33. According to the '551 patent, if an LED lamp apparatus "is independent of the lighting application," it "is simply a lamp not a lamp and fixture combination." EX1001, 6:19-26. However, if a light system with similar LEDs are designed "to generate an application specific light distribution pattern capable of providing recommended illuminance levels," it is a lighting fixture. EX1001, 8:46-9:3. Comparing the lighting fixtures in Figures 2A and 2B, the '551 patent explains that the alleged novelty of "solid-state lighting fixtures (vs. solid-state lamps)" is the control of lighting elements and the

adjustment of the lighting solution in the former. EX1001, 11:8-13, 28:18-29:16, FIG. 2B, 12. As discussed below, the references disclose the above features of a “*lighting fixtures*.” See §§X-XIV. Therefore, there is no need to construe “*lighting fixture*” or “*light fixture*.”

62. I notice that the ’551 patent also refers to an “automotive headlamp” as a “headlamp fixture.” EX1001, 52:1-7. To the extent that Patent Owner impermissibly narrows the “*light fixture*” or “*lighting fixture*” to automotive headlamp, the prior art references still render the challenged claims obvious. See §§X-XIV.

2. “*light source(s)*”

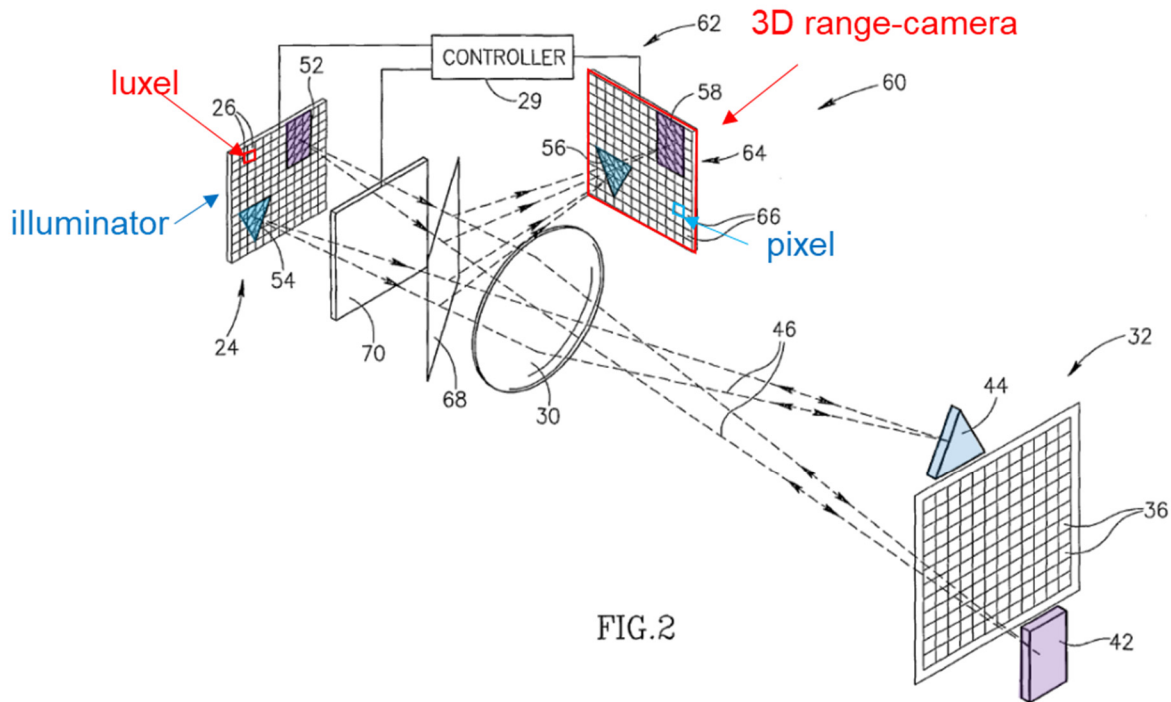
63. The ’551 patent explains that a light source “means any system that is capable of receiving an electrical signal and producing light in response to the signal.” EX1001, 17:3-6. The ’551 patent considers incandescent, fluorescent and LED all as light sources. EX1001, 16:47-51, 17:6-16, 4:57-64, 5:36-40. However, Patent Owner proposed to construe “*light source*” to mean “individual LED” in the *Ex Parte* Reexamination No. 90/014,815 (“the ’815 reexamination”) of the ’551 patent. EX1012, 15-19. I do not agree with such a narrow construction and maintain my position that “*light source(s)*” should be interpreted with its plain and ordinary meaning. But, even if Patent Owner’s narrow construction is adopted, the prior art references still disclose the claimed “*light source(s)*.” See §§X-XIV.

64. Under any reasonable construction or interpretation, it is my opinion that the challenged claims are unpatentable for the grounds presented, as I describe in this declaration. Should Patent Owner propose any claim construction(s), I reserve the right to review and revisit my opinions presented here.

IX. SUMMARY OF THE APPLIED REFERENCES

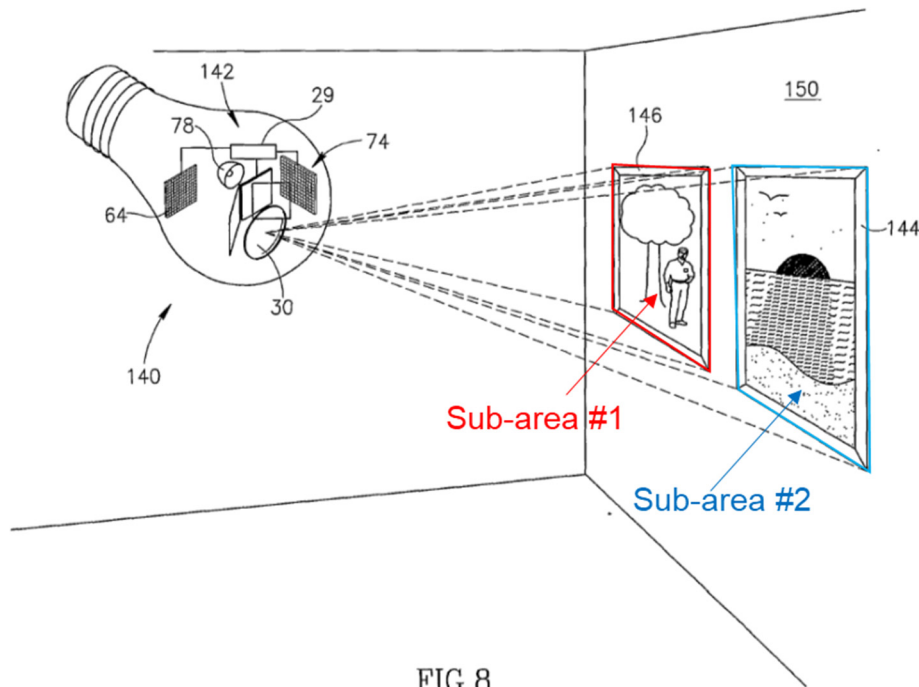
A. Braun

65. Just like the '551 patent, Braun “automatically adapt[s] the illumination to characteristics and features of the scene.” EX1005, 1:3-5. Braun’s illumination system for illuminating a scene comprises an illuminator having independently controllable light providing regions (i.e., luxels), each of which provides light that illuminates a different region of the scene. EX1005, Abstract, 2:7-13, FIGs. 1-3. For example, Braun uses a range finder (e.g., a 3D range-camera) to determine distances to regions of the scene, and uses a controller to control the luxels to illuminate the scene responsive to distances determined by the range finder. EX1005, Abstract, 2:7-13, FIGs. 1-3. Braun’s controller uses pattern recognition to process images of a scene acquired by the 3D range-camera, identifies features and objects in the scene, and adjusts the luxels to illuminate the scene responsive to the identified features and/or objects. EX1005, 4:17-20.



EX1005, FIG. 2 (annotated).

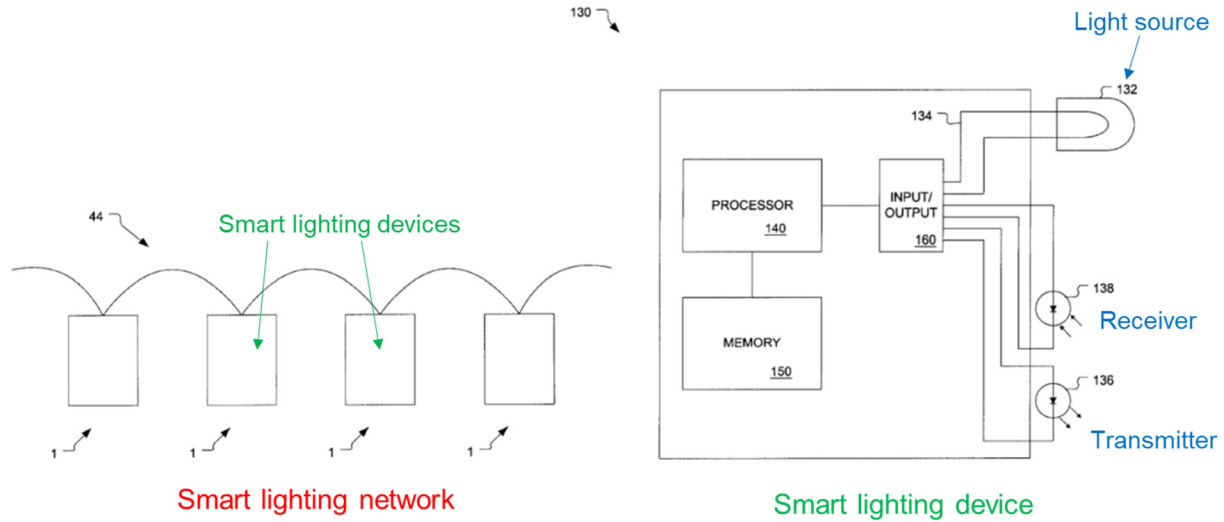
66. Braun's illumination system can have "monolithically integrated structures" or "distributed components." EX1005, 6:24-32. Braun illumination system can be used as an automotive headlight. EX1005, 5:21-6:15, FIGs. 5-7. Braun's illumination system can also be used as interior lighting (the focus of the '551 patent) to provide "general illumination of a room or area" and "different illumination effects." EX1005, 28:6-9, FIG. 8. For example, light bulb 140 uses the pattern recognition application to "identif[y] and locate[] pictures 144 and 146," and adjusts the light sources "to illuminate pictures 144 and 146 with appropriate lighting," e.g., to enhance their respective colors. EX1005, 27:27-32.



EX1005, FIG. 8 (annotated).

B. Dowling

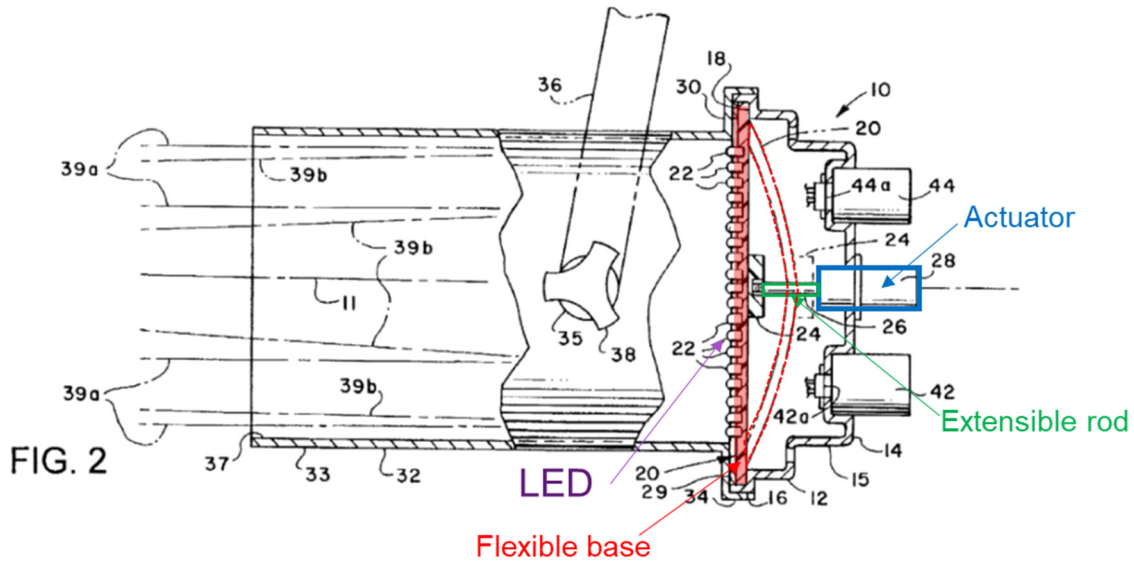
67. Similar to the '551 patent, Dowling discloses smart lighting devices and networks “for communication purposes, building automation, systems monitoring.” EX1027, Abstract, 8:18-21, FIGs. 1, 2, 5, 6. Dowling’s smart lighting device “include[s] a lighting element and a microprocessor,” which controls “the lighting element based on input from sensor components, or facilitate[s] electronic communication by mediating the transmission of signals to or from other devices.” EX1027, 4:9-22, 8:22-9:8, FIGs. 1, 5. The lighting elements include LEDs, and the sensors include a camera, a temperature sensor, etc. EX1027, 5:19-6:5.



EX1027, FIGs. 2, 5 (annotated).

C. Bailey

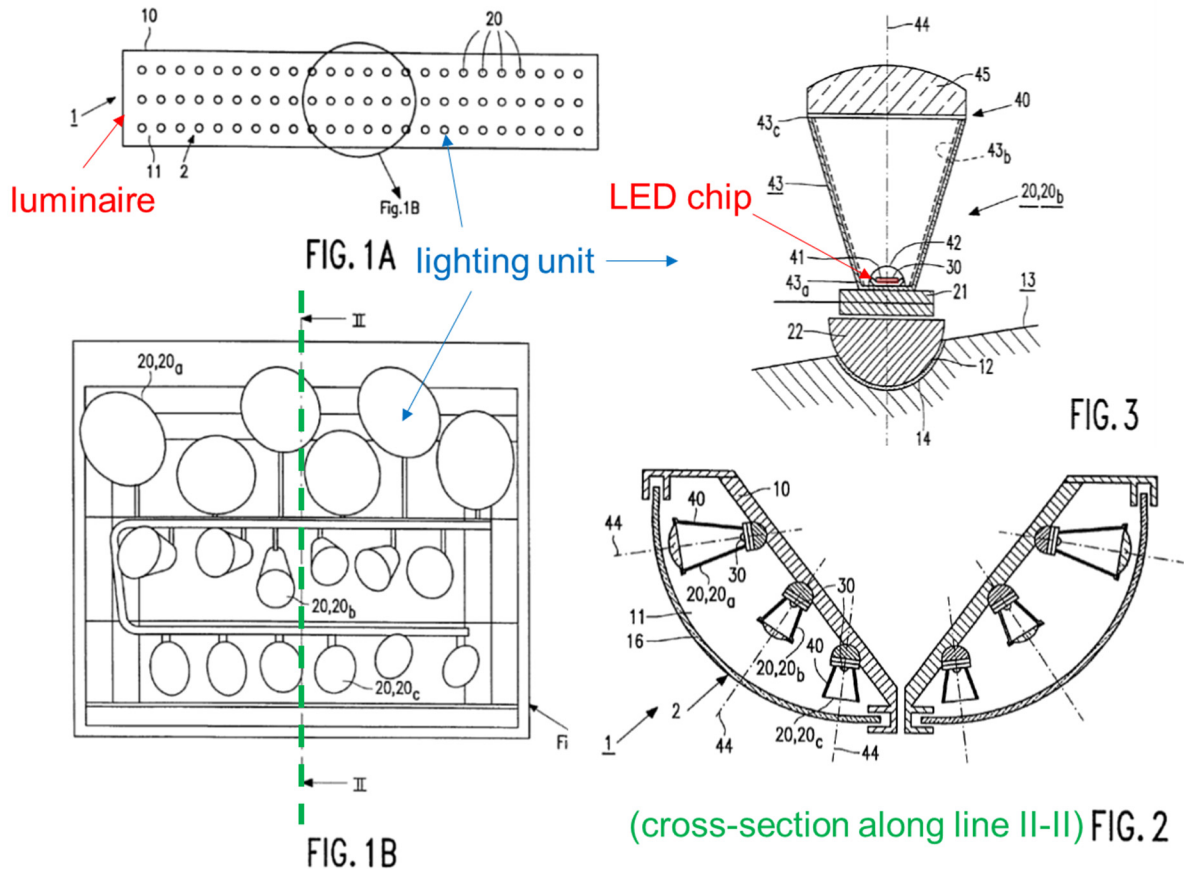
68. Bailey discloses an array of multi-color light emitting diodes (LEDs) mounted on a flexible base member. EX1035, 1:5-9, Abstract, FIG. 2. An actuator “move[s] the base member between a generally planar position and a deflected position to cause the LED array to change the direction of the optical axes of a substantial number of LEDs in the array to focus light emitted from the LEDs, respectively.” EX1035, Abstract, FIG. 2.



EX1035, FIG. 2 (annotated).

D. Begemann

69. Like the '551 patent, Begemann “provide[s] a luminaire in which the light generated by the light source is utilized more efficiently.” EX1006, 1:30-32. Begemann’s “luminaire (1) comprises a housing (10) with a light emission window (11), and at least one lighting module (2) accommodated in the housing for illuminating an object.” EX1006, Abstract, 1:5-8, 5:36-57, FIGs. 1A-1B, 2-3. “The lighting module comprises a set of lighting units (20) which each comprise at least an LED chip (30) and an optical system (40) coupled thereto. The lighting units illuminate respective portions of an object.” EX1006, Abstract, 1:5-8, 5:36-57, FIGs. 1A-1B, 2-3.



EX1006, FIGs. 1A-1B, 2-3 (annotated).

70. Begemann's luminaire "offers wide application possibilities, for example for street lighting, spotlighting, or floodlighting. The light distribution may be adjusted in a flexible manner through a control of the luminous fluxes of lighting modules or of separate lighting units of a lighting module." EX1006, 1:57-65. In one example, Begemann's lighting units "comprise[] two or more varieties of lighting units for illuminating portions of the object with mutually differing spectra," which "may then be adapted to the optical properties, for example the reflectivity, of the individual portions of the object, so that an optimum visibility of

these portions is realized.” EX1006, 2:54-62, FIG. 11. In another example, Begemann’s lighting units “comprise[] two or more types of lighting units for generating beams which widen more and less strongly,” such that “portions of the object situated close to the luminaire are illuminated with comparatively strongly widening beams and portions farther removed with comparatively less strongly widening beams.” EX1006, 3:28-40, FIG. 12.

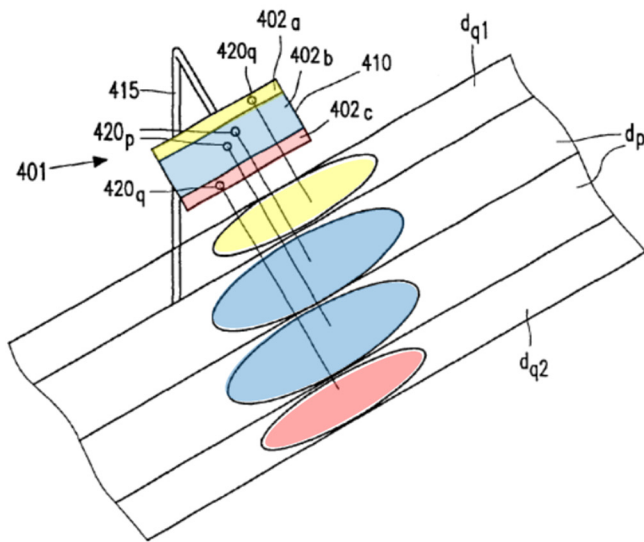


FIG. 11

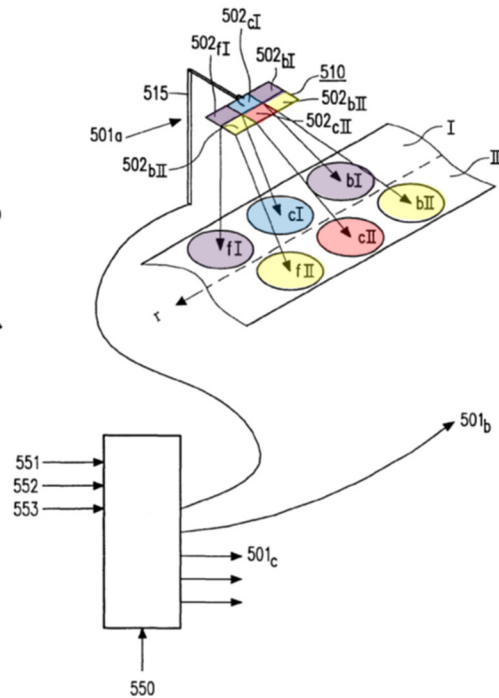


FIG. 12

EX1006, FIGs. 11, 12 (annotated).

E. Lee

71. Similar to the '551 patent, Lee “automatically control[s] systems and devices in a local environment, such as a home.” EX1026, Abstract, 2:37-3:12, FIGs. 1-3. Lee’s control unit “receives images associated with one or more regions

of the local environment,” “processes the images to identify ... known persons located in the regions.” EX1026, Abstract, 2:37-3:12, FIGS. 1-3. Then, the control unit automatically generates a control signal for the servicing components (lighting, heating, etc.) associated with the region, the control signal reflecting a preference of the known persons located in the respective region. EX1026, Abstract, 2:37-3:12, FIGS. 1-3.

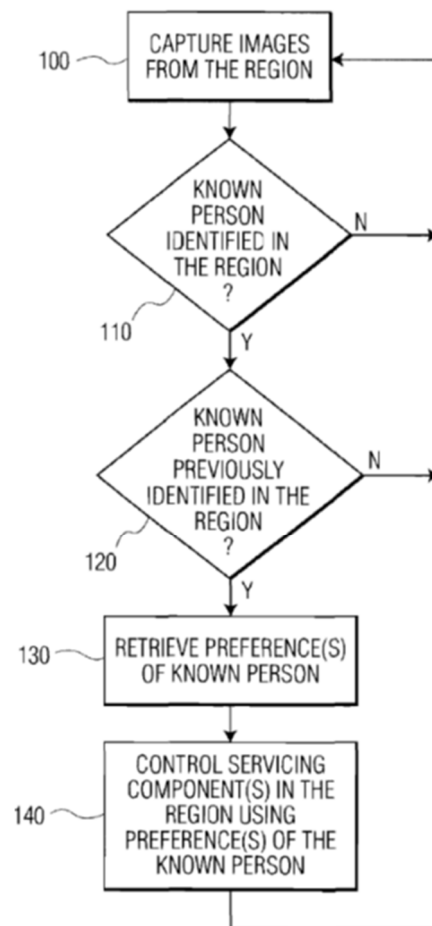
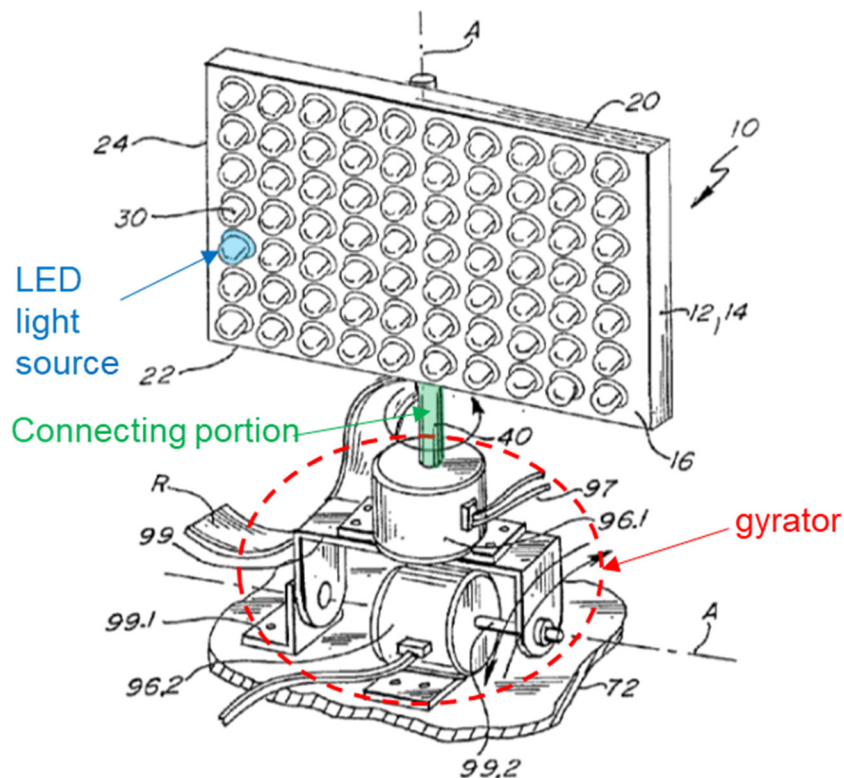


FIG. 3

EX1026, FIG. 3.

F. Pederson

72. Pederson discloses a warning signal light having a single row, single source, or an array of LED light sources. EX1011, ¶37, FIG. 3. Pederson uses a controller to regulate the illumination of LEDs to a desired pattern, sequence, and/or combination of simultaneous and/or individual light signals. EX1011, Abstract. While producing rotating and oscillating light signals by sequentially illuminating the LEDs on a stationary support, Pederson also provides mechanical means (e.g., gyrator) to rotate or oscillate the warning signal light. EX1011, ¶37, FIG. 3.



EX1011, FIG. 3 (annotated).

X. GROUND 1: BRAUN RENDERS CLAIMS 1-3 OBVIOUS

A. Braun renders independent claim 1 obvious

73. In my opinion, Braun renders independent claim 1 obvious.

1. [1.P]⁵

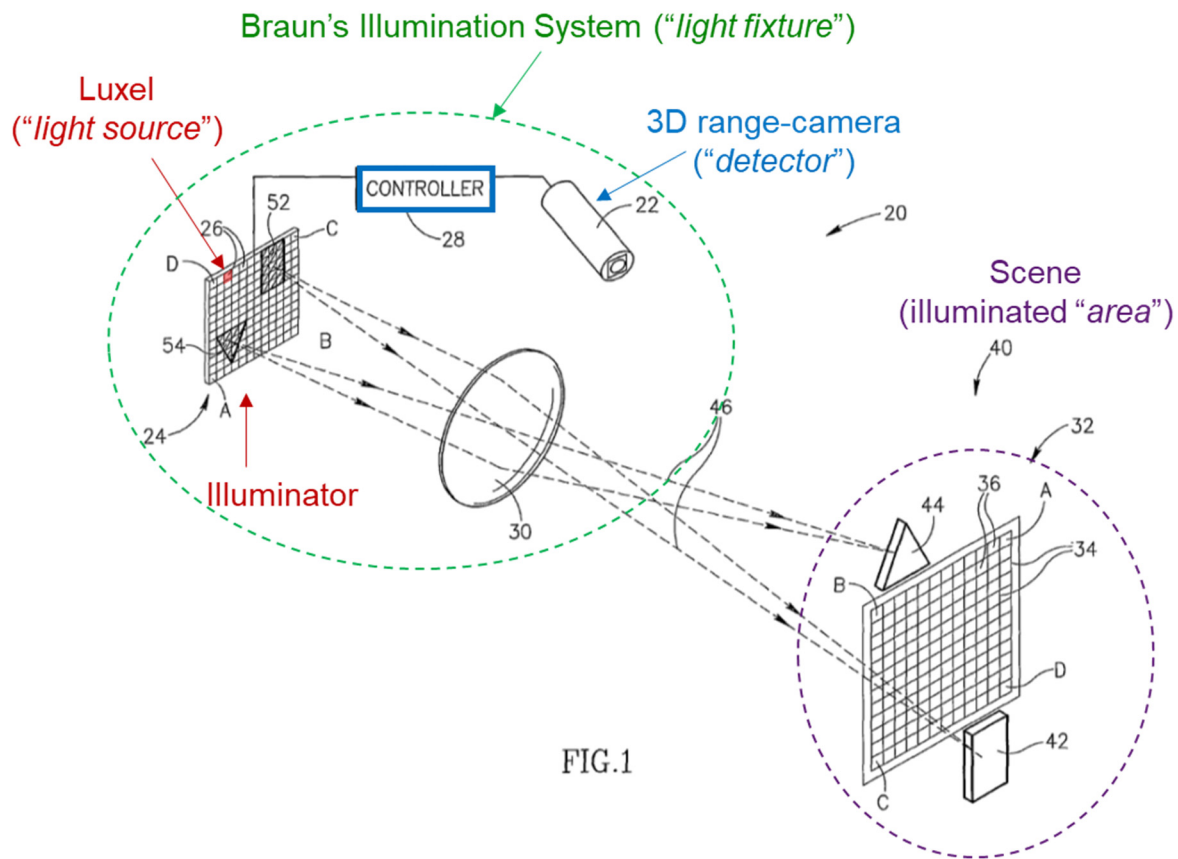
74. Claim element [1.P] recites “[a] *light fixture for illuminating an area to be lit capable of automatically meeting specific illumination requirements of different sub-areas within the area to be lit.*” To the extent that the preamble is limiting, Braun discloses the preamble.

75. Braun’s illumination system discloses the claimed “*light fixture.*” EX1005, FIGs. 1-3, 5, 8; *see also* §VIII.D.1. In one application of the illumination system, Braun describes that the light bulb may be “mounted in a chandelier” on a ceiling. EX1005, 6:29-32. Generally, Braun’s illumination system 20 “for illuminating a scene” includes a plurality of independently controllable light providing regions 26, each of which “provides light that illuminates a **different region** of the scene.” EX1005, Abstract, 2:7-13, 2:19-22, 5:21-26, 5:31-6:1, 7:1-7, 9:6-9, 10:20-24, 12:26-33, 13:9-17, FIGs. 1, 2, 5, 6, 8. The controller 28, 29 “controls the plurality of light providing regions to provide light for illuminating the scene responsive to distances determined by the range finder (22, 64, 112).”

⁵ Claims and claim elements of the ’551 patent are listed in Appendix A. *See* §XVII.

EX1005, Abstract, 2:7-13, 2:19-22, 5:21-26, 5:31-6:1, 7:1-7, 9:6-9, 10:20-24,
12:26-33, 13:9-17, FIGS. 1, 2, 5, 6, 8. Braun's illumination systems

“**automatically** adapt[] the illumination to characteristics and features of the scene.” EX1005, 1:3-5, 6:4-7. Therefore, Braun discloses an illumination system (“*light fixture*”) illuminating a scene (“*area to be lit*”) and capable of automatically meeting specific illumination requirements of different regions (“*sub-areas*”) within the scene.



EX1005, FIG. 1 (annotated).

76. Accordingly, Braun discloses [1.P].

2. [1.A]

77. Claim element [1.A] recites “*a multiplicity of independently controllable light sources, including at least two light sources of directional light output.*” Braun discloses this claim element.

78. The illuminator 24 of Braun’s illumination system 20 includes a plurality of “**independently controllable** light providing regions” 26 (also referred to as “luxels”), “**each of which** provides light that illuminates a different region of the scene” and the luxels 26 “comprise one or a combination of **light sources.**” EX1005, Abstract, 2:7-13, 7:1-7, 12:26-33, 13:9-17, 14:16-20, 15:3-7, 15:30-33, FIGs. 1-3; *see also* §VIII.D.2. Braun’s illuminator 24 includes “R, G, B and IR luxels,” which “may be suitable laser or **LED** diodes.” EX1005, 19:19-21, 20:9-14. For example, Braun independently controls the light providing regions (“*light sources*”) “so that relative intensity of light provided by the illuminator that illuminates two **different** regions of the scene is substantially proportional to a ratio of the squares of their respective distances from the illumination system.” EX1005, 9:6-9. Braun “controls intensity of R, G or B light provided by **each** light providing region so as to control hue, saturation or intensity of light illuminating a region of the scene which is illuminated by light from the light providing region **independently** of hue saturation and intensity of light illuminating other regions of the scene.” EX1009, 3:4-8, 9:19-10:4. Therefore, Braun’s illumination system

includes “*a multiplicity of independently controllable light sources.*”

79. Braun’s luxels (“*light sources*”) output “*directional*” light. Light output from luxels 26 is “**directed** by optics represented by a lens 30 to a scene that is illuminated [by] illumination system 20, which optics focuses light from luxels 26 to an illumination plane 32.” EX1005, 2:14-15, 14:31-33. “**Each** mesh square 36 [of the illumination plane 32] is illuminated by light from a **different, substantially only one**, luxel 26.” EX1005, 15:3-9, 16:6-14. “Dashed lines 46 in Fig. 1 represent selected light rays from luxels 26 in regions 52 and 54 that illuminate rectangular and triangular objects 42 and 44 respectively.” EX1005, 16:6-14, 17:23-25, FIG. 1. Therefore, a POSA would have understood that the light output from Braun’s luxels (“*light sources*”) are “*directional.*”

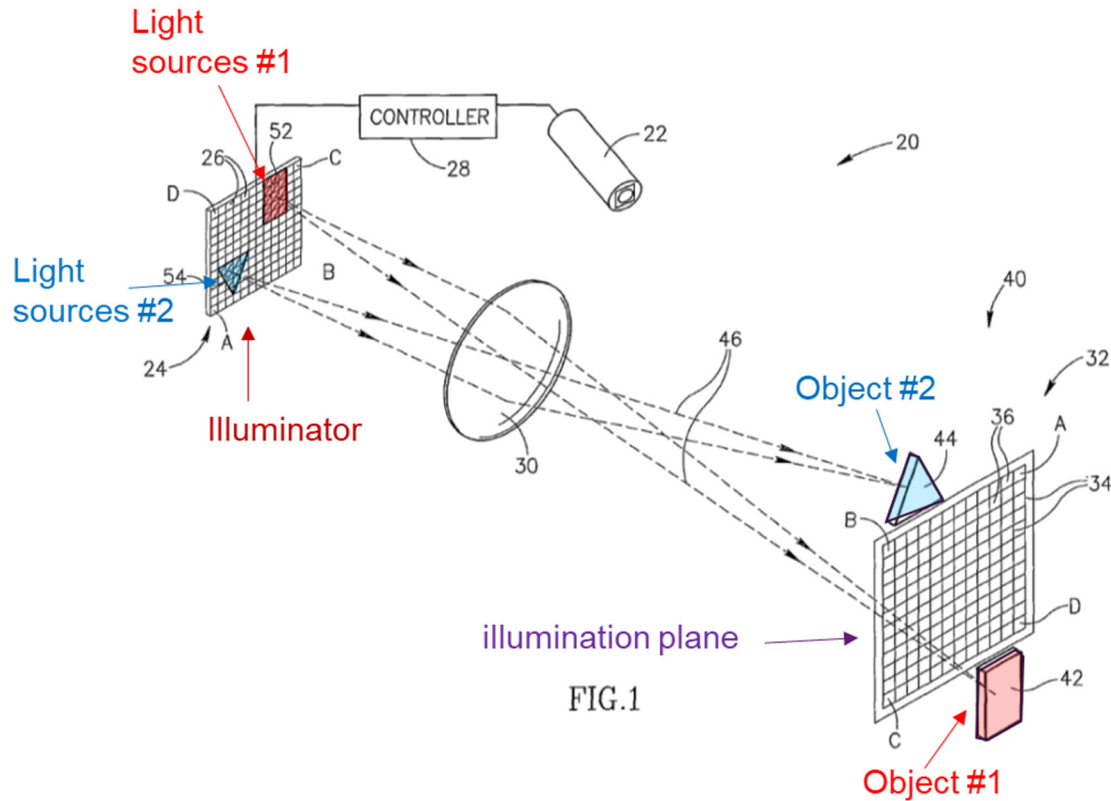


FIG.1

EX1005, FIG. 1 (annotated).

80. Accordingly, Braun discloses [1.A].

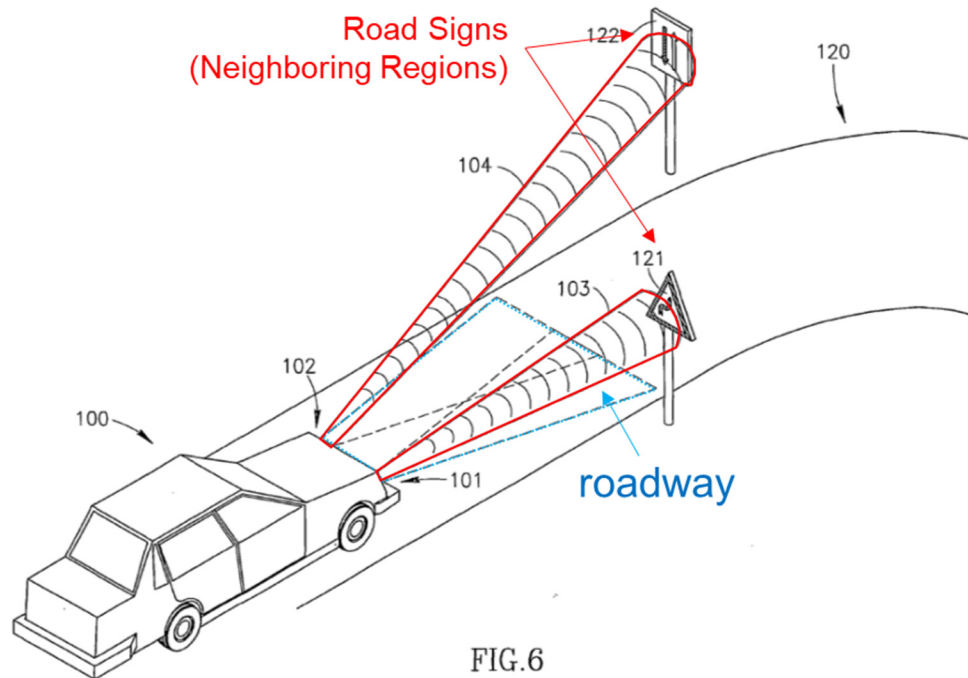
3. [1.B]

81. Claim element [1.B] recites “*each said source substantially illuminates a different sub-area within the area to be lit.*” Braun discloses this claim element.

82. In Braun, within the scene (“*area to be lit*”), “[e]ach luxel 26 provides light that illuminates a **different region** of illumination plane 32.” EX1005, Abstract, 2:6-13, 7:1-7, 15:3-9. “[T]he different regions of the illumination plane towards which light from different luxels is focused are **substantially [] non-**

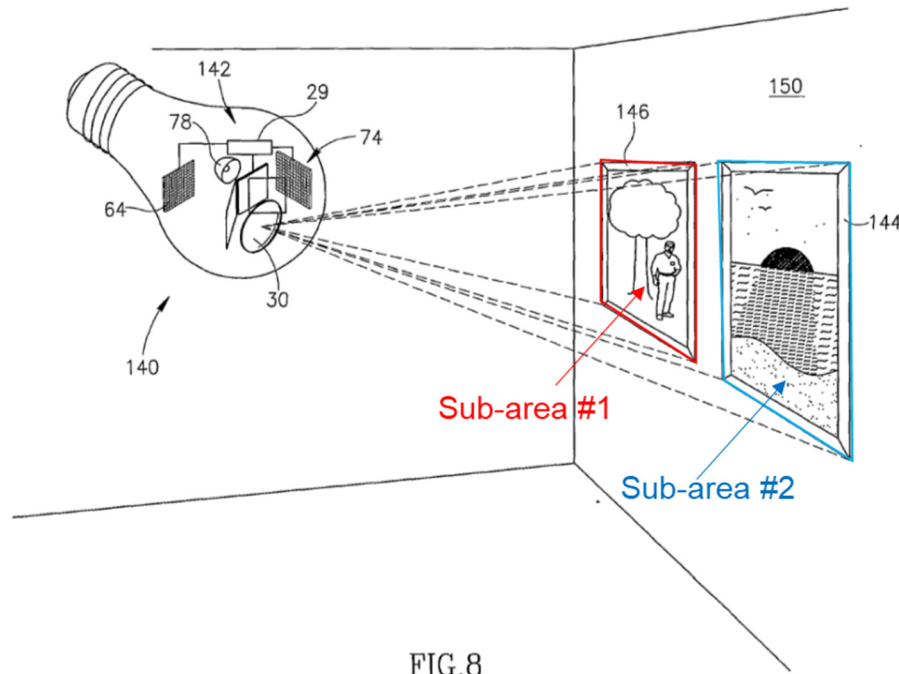
overlapping.” EX1005, 2:18-22, Abstract, FIGs. 1, 2. Namely, **each** mesh square 36 of the illumination plane 32 “is illuminated by light from a **different, substantially only one**, luxel 26.” EX1005, 15:3-7, FIGs. 1, 2. For example, in Figure 1 (reproduced above), illumination system 20 illuminates a rectangular object 42 and a triangular object 44 (“*different sub-area[s]*”) within a scene 40 (“*the area to be lit*”), where “[o]bject 44 is closer to illumination system 20 than is object 42.” EX1005, 16:6-14, FIG. 1. “Luxels 26 that illuminate rectangular object 42 are shown within a shaded rectangular region 52 of illuminator 24 and luxels 26 that provide light that illuminates triangular object 44 are shown within a shaded triangular region 54 on illuminator 24.” EX1005, 16:6-14, FIG. 1. Thus, each of Braun’s luxels (“*each said source*”) substantially illuminates a different mesh square, object or region (collectively discloses the claimed “*sub-area*”) within the scene (“*area to be lit*”).

83. When implemented as an automotive headlight (101, 102), Braun’s illumination system “provides intelligent adaptive illumination of a **roadway and neighboring** regions of the roadway” (“*different sub-area(s)*”) within the roadway scene (“*area to be lit*”). EX1005, 5:19-26, 10:20-24, 13:9-17, 23:8-16, 23:28-29:12, FIGs. 5, 6.



EX1005, FIG. 6 (annotated).

When implemented as a light bulb, Braun's illumination system is "programmable to identify a particular object and/or feature of its environment and **selectively** illuminate the object or feature accordingly." EX1005, 5:6-10, FIG. 8. For example, the light bulb 140 illuminates different pictures (144, 146) ("*different sub-area(s)*") with adjustable intensity and color. EX1005, 5:11-20, 27:27-FIG. 5. The light bulb 140 can also "be used for general illumination of a room or area" with "conventional area lighting" and "can be programmed to provide different illumination effects," e.g., "different 'disco' lighting effects" in a different sub-area of the room. EX1005, 28:6-11.



EX1005, FIG. 8 (annotated).

84. Accordingly, Braun discloses [1.B].

4. [1.C]

85. Claim element [1.C] recites “*the light sources having at least one of controllable light intensity and spectral light distribution.*” Braun discloses this claim element.

86. Braun controls the luxels (“*light sources*”) so that “**intensity** of light provided by a luxel is substantially proportional to the square of a distance from the array of luxels to a region of the scene illuminated by the luxel.” EX1005, 2:32-3:1, 5:11-15, 5:29-6:1, 9:4-9, 11:9-13, 15:30-33, 16:15-20, 17:1-4. The “light providing regions [luxels “light sources”] of the illuminator are controllable to provide visible light at different **wavelengths**.” EX1005, 11:26-30. For example,

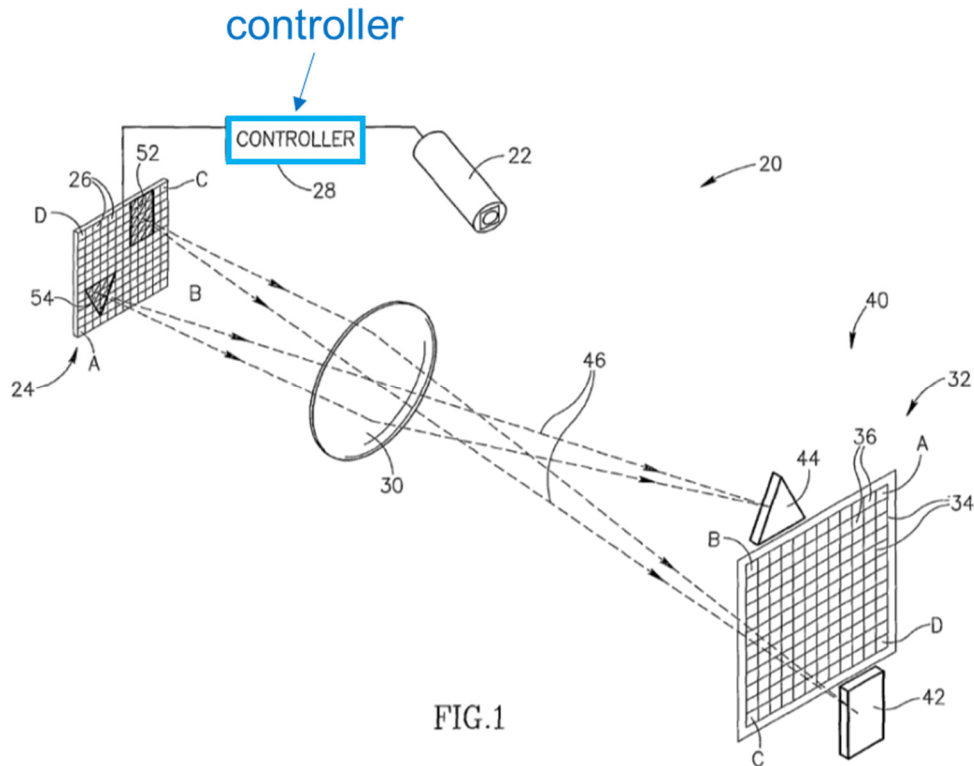
“each luxel can be controlled to provide white light and/or R, G or B light,” or “IR light.” EX1005, 3:4-8, 9:19-28. The “**spectrum and intensity** of light provided by the luxels can be controlled to provide different color light.” EX1005, 9:29-10:4, 14:21-30. The luxels 26 can be controlled “to provide different combinations of R, G and B light so as to control hue, saturation and intensity of light illuminating a scene.” EX1005, 9:29-10:4, 14:21-30.

87. Accordingly, Braun discloses [1.C].

5. [1.D]

88. Claim element [1.D] recites “*a controller for adjusting at least one of a light intensity and light spectrum of the light sources.*” Braun discloses this claim element.

89. Braun’s illumination system 20 includes a **controller 28**. EX1005, 14:12-15, Abstract, FIGs, 1-5, 8.



EX1005, FIG. 1 (annotated).

90. In Braun, “the **controller** of the illumination system is programmable to provide different desired lighting effects and/or to identify different types of objects and features of a scene that is illuminated by the illumination system.” EX1005, 5:1-5, 7:1-7, 15:17-25, 16:21-24, 17:5-6. For example, “the **controller** controls **intensity** of light provided by light providing regions [i.e., luxels “light sources”] responsive to distances determined by the range finder.” EX1005, 2:32-3:3, 9:4-9, 11:9-13, 15:30-16:5, 16:15-20, 24:5-12. The controller “controls intensity of R, G or B light provided by each light providing region so as to control **hue, saturation or intensity** of light illuminating a region of the scene.” EX1005, 3:4-8, 5:27-6:1, 9:29-10:4, 11:14-17, 24:13-18, 27:29-32. “[T]he controller adjusts

wavelength of visible light provided by the light providing regions to maximize visibility.” EX1005, 11:26-30.

91. Accordingly, Braun discloses [1.D].

6. [1.E]

92. Claim element [1.E] recites “*one or more detectors for sensing at least one of objects, surfaces and beings within the area to be lit including the specific sub-area location information and of passing the sensed information to the controller.*” Braun discloses this claim element.

93. Braun’s illumination systems include range finders, e.g., 3D range-cameras (“*one or more detectors*”). EX1005, 2:7-13, 2:16-18, 3:9-14, 3:28-4:20, 14:12-15, 15:26-30, 17:7-10, Abstract, FIGs. 1-5, 8. The 3D range-camera 62 “comprises a photosurface 64 such as a CCD or CMOS **light sensitive** surface, having pixels 66,” and “collecting optics that collects light from the scene and images the collected light on the photosurface.” EX1005, 7:8-10, 17:11-25, 30:3-15, 34:26-28, FIGs. 2-4.

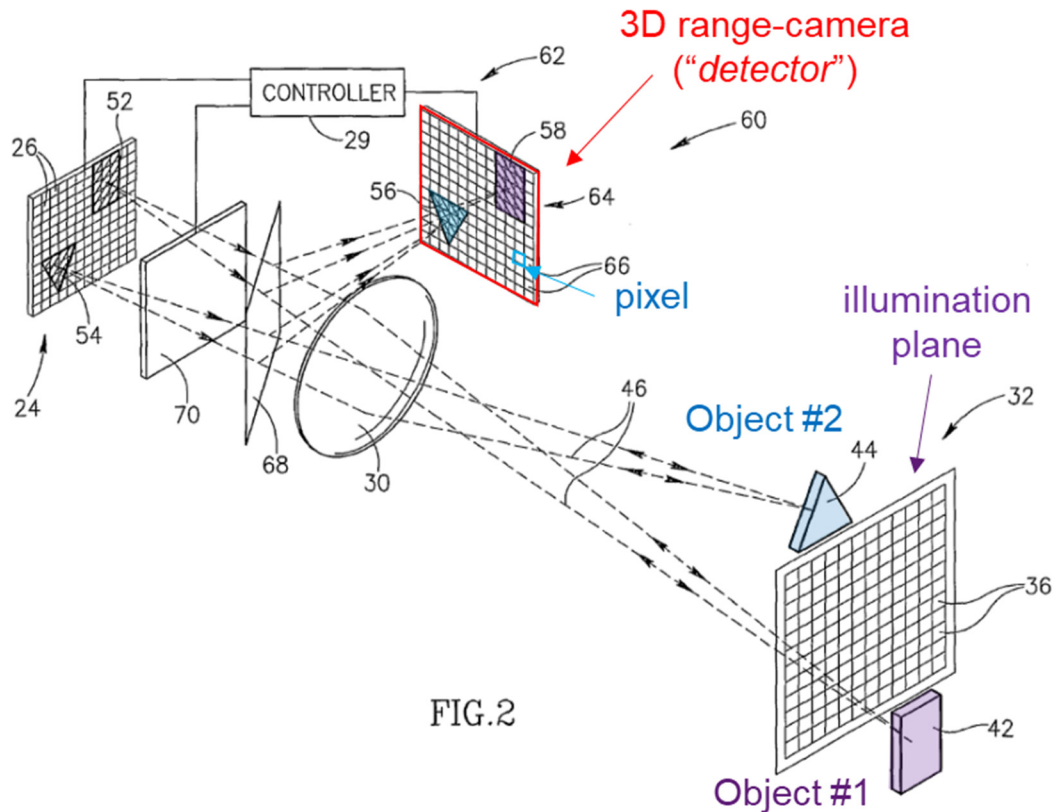


FIG.2

EX1005, FIG. 2 (annotated).

94. Braun's 3D range-camera 62 senses the objects, surfaces or beings within the scene 40 (*"the area to be lit"*). EX1005, 4:6-9, 4:17-20, 18:24-19:8, 21:31-22:7, FIGs. 1-4. For example, the **"objects 42 and 44 are imaged on pixels 66 shown in shaded areas 56 and 58 respectively of photosurface 64"** of the 3D range-camera 62. EX1005, 18:24-19:8, FIG. 2. **"Pixels 66 in shaded areas 56 and 58 of photosurface 64 correspond to luxels 26 in shaded regions 52 and 54 of illuminator 24 that illuminated objects 42 and 44 respectively."** EX1005, 18:24-19:8, FIG. 2. The 3D range-camera 62 of Braun's illumination system also senses road signs, people, animals and obstacles in the roadway. EX1005, 5:27-6:3, 13:1-

17, 21:31-22:16, 22:24-30, 23:8-16, 24:2-12, 26:31-27:4.

95. Braun's range finder 22 determines the "**distances** to rectangular and triangular objects 42 and 44," respectively, as represented by D42 and D44.

EX1005, 16:15-20, 18:31-19:8. The "photosurface 64 images substantially only and substantially all of a scene illuminated by light from illuminator 24 and each pixel 66 in photosurface 64 measures distance to a region of scene 40 that is illuminated by a known corresponding luxel or luxels 26 in illuminator 24."

EX1005, 4:6-9, 18:24-19:8. "[T]here is a **one to one correspondence** between light providing regions and pixels of the photosurface and light from a region of the scene illuminated with light from substantially only one light providing region is imaged substantially only on the pixel corresponding to the light providing region." EX1005, 7:11-14, 4:6-9. Therefore, a POSA would have understood that Braun's range finder (3D range-camera) provides "*specific sub-area location information*" of the objects in order to determine the distances to the objects.

96. A POSA would have understood that Braun's 3D range-camera passes "*the sensed information*" to the controller. For example, the controller "controls the plurality of light providing regions to provide light for illuminating the scene **responsive to** distances determined by the range finder." EX1005, Abstract, 2:11-14, 7:1-7, 9:4-5, 12:3-10, 18:24-19:8, 32:5-8, 32:20-25, 33:1-3; 37:20-22; 39:18-20. The controller "identif[ies] features and/or objects **in images** of the scene

formed on the photosurface” of the 3D range-camera and determines transverse or radial components of velocity of the feature that has different locations in the images acquired by the 3D range-camera. EX1005, 8:11-31, 12:17-20, 12:26-33, 22:17-23.

97. Accordingly, Braun discloses [1.E].

7. [1.F]

98. Claim element [1.F] recites “*a processor for processing the sensed information and determining illumination requirements of the at least one of objects, surfaces and beings.*” Braun renders this claim element obvious.

99. Although Braun does not use the word “*processor*,” a POSA would have understood that Braun’s intelligent controller includes a processor. Braun’s controller “**processes** images of a scene imaged on the photosurface to identify features of the scene and objects in the scene,” e.g., road signs, oncoming vehicles, people, obstacles, pictures and colors. EX1005, 4:17-20, 9:33-10:1, 11:5-8, 11:14-17, 13:4-8, 22:17-23:7, 26:31-27:4. Braun’s controller runs a pattern recognition application “using **algorithms**” to process images. EX1005, 22:17-23, 4:17-20, 5:27-29, 6:4-7, 24:4-5. Braun’s controller “comprises a **memory**” and “is **programmable**.” EX1005, 5:2-20, 5:32-6:1, 10:18-19, 17:5-6, 28:2-4. Braun’s controller also processes signals via wireless transmission. EX1005, 28:16-18. Braun’s controller performs computation “so that intensity of light provided by a

luxel is substantially proportional to the square of a distance from the array of luxels to a region of the scene illuminated by the luxel.” EX1005, 2:32-3:3, 9:6-9, 15:30-16:5, 16:15-20, 24:7-12. Braun’s controller “calculate[s] how to adjust illumination to track objects and features of a roadway scene” based on the vehicle speed, the azimuth angle of the object with respect to the vehicle, and the distance from the object to the vehicle, etc. EX1005, 24:28-25:19. Therefore, a POSA would have understood that Braun’s intelligent controller, which processes images, runs algorithms and application programs, and performs mathematical computation, includes a processor. To the extent that claim 1 requires the recited “*controller*” and “*processor*” to be discrete components, Braun’s illumination system, although shown as monolithically integrated structures, “can have distributed components.” EX1005, 6:24-26.

100. Moreover, according to the ’551 patent, a controller can include a processor and a processor can function as a controller. The ’551 patent explains that a controller “may be ... a Digital Signal Processor ... or a processor which executes instructions from a memory medium.” EX1001, 18:23-29. Prior art cited in the ’551 patent also confirms that it was known to use processors as controllers. A processor is “capable of independently controlling the intensity of each light source.” EX1001, 7:8-23, 7:50-60. “Electronic circuits for control of the independent light sources consist of microprocessor controlled adjustable current

sources.” EX1001, 7:24-32. Therefore, it would have been obvious that Braun’s illumination system includes the claimed “*processor*.”

101. Braun’s processor, included in the controller, “process[es] the sensed information and determin[es] illumination requirements of the at least one of objects, surfaces and beings.” For example, Braun’s processor in the controller determines “intensity of light provided by a luxel [to be] substantially proportional to the square of a distance from the array of luxels to a region of the scene illuminated by the luxel.” EX1005, 2:32-3:3, 16:15-20. Braun’s processor in the controller “processes an image of the scene to determine color components of the scene” “so as to control hue, saturation or intensity of light illuminating the scene responsive to the determined color components.” EX1005, 5:11-20, 5:27-6:1, 9:33-10:4, 11:14-17, 24:13-21. Braun’s processor in the controller “is programmable to control the light providing regions to provide desired illumination effects,” e.g., “to illuminate a disco club ... to provide different ‘disco’ lighting effects as well as conventional area lighting.” EX1005, 17:5-6, 28:6-11.

102. Accordingly, Braun renders [1.F] obvious. *See also* §X.A.5.

8. [1.G]

103. Claim element [1.G] recites “[*the processor*] using at least one of *artificial intelligence, pattern recognition, video analytics, and look-up tables*.” Braun discloses this claim element.

104. Braun's "controller comprises a pattern recognition application that processes images of a scene imaged on the photosurface to identify features of the scene and objects in the scene." EX1005, 4:17-20, 5:27-6:3, 6:4-7, 22:17-23:16, 24:4-5, 27:27-28, 31:31-33. As discussed above, Braun's intelligent controller includes a processor.

105. Accordingly, Braun discloses [1.G].

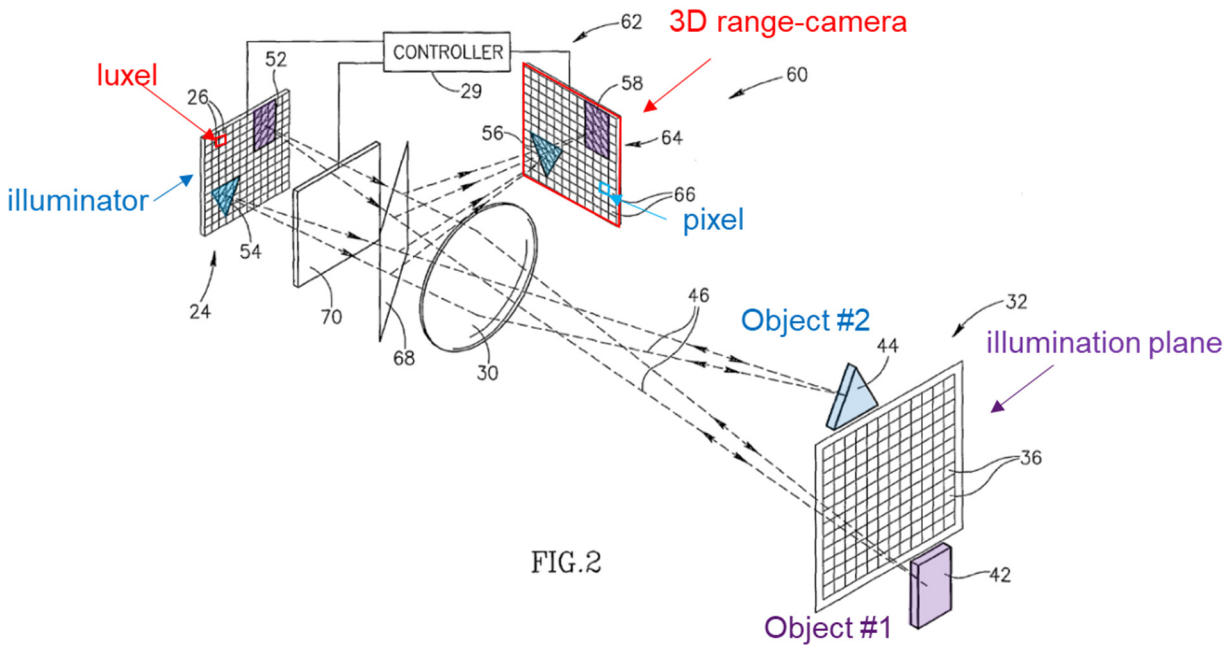
9. [1.H]

106. Claim element [1.H] recites "[*the processor*] for directing the controller to adjust the light source for that sub-area to meet the specific illumination requirement." Braun discloses this claim element.

107. Braun's processor in the controller determines illumination requirements of the objects and Braun's controller adjusts the light intensity and/or light spectrum of the light sources. See §§X.A.5, X.A.7. Braun further describes that the controller is directed to "*adjust the light source **for that sub-area** to meet the specific illumination requirement.*"

108. Braun independently controls the luxels, ("*light sources*"), "each of which provides light that illuminates a different region of the scene," where the controller adjusts the "intensity of **light provided by a luxel** [to be] substantially proportional to the square of a distance from the array of luxels to **a region of the scene illuminated by the luxel**" (i.e., "*for that sub-area*"). EX1005, 2:32-3:1,

Abstract; §§X.A.1-X.A.3. Each of Braun's luxels "*for that sub-area*" is adjustable by the controller to meet its specific illumination requirement because "a region of the illumination plane of the illumination system that is illuminated by a luxel [*("that sub-area")*] is imaged on **a single pixel** of the photosurface" of the 3D range-camera. EX1005, 4:6-8. "[T]here is a **one to one correspondence** between light providing regions [i.e., luxels] and pixels of the photosurface [of the 3D range-camera,] and light from a region of the scene illuminated with light from substantially only one light providing region is imaged substantially **only on the pixel corresponding to** the light providing region." EX1005, 7:11-14, 18:30-19:8, 19:9-11, FIGs. 2, 3. For example, "Pixels 66 in shaded areas 56 and 58 of photosurface 64 correspond to luxels 26 in shaded regions 52 and 54 of illuminator 24 that illuminated objects 42 and 44 respectively." EX1005, 18:30-19:2, FIG. 2. "A distance determined from light incident on a pixel 66 is a distance of a region of scene 40 illuminated by illumination system 60 that is illuminated by light **from substantially only the pixel's corresponding luxel 26.**" EX1005, 19:4-8, FIG. 2.



EX1005, FIG. 2 (annotated).

109. In one application, Braun's headlight "provides intelligent **adaptive** illumination of a roadway and neighboring regions of the roadway," such that the controller adjust the luxels for the identified road sign ("*that sub-area*") to meet the specific illumination requirement, i.e., by adjusting "hue, saturation and intensity of light" "so as to 'spotlight' the [identified] road sign and improve its readability." EX1005, 5:21-6:3, 24:2-20. The controller also adjusts the color of the luxels according to the color of the identified road sign. EX1005, 24:13-21. In the application for interior lighting, Braun's controller adjusts the luxels of the light bulb to "selectively illuminate" the identified particular object and/or feature of its environment, e.g., adjusts "intensity of light illuminating **each of the pictures** [to be] substantially the same, and "adjusts color of light that it provides to illuminate

each picture responsive to a color pattern of the picture.” EX1005, 5:9-20, 27:27-32.

110. Accordingly, Braun discloses [1.H].

111. In summary, Braun renders independent claim 1 obvious.

B. Claim 2

112. Claim 2 depends from claim 1, and recites “*the detector is comprising at least one of (i) a camera being a photo sensor array coupled with an optical lens, (ii) a photo sensor, (iii) an ultrasound transducer and sensor, (iv) microwave transducer and sensor, and (v) pyroelectric detectors.*” Braun discloses this limitation.

113. Braun’s 3D range-camera has “a gated photosurface having pixels and collecting optics that collects light from the scene and images the collected light on the photosurface.” EX1005, 7:8-10, 3:15-21, FIGs. 1-5, 8. The photosurface of the 3D range-camera is “a CCD or CMOS light sensitive surface.” EX1005, 17:11-13. “Lens 30 functions not only to direct light from illuminator 24 to illuminate scene 40 but also collects light from the scene for imaging on photosurface 64.” EX1005, 17:11-25, FIG. 2. Therefore, Braun’s 3D range-camera is “*a photo sensor array coupled with an optical lens.*” Furthermore, the photosurface of Braun’s 3D range-camera (“*photo sensor*”) is “sensitive to color.” EX1005, 11:14-17.

114. Accordingly, Braun discloses the limitation in claim 2.

C. Claim 3

115. Claim 3 depends from claim 1, and recites “*the illuminated area is indoors and [the illumination device] further comprising a detector for detecting variable illumination from daylight and/or sunlight entering indoors, wherein the controller taking into consideration the intensity variations over the area now illuminated by the daylight and/or sunlight adjusts the light intensity of the directional light sources to meet the varied illumination requirement.*” Braun renders this limitation obvious.

116. Braun’s illumination system can “be used for general illumination of a room or area,” and can be programmed to “identify a particular object and/or **feature of its environment** and **selectively** illuminate the object or feature accordingly” with “different illumination effects.” EX1005, 5:9-10, 28:6-9. For example, Braun’s light bulb “may be programmed to identify and determine distances to pictures on a wall of a **room**,” where the light bulb “adjusts illumination that it provides so that **intensity** of light illuminating each of the pictures is **substantially the same**.” EX1005, 5:11-15, 27:27-30, FIG. 8. It would have been obvious for Braun’s controller to adjust the light intensity when ambient light changes, e.g., when one of the pictures is illuminated by daylight and/or sunlight near a window and the other picture is not.

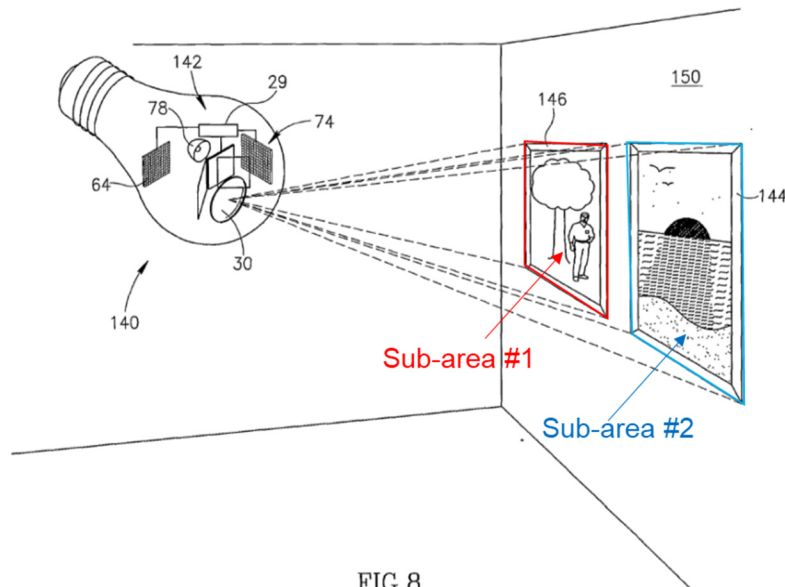


FIG. 8

EX1005, FIG. 8 (annotated).

117. Although Braun does not explicitly describe detecting “*daylight and/or sunlight*,” Braun’s 3D range-camera detects “atmospheric effects,” e.g., fog, and has a “light sensitive surface.” EX1005, 25:20-25, 17:11-13. Additionally, a camera does not differentiate among the types of light it detects; that is, all light is detected including direct sunlight, diffuse daylight, and the light emitted by Braun’s lighting fixture. It would have been obvious for Braun’s 3D range-camera to detect daylight and/or sunlight, such that the intensity variations over the illumination area can be sensed by the pixels of the camera and Braun’s controller can adjust the light intensity of each luxel (“*light source*”) corresponding to the camera’s pixel by “*taking into consideration the intensity variations over the area now illuminated by the daylight and/or sunlight.*”

118. Accordingly, Braun renders the limitation in claim 3 obvious.

**XI. GROUND 2: BRAUN, ALONE OR IN VIEW OF DOWLING,
RENDERS CLAIMS 4 AND 7 OBVIOUS**

A. Motivation to combine Braun and Dowling

119. Braun “automatically adapt[s] the illumination to characteristics and features of the scene.” EX1005, 1:3-5. Braun uses pattern recognition to identify features and objects of the scene (e.g., people) and “controls the luxels to illuminate the scene responsive to the identified features and/or objects.” EX1005, 4:17-20, 13:1-8, 16:27-32, 21: 31-22:16, 26:29-27:1, 27:19-20. Braun tracks the positions of the features and objects in the scene and adjusts the illumination accordingly. EX1005, 10:8-11. Braun’s illumination system can at least receive wireless signals. EX1005, 28:16-20. However, Braun does not explicitly describe how the illumination system communicates with other devices through wireless communication. Thus, a POSA would have been motivated to look to prior art, such as Dowling, for such details.

120. Dowling provides techniques for receiving and transmitting data. EX1027, 6:14-16, 7:1-13. Dowling “integrat[es] illumination with data manipulation and transmission functions.” EX1027, 1:17-20, 4:9-22, FIGs. 2, 6. Dowling builds smart lighting networks from smart lighting devices “for communication purposes, building automation, systems monitoring, and a variety of other functions.” EX1027, Abstract, 8:18-21, FIGs. 9, 10.

121. A POSA would have been motivated to apply Dowling’s teachings of

an advanced, interconnected, communicative, intelligent lighting system to Braun so as to enhance Braun with the advanced features disclosed by Dowling. Based on the teachings of Dowling, a POSA would have been motivated to modify Braun's illumination system to incorporate Dowling's transmitter 136, receiver 138 and input/output circuitry 160 (shown in Figure 5) such that transmitter 136 and the receiver 138 may provide a physical link to a network over which the lighting subsystem 130 may send and receive data over any physical medium, wireless link, mobile devices or computers. EX1027, 38:1-19, 14:1-16:15, FIG. 5.

122. A POSA would have been further motivated to combine Braun and Dowling because both are in the same general field of illumination systems using light emitting diodes (LEDs), and address the same problem—providing smart or adaptive lighting for specific characteristics and features of the scene. EX1005, 1:3-5, 19:19-21; EX1027, 4:9-22, Abstract. Furthermore, a POSA would have combined the system of Braun with the teachings of Dowling by known methods (e.g., adding electronic components, e.g., transmitter/receiver, input/output circuitry), and the results of the combination would have been predictable to a POSA (e.g., Braun's illumination system acquiring both lighting and communication capability). Finally, the proposed combination of Braun and Dowling would involve nothing more than incorporating a well-known concept (i.e., Dowling's transmitter, receiver and input/output circuitry for communication)

into a known system (i.e., Braun's illumination system).

B. Claim 4

123. Claim 4 depends from claim 1. Braun, alone or in view of Dowling, renders claim 4 obvious.

1. [4.A]

124. Claim element [4.A] recites “*the one or more detectors detects information regarding one or more individuals within the illuminated area, said information is at least one of (i) age, (ii) sex, and (iii) recognition of an individual for matching with stored data about that individual's needs.*” Braun, alone or in view of Dowling, renders this claim element obvious.

125. Braun's 3D range-camera provides images of the illuminated area for the pattern recognition application to identify features and/or objects that are of interest. EX1005, 8:11-13, 22:17-23; *see also* §§X.A. Braun uses pattern recognition to “determine presence of a person,” “detect[] motion of the person” and “distinguish between types of behavior of a person” (e.g., walking vs. running). EX1005, 13:4-6, 22:24-30, 26:29-31:1, 21:31-22:16. Therefore, Braun's 3D range-camera “*detects information regarding one or more individuals within the illuminated area.*”

126. As the '551 patent admits, pattern/image/facial recognition, neural networks and artificial intelligence were “**known in the art**” before the effective

filing date of the '551 patent. EX1001, 41:8-11, 44:37-40, 44:63-45:22, 48:30-32, 63:9-12, 63:31-39, 63:41-46, 63:48-52, 64:5-9, 64:46-49, 69:25-29, 83:1-5; EX1002, 333-337; EX1014; *see also* §§VIII.A, VIII.B. During prosecution, Applicant clarified that the term “*age*” is not “the real age in terms of exact years,” but only needs “a probabilistic guess that the image recognized person is belonging to group of people whose age is a factor in correct lighting practice.” EX1002, 333; *see also* §VIII.C. Applicant again cited Schalkoff to show that “techniques for face recognition and training, learning and classification into common attribute sets such as age are known in the art.” EX1002, 335; EX1014, FIG. 2. Therefore, it would be obvious for a POSA to use Braun’s pattern recognition to classify “*at least one of (i) age, (ii) sex, and (iii) recognition of an individual*” when the presence of the person is detected. For example, individuals can be classified into different age groups based on the “types of behavior” as described in Braun, e.g., a younger group often walks or runs faster than an older group.

127. Braun’s controller “comprises a **memory**,” which “is programmable to remember” the recognized objects. EX1005, 28:2-4. Braun’s light bulb is “**preprogrammed** with **desired** functions and a menu of lighting effects.” EX1005, 28:12-13. Therefore, Braun stores data of the specific illumination requirement for “*that individual’s needs*” in the memory such that the illumination condition for the person can be matched with the stored data. Braun’s detected

information is “*for matching with stored data about that individual’s needs.*”

128. Additionally, Dowling’s sensor (e.g., camera) “enables more complex, interactive functions,” e.g., with individuals, “based on **identity** or a **general classification** scheme” determined by, e.g., “**face recognition**,” such that the smart lighting system “moderate[s] access,” “**matches the predetermined preference**,” and “monitor[s] activity and locations of a building’s occupants.” EX1027, 22:11-23:14, 5:19-6:5.

129. Accordingly, Braun, alone or in view of Dowling, renders [4.A] obvious.

2. [4.B]

130. Claim element [4.B] recites “*the controller adjusts the light intensity and/or spectrum of the illumination provided to the one or more individuals based on illumination requirements from at least one of (i) best practices looked up and calculated from stored data, (ii) age and/or sex of the individual, (iii) personal preferences input to the controller and stored in memory, and (iv) commands received by the controller from an input device.*” Braun, alone or in view of Dowling, renders this claim element obvious.

131. Braun’s light bulb “is preprogrammed with **desired** functions and a menu of lighting effects,” where programming the light bulb “is performed by transmitting **signals** to the light bulb” via wires or wireless transmission of

appropriate signals to the controller. EX1005, 28:12-20. Individuals “**choos[e]** a particular lighting effect or [desired] function from the menu ... by transmission of wireless **signals** to the light bulb.” EX1005, 28:12-20. Thus, Braun’s controller adjusts the illumination at least based on wireless signals (“*commands*”) received by the controller from a remote device (“*input device*”). It would have been obvious for Braun’s controller to also adjust the illumination at least based on “*personal preferences input to the controller and stored in memory.*” EX1005, 13:6-8, 22:2-16, 26:31-27:1, 27:19-20.

132. Accordingly, Braun, alone or in view of Dowling, renders [4.B] obvious.

133. In summary, Braun, alone or in view of Dowling, renders the limitations in claim 4 obvious. *See also* §X.A.

C. Claim 7

134. Claim 7 depends on independent claim 6, which is cancelled after the ’815 reexamination in view of Stam PCT. EX1008, 1:15; EX1012, 928-940, 958-968; EX1017. Claim 7 was not reexamined. EX1008, 1:18; EX1012, 929.

135. Claim 6 recites similar features as claim 1. EX1001, 95:30-51, 96:17-31. In addition to Stam PCT, Braun, alone or in view of Dowling, renders independent claim 6 obvious, and renders dependent claim 7 obvious.

1. [6.P]

136. Braun discloses “[a]n illuminating device having automatic control of the light provided to an illuminated area comprising.” See §X.A.

2. [6.A]

137. Claim element [6.A] recites “a structure for incorporating illuminating device elements.” Braun discloses this element.

138. Braun’s illumination system (e.g., headlight and light bulb) have a “monolithically integrated” structure. EX1005, 6:24-32, 28:24-32, FIGs. 5, 8. For example, Braun’s light bulb can be “mounted in a chandelier.” EX1005, 6:29-32.

139. Braun also discloses light-emitting elements, or LEDs, which are the claimed “illuminating device elements.” Braun states that “[b]y way of example R, G, B, and IR luxels 26 may be suitable laser or LED diodes.” EX1005, 19:20-21. Thus, the elements of Braun’s illumination system (“*illuminating device elements*”), e.g., luxels, controller, camera, are incorporated in the integrated structure. EX1005, FIGs, 5, 8.

140. Accordingly, Braun discloses [6.A]. See also §X.A.

3. [6.B]

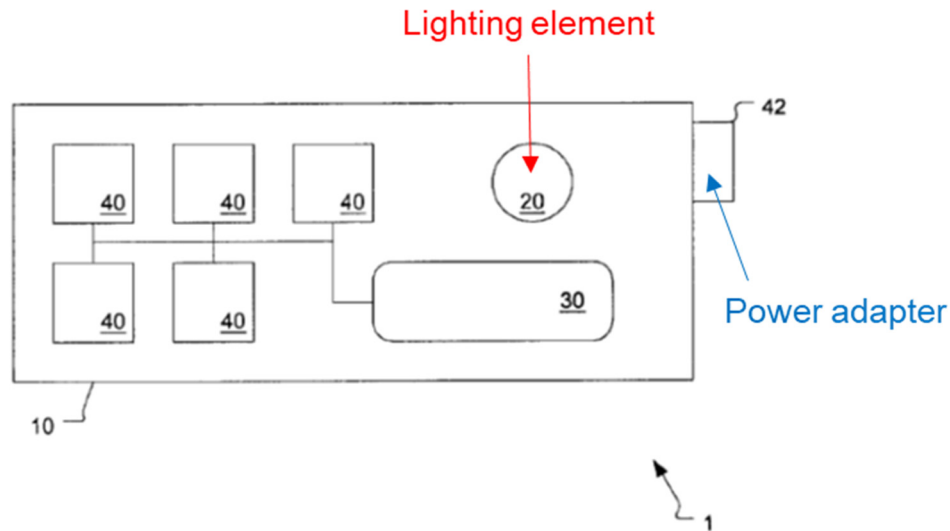
141. Claim element [6.B] recites “one or more light sources incorporated in the structure and in communication with a power source.” Braun, alone or in view of Dowling, renders this claim element obvious.

142. Braun’s luxels (“*light sources*”) are incorporated in the structure of an

illuminator. EX1005, Abstract, FIGs. 1, 8. And it would have been obvious that Braun's luxels are "*in communication with a power source*" to "provide and control light by emission," with adjustable intensity, to be turned on/off to produce light pulse, etc. EX1005, 2:32-3:3, 3:23-24, 8:1-3, 9:4-9, 14:16-17, 14:27-28, 19:20-21.

143. IESNA Handbook explains that "[l]ight-emitting diodes (LEDs) produce light by electroluminescence when low-voltage direct **current** is applied to a suitably doped crystal containing a p-n junction (Figure 1-18)." EX1013, 26, 265-267, FIG. 1-18 (schematics showing a battery); EX1022, 9:56-57, 10:48, FIGs. 1, 3, 6, 9, 22.

144. Furthermore, Dowling's smart lighting device includes lighting elements 20 "coupled to an electrical connection, for emitting light," where the electrical connections 40 are "coupled to a power adapter [42]." EX1027, 3:23-31, 5:37-57, 6:36-50, FIG. 1.



EX1027, FIG. 1 (annotated).

145. Braun, alone or in view of Dowling, renders [6.B] obvious. *See also* §X.A.

4. [6.C]

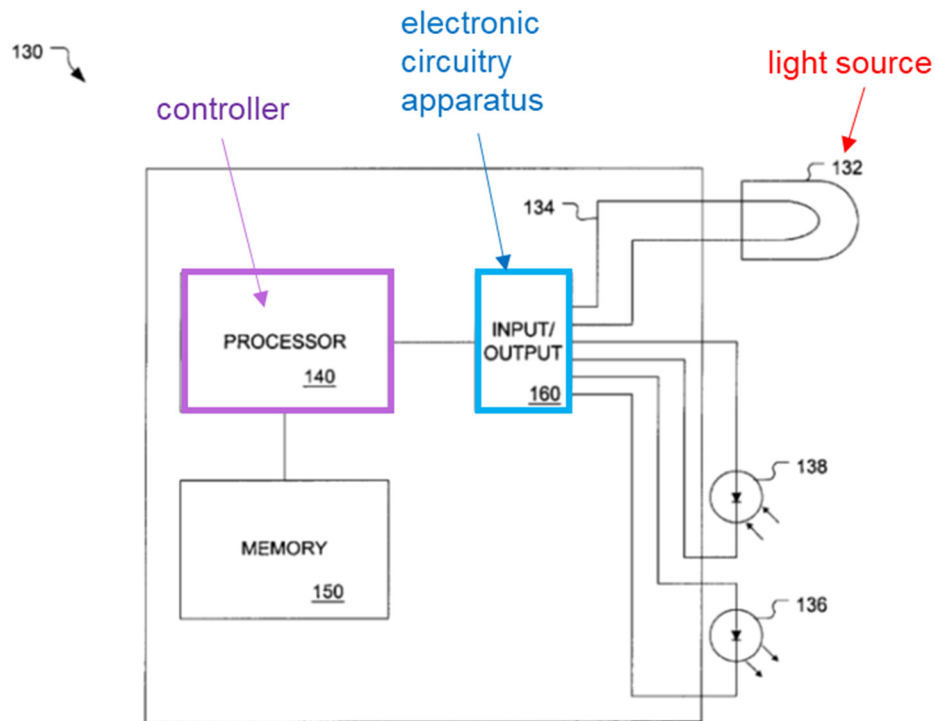
146. Claim element [6.C] recites “*electronic circuitry apparatus for the controlled powering of the light source and other illuminating device elements.*”

Braun, alone or in view of Dowling renders the claim element obvious.

147. A POSA would have been understood that Braun’s illumination system includes an “*electronic circuitry apparatus*” to provide a forward biased current to the p-n junction of the light emitting diode. *See* §XI.C.3.

148. Additionally, Dowling’s smart lighting system includes “a light source 132 responsive to an illumination signal 134,” and an input/output circuitry 160 (including the LED driver 75 in FIG. 3) “for transforming signals from the

processor 140 into signals for the light source 132.” EX1027, 38:1-19; 34:18-35:4, FIGs. 3, 5. The input/output circuitry 160 includes an LED driver “used to activate the LED.” EX1027, 36:16-17, 38:18-19, FIG. 3.



EX1027, FIG. 5 (annotated).

149. Accordingly, Braun, alone or in view of Dowling renders [6.C] obvious. *See also* §X.A.

5. [6.D]

150. Claim element [6.D] recites “*one or more cameras placed on the structure for detecting coordinate-specific information about the illuminated area, said camera in communication with power and control device elements.*” Braun discloses this claim element.

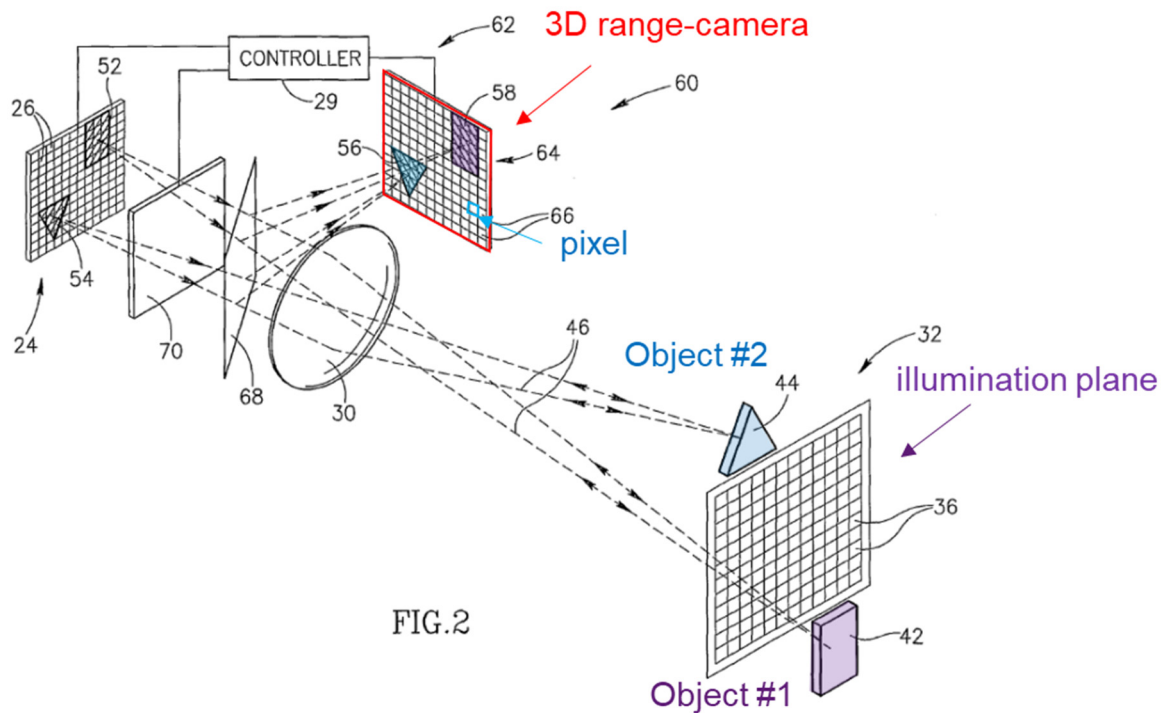
151. When Braun's illumination system (e.g., light bulb) is "mounted in a chandelier," the "3D-range camera [can also be] mounted in the chandelier structure." EX1005, 6:24-32. Therefore, Braun's 3D range-camera is "*placed on the structure.*"

152. Braun's 3D range-camera 62 "comprises a photosurface 64 such as a CCD or CMOS light sensitive surface, having pixels 66." EX1005, 17:12-13. Each pixel of the 3D range-camera "has a **circuit** controllable to turn on and turn off the pixel." EX1005, 4:10-16; EX1039, FIGs. 1A, 2-4. Thus, Braun's CCD camera is "*in communication with power.*" EX1047, 14-34.

153. Braun's controller "controls the 3D range-camera to repeatedly acquire an image of the scene and determine distances to regions of the scene." EX1005, 10:5-7. "[T]he controller controls the 3D range-camera to acquire a first image of the scene at a first time and a second image of the scene at a second time and identifies a feature of the scene that has a location in the second image different from its location in the first image." EX1005, 8:15-18. Therefore, Braun's 3D range-camera is also "*in communication with ... control device elements.*" See also §X.A.

154. Braun's illumination plane ("*illuminated area*") is represented by coordinates, "shown with a grid of mesh lines 34 that divides the area of illumination plane 32 into square mesh regions 36." EX1005, 15:3-9. Each pixel 66

of the photosurface 64 of the 3D range-camera “images substantially only and all of a different **single mesh region** 36 of illumination plane 32.” EX1005, 19:4-5. Therefore, Braun’s 3D range-camera provides an image in each mesh square 26 and thus detects “*coordinate-specific information about the illuminated area.*”



EX1005, FIG. 2 (annotated).

155. Accordingly, Braun discloses [6.D]. *See also* §X.A.

6. [6.E]

156. Claim element [6.E] recites “*a controller integrated with the structure, in communication with the light source controlling power circuitry, said controller arranged to processes [sic] the information communicated from the camera and automatically control the light provided to the illuminated area.*”

Braun renders this claim element obvious.

157. Braun's illumination system (e.g., headlight, light bulb) can be a "monolithically integrated structure." EX1005, 6:24-26. Thus, Braun's controller is "*integrated with the structure.*"

158. Braun's controller "processes the information communicated from the camera and automatically control the light provided to the illuminated area." *See* §X.A.

159. Braun's controller "controls the plurality of light providing regions to provide light for illuminating the scene responsive to distances determined by the range finder." EX1005, Abstract. For example, "the controller controls luxels so that intensity of light provided by a luxel is substantially proportional to the square of a distance from the array of luxels to a region of the scene illuminated by the luxel." EX1005, 2:32-3:1. As discussed above, Braun's illumination system includes an "*electronic circuitry apparatus for the controlled powering of the light source and other illuminating device elements.*" *See* §XI.C.4. Therefore, it would have been obvious that Braun's controller is "*in communication with the light source controlling power circuitry*" to adjust the intensity of the illuminator.

160. Thus, Braun renders [6.E] obvious. *See also* §X.A.

161. In summary, Braun, alone or in view of Dowling, renders claim 6 obvious.

7. Claim 7

162. Claim 7 depends from claim 6, and recites “*one or more light sources are directional wherein the one or more detectors are configured to sense a presence of glare on a person’s eyes in the illuminated area, and wherein the controller is programmed to adjust an intensity of the directional light sources to reduce the glare.*” Braun renders this limitation obvious.

163. Braun’s “light sources are directional.” See §X.A.

164. When Braun’s illumination system is used as headlight, the controller “process[es] images provided by the photosurface [of the 3D range-camera] to identify 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.” EX1005, 6:4-7, 12:17-20. It would also have been obvious that Braun’s 3D range-cameras senses or derives “*a presence of glare on a person’s eyes*” by measuring the amount of light reflected by the objects in the scene (e.g., the driver’s head) such that such that Braun’s controller adjusts the intensity of the luxels to reduce the glare. EX1005, 17:12-23, 3:15-21, 11:18-25, 18:9-23.

165. Therefore, Braun renders the limitation in claim 7 obvious. Claim 7 depends from claim 6. Braun, alone or in view of Dowling, renders claim 7 obvious. *See also* §X.A.

XII. GROUND 3: THE COMBINATION OF BRAUN, DOWLING AND BAILEY RENDERS CLAIMS 8, 10-13 AND 15-18 OBVIOUS

A. Motivation to combine Braun, Dowling and Bailey

166. Braun adapts illumination for identified objects by adjusting the intensity and color of the luxels (“*light sources*”). EX1005, 1:3-5, 2:32-3:1, 5:11-20, 5:29-6:1, 9:4-9, 29-10:4. Braun also adjusts the light sources to “match changes in the positions” of the objects. EX1005, 10:8-11. By selectively turning on and turning off luxels, as disclosed by Braun, Braun changes the direction of light emission without a mechanical adjustment. Braun and Dowling do not explicitly describe how to mechanically adjust the directions of the light sources to track moving the object. When mechanical structures would be desirable to provide additional adjustment of light directions, a POSA would have been motivated to look to prior art, such as Bailey, for such details.

167. Bailey provides “variable color and intensity of light as well as **selective** concentration or focusing of light on particular areas.” EX1035, 1:26-32, 1:53-56. In Bailey, “an array of LEDs is supported on a flexible base or support structure which may be **selectively deflected** to effect focusing of a light beam generated by the multiple LEDs of the array.” EX1035, 1:5-9, 1:63-1:67, 2:1-10, 2:60-3:16, FIG. 2. Bailey’s actuator is connected to the flexible support base “to deflect the base to change the **directional** characteristics of light beams being projected by each LED so that the resultant or collective light beam generated by

the apparatus may be focused or concentrated on a target distant from the apparatus.” EX1035, 1:5-9, 1:63-1:67, 2:1-10, 2:60-3:16, FIG. 2. Bailey uses a “controller [] for varying the color and intensity of light,” and “for varying the focus of the array of LEDs 22 by movement of the actuator 28 to deflect the flexible base 20.” EX1035, 3:66-4:8, 2:64-66, 3:1-5, FIG. 3.

168. Based on the teachings of Bailey and to the extent that a mechanical adjustment of the light emission direction would be needed (e.g., selectively focus the light beams), a POSA would have been motivated to modify Braun’s illumination system to i) mount at least a portion of Braun’s luxels (i.e., LEDs) on one or more movable structures like Bailey’s flexible base 20 and ii) couple an actuator to the movable structure to automatically control the direction of the light beams. The combined system of Braun, Dowling and Bailey is compatible with the modification from Dowling, i.e., incorporation of Dowling’s transmitter 136, receiver 138 and input/output circuitry 160 for communication with other devices.

169. A POSA would have been further motivated to combine Braun and Bailey because both are in the same general field of illumination systems using light emitting diodes (LEDs), and address the same problem—providing smart or adaptive lighting. EX1005, 1:3-5, 19:19-21; EX1035, 1:53-2:10, 5:9-15, Abstract. Furthermore, a POSA would have combined the system of Braun with the teachings of Bailey by known methods (e.g., mounting LEDs on flexible bases and

connecting with actuators), and the results of the combination would have been predictable to a POSA (e.g., Braun's light beams can be selectively focused according to the bending of the flexible base that each luxel is mounted on). Finally, the proposed combination of Braun and Bailey would involve nothing more than incorporating a well-known concept (i.e., Bailey's flexible base and actuator) into a well-known system (i.e., Braun's illumination system).

B. Independent Claim 8

170. Claim 8 is an independent claim, reciting similar features as claim 1. The additional features of claim 8 are discussed below. The combination of Braun, Dowling and Bailey renders claim 8 obvious.

1. [8.P]

171. Claim element [8.P] recites “[a]n illuminating device which provides light to meet an illumination requirement of an illuminated area in which visual activities are performed, where different sub-areas of the illuminated area need to be illuminated at a different intensity and/or at a different spectrum than another sub-area of the illuminated area, comprising.” To the extent that the preamble is limiting, Braun discloses the preamble.

172. Braun explains that “[o]bjects in a scene that are illuminated so that they **contrast strongly** with their local background tend to capture our attention.” EX1005, 1:8-9. Thus, Braun's “the light bulb adjusts color of light that it provides

to illuminate each picture **responsive to a color pattern of the picture**,” to “illuminate the picture with light that ‘brings out’ the natural colors of the picture.” EX1005, 5:15-20. Braun “control[s] hue, saturation or intensity of light illuminating **a region of the scene** which is illuminated by light from the light providing region **independently** of hue saturation and intensity of light illuminating **other regions of the scene**.” EX1005, 34:12-16. Therefore, Braun discloses that different sub-areas of the illuminated area need to be illuminated differently. *See also* §X.A.

173. Braun’s illumination system provides lights for “*visual activities*” (e.g., viewing pictures and roadway scenes). EX1005, 5:11-20, FIG. 8. Braun’s controller adjusts illumination “responsive to the determined visibility,” e.g., by “adjust[ing] wavelength of visible light provided by the light providing regions to **maximize visibility**.” EX1005, 11:26-30. For example, Braun’s light bulb “illuminate[s] the picture with light that ‘brings out’ the natural colors of the picture.” EX1005, 5:11-20, FIG. 8.

174. Accordingly, Braun discloses [8.P]. *See also* §X.A.

2. [8.A]

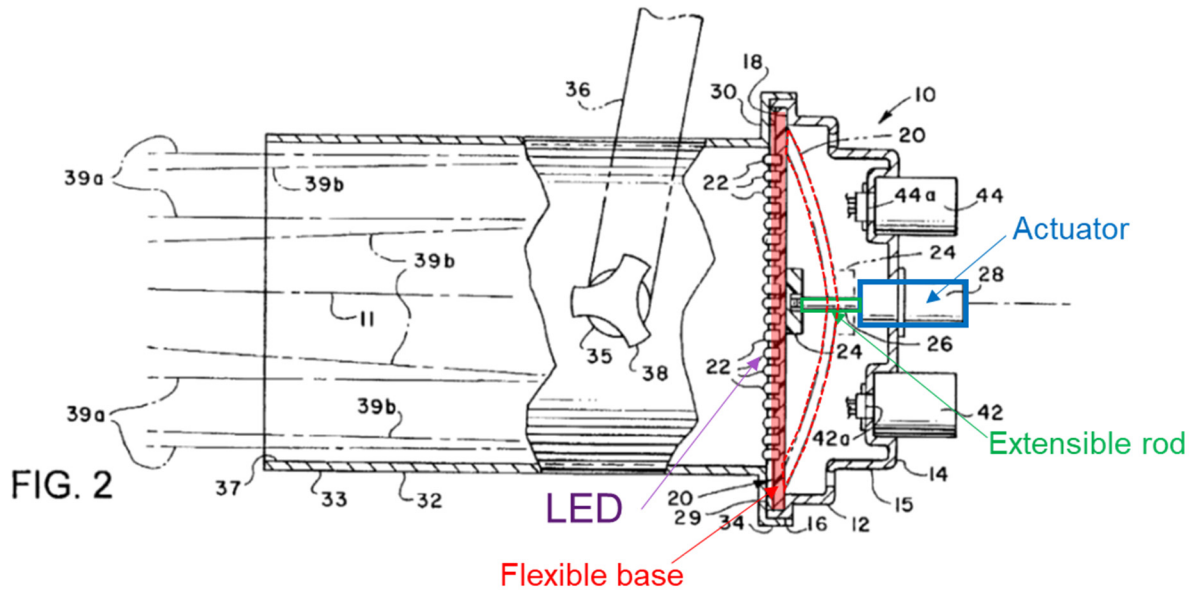
175. Braun discloses “*a light fixture including a multiplicity of directional light sources including at least two directional light sources pointing in different directions thereby illuminating different sub-areas of the illuminated area*.” *See*

§X.A.

3. [8.B]

176. Claim element [8.B] recites “*the light fixture having movable structure for aiming the directional light sources mounted thereon in a defined direction.*” Braun in view of Bailey renders this claim element obvious.

177. Bailey’s “multi-color, focusable, lighting apparatus” “comprises an array of light emitting diodes (LEDs) supported on a **flexible** base member.” EX1035, Abstract, 1:6-10, 1:67-2:4, 2:58-63, FIGs. 1, 2, 4, 5. Bailey’s flexible base 20 “comprise[s] a flexible elastomeric member which may include suitable circuitry mounted thereon or embedded therein for providing electrical signals to each LED of the array.” EX1035, 1:67-2:4, FIG. 5. Bailey’s flexible base “may be selectively deflected to effect focusing of a light beam generated by the multiple LEDs of the array.” EX1035, 1:63-67, FIG. 2. “The flexible support base is operably connected to an actuator which may be controlled to deflect the base to change the directional characteristics of light beams being projected by each LED so that the resultant or collective light beam generated by the apparatus may be focused or concentrated on a target distant from the apparatus.” EX1035, 2:4-10, 1:63-67, FIG. 2.



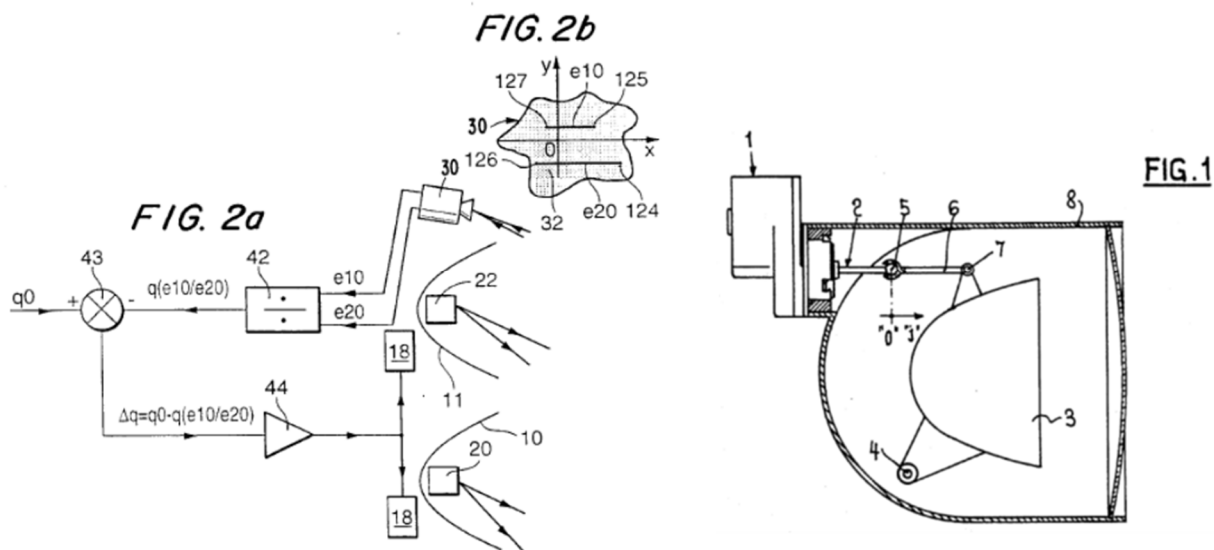
EX1035, FIG. 2 (annotated).

178. “[W]hen the support base 20 is in the position shown by the solid lines in FIG. 2”, light beams generated by the LEDs 22 “project[] substantially parallel light beams 39a.” EX1035, 3:39-49, FIG. 2. “[W]hen the base 20 is deflected to the position shown by the alternate position lines in FIG. 2,” “the axes of the light beams being projected by the LED array may be altered to generally follow the beam path lines 39b, for example, which beam path lines converge toward each other.” EX1035, 3:39-49, FIG. 2. Bailey’s LED array “includes clusters of three LEDs 22a, 22b and 22c,” each cluster having “one red LED 22a, one blue LED 22b and one green LED 22c” “energized for selective periods of time and/or illuminated with different degrees of intensity” such that “the perceived color of light emitted from the apparatus 10 may be selectively varied

over a wide range of colors.” EX1035, 4:9-27, FIG. 4. “The particular orientation or position of each of the LEDs 22a, 22b and 22c in each cluster may be varied.” EX1035, 4:9-27, FIG. 4.

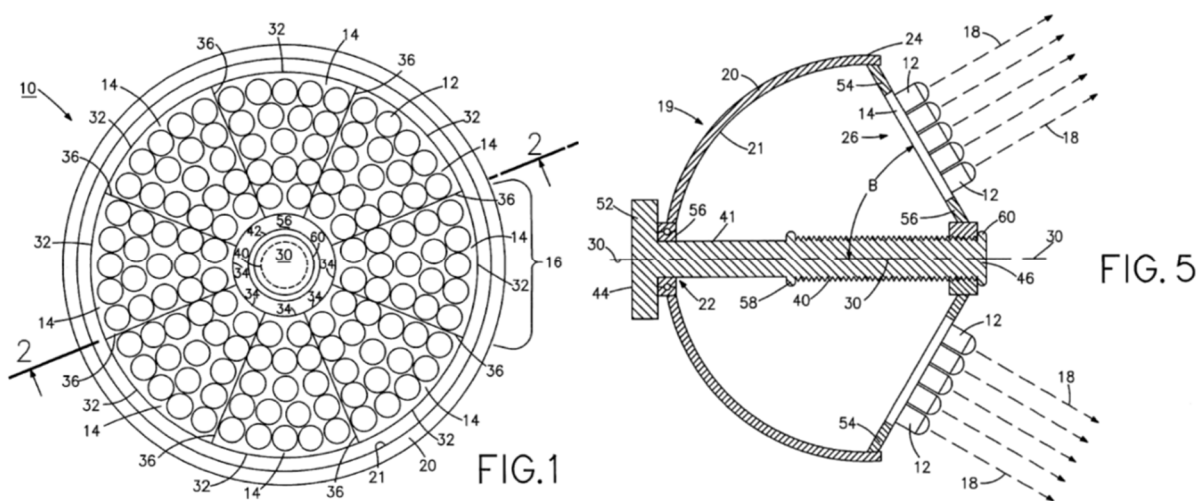
179. When Bailey is combined with Braun, the combined illumination system would result in i) at least a portion of Braun’s luxels of the illuminator mounted on one or more movable structures like Bailey’s flexible base 20” for “*aiming the directional light sources mounted thereon in a defined direction,*” and ii) Braun’s controller controlling one or more actuators like Bailey’s actuator 28 that connected to the one or more movable structures. *See* §XII.A.

180. Indeed, mounting light sources on a “*movable structure*” was well known long before the effective filing date of the ’551 patent. For example, Lopez discloses “a unit for adjusting the alignment position of the headlights.” EX1010, Abstract, 5:38-63, FIG. 2a. Sieber discloses a headlamp-positioning device having a stepping motor. EX1034, Abstract, FIG. 1.



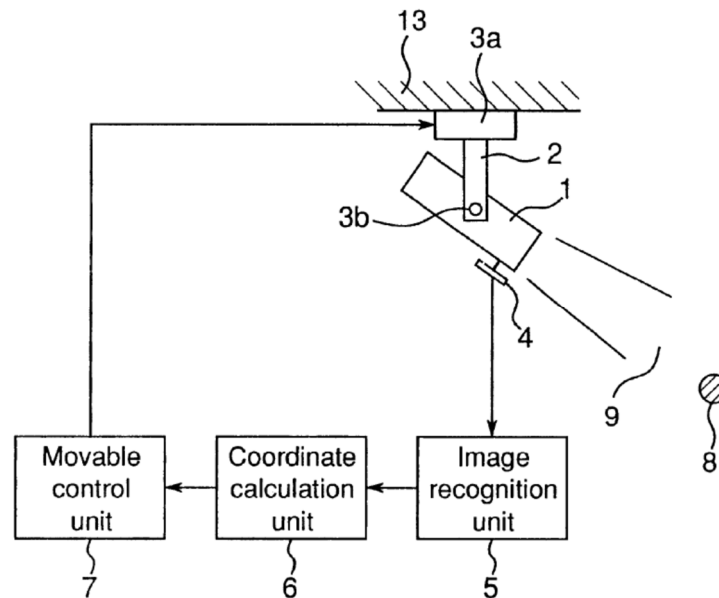
EX1010, FIGs. 2a-2b; EX1034, FIG. 1.

181. Luk improves Bailey by mounting LED arrays 12 on multiple panels 14 to produce parallel, converging and diverging modes of light beams. EX1033, 3:62-4:4, FIGs, 2, 4, 5.



EX1033, FIGs. 1, 5.

182. Kawashima's spotlight 1 automatically tracks object 8 using CCD camera 4, image recognition unit 5, coordinate calculating unit 6 and movable control unit 7, where a horizontal drive means 3a changes a horizontal angle (PAN) and a vertical drive means 3b changes a vertical angle (TILT) of the lighting direction of the spotlight 1. EX1007, Abstract, 9:53-10:14, FIGs. 1, 2.



EX1007, FIG. 1.

183. At least for the above reasons, the combination of Braun and Bailey renders [8.B] obvious.

4. [8.C]

184. Braun discloses “a camera for obtaining images of the illuminated area functioning as a detector for at least one of (i) a light detector (ii) a spectrum detector, (iii) a motion detector, (iv) a measuring detector for sensing a geometry of the illuminated area, and (v) a detector for sensing at least one of work surfaces

and road objects and at least one of vehicles and people.” See §§X.A, X.B.

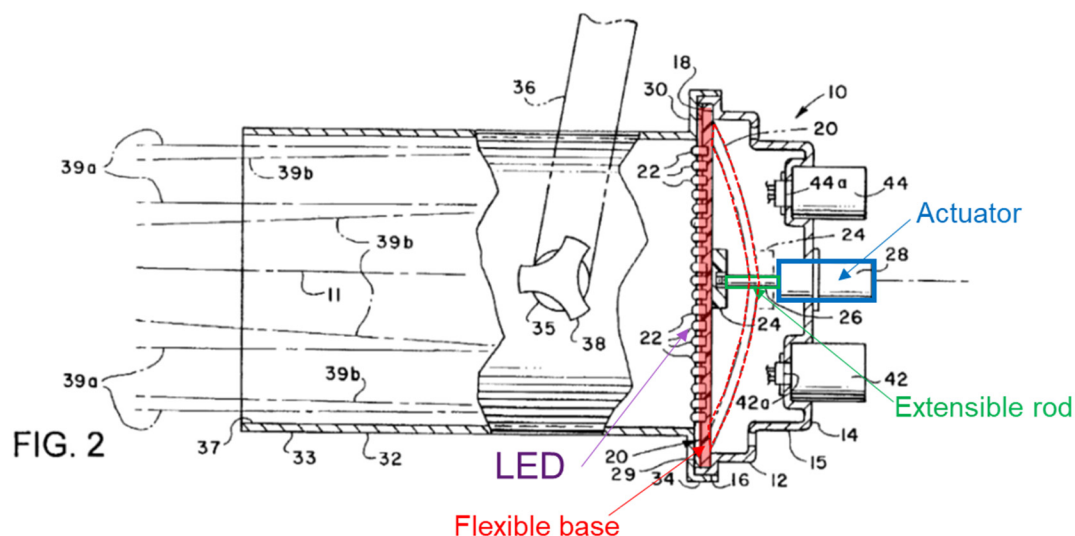
5. [8.D]

185. Claim element [8.D] recites “*a controller for adjusting a light intensity and a direction of each of the directional light sources.*” Braun, alone or in view of Bailey, renders this claim element obvious.

186. In Braun, “following the acquisition of each image, the controller adjusts light provided by the light providing regions to **match changes in the positions** of one or both of features and objects in the scene relative to their positions in an immediately preceding image of the scene.” EX1005, 10:8-11, 12:7-10. Braun’s illumination system “**tracks** objects and features” to provide desired illumination patterns. EX1005, 24:32-25:2, 25:16-18. Braun acknowledges that providing the desired illumination to an individual and following the individual that moves around was known in the art. EX1005, 1:22-30. A POSA would have understood that Braun’s controller adjusts the direction of illumination according to the position of the object.

187. Also, in the combined system of Braun and Bailey, Braun’s luxels (e.g., LED diodes) would be mounted on one or more movable structures (e.g., Bailey’s flexible base 20), where light directions are adjustable through the position of the flexible base 20. *See* §XII.B.3. Bailey’s base 20 is “connected to an extensible rod 26 of a linear actuator 28.” EX1035, 2:64-66. “The actuator 28 is

operable to move the rod 26 in opposite directions along the central axis 11 of the apparatus 10 between a position as indicated the solid lines in FIG. 2 and a selected one of alternate working positions, a limit one of which is indicated by the alternate position lines in FIG. 2.” EX1035, 3:1-5. Bailey also provides the control cable connector 46 “for connecting the apparatus 10 to a suitable **controller** [] for varying the color and intensity of light emitted by the apparatus 10 and [] for varying the focus of the array of LEDs 22 by movement of the actuator 28 to deflect the flexible base 20.” EX1035, 3:66-4:8, FIG. 3. In the combined system of Braun and Bailey, Braun’s controller would adjust the position of the one or more movable structures through one or more actuators and thereby adjusts “*a direction of each of the directional light sources*” mounted on the respective movable structures.



EX1035, FIG. 2 (annotated).

188. Accordingly, Braun, alone or in view of Bailey, renders [8.D] obvious. *See also* §X.A.

6. [8.E]

189. Claim element [8.E] recites “*a processor with stored algorithms and data for identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance any of which is used by said processor for determining illumination within the illuminated area using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables.*” Braun, alone or in view of Dowling, renders this claim element obvious.

190. Braun’s 3D range-camera “collects light from the scene and images the collected light on the photosurface.” EX1005, 3:15-21, 7:8-10, 17:7-9, FIG. 2. Braun’s controller/processor uses a pattern recognition application that “processes the images to determine presence of a person,” “detects motion of the person,” and “types of behavior of a person,” e.g., walking or running. EX1005, 4:17-20, 5:27-6:3, 6:4-7, 22:17-23:16, 24:4-5, 27:27-28, 31:31-33, 13:1-8, 21:31-22:16, 26:29-27:4. Braun’s controller “identifies **position** of an image of the object in an image of the scene at different times,” for example, “identifies a feature of the scene that has a **location** in the second image different from its location in the first image.”

EX1005, 4:29-31, 8:15-18, 22:31-23:3. “[F]ollowing the acquisition of each image, the controller adjusts light provided by the light providing regions to **match changes in the positions** of one or both of features and objects in the scene relative to their positions in an immediately preceding image of the scene.”

EX1005, 10:8-11, 12:7-10.

191. Dowling’s lighting element 20 is “coupled to the processor 30, to permit variation of the emitted light as a function of input from a sensor, or a predetermined program executed by the processor 30, particularly when LED lighting elements are employed.” EX1027, 10:19-22, 13:17-22, FIG. 1. Dowling places smart lighting elements in public spaces “to monitor the flow of people, vehicles, or other objects.” EX1027, 20:3-15. “The collected data may then be analyzed” using the processor “to determine traffic flow, traffic patterns, points of congestion, etc.” EX1027, 20:3-15. Dowling uses this analysis “to determine points where traffic is congested, to help identify a change in the layout or configuration that may help redirect traffic flow or ease passage and congestion, or to determine, for example, how customers prefer to navigate through a supermarket or find seats in a theater.” EX1027, 20:3-15.

192. Accordingly, Braun, alone or in view of Dowling, renders [8.E] obvious. *See also* §§X.A, XI.B.

7. [8.F]

193. Claim element [8.F] recites “*said processor*⁶, upon calculating the required illumination parameters according to best practice standards, directs the controller to adjust the directional light sources that illuminates the specific sub-areas to meet the illumination requirements of the visual activities.” Braun renders this claim element obvious.

194. Although Braun and Bailey do not explicitly describe the processor calculating the required illumination parameters “*according to best practice standards*,” the ’551 patent admits that “best lighting practices [is] recommended by lighting engineers and published in handbooks such as the Illuminating Engineering Society of North America IESNA and standards such as ANSI or CIE.” EX1001, 62:1-62:9. The IESNA Handbook “has numerous recommendations and best practice standards specifically related to LED lighting.” EX1001, 62:1-62:9. Indeed, the IESNA Handbook provides general lighting design guides for various applications, for example, for theater, residential, exterior, roadway and emergency lighting. EX1013, 441-479, 485-644. The IESNA Handbook points out that “the International Electrotechnical Commission (IEC) and European Committee for Electrotechnical Standardization (CENELEC) have

⁶ I assume it is the “*processor*” recited in [8.E].

developed standards to minimize risks of eye injury from use of products containing LEDs. These standards include maximum permissible exposure (MPE) levels and required testing methods for products using LEDs, as well as eye safety labeling recommendations based on the amount and type of emission produced by these products, just as with other light sources.” EX1013, 174. The IESNA Handbook also includes various lighting calculations. EX1013, 351-422. Thus, it would have been obvious to a POSA to calculate the required illumination parameters “*according to best practice standards*” available, e.g., in the IESNA Handbooks.

195. Accordingly, Braun renders [8.F] obvious. *See also* §X.A.

196. In summary, Braun, Dowling and Bailey render independent claim 8 obvious.

C. Claim 10

197. Claim 10 depends from claim 8, and recites “*the controller receives real time information from the camera and [] the processor, using image recognition capability, directs the controller to adjust at least one of (i) the intensity, (ii) the spectral light distribution and, (iii) the direction of the light sources based on at least one of (i) where people requiring illumination are located, (ii) what object the person is viewing and (iii) what visual task the person needs to perform.*” Braun discloses these limitations.

198. Braun discloses that the processor (in the controller) “*using image recognition capability, directs the controller to adjust at least one of (i) the intensity, (ii) the spectral light distribution [e.g., in response to a color pattern of the picture] and, (iii) the direction of the light sources based on at least one of (i) where people requiring illumination are located, (ii) what object the person is viewing [e.g., different pictures] and (iii) what visual task the person needs to perform.*” See §§X.A, XII.B.

199. Additionally, a POSA would have understood that Braun’s controller receives “*real time information*” from the camera. For example, Braun’s controller “adjusts light provided by the light providing regions to match **changes in the positions** of one or both of features and objects in the scene relative to their positions in an immediately preceding image of the scene.” EX1005, 8:11-31. “[A] **time lapse** between acquisition of the image and a time at which the illuminator provides light adjusted responsive to the image is **sufficiently short** so that during the time lapse the positions of features and/or objects of the scene do not change sufficiently to generate a substantial mismatch between the illumination and the scene.” EX1005, 10:12-17.

200. Accordingly, Braun discloses the limitations in claim 10. *See also* §§X.A, XII.B.

D. Claim 11

201. Claim 11 depends from claim 8, and recites “*at least one of the directional light sources mounted on the movable structure where the movement of the light source direction is automatically controlled by the controller.*”

202. As discussed above, the combination of Braun and Bailey renders the limitation in claim 11 obvious. *See* §§ XII.A, XII.B.

E. Claim 12

203. Claim 12 depends from claim 11, and recites “[*the illumination device*] *providing a different illumination to a sub-area based on usage wherein the controller interpreting images from the camera adjusts the moveable light sources such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.*” Braun, alone or in combination with Dowling, discloses this limitation.

204. Braun’s controller uses the pattern recognition application to identify the position of an object in an image at different times. EX1005, 22:31-23:3. Braun’s illumination system “**tracks** objects and features” to provide desired illumination pattern. EX1005, 24:32-25:2, 25:16-18. “[F]ollowing the acquisition of each image, the controller adjusts light provided by the light providing regions to **match changes in the positions** of one or both of features and objects in the scene relative to their positions in an immediately preceding image of the scene.”

EX1005, 10:8-11, 12:7-10. Braun's illumination system "determine[s] whether regions of a scene are moving from measurements of distances to the scene and control illumination of the scene **responsive to moving** regions of the scene and/or to components of their velocity of motion." EX1005, 21:17-20. For example, Braun's illumination system "detects motion of the person," and the controller "control[s] illumination of the area to **illuminate the person.**" EX1005, 21:31-22:16. Braun's illumination system also "distinguish[es] between types of behavior of a person," e.g., walking or running, and "illuminate the person **responsive to his or her behavior.**" EX1005, 21:31-22:16. Indeed, "[t]he illumination device is controllable to **follow** the actor as he or she moves on the stage and illuminate the actor accordingly," where "the projected light beam, e.g., its shape and color can be controlled by 'image processing software such as Adobe photoshop™, Kai's power tools™ and the like'." EX1005, 1:22-30; EX1036, Abstract, FIG. 5. Therefore, it would have been obvious that in the combined system of Braun and Bailey, Braun's controller would track people and adjust the direction of the light sources "*such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.*"

205. Dowling also discloses that "[t]he tracking features and sensing devices of the smart lighting network might pinpoint and follow" an individual to provide desired illumination. EX1027, 17:16-18:11, 21:10-16, 25:11-26:4, 26:16-

19. In the combined system of Braun, Dowling and Bailey, Braun's controller tracks people and adjusts the direction of the light sources "*such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.*"

206. Accordingly, Braun, alone or in combination with Dowling, discloses the limitation in claim 12. *See also* §§X.A, XII.B.

F. Claim 13

207. Claim 13 depends from claim 8, and recites "*the illuminated area is a road and the objects include road signs.*" Braun discloses this limitation.

208. When Braun's illumination system is implemented as a headlight, the illuminated area includes "a roadway and neighboring regions of the roadway." EX1005, 5:21-26. Braun's illumination system also spotlights the road sign and improves its readability. EX1005, 5:29-6:3. Also, a POSA would have understood that Braun's illumination system can be used outdoors, e.g., as a street light, so that "*the illuminated area is a road and the objects include road signs.*"

209. Accordingly, Braun discloses the limitation in claim 13. *See also* §X.A.

G. Claim 15

210. Claim 15 depends from claim 8, and recites "*a controller with communication capability to other devices, where the camera in one location*

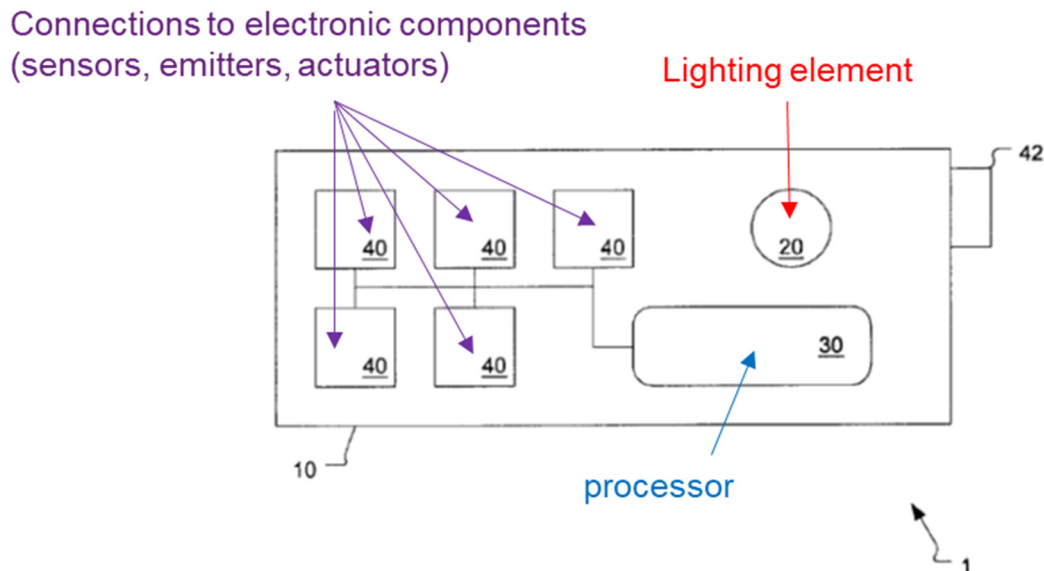
obtains information and the controller process [sic] the information and communicates the camera obtained information to a second device.” Braun, alone or in combination with Dowling, discloses this limitation.

211. Braun programs light bulb 140 with a menu of functions and lighting effects “by **transmitting signals** to the light bulb via wires,” or “wireless transmission.” EX1005, 28:12-20. Also, “choosing a particular lighting effect or function from the menu is accomplished by transmission of **wireless signals** to the light bulb.” EX1005, 28:12-20. When a person or obstacle is detected by the 3D range-camera, the controllers of Braun’s headlights generate signals “to a **visual or audio display** inside the vehicle to cue the driver to road conditions.” EX1005, 26:29-27:4, 27:5-20. Each headlight has its own controller, where “a slave controller [is] subordinate to... a master controller,” which “**coordinates** light provided by illuminators 116 of headlights.” EX1005, 23:17-24:1, FIGs. 5-7. Therefore, Braun’s controller has “*communication capability to other devices*” (e.g., a remote controller, visual/audio display, another headlight).

212. Additionally, Dowling discloses smart lighting devices “capable of providing illumination and detecting stimuli with sensors and/or sending signals,” which can be “used for **communication** purposes, building automation, systems monitoring, and a variety of other functions.” EX1027, Abstract, FIGs. 2, 6. Dowling’s processor 30 (e.g., a microprocessor) performs as “*a controller*” for

adjusting light emitted by lighting element 20 “as a function of input from a sensor [e.g., camera], or a predetermined program executed by the processor 30.”

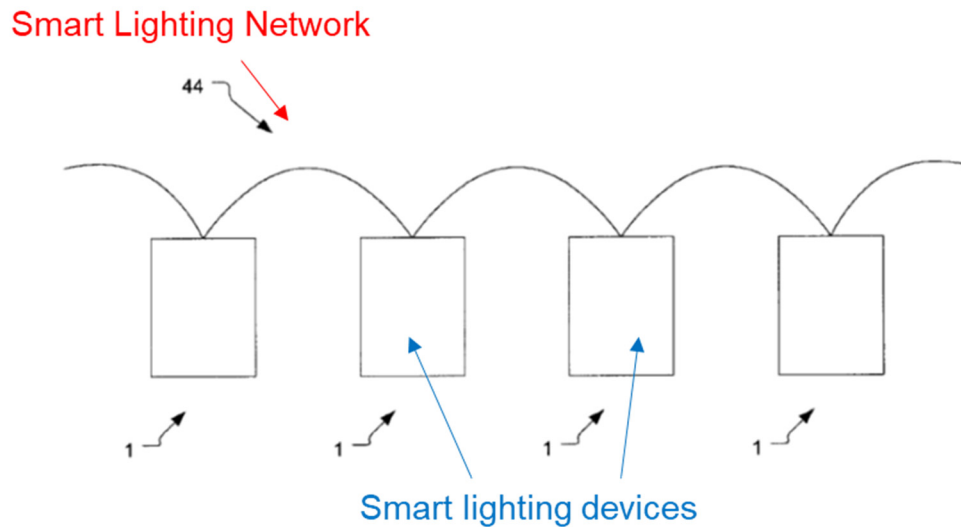
EX1027, 10:15-22, 12:19-13:22, 16:17-18, 40:1-13, FIGs. 1, 5. Dowling’s sensors include cameras. EX1027, 12:19-13:22. Dowling’s smart lighting device includes “a data connection for coupling the processor to a data network, or a communication connection between the sensor and the processor for transmitting signals from the sensor to the processor.” EX1027, 6:14-16.



EX1027, FIG. 1 (annotated).

213. Dowling couples smart lighting devices 1 “together to form networks 44,” where “data may be transmitted **between smart lighting devices 1.**” EX1027, 14:1-17, 8:18-21, 21:10-16, FIG. 2. Each smart lighting device “permit[s] communication between the components [40] and the microprocessor [30], e.g., to permit control of the lighting element [20] based on input from **sensor**

components, or facilitate electronic **communication** by mediating the transmission of signals **to or from other devices.**” EX1027, 4:9-22.



EX1027, FIG. 2.

214. Dowling’s smart lighting elements “operate as a platform to support the collection, **exchange**, and interpretation of **sensor information** available throughout a network, and to support application of the sensor information to control and modify the environment.” EX1027, 23:22-24:4, 40:20-41:2, 48:6-18, FIGs. 6, 10. Dowling’s smart lighting networks can be used to track the motion of people, and/or “reproduce on-stage lighting effects throughout the entire audience.” EX1027, 17:16-18:11. When an object identified by a camera of a first smart lighting device passes out of range, Dowling’s smart lighting network can “track the motion of the object, determine where the object is going, identify the smart lighting element associated with that location, and track the object as it

moves into the range of the second smart lighting element, e.g., by a hand-off technique or other protocol.” EX1027, 21:10-16. Therefore, Dowling’s processor (“*controller*”) processes the information obtained from a camera in one location and communicates the camera obtained information to “*a second device*” (e.g., another smart lighting device, a sound system, a phone, etc.). *See also* EX1027, 18:12-19:2.

215. When Braun is combined with Dowling, multiple illumination systems of Braun can be coupled together to form a smart lighting network similar to Dowling’s networks 44 in Figures 2 and 6. As such, the smart lighting network based on the combined illumination system of Braun and Dowling can be used for communication purposes and traffic monitoring in e.g., public streets.

216. Accordingly, Braun, alone or in combination with Dowling, discloses the limitation in claim 15.

H. Claim 16

217. Claim 16 depends from claim 15, and recites “*the illuminated area is a road and the second device to where the camera obtained information is communicated to is a lighting fixture.*” Braun, alone or in combination with Dowling, discloses this limitation.

218. To the extent that vehicle headlight is considered as a “*lighting fixture*” or “*light fixture*,” Braun’s “automotive light for use in a vehicle for

illuminating a roadway scene comprising a portion of a road on which the vehicle is located and neighboring regions thereof.” EX1005, 10:20-24. In this example, Braun’s controller of the headlight “*communicates the camera obtained information to a second device*” that is “*a lighting fixture*” because “each headlight 101 and 102 ... ha[s] its own controller 118,” where “one of controllers 118 is a slave controller **subordinate** to the other of controllers 118, which functions as a master controller.” EX1005, 23:17-27, FIG. 5. “The master controller **coordinates** light provided by illuminators 116 of headlights 101 and 102.” EX1005, 23:17-24:1, FIGs. 5, 6. Braun’s headlight controlled by the master controller communicates to the other headlight controlled by the slave controller according to the obtained image information received by the camera. *See also* §XII.G.

219. Dowling’s smart lighting elements may be placed in “**public streets.**” EX1027, 20:3-15. In Dowling’s smart lighting network, the “*second device*” is “*a lighting fixture.*” *See* §XII.G.

220. Accordingly, Braun, alone or in combination with Dowling, discloses the limitation in claim 16.

I. Claim 17

221. Claim 17 depends from claim 16, and recites “*the processor uses information obtained from the cameras and exchanged between fixtures for identifying traffic requirements in the illuminated area and from the vehicles*

locations and geometry determining the illumination requirements of the illumination area thereby directing the controller to adjust the directional light sources to meet the illumination requirements.” Braun, alone or in combination with Dowling, discloses this limitation.

222. As discussed above, Braun’s processor (in the controller) “*uses information obtained from the cameras and exchanged between fixtures*” through communication between the master and slave controllers. *see* §XII.H. Braun’s description of the functions of the headlights, “refers to the **combination** of master and slave controller, which control operation of headlights 101 and 102.” EX1005, 23:28-24:1, FIG. 5. Through the corporation of the master and slave controllers, Braun’s illumination system “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.” EX1005, 6:4-7, 12:17-20. When “the vehicle is closing too quickly on a preceding vehicle in front of the driver’s vehicle,” “the headlight alerts the driver to a dangerous closing speed by illuminating the preceding vehicle with a suitable spatial and/or temporal illumination pattern e.g. by illuminating the back of the preceding vehicle with intense flashing red light.” EX1005, 6:8-15, 26:18-28, FIG. 7. Therefore, Braun’s master and slave controllers identify “*traffic requirements*” in the illuminated area using the information obtained from the 3D range-cameras, and “*from the vehicles*

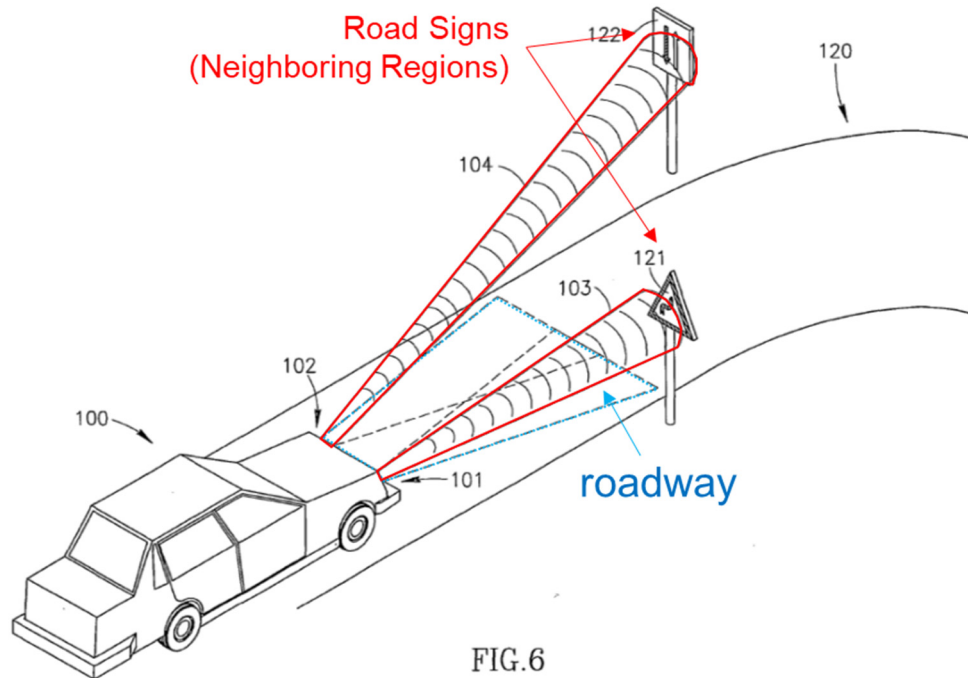
locations and geometry determining the illumination requirements of the illumination area thereby directing the controller to adjust the directional light sources to meet the illumination requirements.”

223. Furthermore, Braun, referring to Figure 6, states:

The pattern recognition application processes the images of the roadway scene and identifies roadway signs 121 and 122. Controller 118 optionally controls luxels in illuminators 116 of headlights 101 and 102 to provide light beams 103 and 104 that spotlight roadway signs 121 and 122 respectively. Since road sign 102 is further from vehicle 100 than is road sign 101, controller 118 controls luxels in headlight 102 that illuminate roadway sign 122 to provide light at intensity greater than light provided by luxels in headlight 101 that illuminate roadway sign 121. In some embodiments of the present invention, intensity of light provided by luxels that illuminate each roadway sign 121 and 122 is proportional to D^2 where D is the distance of the roadway sign from vehicle 100.

EX1005, 24:4-12. Braun’s statement and the associated image (below) are a specific example that meets the claim limitation that “*the processor uses information obtained from the cameras ... for identifying traffic requirements in the illuminated area and from the vehicles locations and geometry determining the illumination requirements of the illumination area thereby directing the controller*

to adjust the directional light sources to meet the illumination requirements.” See also §§X.A.7, X.A.9.



EX1005, FIG. 6 (annotated).

224. Additionally, Dowling’s smart lighting elements may be placed in public streets “**to monitor the flow of people, vehicles.**” EX1027, 20:3-15. The smart lighting element “determine[s] the number of people or objects which pass by the unit, the speed at which the people or objects pass the unit,” and “[t]he collected data may then be analyzed, e.g., using a processor connected to the smart lighting network ... to determine **traffic flow, traffic patterns**, points of congestion,” and to “help redirect traffic flow or ease passage and congestion.” EX1027, 20:3-15. The smart lighting network “may continuously monitor” the

public space (e.g., public street) and the resulting information “can be used to reveal traffic flow, provide feedback ... **assess the effects of ... lighting.**”

EX1027, 24:5-15.

225. Accordingly, Braun, alone or in combination with Dowling, discloses the limitation in claim 17.

J. Claim 18

226. Claim 18 depends from claim 17, and recites “*the controller is programmed to adjust at least one of (i) increase illumination with an approach of a vehicle, and (ii) change beam cut-off levels as the vehicle advances toward the lighting fixture to eliminate glare.*” Braun renders this limitation obvious.

227. Braun discloses that “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.” EX1005, 6:4-7. Reading Braun, a POSA would have understood that the luxels in Braun’s automotive lighting fixture can be controlled individually to eliminate glare perceived by the driver of an oncoming vehicle. A POSA would also have understood that glare can be eliminated by reducing light intensity or changing the beam cut-off angle.

228. Adjusting cut-off angle/level to reduce glare was indeed well known. EX1013, 109-112, 311, 552-554; EX1030, 9, 14-18; EX1032, 41, 85, 87. The

IESNA Handbook points out that “[d]istributions with lower vertical angles of maximum intensity emission are used in order to reduce system glare.” EX1013, 550. Indoor and outdoor luminaires had also been classified by “the degree to which they provide cutoff.” EX1013, 277-278. As Westermann points out, unbearable glare occurs “when the passing beams are wrongly levelled such that they emit the high intensities from below cut-off above the horizon.” EX1030, 9. “Any upward inclination of the beam shifts higher intensities upwards towards opposers [*“the vehicle advanc[ing] toward the lighting fixture”*] with the result of very disturbing or even unbearable glare sensation.” EX1030, 14, 16. Accordingly, Westermann’s front lighting has “either a horizontal cut-off, a lowered inclination of the cut-off and reduced intensity” to “give an improvement with respect to both, visibility and glare.” EX1030, 18.

229. Therefore, Braun renders the limitation in claim 18 obvious.

XIII. GROUND 4: BEGEMANN AND LEE RENDER CLAIMS 1-4 OBVIOUS

A. Rationale for combining Begemann and Lee

230. Begemann’s luminaire includes lighting modules, each of which comprises a set of lighting units, where “the lighting units illuminate respective portions of an object.” EX1006, Abstract. Begemann’s luminaire can be used, for example, “for street lighting, for lighting a portion of a street, or in spotlighting, for example for lighting objects in shop windows.” EX1006, 1:9-12. In one example,

Begemann's lighting modules "are connected to a control system 550" to adjust the setting of the lighting modules according to weather/road conditions (e.g., rain, snow and fog), traffic density and approaching vehicles. EX1006, 8:58-9:29.

However, Begemann leaves to a POSA how its lighting system identifies weather/road conditions, traffic density and approaching vehicles. Additionally, although Begemann's lighting system "for interior lighting receives signals, for example, ... from a proximity detector which detects the presence of persons in the room to be illuminated," Begemann leaves to a POSA how "the lighting situation, for example the light distribution, illuminance, or colour temperature, can be automatically adapted to the circumstances" when its lighting system is used in an interior environment. EX1006, 1:30-32, 4:47-5:3. Thus, a POSA would have been motivated to look to prior art, such as Lee, for such details.

231. Lee "provide[s] automatic setting of conditions or ambiance in a local environment, such as a home," for example, lighting or room temperature. EX1026, 1:10-12, 2:37-46. Lee's processor 22 of control unit 20 includes "known image recognition software loaded therein that analyzes the image data received from camera C1." EX1026, 6:15-17, 4:48-5:6, 5:56-60, FIG. 2, 2a. Lee's control unit "processes the images to identify ... persons located in the regions," and "automatically generates a control signal for at least one of the servicing components associated with the region" according to the preference of the

identified persons. EX1026, Abstract.

232. Based on the teachings of Lee, a POSA would have been motivated to modify Begemann's lighting system to i) incorporate Lee's digital camera for obtaining the images of the illumination area such that Begemann's control system receives signals from the camera just like receiving signals 551, 552 from other sensors as shown in Figure 12, and ii) incorporate Lee's image recognition software into Begemann's control system for processing the images such that objects, including people, rain, snow, fog, traffic density, approaching vehicles, etc., can be identified. EX1006, 8:38-9:29, FIG. 12.

233. A POSA would have been further motivated to combine Begemann and Lee because both are in the same general field of lighting systems, and address the same problem—automation of lighting. EX1006, 4:48-5:3; EX1026, 1:10-12, 2:37-46. Furthermore, a POSA would have combined the system of Begemann with the teachings of Lee by known methods (e.g., installing Lee's camera and image recognition software in Begemann's lighting system), and the results of the combination would have been predictable to a POSA (e.g., Begemann's lighting system capable of identifying objects such as people, vehicles, etc.). Finally, the proposed combination of Begemann and Lee would involve nothing more than incorporating a well-known concept (e.g., image recognition) into a well-known system (i.e., Begemann's lighting system).

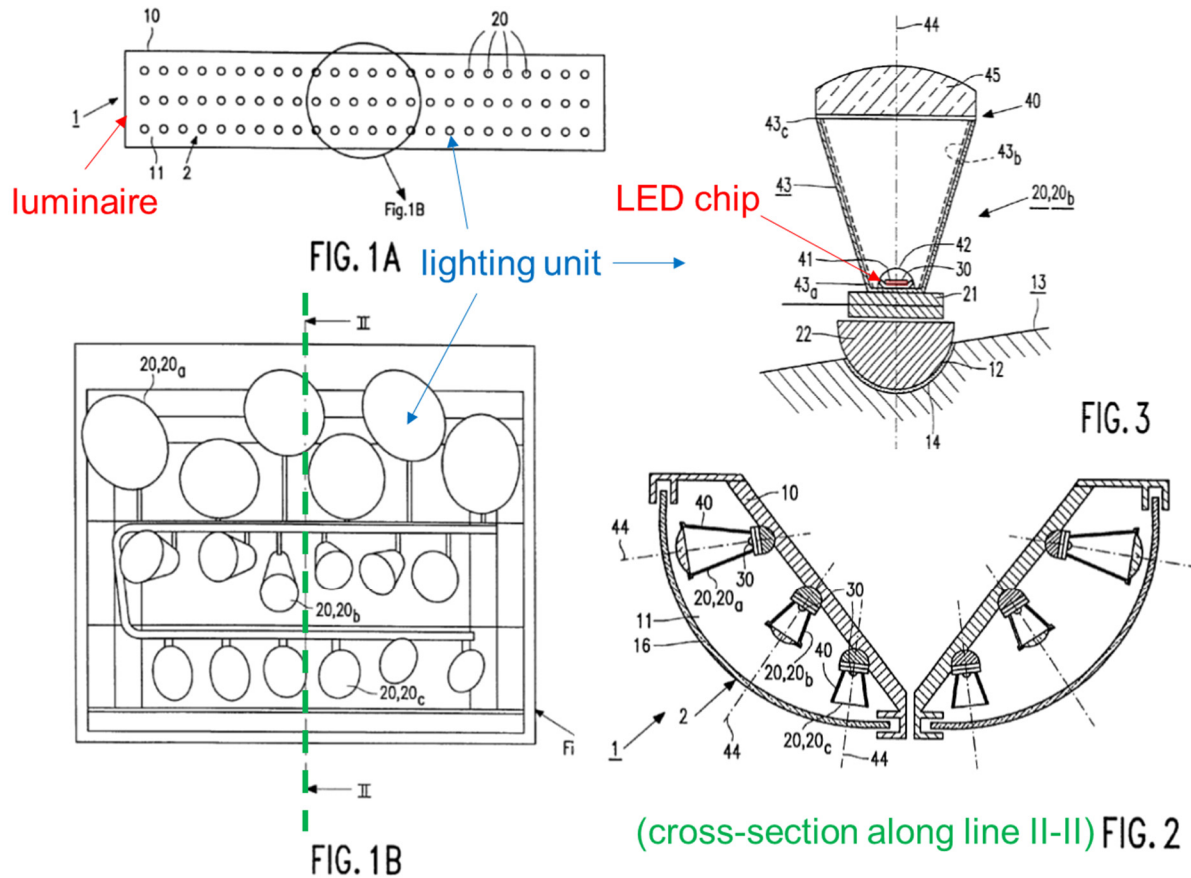
B. Begemann, alone or in view of Lee, renders independent claim 1 obvious.

234. In my opinion, Begemann, alone or in view of Lee, renders independent claim 1 obvious.

1. [1.P]

235. Claim element [1.P] recites “[a] *light fixture for illuminating an area to be lit capable of automatically meeting specific illumination requirements of different sub-areas within the area to be lit.*” To the extent that the preamble is limiting, Begemann discloses the preamble.

236. Begemann’s luminaire (1) comprises “at least one lighting module (2) accommodated in the housing [10] for illuminating an object,” where each lighting module “comprises a set of lighting units (20) which each comprise at least an LED chip (30).” EX1006, Abstract, 1:33-40, 5:36-57, FIGs. 1A-1B, 2, 3. Begemann’s luminaire (“*light fixture*”) can be mounted “on posts 515 along a street to be illuminated.” EX1006, 5:40-42, 8:42-45, FIGs. 11, 12. Begemann’s luminaire (“*light fixture*”) can also be used for “interior lighting.” EX1006, 4:66-5:3.



EX1006, FIGs. 1A-1B, 2, 3 (annotated).

237. Begemann's lighting units "illuminate **respective portions** of an object." EX1006, Abstract, 1:49-56. Begemann's "lighting situation, for example the light distribution, illuminance, or colour temperature, can be **automatically adapted** to the circumstances." EX1006, 1:62-65, 4:53-57. Therefore, Begemann's luminaire ("*light fixture*") illuminates an object ("*an area to be lit*") and is "*capable of automatically meeting specific illumination requirements of different sub-areas within the area to be lit.*" see also §VIII.D.1.

238. Accordingly, Begemann discloses [1.P].

2. [1.A]

239. Claim element [1.A] recites “*a multiplicity of independently controllable light sources, including at least two light sources of directional light output.*” Begemann discloses this claim element.

240. Begemann’s luminaire has “at least one lighting module” that “comprises a set, for example a few dozen, of lighting units which each comprise at least one LED chip,” where “the LED chips and optical systems forming the light source and the optical means, respectively.” EX1006, 1:33-40, Abstract, FIGs. 1A-1B, 2-3. “[T]he LED chips each supply a luminous flux of at least 5 lm during operation.” EX1006, 1:33-40, Abstract, FIGs. 1A-1B, 2-3. Therefore, Begemann’s lighting units, each of which includes one or more LED chips, disclose the claimed “*light sources.*” *see also* §VIII.D.2.

241. Begemann describes that an LED chip “forms a good approximation of a point source, so that the light generated thereby can be easily and accurately **concentrated** into a beam,” which “may be **narrow**, so that they can be **aimed** with high accuracy.” EX1006, 1:49-56, FIG. 2. For example, the beam angle of Begemann’s lighting units can be 0.012sr, 0.043sr or 0.060sr, where a solid angle of 1 sr is about 8% of the space surrounding a point. EX1006, 6:21-37, 2:8-12. Therefore, Begemann’s lighting unit outputs “*directional*” light.

242. As Begemann points out, “[t]he light sources of the luminaire can be

controlled independently of one another so as to illuminate a road section optimally both in wet and in dry weather.” EX1006, 1:19-22. Begemann’s “light distribution may be adjusted in a flexible manner through a **control** of the luminous fluxes of lighting modules or of **separate lighting units** of a lighting module.” EX1006, 1:62-65, 8:38-9:29, 4:48-5:3, 10:60-62. In Begemann, “the set of lighting units comprises **two or more varieties of lighting units** for illuminating portions of the object with mutually differing spectra,” which “may then be **adapted** to the optical properties, for example the reflectivity, of the individual portions of the object, so that an optimum visibility of these portions is realized.” EX1006, 2:54-62, 3:5-16. Therefore, Begemann’s lighting units are “*independently controllable*.”

243. Therefore, Begemann discloses [1.A].

3. [1.B]

244. Claim element [1.B] recites “*each said source substantially illuminates a different sub-area within the area to be lit*.” Begemann discloses this claim element.

245. Begemann’s “lighting units illuminate respective portions of an object,” particularly, “illuminate **portions of the object remote from one another**.” EX1006, 1:33-40, 2:12-15, 5:55-56, Abstract. Each LED chip of Begemann’s lighting unit “forms a good approximation of a point source, so that

the light generated thereby can be easily and accurately concentrated into a beam,” where “each individual beam **only hitting a portion of the object.**” EX1006, 1:49-56. For example, portions of the road section d illuminated by the lighting units 20 mounted on the post (position $x=0$, $y=0$) are “marked with a triangle (Δ), a circle (o), and a dot ($\bullet$)” corresponding to the lighting unit of the first (20a), the second (20b) and the third type (20c), respectively. EX1006, 6:45-54, FIG. 4. “The object d to be illuminated here is a **road section d1** with a width of 7 m and **two strips d2, d3** on either side of the road section d1 having a width of 2.5 m each.” EX1006, 5:40-50, 3:5-24.

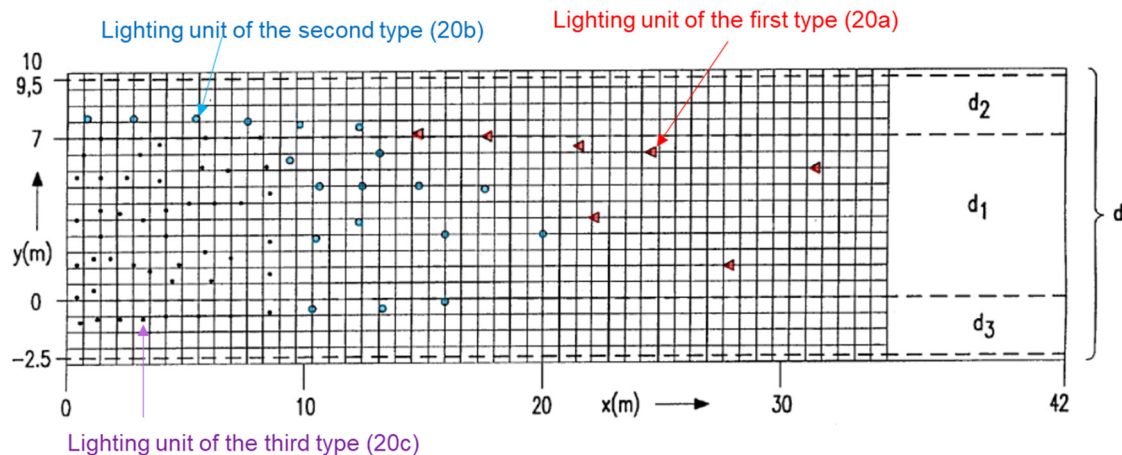


FIG. 4

EX1006, FIG. 4 (annotated).

246. Begemann’s luminaire 401 has “two or more varieties of lighting units 420p, 420q for illuminating portions of the object with **mutually differing spectra.**” EX1006, 8:9-12. The first variety of lighting units 420p “illuminat[e]

central portions of the object, driving lanes of a road ... at a first wavelength.”

EX1006, 8:15-19. The second variety of lighting units 420q “illuminat[e]
peripheral portions of the object with ... a second wavelength ... shorter than the
first wavelength.” EX1006, 8:10-32.

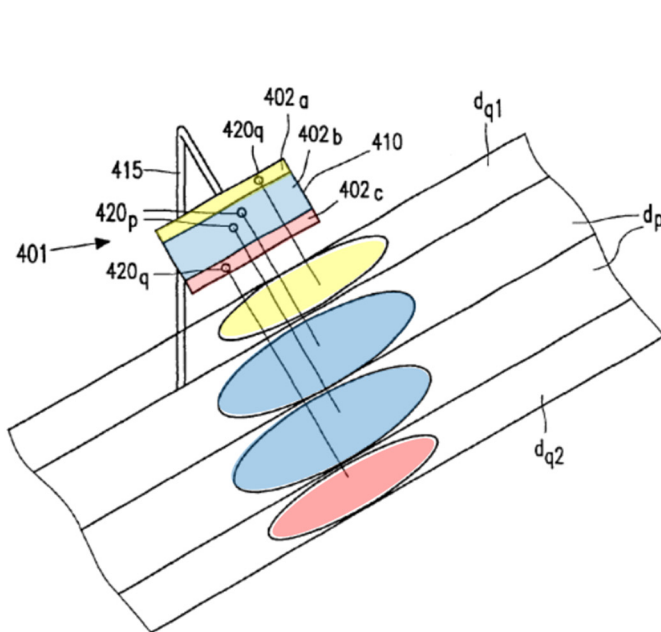


FIG. 11

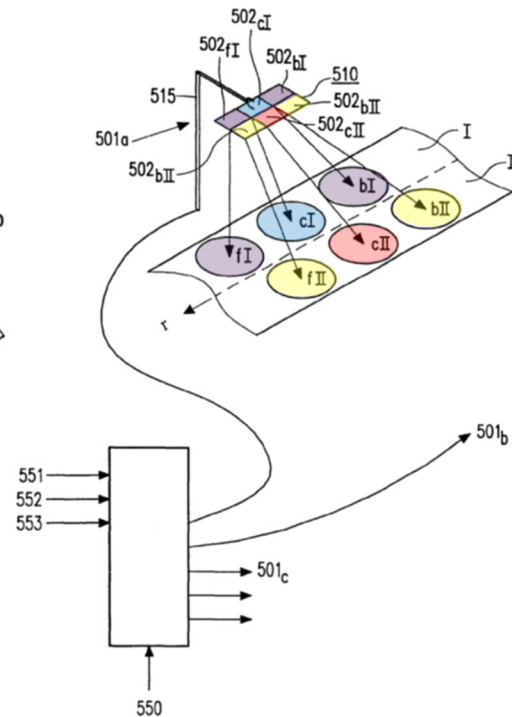


FIG. 12

EX1006, FIGs. 11 and 12 (annotated).

247. Begemann’s luminaire 501_a having “six lighting modules 502_{fI}, 502_{fII}, 502_{cI}, 502_{cII}, 502_{bI}, and 502_{bII}, each fitted with 24 lighting units,” and “are designed for illuminating road sections” f_I, f_{II}, c_I, c_{II}, b_I, b_{II}, respectively, where the lighting modules “are connected to a control system 550 and are controllable independently of one another.” EX1006, 8:5-60, FIGs. 11, 12.

248. Accordingly, Begemann discloses [1.B].

4. [1.C]

249. Claim element [1.C] recites “*the light sources having at least one of controllable light intensity and spectral light distribution.*” Begemann discloses this claim element.

250. Begemann’s lighting system includes “two or more varieties of lighting units for illuminating portions of the object with mutually differing **spectra**. The spectra of the lighting units may then be **adapted** to the optical properties, for example the reflectivity, of the individual portions of the object, so that an optimum visibility of these portions is realized.” EX1006, 2:54-62, 3:5-26, 8:9-35.

251. Additionally, “[t]he light distribution may be adjusted in a flexible manner through a control of the **luminous fluxes** of lighting modules or of separate lighting units of a lighting module.” EX1006, 1:62-65. In Begemann, “the luminous flux of an LED chip is controllable over a wide range.” EX1006, 4:57-60. A POSA would have understood that luminous flux is related to light intensity.

252. Accordingly, Begemann discloses [1.C].

5. [1.D]

253. Claim element [1.D] recites “a controller for adjusting at least one of a light intensity and light spectrum of the light sources.” Begemann discloses this claim element.

254. Begemann’s lighting system includes a control system, which “may receive signals from sensors and other sources, so that the lighting situation, for example the light distribution, **illuminance**, or **colour** temperature, can be automatically adapted to the circumstances.” EX1006, 4:47-5:3, 1:62-65.

255. For example, Begemann’s control system 550 controls intensity of each lighting module of the luminaire 501_a “independently of one another” according to weather conditions, for example, as follows:

Weather conditions	Lighting system setting
—	on: 502 _{fl} , 502 _{flI} , 502 _{cl} , 502 _{clI} , 502 _{bl} , 502 _{blI}
rain	on: 502 _{flI} , 502 _{clI} , 502 _{clII} , 502 _{blI} , 502 _{blII} off: 502 _{fl}
snow	dimmed: 502 _{fl} , 502 _{flI} , 502 _{cl} , 502 _{clI} , 502 _{bl} , 502 _{blI}
fog	on: 502 _{cl} , 502 _{clII} dimmed: 502 _{fl} , 502 _{flI} , 502 _{bl} , 502 _{blI}

EX1006, 8:57-9:10, FIG. 12. Begemann’s controller also adjusts the setting of the lighting modules (e.g., the intensity setting) according to traffic density such that “only one out of every six lighting modules in each luminaire is operating.”

EX1006, 9:11-9:29, FIG. 12. Begemann’s controller switches on the lighting modules “temporarily when they are about to be passed by a vehicle.” EX1006,

9:11-9:29, FIG. 12.

256. Although Begemann illustrates a common control system shared between multiple luminaires in the example of street lighting, a POSA would have understood that Begemann's control system can also be included in each luminaire because controllers (e.g., microcontrollers) had been embedded in electronic devices including electric lights long before the effective filing date of the '551 patent. EX1018, 1; EX1019, 1; EX1006, 4:61-63, FIG. 12.

257. Accordingly, Begemann discloses [1.D].

6. [1.E]

258. Claim element [1.E] recites “*one or more detectors for sensing at least one of objects, surfaces and beings within the area to be lit including the specific sub-area location information and of passing the sensed information to the controller.*” Begemann, alone or in view of Lee, renders this claim element obvious.

259. Begemann's lighting system includes various sensors. “To adapt the lighting conditions to the weather conditions,” Begemann's control system “receive[s] signals inter alia from a fog detector and from means which measure the reflection properties of the road **surface.**” EX1006, 4:63-5:3, 8:57-8:65. Begemann's lighting system “for interior lighting receives signals, for example ... from a proximity detector which detects the presence of **persons** in the room to be

illuminated.” EX1006, 4:63-5:3. Therefore, Begemann’s sensors “*sens[e] at least one of objects, surfaces and beings within the area to be lit*” and “*pass[] the sensed information to the controller*” such that the control system “receive[s] signals from sensors and other sources, so that the lighting situation, for example the light distribution, illuminance, or colour temperature, can be automatically adapted to the circumstances.” EX1006, 4:53-57.

260. Furthermore, Begemann’s sensors sense “*the specific sub-area location information.*” For example, Begemann’s luminaire has “two or more varieties of lighting units for illuminating portions of the object with mutually differing spectra,” where “[t]he spectra of the lighting units may then be adapted to the optical properties, for example the reflectivity, of the individual portions of the object, so that an optimum visibility of these portions is realized.” EX1006, 2:54-62. It would have been obvious for Begemann’s sensors to sense the optical properties and location information of the specific portion of the object so as to adjust the spectra of the lighting units accordingly. Also, Begemann’s luminaire 501_a includes six lighting modules 502_{fI}, 502_{fII}, 502_{cI}, 502_{cII}, 502_{bI}, and 502_{bII} that illuminate road sections f_I, f_{II}, c_I, c_{II}, b_I, b_{II}, respectively. EX1006, 8:38-58, FIG. 12. “If water is present on the road surface [in road section f_I], lighting module 502_{fI} is dimmed or switched off entirely, so that disturbing reflections on the water surface are avoided.” EX1006, 9:11-13. It would have been obvious that Begemann’s

sensors provide the road condition (e.g., water, snow, etc.,) in the specific road section to the control system to adjust the specific lighting module for the illumination in that specific road section. Begemann also adjusts the lighting modules according to traffic density and only temporarily switches on lighting modules “when they are about to be passed by a vehicle.” EX1006, 9:11-29. It would have been obvious to switch on/off respective lighting modules according to the traffic density and the approaching vehicles, information about the driving direction, driving lane and specific road section, all of which are sensed and passed on to the control system to adjust the illumination accordingly.

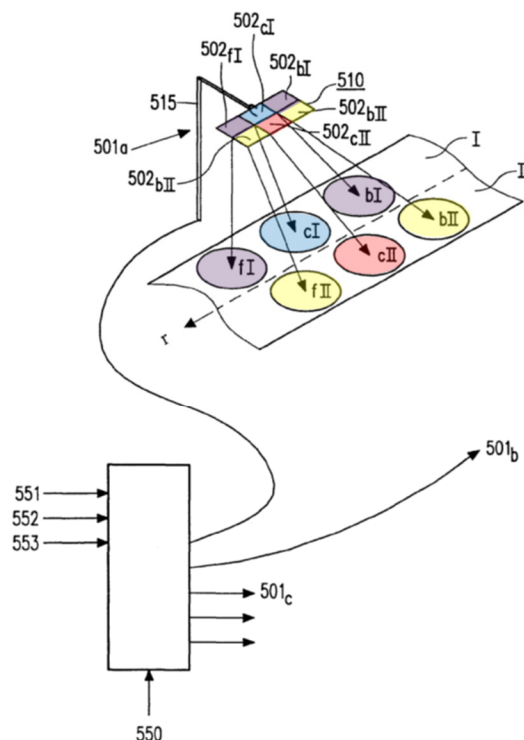


FIG. 12

EX1006, FIG. 12 (annotated).

261. Lee's digital camera of "CCD array" "captures images of room R1 and transmits the image data to control unit 20. The images are typically comprised of **pixel data**," which are processed by the image recognition software in the control unit to identify and track a person. EX1026, 5:65-6:37. In the combined system of Begemann and Lee, Lee's camera provides pixel data ("*the specific sub-area location information*") to Begemann's controller to identify and track person, rain, snow, traffic density, an approaching vehicle, etc, in the specific location.

262. Accordingly, Begemann, alone or in view of Lee, renders [1.E] obvious.

7. [1.F]

263. Claim element [1.F] recites "*a processor for processing the sensed information and determining illumination requirements of the at least one of objects, surfaces and beings.*" Begemann, alone or in view of Lee, renders this claim element obvious.

264. Begemann's intelligent control system includes "*a processor*" because Begemann's control system processes the signals from sensors and determines "the lighting situation, for example the light distribution, illuminance, or colour temperature, [to] be automatically adapted to the circumstances." EX1006, 4:53-57. For example, Begemann's control system "*process[es] the sensed information and determin[es] illumination requirements*" according to the weather conditions,

e.g., fog, rain or snow, to avoid glare or disturbing reflections. EX1006, 4:63-66, 8:61-9:21. Begemann's control system also "*process[es] the sensed information and determin[es] illumination requirements*" according to the traffic density and approaching vehicle "to save energy at a low traffic density," or to switch on the lighting modules "temporarily when they are about to be passed by a vehicle."

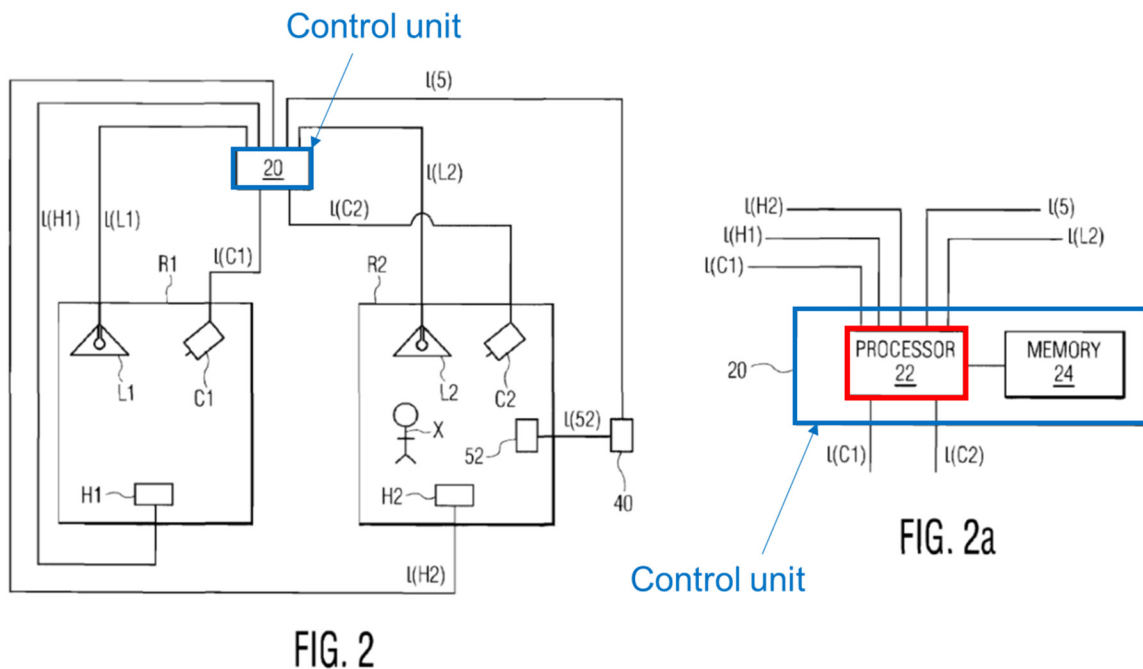
EX1006, 9:21-29. Begemann's control system "*process[es] the sensed information and determin[es] illumination requirements*" in the presence of persons in a room.

EX1006, 4:66-5:3. As discussed previously, controllers (e.g., microcontrollers) that include a processor, had been widely used for control and processing information.

See §§X.A.7, VIII.A.

265. Additionally, Lee's automatic controlling system includes the control unit 20, which "comprise[s] any digital controller, processor, microprocessor, computer, server or the like, and any needed ancillary components (such as a memory, database, etc.) which can carry out the control processing and signal generation." EX1026, 4:51-56. Lee's control unit 20, including "a processor 22 and memory 24," "run[s] software for determining and outputting appropriate control signals to the servicing components." EX1026, 4:56-60, FIGs. 2, 2a. Lee's cameras C1, C2 "provide[] images of the respective room R1, R2 in which it is located to the processor 22 of control unit 20." EX1026, 4:65-67, FIG. 2. And "processor 22 of control unit 20 provides appropriate control signals to lights L1, L2 over lines

1(L1), 1(L2), respectively, for controlling the intensity of the respective lights L1, L2.” EX1026, 5:3-6, FIG. 2. Therefore, in view of Lee, a POSA would have understood that similar to Lee’s control unit 20, Begemann’s control system includes a processor. Otherwise, in view of Lee, it would have been obvious for a POSA to incorporate Lee’s processor 22 to Begemann’s control system.



EX1026, FIGs. 2 and 2a.

266. Accordingly, Begemann, alone or in view of Lee, renders [1.F] obvious.

8. [1.G]

267. Claim element [1.G] recites “[the processor] using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables.”

Begemann, alone or in view of Lee, renders this claim element obvious.

268. Begemann’s processor/controller determines illumination requirement for lighting modules using the following “*look-up table*”:

Weather conditions	Lighting system setting
—	on: 502 _{fI} , 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII}
rain	on: 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII} off: 502 _{fI}
snow	dimmed: 502 _{fI} , 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII}
fog	on: 502 _{cI} , 502 _{cII} ; dimmed: 502 _{fI} , 502 _{fII} , 502 _{bI} , 502 _{bII}

EX1006, 8:58-9:20.

269. Also, as admitted repeatedly by Patent Owner, “*artificial intelligence, pattern recognition, video analytics, and look-up tables*” were well-known before the effective filing date of the ’551 patent. *See* §§VIII.A-VIII.C, XI.B. Thus, it would have been obvious for a POSA to use “*artificial intelligence, pattern recognition, video analytics*” to determine road conditions (e.g., rain, snow, fog), traffic density, approaching vehicles, etc. EX1006, 8:60-9:29.

270. Furthermore, Lee’s control unit “receives images associated with one or more regions of the local environment,” and that “processes the images to identify, from a group of known persons associated with the local environment, any one or more known persons located in the regions” “using image recognition.” EX1026, Abstract, 2:39-67. “For the regions in which one or more known person is identified, the control unit automatically generates a control signal for at least one of the servicing components associated with the region, the control signal

reflecting a preference of at least one of the known persons located in the respective region.” EX1026, Abstract. Specifically, the processor 22 of Lee’s control unit 20 “includes known **image recognition software** loaded therein that analyzes the image data received from camera C1” to “**recognize** the contours of a human body in the image, thus recognizing the person in the image,” and “locate the person’s face in the received image [] to identify the person.” EX1026, 5:56-60, 6:15-36, 7:28-37, 7:53-8:24; EX1038. Therefore, Lee’s processor of the controller unit “*us[es] at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables.*”

271. When Begemann is combined with Lee, the combined system results in, for example, incorporating Lee’s image recognition software into Begemann’s control system 550. *See* §XIII.A. By using Lee’s image recognition processing (“*pattern recognition*” or “*video analytics*”), specific objects (e.g., water, snow, fog, traffic density, approaching vehicles, persons) are recognized and coordinates of the specific objects are provided to Begemann’s control system to determine the illumination requirements for the respective lighting module and/or lighting unit.

272. Accordingly, Begemann, alone or in view of Lee, renders [1.G] obvious.

9. [1.H]

273. Claim element [1.H] recites “[*the processor*] for directing the

controller to adjust the light source for that sub-area to meet the specific illumination requirement.” Begemann discloses this claim element.

274. In Begemann, “the set of lighting units comprises two or more varieties of lighting units for illuminating portions of the object with mutually differing spectra. The spectra of the lighting units may then **be adapted to** the optical properties, for example the reflectivity, of the **individual portions of the object**, so that an optimum visibility of these portions is realized.” EX1006, 2:54-62. In another example, Begemann’s luminaire 501_a includes six lighting modules 502_{fI}, 502_{fII}, 502_{cI}, 502_{cII}, 502_{bI}, and 502_{bII} which illuminate road sections f_I, f_{II}, c_I, c_{II}, b_I, b_{II}, respectively, which “may be adjusted by the control system, for example, as follows.

Weather conditions	Lighting system setting
—	on: 502 _{fI} , 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII}
rain	on: 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII} off: 502 _{fI}
snow	dimmed: 502 _{fI} , 502 _{fII} , 502 _{cI} , 502 _{cII} , 502 _{bI} , 502 _{bII}
fog	on: 502 _{cI} , 502 _{cII} dimmed: 502 _{fI} , 502 _{fII} , 502 _{bI} , 502 _{bII}

EX1006, 8:38-9:20, FIG. 12. “If water is present on the road surface [in road section f_I], **lighting module 502_{fI} is dimmed or switched off entirely**, so that disturbing reflections on the water surface are avoided.” EX1006, 8:66-9:13, FIG. 12. “[I]n the case of fog,” Begemann’s control system adjusts the “setting in which light originates mainly from the lighting modules 502_{cI}, 502_{cII}.” EX1006, 9:18-20.

Therefore, Begemann's control system, which includes a processor, adjusts the lighting units ("*light source(s)*") for each road section ("*for that sub-area*") to meet the specific illumination requirement.

275. Accordingly, Begemann discloses [1.H].

276. In summary, Begemann, alone or in view of Lee, renders claim 1 obvious.

C. Claim 2

277. Claim 2 recites "*the detector is comprising at least one of (i) a camera being a photo sensor array coupled with an optical lens, (ii) a photo sensor, (iii) an ultrasound transducer and sensor, (iv) microwave transducer and sensor, and (v) pyroelectric detectors.*" Begemann, alone or in combination with Lee, discloses this limitation.

278. Begemann's lighting system includes "a sensor for detecting fog and possibly for ascertaining [sic] the degree of light scattering caused thereby," "a sensor for measuring the degree of wetness of the road surface," "a daylight sensor which measures the luminous flux of incident daylight," "a proximity detector which detects the presence of persons in the room to be illuminated," and a sensor for detecting snow, traffic density, approaching vehicle, etc. EX1006, 4:63-5:3, 8:60-9:29. Therefore, a POSA would have understood that Begemann's detectors include a camera, a photo sensor, an ultrasound transducer and sensor, microwave

transducer and sensor, and/or pyroelectric detectors.

279. Lee uses a camera or like image capturing device to “capture[] images within the room and, in particular, images of persons in the room.” EX1026, 3:53-56, FIGs. 1, 2. Lee’s camera provides “pixel data, for example, those from a CCD array in a typical digital camera.” EX1026, 5:65-6:1.

280. Accordingly, Begemann, alone or in combination with Lee, discloses the limitation in claim 2.

D. Claim 3

281. Claim 3 recites “*the illuminated area is indoors and [the illumination device] further comprising a detector for detecting variable illumination from daylight and/or sunlight entering indoors, wherein the controller taking into consideration the intensity variations over the area now illuminated by the daylight and/or sunlight adjusts the light intensity of the directional light sources to meet the varied illumination requirement.*” Begemann, alone or in view of Lee, renders this limitation obvious.

282. Begemann’s lighting system “for interior lighting receives signals, for example, from a **daylight sensor** which measures the luminous flux of incident daylight.” EX1006, 4:66-5:3. Begemann’s control system “receive[s] signals from sensors and other sources, so that the lighting situation, for example the light distribution, illuminance, or colour temperature, can be automatically adapted to

the circumstances.” EX1006, 4:53-57. It would have been obvious that Begemann’s “*controller tak[es] into consideration the intensity variations over the area now illuminated by the daylight and/or sunlight adjusts the light intensity of the directional light sources to meet the varied illumination requirement.*”

283. Furthermore, Lee discloses that “lights can often have an attendant daylight sensor (another real-time input), which will prevent the light from turning on when there is ambient daylight.” EX1026, 1:21-24.

284. Accordingly, Begemann, alone or in view of Lee, renders the limitation in claim 3 obvious.

E. Claim 4

285. In my opinion, the combination of Begemann and Lee renders claim 4 obvious.

1. [4.A]

286. Claim element [4.A] recites “*the one or more detectors detects information regarding one or more individuals within the illuminated area, said information is at least one of (i) age, (ii) sex, and (iii) recognition of an individual for matching with stored data about that individual’s needs.*” The combination of Begemann and Lee renders this claim element obvious.

287. Begemann’s lighting system includes “a proximity detector which detects the presence of **persons** in the room to be illuminated.” EX1006, 4:66-5:3.

288. Lee's camera "captures...images of persons in the room" for the control unit to "process[] the images to **identify**, from a group of known persons associated with the local environment, any one or more known persons located in the regions." EX1026, Abstract, 2:37-3:12, 3:53-56, 4:2-11, 5:56-64, 6:18-7:27, 7:28-8:39, 8:61-9:12.

289. "Each family member's set of preferences **stored** in memory 24 is correlated to the identity of the family member. Processor 22 uses the identification of the family member to access the preferences for the identified family member from memory 24." EX1026, 8:52-56.

290. Accordingly, the combination of Begemann and Lee renders [4.A] obvious. *see also* §VIII.B.

2. [4.B]

291. Claim element [4.B] recites "*the controller adjusts the light intensity and/or spectrum of the illumination provided to the one or more individuals based on illumination requirements from at least one of (i) best practices looked up and calculated from stored data, (ii) age and/or sex of the individual, (iii) personal preferences input to the controller and stored in memory, and (iv) commands received by the controller from an input device.*" The combination of Begemann and Lee renders this claim element obvious.

292. Begemann's control system "receive[s] signals from sensors and other

sources,” e.g., “from a sensor for measuring the degree of wetness of the road surface,” “for detecting fog and possibly for ascertaining [sic] the degree of light scattering caused thereby,” and receives “a central signal” to activate the lighting system. EX1006, 4:53-57, 8:61-9:29, FIG. 12. Begemann’s control system receives “*commands*” (e.g., sensor signals 551/552, central signal 553) from an “*input device*” (e.g., sensor, remote control) to adjust the light intensity of the illumination provided to the individuals (e.g., drivers in vehicles) based on illumination requirements. Begemann’s control system of interior lighting adjusts the illumination conditions according to “*commands*” received “from a proximity detector” when “the presence of persons in the room to be illuminated” is detected. EX1006, 4:66-5:3.

293. In Lee, when a known person is identified, “the processor 22 then executes control software so that the servicing components of the room in which the person is located are automatically adjusted by the control unit 20 **according to the individual preference** of the identified person,” including the individual’s preference for room lighting, room temperature. EX1026, Abstract, 2:37-3:12, 4:2-11, 5:56-64, 6:18-7:27, 7:28-9:29.

294. Accordingly, the combination of Begemann and Lee renders [4.B] obvious. *see also* §VIII.B.

295. In summary, the combination of Begemann and Lee renders claim 4

obvious.

XIV. GROUND 5: THE COMBINATION OF BEGEMANN, LEE AND PEDERSON RENDERS CLAIMS 8 AND 10-18 OBVIOUS

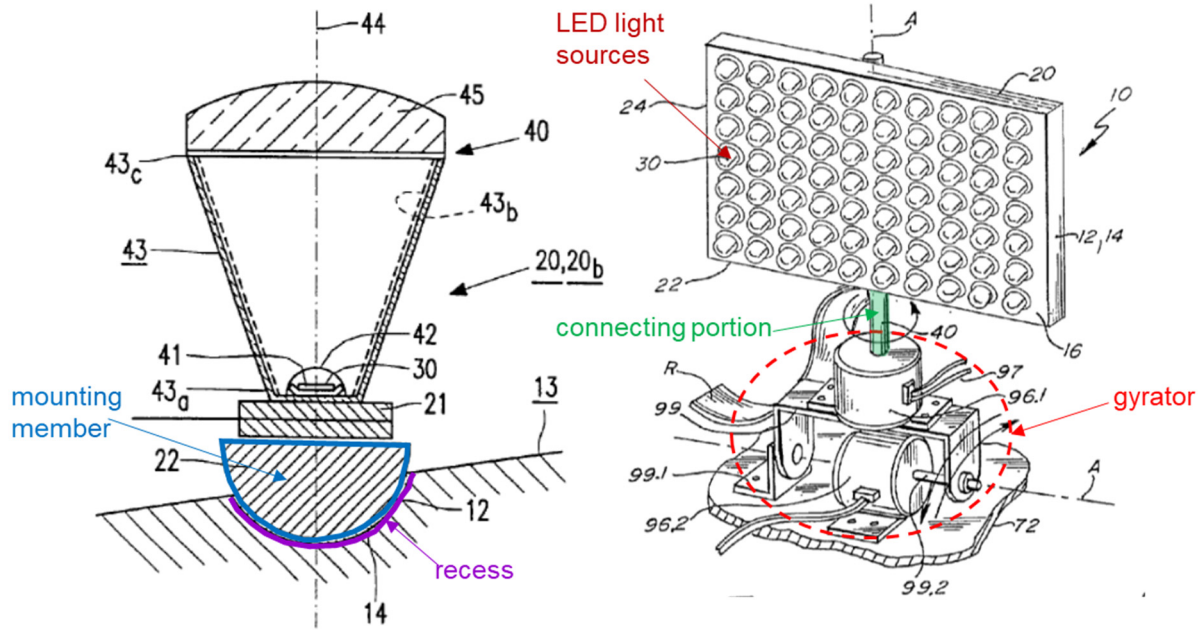
A. The motivation to combine Begemann, Lee and Pederson

296. Begemann's "lighting units may be provided with means for adjusting a predetermined beam direction," such that "[t]he light distribution of the luminaire may thus be readily adapted during manufacture to the conditions of use, for example, in the case of a street lighting luminaire the width of the road and the interspacings of the posts on which the luminaires are mounted." EX1006, 4:7-13. However after "the luminaire is being assembled," the mounting member 22 of Begemann's lighting units 20 is fixed in the recess 12 by the adhesive agent 14. EX1006, 6:1-9, FIG. 3. Begemann does not describe how to automatically adapt the direction of the lighting unit 20 according to the changing environment and specific application. Thus, a POSA would have been motivated to look to prior art, such as Pederson, for such details.

297. Pederson discloses using gyrators 90 to "impart motion to" light 10 that have one or more LED light sources 30. EX1011, ¶¶144-146, FIG. 3. Pederson's gyrator 90 "comprises electric motors 96 ... connected to a power supply and either an external controller 55 or controller 50." EX1011, ¶¶183-185, FIGs. 3, 15. Pederson's gyrator 90 is attached to the light 10 through the connection portion 40 such that light 10 rotates or oscillates about a vertical axis

by motor 96.1 and oscillates about a horizontal axis by motor 96.2. EX1011, ¶¶183-185, FIGs. 3, 15.

298. Based on the teachings of Pederson, a POSA would have been motivated to modify the combined lighting system of Begemann by i) replacing the mounting member 22 and recess 12 of Begemann's lighting unit 20 with Pederson's connecting portion 40 and the attached gyrator 90. EX1006, FIG. 3; EX1011, FIGs. 3, 15. As such, the combined lighting system of Begemann and Pederson can selectively vary the directions of the lighting units. Additionally, a POSA would have been motivated to ii) connect Pederson's gyrator 90 to Begemann's control system such that the directions of the lighting units can be adjusted automatically. These modifications are compatible with the combination of Begemann and Lee, where Lee's camera and image recognition software are incorporated in Begemann's lighting system. *See also* §XIII.A.



EX1006, FIG. 3 (annotated); EX1011, FIG. 3 (annotated).

299. A POSA would have been further motivated to combine Begemann, Lee and Pederson because all of them are in the same general field of lighting systems, and address the same problem—improve efficiency (e.g., by subdividing illumination area, adding communication capability or providing spatial and electrical efficiency). EX1006; 1:24-27, 1:30-32; EX1026, 1:65-2:23; EX1011, ¶17. Furthermore, a POSA would have combined the system of Begemann and Lee with the teachings of Pederson by known methods (e.g., mounting LED chips or installing connecting portions and motors), and the results of the combination would have been predictable to a POSA (e.g., adjustable directions of Begemann’s lighting units). Finally, the proposed combination of Begemann, Lee and Pederson would involve nothing more than incorporating a well-known concept (i.e.,

gyrators) into a well-known system (i.e., Begemann's lighting system).

B. Independent Claim 8

300. In my opinion, the combination of Begemann, Lee and Pederson renders claim 8 obvious.

1. [8.P]

301. Claim element [8.P] recites “[a]n illuminating device which provides light to meet an illumination requirement of an illuminated area in which visual activities are performed, where different sub-areas of the illuminated area need to be illuminated at a different intensity and/or at a different spectrum than another sub-area of the illuminated area.” To the extent that the preamble is limiting, Begemann discloses the preamble.

302. Begemann's luminaire “offers wide application possibilities, for example for street lighting, spotlighting, or floodlighting,” “for lighting a portion of a street ... for lighting objects in shop windows,” and “for interior lighting.” EX1006, 1:9-12, 1:57-62, 4:66-5:3. “The luminance often lies in the mesopic vision range.” EX1006, 2:63-66. Therefore, Begemann's luminaire provides light to an illuminated area “*in which visual activities are performed.*”

303. In Begemann, portions of the object (“*different sub-areas*”) need to be illuminated “with mutually **differing spectra**,” “so that an optimum visibility of these portions is realized,” and “it [is] easy for an observer to orient himself.”

EX1006, 2:54-62. For example, “for road lighting, the first portion [can be] a driving lane, and the second portion [can be] a lane lying alongside the former lane,” such that “[a] higher visibility of the surroundings, and a resulting shorter reaction time of drivers present in the driving lane are obtained thereby,” and “a clear demarcation of the driving lane” can be provided for drivers to easily orient themselves. EX1006, 3:5-40, 8:5-9:29.

304. Therefore, Begemann discloses [8.P]. *See also* §XIII.B.

2. [8.A]

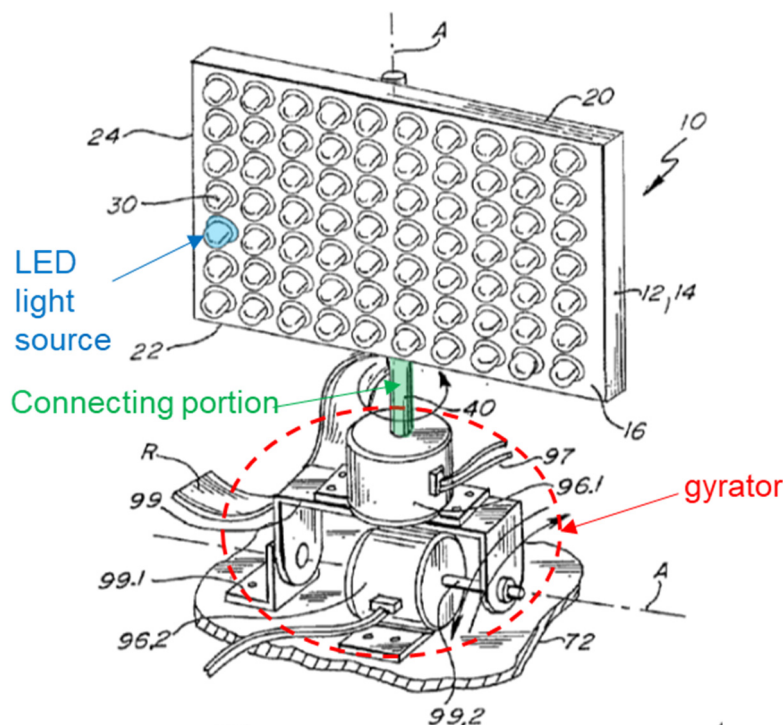
305. Claim element [8.A] recites “*a light fixture including a multiplicity of directional light sources including at least two directional light sources pointing in different directions thereby illuminating different sub-areas of the illuminated area.*” Begemann discloses this claim element. *See* §XIII.B.

3. [8.B]

306. Claim element [8.B] recites “*the light fixture having movable structure for aiming the directional light sources mounted thereon in a defined direction.*” The combination of Begemann, Lee and Pederson renders this claim element obvious.

307. Pederson’s light 10 “comprises light support 12, LED light sources 30, controller 50 (shown in FIG. 11), and connecting portion 40,” for attaching light 10 to gyrator 90, where gyrators 90 is used to “impart motion to” lights 10.

EX1011, ¶¶144-145, FIGs. 3, 15. Pederson's gyrator 90 "comprises electric motors 96 having cables 97," which is "connected to a power supply and either an external controller 55 or controller 50." EX1011, ¶183, FIG. 3. Gyrator 90 rotates or oscillates light 10 about a vertical axis by motor 96.1 and oscillates light 10 about a horizontal axis by motor 96.2. EX1011, ¶184, FIG. 3. While rotation or oscillation about the vertical axis is accomplished through direct attachment of connecting portion to motor 96.1, oscillation about horizontal axis is accomplished by attaching swivel arm 99 to bracket 99.1 and post 99.2 which is mounted to motor 96.2. EX1011, ¶¶183-184.



EX1011, FIG. 3 (annotated).

308. Begemann's lighting unit 20 ("light source") "comprise[s] at least an

LED chip.” EX1006, Abstract, 5:51-57, FIG. 3. In the combined system of Begemann, Lee and Pederson, Begemann’s lighting unit 20 is mounted on a “movable structure” similar to Pederson’s gyrator “for aiming the directional light sources mounted thereon in a defined direction.” See also §XIV.A.

309. Thus, the combination of Begemann, Lee and Pederson renders [8.B] obvious.

4. [8.C]

310. Claim element [8.C] recites “a camera for obtaining images of the illuminated area functioning as a detector for at least one of (i) a light detector (ii) a spectrum detector, (iii) a motion detector, (iv) a measuring detector for sensing a geometry of the illuminated area, and (v) a detector for sensing at least one of work surfaces and road objects and at least one of vehicles and people.” The combination of Begemann, Lee and Pederson renders this claim element obvious. See §§XIII.A-XIII.C.

5. [8.D]

311. Claim element [8.D] recites “a controller for adjusting a light intensity and a direction of each of the directional light sources.” The combination of Begemann, Lee and Pederson renders this claim element obvious.

312. Begemann discloses “*a controller for adjusting a light intensity.*” See §XIII.B.5. Begemann/Lee in view of Pederson discloses a controller for “*adjusting ... a direction of each of the directional light sources.*”

313. Pederson’s light 10 includes a controller 50, which can be “programmed by an external controller 55 and powered through cable R.” EX1011, ¶¶145, 149, FIG. 3. Pederson’s gyrator 90 provides mechanical rotation and oscillation of lights 10 about a vertical axis and a horizontal axis. EX1011, ¶¶183-184, FIG. 3. Pederson’s controller 50 is connected to gyrator 90 through cables 97. EX1011, ¶¶183-184, FIG. 3.

314. In the combined system of Begemann, Lee and Pederson, Begemann’s lighting unit 20 can be mounted, for example, on a movable structure similar to Pederson’s gyrator 90, which is controllable through Begemann’s control system, to adjust the direction of Begemann’s lighting unit. See §XIV.A, XIV.B.3.

315. Thus, the combination of Begemann, Lee and Pederson renders [8.D] obvious. See also §XIII.B.

6. [8.E]

316. Claim element [8.E] recites “*a processor with stored algorithms and data for identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects,*

people and/or vehicles, and (vii) roadway surface luminance any of which is used by said processor for determining illumination within the illuminated area using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables.” The combination of Begemann, Lee and Pederson renders this claim element obvious.

317. First, Begemann in view of Lee discloses “*a processor ... for determining illumination within the illuminated area using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables.*” See §§XIII.B.7, XIII.B.8.

318. Furthermore, Begemann’s luminaire “for interior lighting” includes “a **proximity** detector which detects the presence of **persons** in the room to be illuminated,” and the control system/processor “receives signals” from the proximity detector for identifying the “*location of people.*” EX1006, 4:63-5:3. Begemann’s control system/processor also identifies “reflection properties of the road surface,” “traffic density,” water, snow, fog and approaching vehicle. EX1006, 8:60-9:29. Therefore, Begemann’s processor/controller “*identiff[ies] at least one of ... (ii) location of people, ..., (iv) traffic density in the illuminated area from the sensed geometry, ..., (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance.*”

319. Also, Lee provides cameras for “automatic detection of the **location**

of a particular person in the local environment and automatic setting of conditions or ambiance in the region of local environment in which the person is detected based on the preferences of the particular person.” EX1026, 2:37-46, 3:53-58, Abstract, FIGs, 1, 2. Lee’s processor 22 runs the “image recognition software that is **stored in memory 24**” and “processes the incoming images of each room R1, R2 received from cameras C1, C2, respectively.” EX1026, 5:56-60, FIG. 2a. Lee uses the image recognition software “to locate the person’s face in the received image and to **identify the person.**” EX1026, 6:15-24. Lee’s control unit 20 “detect[s] and track[s] a person that moves into the room R1 covered by camera C1 and, in particular, may detect and track the **approximate location** of the person’s head.” EX1026, 6:25-36. Therefore, Lee’s processor 22 of the control unit 20 stores “*algorithms and data for identifying at least one of ... (ii) location of people ... (vi) road objects, **people** and/or vehicles.*”

320. In the combined system of Begemann, Lee and Pederson, the processor of Begemann’s lighting system runs image recognition software “*for identifying at least one of ... (ii) location of people, ..., (iv) traffic density in the illuminated area from the sensed geometry, ... (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance.*” See also §§XIII.A, XIV.A.

321. Accordingly, the combination of Begemann, Lee and Pederson renders [8.E] obvious. See also §XIII.B.

7. [8.F]

322. Claim element [8.F] recites “*said processor*⁷, upon calculating the required illumination parameters according to best practice standards, directs the controller to adjust the directional light sources that illuminates the specific sub-areas to meet the illumination requirements of the visual activities.” As discussed previously, “calculating the required illumination parameters according to best practice standards” was well known. See §§XII.B.7. The combination of Begemann, Lee and Pederson renders [8.F] obvious. See also §XIII.B.

323. In summary, the combination of Begemann, Lee and Pederson renders claim 8 obvious.

C. Claim 10

324. Claim 10 recites “*the controller receives real time information from the camera and [] the processor, using image recognition capability, directs the controller to adjust at least one of (i) the intensity, (ii) the spectral light distribution and, (iii) the direction of the light sources based on at least one of (i) where people requiring illumination are located, (ii) what object the person is viewing and (iii) what visual task the person needs to perform.*” The combination of Begemann, Lee and Pederson renders this limitation obvious.

325. Begemann’s control system sets the lighting modules “depend[ing] on

⁷ See note 6.

the traffic density,” and switches on the lighting modules “temporarily when they are about to be passed by a vehicle.” EX1006, 9:21-29. Begemann’s control system “receive signals inter alia from a fog detector and from means which measure the reflection properties of the road surface” to “adapt the lighting conditions to the weather conditions.” EX1006, 4:63-66, 8:61-9:20. Begemann’s lighting system “for interior lighting receives signals, for example, from a daylight sensor which measures the luminous flux of incident daylight and from a proximity detector which detects the presence of persons in the room to be illuminated.” EX1006, 4:66-5:3. Daylight, presence of person, weather and road conditions (e.g., rain, snow, fog, traffic density, approaching vehicle, etc.) are “*real time information*.”

326. When Begemann, Lee and Pederson are combined, the combined system includes a camera, similar to Lee’s camera (C1, C2), to provide images of the “*real time information*.” EX1026, 3:53-56. The combination of Begemann, Lee and Pederson discloses that “*the controller receives real time information from the camera*.” See also §§XIV.A, XIV.B.

327. Accordingly, the combination of Begemann, Lee and Pederson renders the limitation in claim 10 obvious. See also §§XIII.B, XIV.B.

D. Claim 11

328. Claim 11 recites “*at least one of the directional light sources mounted on the movable structure where the movement of the light source direction is*

automatically controlled by the controller.” The combination of Begemann, Lee and Pederson renders claim 11 obvious. *See* §XIV.B.

E. Claim 12

329. Claim 12 recites “[*the illumination device*] *providing a different illumination to a sub-area based on usage wherein the controller interpreting images from the camera adjusts the moveable light sources such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.*” The combination of Begemann, Lee and Pederson renders this limitation obvious.

330. Begemann’s luminaire (e.g., street lighting) provides different illumination for different road sections according to different weather and road conditions. EX1006, 8:38-9:29, FIG. 12; *see also* §§XIII.B, XIV.B.

331. Begemann aims each individual beam “with high accuracy **within the boundaries** of the object.” EX1006, 1:52-56, 6:54-58. Begemann’s luminaire (e.g., interior lighting) provides illumination when “a **proximity** detector [] detects the presence of persons in the room.” EX1006, 4:66-5:3. Begemann’s luminaire (e.g., street lighting) provides temporary illumination when it is “about to be passed by a vehicle.” EX1006, 9:26-29. Therefore, Begemann’s luminaire provides illumination “*proximate to the individuals*” (e.g., persons in the room, or drivers in the vehicles).

332. In Lee, “if control unit 20 receives a series of images from camera C1, control unit 20 may detect and **track a person** ... in particular, may detect and **track the approximate location** of the person’s head.” EX1026, 6:25-29. “When an image of a known person (such as a family member) located in a room is identified,” “the servicing components of the room [e.g., lighting] in which the person is located are automatically adjusted by the control unit 20 according to the individual **preference** of the identified person.” EX1026, 8:40-60.

333. Therefore, Begemann, alone or in combination with Lee, teaches providing the required illumination in a sub-area proximate to the individuals “*as they move around in the illuminated area*” by tracking the location of the person.

334. In the combined system of Begemann, Lee and Pederson, Begemann’s control system controls Pederson’s gyrotor 90 to change the direction of Begemann’s lighting unit “*such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.*” See §§XIV.A, XIV.B.

335. Accordingly, the combination of Begemann, Lee and Pederson renders the limitation in claim 12 obvious. *See also* §§XIII.B, XIII.E.

F. Claim 13

336. Claim 13 recites “*the illuminated area is a road and the objects include road signs.*” Begemann renders this limitation obvious.

337. Begemann's luminaire is applicable to "lighting of roads," "street lighting," and the illuminated area includes "road surface," "road section." EX1006, 2:30-34, 3:13-16, 4:63-66, 5:41-49, 6:45-51. It would have been obvious that the objects of street lighting would include "*road signs*."

338. Accordingly, Begemann renders obvious the limitation in claim 13. *See also* §§XIII.B.

G. Claim 14

339. Claim 14 recites "*at least one of the directional light sources on an automatic swivel joint and providing spot lights of limited beam angle for task lighting while other light source provide general illumination to the illuminated area*." The combination of Begemann, Lee and Pederson renders this limitation obvious.

340. Begemann's luminaire "offers wide application possibilities, for example for street lighting, **spotlighting**, or **floodlighting**," where "[t]he light distribution may be adjusted in a flexible manner through a control of the luminous fluxes of lighting modules or of separate lighting units of a lighting module." EX1006, 1:9-11, 1:57-65, 7:29-30. Begemann's "lighting units comprises two or more types of lighting units for generating beams which **widen more and less strongly**." EX1006, 3:28-31. Begemann uses reliefs to split, deflect or widen light beams. EX1006, 7:13-30, FIGs. 6, 7. A POSA would have understood that some of

Begemann's lighting units provide spotlighting with limited beam angle while other lighting units provide general illumination with wider beam angle.

341. Pederson's gyrator 90 includes a swivel arm 99 controlled by motors 96. EX1011, ¶184, FIG. 3; *see also* §§XIV.A, XIV.B.

342. Also, "*automatic swivel joint*" had been widely used, e.g., in headlamps. EX1032, 3-4, 23-25. Kloos discloses a cardanic mounting of the operating lamp using pivot joints 3, 4 such that the lamp housing swivels around a reference point, where positions can be automatically adjusted using sensors and motors. EX1042, 4:3-20, Abstract, FIGs. 1-4. Fredricks mounts LED light source on gimbals driven by servo motors to "permit[] rotations of the LED 40, and hence LED light beam 42" about a vertical axis 49 and a horizontal axis 47. EX1043, 19:41-54, 20:12-24, FIGs. 7, 10. Gordin's luminaire is vertically and horizontally adjustable by a control circuitry. EX1037, Abstract, FIGs. 1, 7.

343. At least for the above reasons, the combination of Begemann, Lee and Pederson renders in the limitation in claim 14 obvious. *See also* §§XIII.B, XIV.B.

H. Claim 15

344. Claim 15 recites "*a controller with communication capability to other devices, where the camera in one location obtains information and the controller process [sic] the information and communicates the camera obtained information*

to a second device.” The combination of Begemann, Lee and Pederson renders this limitation obvious.

345. Begemann’s lighting system includes “a luminaire 501_a and a control system 550.” EX1006, 8:40-42, FIG. 12. While each luminaire can include a control system, “luminaires for street lighting may be connected to a common control system.” EX1006, 4:61-63, FIG. 12. The control system 550 controls “a group of identical luminaires 501_a, 501_b, ... along a street to be illuminated.” EX1006, 8:42-45, FIG. 12. Begemann’s control system provides communications between luminaires 501_a, 501_b, 501_c such that “the lighting system is used as a guiding lighting” “to save energy at a low traffic density.” EX1006, 9:21-29. When a particular luminaire is “about to be passed by a vehicle,” Begemann’s control system “switched on temporarily” the lighting modules of the particular luminaire. EX1006, 9:21-29.

346. In the combined system of Begemann, Lee and Pederson, each of Begemann’s luminaires (501_a, 501_b, 501_c, ...) includes a camera to obtain images of the road sections around respective post 515, and Begemann’s control system processes the images, using Lee’s image recognition, to determine the weather and road conditions (e.g., rain, snow, fog, traffic density and approaching vehicles) around each post 515. It would have been obvious for Begemann’s control system to communicate the information obtained from the camera of one luminaire (e.g.,

501_a) to another luminaire (e.g., 501_b) (“*a second device*”) such that information about, e.g., approaching vehicle, can be passed from one luminaire to the others.

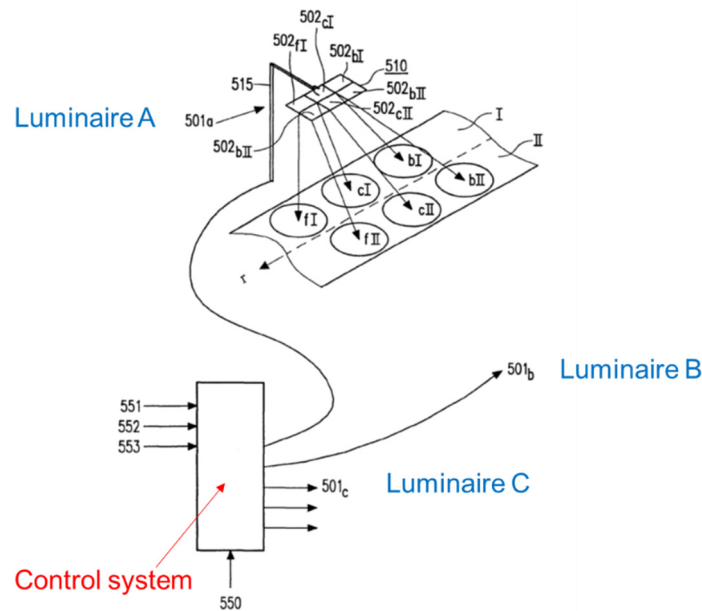


FIG. 12

EX1006, FIG. 12 (annotated).

347. Accordingly, the combination of Begemann, Lee and Pederson renders the limitation in claim 15 obvious.

I. Claim 16

348. Claim 16 recites “*the illuminated area is a road and the second device to where the camera obtained information is communicated to is a lighting fixture.*” The combination of Begemann, Lee and Pederson renders this limitation obvious. See §§XIV.H, XIV.B, XIII.B.

J. Claim 17

349. Claim 17 recites “*the processor uses information obtained from the*

cameras and exchanged between fixtures for identifying traffic requirements in the illuminated area and from the vehicles locations and geometry determining the illumination requirements of the illumination area thereby directing the controller to adjust the directional light sources to meet the illumination requirements.” The combination of Begemann, Lee and Pederson renders this limitation obvious.

350. In the combined system of Begemann, Lee and Pederson, the information exchanged between Begemann’s luminaires (e.g., 501_a, 501_b, 501_c, ...) is used for “*identifying traffic requirements*” (e.g., traffic density and approaching vehicles) and “*from the vehicles locations and geometry*” the illumination requirements of the illumination area is determined (e.g., temporarily switching on a luminaire according to the location of an approaching vehicle and the geometry of the road sections and distances between posts). *See* §§XIV.H, XIV.I; EX1006, 9:21-29.

351. Accordingly, the combination of Begemann, Lee and Pederson renders the limitation in claim 17 obvious.

K. Claim 18

352. Claim 18 recites “*the controller is programmed to adjust at least one of (i) increase illumination with an approach of a vehicle, and (ii) change beam cut-off levels as the vehicle advances toward the lighting fixture to eliminate*

glare.” The combination of Begemann, Lee and Pederson renders this limitation obvious.

353. Begemann’s luminaires are “switched on temporarily when they are about to be passed by a vehicle.” EX1006, 9:26-29. Thus, Begemann’s control system “*increase[s] illumination with an approach of a vehicle.*”

354. Accordingly, the combination of Begemann, Lee and Pederson renders the limitation in claim 18 obvious. *See also* §§XIII.B, XIV.B.

XV. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.

355. I understand that the obviousness analysis includes considering evidence of secondary indicia of nonobviousness (if available). I understand that any secondary indicia of nonobviousness must have a nexus, or a close connection, to the novel aspects of the claimed invention. I understand that secondary indicia of nonobviousness include the following: commercial success, long-felt but unmet need, failure of others, copying, praise in the industry, and unexpectedly superior results as compared with the closest prior art.

356. Considering the information I have reviewed, my general knowledge of the field of lighting systems, including adaptive lighting systems, and publications within that and related fields, I am not aware of any objective evidence that might support the patentability of the claims of the ’551 patent. Further, from my review of the file history (EX1002) of the ’551 patent, I did not

see that the applicant raised any secondary indicia of nonobviousness during prosecution. I am not otherwise aware of any publicly available evidence of secondary indicia of nonobviousness. Should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

357. Counsel has informed me that Patent Owner submitted alleged evidence of secondary considerations in a reexamination proceeding involving the '551 patent, but I understand that the Central Reexamination Unit did not address it. EX1012, 66-83, 930-943. Petitioner's counsel requested that I consider if the secondary considerations evidence changed the technical opinions I deliver in this declaration. As I explain below, the alleged secondary considerations evidence does not change my opinions in this report.

358. Initially, I note that Patent Owner cites alleged industry praise, EX1012, 66-77, and long felt need, EX1012, 77-83. However, I do not see a link between the evidence, which consists of various industry reports, publications, and awards, and the challenged claims. There is no alleged product linked to the claims that corresponds to this evidence. Further, I do not see an apparent link (or nexus) between the evidence and these claims. For example, Patent Owner does not explain how an award given to HELLA for a headlamp is directly linked to the claims of the '551 patent. EX1012, 66-72.

359. Technically, the various pieces of evidence seem to only involve applications of adaptive headlight technology that were known before the critical priority date of the '551 patent. Thus, my opinions in this report are not changed in view of this alleged secondary considerations evidence.

XVI. CONCLUSION

In signing this Declaration, I recognize that this 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 are made of my own knowledge and 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 21st day of December 2022, in Troy, New York.



E. Fred Schubert, Ph.D.

XVII.APPENDIX A: THE CHALLENGED CLAIMS

1. [1.P] A light fixture for illuminating an area to be lit capable of automatically meeting specific illumination requirements of different sub-areas within the area to be lit, comprising:

[1.A] a. a multiplicity of independently controllable light sources, including at least two light sources of directional light output, **[1.B]** such that each said source substantially illuminates a different sub-area within the area to be lit, **[1.C]** the light sources having at least one of controllable light intensity and spectral light distribution;

[1.D] b. a controller for adjusting at least one of a light intensity and light spectrum of the light sources;

[1.E] c. one or more detectors for sensing at least one of objects, surfaces and beings within the area to be lit including the specific sub-area location information and of passing the sensed information to the controller and;

[1.F] d. a processor for processing the sensed information and determining illumination requirements of the at least one of objects, surfaces and beings **[1.G]** using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables and **[1.H]** for directing the controller to adjust the light source for that sub-area to meet the specific illumination requirement.

2. The illuminating device of claim 1 where the detector is comprising at least

one of (i) a camera being a photo sensor array coupled with an optical lens, (ii) a photo sensor, (iii) an ultrasound transducer and sensor, (iv) microwave transducer and sensor, and (v) pyroelectric detectors.

3. The illumination device of claim 1, wherein the illuminated area is indoors and further comprising a detector for detecting variable illumination from daylight and/or sunlight entering indoors, wherein the controller taking into consideration the intensity variations over the area now illuminated by the daylight and/or sunlight adjusts the light intensity of the directional light sources to meet the varied illumination requirement.

4. The illuminating device of claim 1, **[4.A]** wherein the one or more detectors detects information regarding one or more individuals within the illuminated area, said information is at least one of (i) age, (ii) sex, and (iii) recognition of an individual for matching with stored data about that individual's needs and **[4.B]** wherein the controller adjusts the light intensity and/or spectrum of the illumination provided to the one or more individuals based on illumination requirements from at least one of (i) best practices looked up and calculated from stored data, (ii) age and/or sex of the individual, (iii) personal preferences input to the controller and stored in memory, and (iv) commands received by the controller from an input device.

6. (Cancelled) **[6.P]** An illuminating device having automatic control of the

light provided to an illuminated area comprising: **[6.A]** a structure for incorporating illuminating device elements; **[6.B]** one or more light sources incorporated in the structure and in communication with a power source; **[6.C]** electronic circuitry apparatus for the controlled powering of the light source and other illuminating device elements; **[6.D]** one or more cameras placed on the structure for detecting coordinate-specific information about the illuminated area, said camera in communication with power and control device elements; **[6.E]** a controller integrated with the structure, in communication with the light source controlling power circuitry, said controller arranged to process the information communicated from the camera and automatically control the light provided to the illuminated area.

7. The illumination device of claim 6, where one or more light sources are directional wherein the one or more detectors are configured to sense a presence of glare on a person's eyes in the illuminated area, and wherein the controller is programmed to adjust an intensity of the directional light sources to reduce the glare.

8. [8.P] An illuminating device which provides light to meet an illumination requirement of an illuminated area in which visual activities are performed, where different sub-areas of the illuminated area need to be illuminated at a different intensity and/or at a different spectrum than another sub-area of the illuminated area, comprising: **[8.A]** a light fixture including a multiplicity of directional light sources

including at least two directional light sources pointing in different directions thereby illuminating different sub-areas of the illuminated area, **[8.B]** the light fixture having movable structure for aiming the directional light sources mounted thereon in a defined direction; **[8.C]** a camera for obtaining images of the illuminated area functioning as a detector for at least one of (i) a light detector (ii) a spectrum detector, (iii) a motion detector, (iv) a measuring detector for sensing a geometry of the illuminated area, and (v) a detector for sensing at least one of work surfaces and road objects and at least one of vehicles and people; **[8.D]** a controller for adjusting a light intensity and a direction of each of the directional light sources; **[8.E]** a processor with stored algorithms and data for identifying at least one of (i) tasks being carried out by people, (ii) location of people, (iii) frequency of area usage by people, (iv) traffic density in the illuminated area from the sensed geometry, (v) work surfaces, (vi) road objects, people and/or vehicles, and (vii) roadway surface luminance any of which is used by said processor for determining illumination within the illuminated area using at least one of artificial intelligence, pattern recognition, video analytics, and look-up tables **[8.F]** wherein said processor⁸, upon calculating the required illumination parameters according to best practice standards, directs the controller to adjust the directional light sources that

⁸ Assume to be the “*processor*” recited in [8.E].

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

10. The illumination device of claim 8, wherein the controller receives real time information from the camera and wherein the processor, using image recognition capability, directs the controller to adjust at least one of (i) the intensity, (ii) the spectral light distribution and, (iii) the direction of the light sources based on at least one of (i) where people requiring illumination are located, (ii) what object the person is viewing and (iii) what visual task the person needs to perform.

11. The illumination device of claim 8, further comprising at least one of the directional light sources mounted on the movable structure where the movement of the light source direction is automatically controlled by the controller.

12. The illumination device of claim 11, providing a different illumination to a sub-area based on usage wherein the controller interpreting images from the camera adjusts the moveable light sources such that they provide the required illumination in a sub-area proximate to the individuals as they move around in the illuminated area.

13. The illumination device of claim 8, wherein the illuminated area is a road and the objects include road signs.

14. The illumination device of claim 8, further comprising at least one of the directional light sources on an automatic swivel joint and providing spot lights of

limited beam angle for task lighting while other light source provide general illumination to the illuminated area.

15. The illumination device of claim 8, further comprising a controller with communication capability to other devices, where the camera in one location obtains information and the controller process the information and communicates the camera obtained information to a second device.

16. The illumination device of claim 15, where the illuminated area is a road and the second device to where the camera obtained information is communicated to is a lighting fixture.

17. The illumination device of claim 16, where the processor uses information obtained from the cameras and exchanged between fixtures for identifying traffic requirements in the illuminated area and from the vehicles locations and geometry determining the illumination requirements of the illumination area thereby directing the controller to adjust the directional light sources to meet the illumination requirements.

18. The illumination device of claim 17, wherein the controller is programmed to adjust at least one of (i) increase illumination with an approach of a vehicle, and (ii) change beam cut-off levels as the vehicle advances toward the lighting fixture to eliminate glare.