

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JESCO LIGHTING GROUP, LLC,
Petitioner,

v.

AGS LIGHTING MANAGEMENT LLC,
Patent Owner.

Case No. IPR2025-01328
Patent No. 11,751,302

DECLARATION OF DR. J. GARY EDEN

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TABLE OF EXHIBITS

Exhibit No.	Description
EX1001	U.S. Patent No. 11,751,302
EX1002	Declaration of J. Gary Eden
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EX1004	U.S. Patent No. 11,751,302 File History
EX1005	U.S. Patent No. 9,995,440B2 (“Edwards”)
EX1006	U.S. Patent Appln. 2019/0320515A1 (“Sadwick”)
EX1007	U.S. Patent No. 10,683,969B2 (“Jeswani”)
EX1008	U.S. Patent Appln. 2019/0041009A1 (“May”)
EX1009	Montes de Oca, Samantha, “ <i>CCT: Understanding the Basics</i> ”, Superbrightleds.com, dated March 2, 2016, available at https://www.superbrightleds.com/blog/what-is-cct-understanding-the-basics.html
EX1010	U.S. Patent Publication 2017/0314743 to Del Castillo (“Del Castillo”)
EX1011	U.S. Patent Publication No. 2004/0062041 to Cross (“Cross”)
EX1012	U.S. Patent No. 9,345,112B2 (“112 Patent”)
EX1013	U.S. Patent No. 9,964,289B2 (“Pearson”)
EX1014	U.S. Patent No. 8,764,220B2 (“Chan”)
EX1015	Kay, Gregory, “ <i>Tunable white light and its benefits become more accessible</i> ”, Architectural Products, dated June 28, 2023, available at https://www.arch-products.com/architectural-lighting/article/55092734/tunable-white-light-and-its-benefits-for-commercial-offices-become-more-accessible .
EX1016	U.S. Patent No. 7,014,336B1 (“Ducharme”)
EX1017	U.S. Patent No. 8,207,821B2 (“Roberge”)
EX1018	“ <i>The Light Emitting Diode</i> ”, Electronics Tutorials, available at https://www.electronics-tutorials.ws/diode/diode_8.html
EX1019	“ <i>Tunable White technology At a Glance</i> ”, Tridonic, dated March 2019
EX1020	ENERGY STAR® Program Requirements Product Specification for Decorative Light Strings Eligibility Criteria Version 1.5 available at https://www.energystar.gov/sites/default/files/specs//private/spec_v1.5_draft.pdf

Exhibit No.	Description
EX1021	<i>“Decorative Light Strings Specification Version 1.5”</i> , Energy Star, available at https://www.energystar.gov/products/spec/decorative_light_strings_specification_version_1_5_pd .

LISTING OF CHALLENGED CLAIMS

[1pre]. A linear light-emitting diode (LED) lighting apparatus, comprising:

[1a] an array of light emitting diodes (LEDs) having a first length, wherein the array of LEDs comprises:

[1b] a first plurality of LEDs configured to produce a first light having a first color temperature, wherein the first plurality of LEDs aligns within a first linear shape;

[1c] a second plurality of LEDs configured to produce a second light having a second color temperature different from the first color temperature, wherein the second plurality of LEDs align within a second linear shape;

[1d] a driver circuit configured to output a plurality of currents;

[1e] a switch assembly configured to couple to the driver circuit, wherein the switch assembly comprises:

[1f] a first switch configured to cause the driver circuit to output one of the plurality of currents;

[1g] a second switch configured to cause the one of the plurality of currents to couple to the first plurality of LEDs, the second plurality of LEDs, or both; and

[1h] wherein the linear LED lighting apparatus is configured to electrically couple to an additional linear LED lighting apparatus having a second length different than the first length by a scale factor, wherein the additional linear LED lighting apparatus is configured to produce a third light having the first color temperature via a third plurality of LEDs or a fourth light having the second color temperature via a fourth plurality of LEDs.

2. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions.

3. The linear LED lighting apparatus of claim 2, wherein the plurality of selectable positions comprises:

a first position configured to cause the switch assembly to couple the one of the plurality of currents to the first plurality of LEDs;

a second position configured to cause the switch assembly to couple the one of the plurality of currents to the second plurality of LEDs; and

a third position configured to cause the switch assembly to couple a first portion of the one of the plurality of currents to the first plurality of LEDs and a second portion of the one of the plurality of currents to the second plurality of LEDs.

4. The linear LED lighting apparatus of claim 1, wherein the first color temperature corresponds to 3000 Kelvin and the second color temperature corresponds to 4000 Kelvin.

5. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions, wherein each of the plurality of selectable positions is configured to cause the switch assembly to send a respective signal to the driver circuit, wherein the respective signal is configured to cause the driver circuit to output the one of the plurality of currents that corresponds to a current position of the plurality of selectable positions.

6. The linear LED lighting apparatus of claim 1, comprising a housing comprising an interior volume configured to hold the driver circuit, the first plurality of LEDs, and the second plurality of LEDs.

7. The linear LED lighting apparatus of claim 6, wherein the housing comprises a length greater than or equal to 24 inches.

8. The linear LED lighting apparatus of claim 6, wherein the switch assembly is configured to be positioned in a receptacle of the housing, and wherein the switch assembly is configured to be flush with a surface of the housing when positioned in the receptacle.

9. The linear LED lighting apparatus of claim 1, comprising at least one electrical connection configured to transmit electricity from the lighting apparatus to at least one other lighting apparatus.

[10pre] A linear light-emitting diode (LED) lighting system, comprising:

[10a] a first modular lighting apparatus traversing a first linear distance, wherein the first modular lighting apparatus comprises:

[10b] a first plurality of light-emitting diodes (LEDs) arranged within a first linear form factor and having a first number of LEDs, each LED of the first plurality of LEDs associated with a first color temperature;

[10c] a first driver circuit configured to output a first plurality of currents;

[10d] a first switch assembly configured to:

[10e] cause the first driver circuit to output one of the first plurality of currents; and

[10f] couple the one of the first plurality of currents to the first plurality of LEDs; and

[10g] a first extender port; and

[10h] a second modular lighting apparatus traversing a second linear distance that is longer than the first linear distance, wherein the second modular lighting apparatus comprises:

[10i] a second plurality of light-emitting diodes (LEDs) arranged within a second linear form factor and having a second number of LEDs, each LED of the second plurality of LEDs associated with the first color temperature, wherein the second number is greater than the first number by a scale factor;

[10j] a second driver circuit configured to output a second plurality of currents;

[10k] a second switch assembly configured to:

[10l] cause the second driver circuit to output one of the second plurality of currents; and

[10m] couple the one of the second plurality of currents to the second plurality of LEDs, wherein the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor; and

[10n] a second extender port configured to couple with the first extender port to combine the first modular lighting apparatus and the second modular lighting apparatus to traverse the first linear distance and the second linear distance.

11. The linear LED lighting system of claim 10, wherein the first switch assembly is configured to receive a signal to cause the first driver circuit to output the one of the first plurality of currents.

12. The linear LED lighting system of claim 11, wherein the signal is received via a wired connection.

13. The linear LED lighting system of claim 11, wherein the signal is received via a mechanical switch.

14. The linear LED lighting system of claim 11, wherein the signal comprises a wireless signal.

15. The linear LED lighting system of claim 10, wherein the first driver circuit comprise a current regulator.

16. The linear LED lighting system of claim 10, wherein the first extender port is configured to electrically couple the first modular lighting apparatus to the second modular lighting apparatus.

17. The linear LED lighting system of claim 10, wherein each LED of the first plurality of LEDs receives a same amount of current via the one of the first plurality of currents that each LED of the second plurality of LEDs receives via the one of the second plurality of currents.

[18pre] A linear light-emitting diode (LED) system, comprising:

[18a] a first modular lighting apparatus comprising:

[18b] a first array of light emitting diodes (LEDs) comprising:

[18c] a first plurality of LEDs associated with a first color temperature, wherein the first plurality of LEDs aligns within a first linear shape;

[18d] a second plurality of LEDs associated with a second color temperature different from the first color temperature,

[18e] wherein the second plurality of LEDs aligns within a second linear shape;

[18f] a first driver circuit configured to output a first plurality of currents;

[18g] a first switch assembly configured to couple to the first driver circuit, wherein the first switch assembly comprises:

[18h] a first switch configured to cause the first driver circuit to output one of the first plurality of currents;

[18i] a second switch configured to:

[18j] cause a first portion of the one of the first plurality of currents to couple to each LED of the first plurality of LEDs;

[18k] cause the first portion of the one of the first plurality of currents to couple to each LED of the second plurality of LEDs; or

[18l] cause half of the first portion of the one of the first plurality of currents to couple to each LED of the first plurality of LEDs and each LED of the second plurality of LEDs; and

[18m] a second modular lighting apparatus configured to electrically couple to the first modular lighting apparatus, wherein the second modular lighting apparatus comprises:

[18n] a second array of light emitting diodes (LEDs) comprising:

[18o] a third plurality of LEDs associated with a third color temperature, wherein the third plurality of LEDs aligns within a third linear shape, wherein the third color temperature matches the first color temperature, and wherein the third plurality of LEDs is longer than the first plurality of LEDs;

[18p] a fourth plurality of LEDs associated with a fourth color temperature matching the second color temperature, wherein the fourth plurality of LEDs aligns within a fourth linear shape, and wherein the fourth plurality of LEDs is longer than the second plurality of LEDs;

[18q] a second driver circuit configured to output a second plurality of currents;

[18r] a second switch assembly configured to couple to the second driver circuit, wherein the second switch assembly comprises:

[18s] a third switch configured to cause the second driver circuit to output one of the second plurality of currents; and

[18t] a fourth switch configured to:

[18u] cause a second portion of the one of the second plurality of currents to couple to each LED of the third plurality of LEDs;

[18v] cause the second portion of the one of the second plurality of currents to couple to each LED of the fourth plurality of LEDs; or

[18w] cause half of the second portion of the one of the second plurality of currents to couple to each LED of the third plurality of LEDs and each LED of the fourth plurality of LEDs.

19. The linear LED system of claim 18, wherein the first modular lighting apparatus comprises a first connector configured to couple to a second connector part of the second modular lighting apparatus, wherein the first connector and second connector are configured to transmit data between the first modular light apparatus and the second modular lighting apparatus.

20. The linear LED system of claim 18, wherein a first ratio of the one of the second plurality of currents to the one of the first plurality of currents matches a second ratio of a first number of LEDs in the first plurality of LEDs to a second number of LEDs in the third plurality of LEDs.

I. INTRODUCTION

1. My name is Dr. J. Gary Eden. I am an electrical engineer and professor at the University of Illinois. I submit this declaration at the request of counsel for Jesco Lighting Group in the above captioned case.

2. In particular, I have been asked to analyze the validity of claims 1-20 of U.S. Patent 11,751,302 view of the following prior art references identified by Jesco Lighting Group, LLC (“Jesco”).

Short Name	Prior Art Reference	Exhibit Number
Edwards	U.S. Patent No. 9,995,440	1005
Sadwick	U.S Publication No. 2019/0320515	1006
May	Publication No. US 2019/0041009	1008
Jeswani	U.S. Patent No. 10,683,969	1007

3. It is my opinion that the claims of '302 Patent are invalid for the reasons set forth in this declaration.

4. I am being compensated at \$850/hour for my work on this matter. My compensation does not depend on the outcome of this matter.

II. QUALIFICATIONS

5. My qualifications for forming the opinions set forth in this declaration are summarized here and explained in more detail in my *curriculum vitae*, which is submitted as Exhibit 1003 and incorporated herein. Exhibit 1003 also includes a

list of my publications and the patent matters in which I have testified at a deposition, hearing, or trial during the past ten years. The following description is meant to be exemplary, and for brevity I omit some of my relevant experience from the approximately 51 years I have spent working in the optoelectronics field.

6. I received the B.S. degree in Electrical Engineering from the University of Maryland (College Park) in 1972, the M.S. degree in Electrical Engineering from the University of Illinois (Urbana) in 1973, and the Ph.D. degree in Electrical Engineering from the University of Illinois in 1976. During my graduate research at the University of Illinois, I conducted experiments with some of the earliest semiconductor lasers and LEDs (Gallium Arsenide – GaAs) that had been fabricated at IBM by Dr. John Marinace. Professor Nick Holonyak, Jr., the inventor of the first LEDs (Aluminum Gallium Arsenide – AlGaAs), was a member of my Ph.D. Committee.

7. In 1975, I was appointed a National Research Council (NRC) Postdoctoral Research Associate at the U.S. Naval Research Laboratory (NRL) in Washington, D.C. where I conducted research on ultraviolet and visible lasers. From 1976 through August of 1979, I served as a Laser Physicist on the staff of NRL's Optical Sciences Division. In that capacity, I discovered and developed a variety of ultraviolet and visible (primarily violet, blue, and green) lasers, and

received the NRL Research Publication Award for the discovery of a particular laser.

8. In 1979, I joined the faculty of the University of Illinois (Urbana-Champaign) and have now served in the Department of Electrical and Computer Engineering (ECE) for more than 44 years. I have served as Assistant Dean in the College of Engineering, Associate Dean of the Graduate College, and Associate Vice-Chancellor for Research. I have served (and continue to serve) as Director of the Laboratory for Optical Physics and Engineering, as well as Research Professor in the Coordinated Science Laboratory, and Professor in the Holonyak Micro and Nanotechnology Laboratory (HMNTL). I have received affiliate faculty appointments in the Departments of Bioengineering, Materials Science and Engineering, and Nuclear, Plasma and Radiological Engineering for a number of years. During my career, I have taught a wide range of courses in electronic circuits, electromagnetics (study of antennas, theory of light, etc.), semiconductor devices such as transistors and LEDs, lasers, nonlinear optics, and plasmas.

9. During my tenure at the University of Illinois, I have conducted research devoted to the discovery and development of numerous types of light sources in the visible, ultraviolet (UV), and vacuum ultraviolet (VUV) regions of the electromagnetic spectrum, including light emitting diodes (LEDs), lasers, and plasma lamps. My research has involved studying the atomic and molecular

physics, material properties (including optical properties), and laser spectroscopy of both solid state (semiconductor and non-semiconductor) and plasma (gas discharge)-based optical sources. I have worked on both the light emitting elements of these devices and their packaging for use in a variety of applications.

10. To date, 65 individuals have received the Ph.D. degree in ECE, Physics, Materials Science and Engineering, Chemistry, Bioengineering, Nuclear, Plasma, and Radiological Engineering, or Environmental Engineering under my direction. I am the author or co-author of more than 330 peer-reviewed scientific publications and 104 patents. The claims for several other patent applications have recently been allowed.

11. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), the Optical Society of America, the American Physical Society, the American Association for the Advancement of Science (AAAS), and the Society of Photo-Optical Instrumentation Engineers (SPIE). I have served in several official positions of the IEEE Photonics Society and, in 1998, I served as President of the Society.

12. I am a co-founder of four companies, three of which are manufacturing products today. Two of these (Eden Park Illumination and Cygnus Photonics) are devoted to visible/ultraviolet optical sources and their applications in industry and medicine. For a number of years, Eden Park manufactured large (1

ft² in area) but flat white lamps for the cinematography and videography markets. Producing more than 3000 lumens with a color rendering index (CRI) above 90, these lamps received awards from the National Association of Broadcasters. Today, Eden Park manufactures a wide range of flat and efficient UV and VUV lamps. These lamps are used for applications such as materials identification, curing of polymers, medical phototherapeutics, and surface disinfection. Indeed, Eden Park lamps emitting at 222 nm are presently (and during the COVID-19 pandemic) being applied worldwide to disinfect air and surfaces in public spaces. These lamps have been installed in restaurants, restrooms, commercial buildings, and military installations because 222 nm UV “light” is not harmful to human tissue (as are UV “germicidal” lamps) but is lethal for viral and bacterial pathogens. Cygnus Photonics manufactures ultraviolet photolithography systems, as well as systems for the photo-assisted growth of semiconductor thin films and electronic and optical devices.

13. During my formal education, I acquired a background in electrical engineering and physics, particularly in the sub-fields of optics, optical engineering, semiconductor physics, microelectronics, and optoelectronics. This background facilitated my academic, governmental, and industrial research and development activities. Over the past 51 years, my work has centered on research in, and the development of, light-emitting devices including LEDs, lasers, and

lamps. In short, my academic, government laboratory, and industry experience in creating, developing, and manufacturing optoelectronic devices and products has explored most of the visible and UV emitters in existence (in the solid or gas phase).

14. In addition to the above educational background, I hold two licenses from the Federal Communications Commission (FCC). The first is a professional “First Class Radiotelephone” license that qualifies me to control commercial radio stations. The second is also a radio license that authorizes me to operate a private radio station. Qualifying for these licenses, and operating stations, gave me considerable experience with electronic circuits.

15. I have received a number of research honors, including, among others, the SPIE Harold E. Edgerton Award (2010), the C.E.K. Mees Medal from the Optical Society of America (2007), the Aron Kressel Award from the IEEE Lasers and Electro-Optics Society (2005) (now known as the IEEE Photonics Society), the Third Millennium Medal from the IEEE (2000), and the Distinguished Service Award from the IEEE Lasers and Electro-Optics Society (1996). In 2014, I was elected into the National Academy of Engineering (NAE) and the National Academy of Inventors (NAI). In 2020, I was elected into the Innovation Hall of Fame of the A. James Clark School of Engineering at the University of Maryland.

16. As noted earlier, this summary of my research and experience is meant only to provide general background, and additional experience is set forth in my CV. Nevertheless, I believe that my experience provides the background necessary for me to provide expert testimony on the issues set forth in this declaration.

III. LEGAL PRINCIPLES APPLIED

17. I have been asked to provide my opinion as to whether certain claims of the '302 Patent are invalid under 35 U.S.C. §103.

18. I am an electrical engineer by training and profession. The opinions I am expressing in this report involve the application of my knowledge and experience to the evaluation of certain prior art with respect to the '302 Patent. My formal knowledge of patent law is no different than that of any lay person. Therefore, I have requested the attorneys who represent Jesco to provide me with guidance as to the applicable law in this matter. The paragraphs below express my understanding of how I must apply current principles related to patent validity to my analysis.

A. Level of Ordinary Skill in the Art

19. I have been informed that certain questions in patent law are assessed from the perspective of a hypothetical person of ordinary skill in the art to which the invention pertains. I understand that a person of ordinary skill in the art is a

person with a level of experience, education, or training generally possessed by those individuals who work in the area or field of the invention at the time of the invention. A person of ordinary skill is also a person of ordinary creativity that can use common sense to solve problems.

B. Claim Construction

20. I understand that a patent's claims define the scope of the alleged invention.

21. I understand that claim construction is a legal issue to be decided by the Board. I further understand that the Board does not hold a formal claim construction process, but instead construes claims on an as-needed basis based upon those issues which they affect.

C. Prior Art

22. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim. It is my understanding that prior art includes publications or patents that disclose the claimed invention or elements of the claimed invention. I understand that a printed publication, such as an article published in a magazine or trade publication, qualifies as prior art to an asserted patent if the date of publication is prior to the effective filing date of the asserted patent.

23. I understand that a U.S. or foreign patent qualifies as prior art to an asserted patent if the date of issuance of the patent is more than one year before the effective filing date of the asserted patent. I further understand that a printed publication, such as an article published in a magazine or trade publication, constitutes prior art to an asserted patent if the publication occurs more than one year before the effective filing date of the asserted patent.

24. I understand that a U.S. patent or published patent application qualifies as prior art to the asserted patent if the application for that patent or publication was made by another and filed in the United States before the effective filing date of the asserted patent.

25. I understand that to qualify as prior art, a reference must contain an enabling disclosure that allows one of ordinary skill to practice the claims without undue experimentation.

26. I understand that documents and materials that qualify as prior art can be used to invalidate a patent claim as anticipated or as obvious.

D. Anticipation

27. I understand that a patent may be invalid as anticipated under 35 U.S.C. § 102. I understand a claim may be anticipated if all its limitations are disclosed in a single prior art reference. I also understand that, although the prior

art reference does not have to use the same words as the claim, all the claim limitations must be present and arranged as in the claim.

28. In addition, I understand that even if a prior art reference does not explicitly disclose all the claimed limitations, it may still inherently disclose them. I understand that a limitation is inherent if it is necessarily present in the prior art reference. I also understand that the test for infringement and anticipation is the same, meaning that an invention that infringes if it comes after the priority date would anticipate if it came before the priority date.

E. Obviousness

29. I understand that a patent may be invalid as obvious under 35 U.S.C. § 103. I understand that when assessing the potential obviousness of a patent, a fact finder must determine if the differences between the patented subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSA.

30. I understand that in cases where a single reference does not disclose all of the limitations of a claim, the claim may still be invalid if: (1) in view of a prior art reference and the common knowledge of a POSA, the claimed invention would have been obvious to a POSA at the time of the claim's effective filing date; or (2) all of the limitations of the claim are disclosed in multiple reference and it would have been obvious to a POSA to combine those references.

31. I also understand that an obviousness inquiry includes consideration of the following four factors, although not necessarily in this order:

- (a) the scope and content of the prior art;
- (b) the differences between the prior art and the claims at issue;
- (c) the level of ordinary skill in the pertinent art; and
- (d) whatever objective factors indicating obviousness or non-obviousness may be present in any particular case.

32. I further understand that other factors, known as “secondary considerations” of non-obviousness, should be considered if evidence of them has been presented. I understand these factors may include: (i) commercial success of a product due to the merits of the claimed invention; (ii) a long-felt need for the solution provided by the claimed invention; (iii) unsuccessful attempts by others to find the solution provided by the claimed invention; (iv) copying of the claimed invention by others; (v) unexpected and superior results from the claimed invention; (vi) praise of the claimed invention by others in the art; (vii) independent invention of the claimed invention by others before or at about the same time as it was conceived by the named inventors; (viii) whether others expressed surprise or disbelief regarding the invention; (ix) whether others sought or obtained rights to the claimed invention from the patentee; and (x) whether the inventor proceeded contrary to accepted wisdom in the art. I also understand that

there must be an association or “nexus” demonstrated between the claimed elements and the secondary considerations.

33. I understand that there also must have been a reason for a POSA to have combined or modified the elements or concepts from the prior art in the same way as in the claimed invention, and that the skilled artisan would have had a reasonable expectation of success from doing so.

34. I understand that when assessing the potential obviousness of a patent, one should be careful not to use the benefit of hindsight and instead one should put oneself in the position of a POSA as of the effective filing date of the claimed invention and should not consider what is known today or what is learned from the teaching of the patent.

IV. BASES OF OPINIONS AND MATERIALS CONSIDERED

35. My opinions are based primarily on my review of the '302 Patent, the file history of the '302 Patent and the prior art references cited herein.

36. The materials considered I have considered include the materials listed in the table of exhibits and referenced in this declaration.

37. If I am called upon to testify at deposition or a hearing before the Board, I may cite other documents or information similar to that specifically identified in this report. I may also use graphics, animations, pictures, demonstrations, and/or other audio/visual aids to explain my analysis and opinions.

V. SUMMARY OF CONCLUSIONS

38. It is my opinion that the claims of the '302 Patent are obvious over the prior art on the following grounds:

Ground	Claims	Description
1	1, 2, 4, 5, 6, 7, 9-20	Obvious under 103 over Edwards in view of Sadwick
2	2, 3, 8	Obvious under 103 over Edwards in view of Sadwick and further in view of Jeswani
3	1-14, 16-20	Obvious over May in view of Jeswani
4	15	Obvious over May in view of Jeswani and further in view of Sadwick

VI. THE '302 PATENT

A. Overview

39. The '302 Patent is directed towards conventional LED lighting technology that was known in the art well before the '302 Patent priority date. The '302 Patent purports to teach a “(LED) lighting apparatus” which includes “an array of light emitting diodes (LEDs) that may include a first plurality of LEDs that produces a first light having a first color temperature” and which “aligns within a first linear shape” and a “second plurality of LEDs” which “may produce a second light having a second color temperature different from the first color temperature” and which aligns within a second linear shape.” Ex.1001-Abstract. The lighting device also includes “a driver circuit that outputs a plurality of

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Declaration of Dr. J. Gary Eden

currents” and “a switch assembly.” *Id.* The switch assembly “may cause the one of the plurality of currents to couple to the first plurality of LEDs, the second plurality of LEDs, or both.” *Id.* Figure 2 purports to show the features of the purported invention.

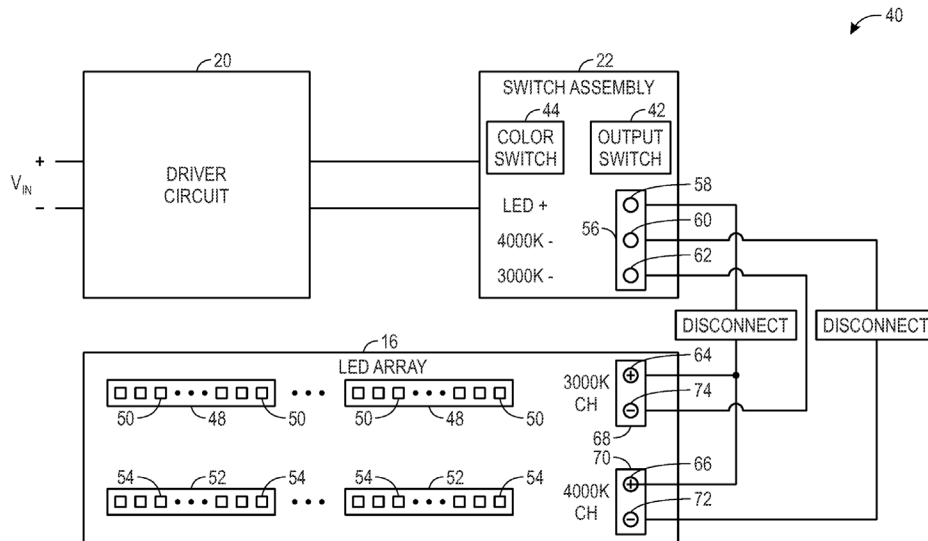


FIG. 2

Ex.1001-Fig. 2.

40. In contrast to the prior art references discussed below, the '302 Patent describes only the most basic form of color temperature (CCT) control that, as discussed below, was available well before the priority date for the '302 Patent. Specifically, Fig. 2 above shows that only three CCT values were made available to the user through a switch. Ex.1001.

41. As described in the sections to follow, the features claimed in the '302 Patent were known and commercialized long before its priority date, and each of

the claims are, at most, combinations of electrical and mechanical features well known by a POSA and the LED lighting industry.

B. Prosecution History

42. I have reviewed the prosecution history for the '302 Patent as part of my analysis.

43. The Application that issued as the '302 Patent was filed on December 21, 2020, claiming priority to a provisional application dated June 18, 2020.

Ex.1001-1:8-12. On December 7, 2022 claims 1-9 of the pending application were rejected. Claim 10-20 were allowed. Ex.1004, 12-7-22 Action. On January 25, 2023 the applicants amended claim 1 to recite one of the limitations of the allowed claims, particularly the ability to electrically couple the claimed fixture to an additional LED fixture having similar structural and functional characteristics. Ex.1004, 1/25/2023 Amendment.

44. My understanding is the Examiner allowed the claims because the art before the Examiner did not show connection of multiple fixtures serially. However, as discussed below, this feature was well-known in the art and was considered conventional.

C. Challenged Claims

45. As I discuss further below, the '302 Patent discloses widely known features, particularly a linear light that allows for rudimentary control of color

temperature by sending: (a) all current to a string of LEDs having a first color temperature; (b) sending all current to a string having a second color temperature or (c) sending some current to each. The claims further recite the ability to connect the fixture to adjoining fixtures. *Id.*

46. These features were well known in the art. As described below, both Edwards and May disclose the core design and functionality of the invention and more generally the ability to switch color temperatures in this manner has existed for a long time. To the extent that Edwards and May do not teach the claimed features, it would be obvious to respectively combine them with Sadwick and Jeswani.

D. Level of Ordinary Skill for the '302 Patent

47. A Person of Ordinary Skill (POSA) would have a B.S. degree in electrical engineering, or an equivalent field, as well as at least 2-4 years of academic or industry experience designing LED light fixtures. A person of ordinary skill in the art with a higher level of education may have fewer years of academic or industry experience, or vice versa.

48. The '302 Patent has an earliest-claimed priority date of June 18, 2020. For the purposes of my analysis I have applied that date, but if is later determined that the '302 Patent is only entitled to its December 21, 2020 filing date for priority my analysis will not change.

E. Claim Construction of the '302 Patent

49. It is my belief that the claims should be understood according to their ordinary and customary meaning as understood by a POSA at the time of the invention considering the language of the claims, the specification, and the prosecution history of record – my analyses do not depend on a specific construction.

50. I note that the '302 Patent states that “terms such as ‘linear’, ‘equal’, ‘parallel’, ‘half’ and ‘same’ should not be interpreted in a rigid or purely mathematical manner” and accordingly that ordinary and customary understanding of those terms should be applied in interpreting the claims. Ex.1001-12:62-64.

VII. BACKGROUND OF THE TECHNOLOGY

A. LEDs and Correlated Color Temperature (CCT)

51. A POSA would be familiar with the state of the art, which I describe below.

52. There have been many innovations in since Edison received U.S. Patent No. 223,898 for his incandescent light bulb in 1880. In 1896, the prolific American inventor Granville Woods received U.S. Patent No. 569,443 for his safety dimmer, which used a variable resistor to dim electric lights.

53. Light Emitting Diodes (LEDs) are semiconductor devices that convert electrical energy into light. LEDs emit light as electric current flows through them.

In 1994, Shuji Nakamura received U.S. Patent No. 5,290,393 for his invention of the bright blue LED, which among other things, allowed for efficient white LEDs suitable for replacing traditional incandescent or fluorescent bulbs. In the three decades since, white LEDs have become the dominant lighting technology, particularly for general lighting.

54. The flexibility and increasing commodification of white LEDs has led manufacturers to design light fixtures incorporating desirable features, such as user-selectable brightness and color temperature, in desirable formats, such as linear, modular lighting.

55. LEDs are placed within packages, which serve multiple functions, including mechanical protection, light extraction, and thermal management. Phosphors are sometimes incorporated into these packages. Phosphors work by absorbing photons of a specific wavelength and re-emitting them at a different wavelength to create a different color light. By mixing blue and yellow light, white light is generated.

56. LED lamps are currently manufactured in various forms, including the familiar bulb and cylindrical replacements for fluorescent tubes. One or more LED lamps installed into a light fixture is a complete lighting unit known as a luminaire. At the risk of a loss of precision, the terms “light fixture” and “luminaire” will be treated interchangeably throughout the remainder of this report.

57. An important consideration in the design of white LEDs and white light luminaires is the desired spectrum. Although white light generally comprises all the colors of the rainbow, manufacturers offer a range of white LEDs and LED lamps that produce differing hues and tones. For example, “warm white” is the term given to white light that has an orange or red hue. Such a “warm white” LED or lamp emits light for which the spectrum has been intentionally skewed to the red portion of the visible region such that the spectrum produced by the lamp contains *proportionately* more red and orange light than that generated by the sun, for example. Consequently, the preponderance of the light emitted by the lamp or luminaire is red, orange, and yellow. Conversely, “cool white” LED lamps emit light having a bluish-tinge and a spectrum that is blue “rich” (i.e., having a spectrum with the blue portion of the spectrum proportionately more intense than the same portion of the sun’s spectrum).

58. The term “color temperature” or “correlated color temperature” (CCT) has been adopted by industry as a guide describing the hue of light emitted by a lamp or light fixture. The “warm” white light discussed above, for example, will have a CCT value between approximately 2500 K and 3500 K, where K represents Kelvin which is a measure of temperature similar to Fahrenheit and Celsius. Those lamps producing relatively more orange and red light will have a lower CCT value. Conversely, a lamp or luminaire producing “cool” white light has a blue tint.

Because it produces relatively more blue light than the sun's spectrum, it will typically be assigned a value of CCT above 5000 K by the manufacturer. For reference, the color temperature of the spectrum radiated by the sun is 5700 K.

59. The desired location for a particular LED lamp or fixture often has a strong influence on the CCT of the lamp. The set of photographs below, for example, illustrates the impact of varying the CCT of the lighting on the appearance of a particular residential setting. Architectural lighting is the occupation concerned with the design of interior lighting through the control of CCT and light intensity throughout a given interior or exterior space. Speaking generally, lighting of lower CCT can be found in restaurants and homes whereas higher CCT lighting (above 4500 K) is more common in office settings and industrial areas.



“CCT: Understanding the Basics”, superbrightleds.com March 2, 2016) (Ex.1009; <https://www.superbrightleds.com/blog/what-is-cct-understanding-the-basics.html>).

60. The ability to independently control the CCT of luminaires and their intensity, and to vary these values throughout the day, has come to be the dominant theme in architectural lighting and is known as “tunable white technology”. A recent article by Gregory Kay, an architectural lighting designer, described the development and status of “*Tunable white light and its benefits become more accessible*”, Architectural Products, June 28, 2023 (Ex.1015; <https://www.architectural-products.com/architectural-lighting/article/55092734/tunable-white-light-and-its-benefits-for-commercial-offices-become-more-accessible>). Changing (“tuning”) the CCT of lighting has been of considerable interest to lighting designers since at least the early 2010s and Kay describes the installation in 2016 of “time-controlled, Kelvin-changing lighting” in the Amsterdam offices of a major European company. *Id.*

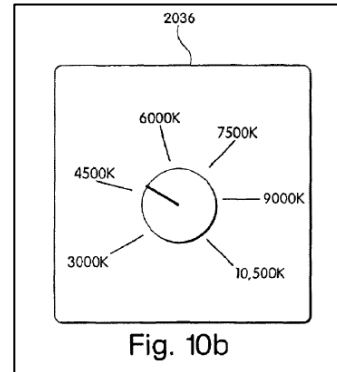
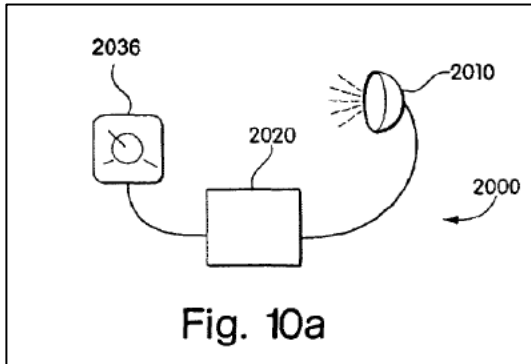
B. Tunable White Light Technology Has Been Known In The Field of Architectural Lighting For Two Decades

61. As discussed above, the ability to independently control the CCT of luminaires and their intensity, and to vary these values at will, is well known in the field of architectural lighting and is known as “tunable white technology” or “CCT tuning.”

62. For example, U.S. Patent No. 7,014,336 (“Ducharme”), awarded to Color Kinetics in the early 2000s, disclosed a number of lighting fixtures,

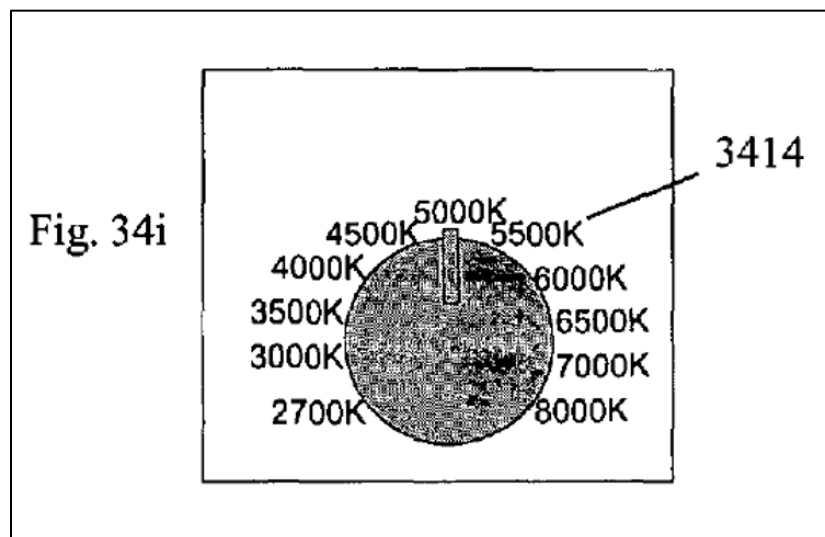
including luminaires, that “comprise a plurality of LEDs” producing “white light within a range of color temperatures such as, but not limited to, the range 500K to 10,000K.” Ex.1016-4:54-61.

63. Ducharme’s “lighting fixture may include a controller and/or processor for controlling the intensities of the LEDs to produce various color temperatures in the range.” *Id.*-4:62-64. Figure 10a of Ducharme shows “a manual control”—*i.e.*, a switch—for controlling the CCT output of a LED lighting fixture. *Id.*-7:23-24. Figure 10b shows the control unit 2036 in detail, which is a “dial [switch] marked to indicate a range of color temperatures, e.g., from 3000K to 10,500K.” *Id.*-16:64-67. Ducharme discloses that the switch 2036 “would be useful on a lighting fixture to produce a range of color temperatures (‘colors’) of white light.” *Id.*-16:67-17:2. While the switch 2036 is shown as a dial switch, Ducharme discloses that it could be “a dial, slider, switch, multiple switch, console ... or any other ... combination of controllers to permit a user to modify the illumination conditions.” *Id.*-16:45-50. In summary, the use of any of a wide range of switches to vary the CCT of light produced by an LED light fixture (luminaire) was well known at least as early as 2000.



Id.-Figs. 10a, 10b.

64. U.S Patent No. 8,207,821 to Roberge (Ex.1017), below, provides another example of a manual CCT switch that was disclosed in May 2003. Roberge discloses a number of LED “[l]ighting methods and systems...[with] a plurality of LEDs.” *Id.*-1:31-33. Roberge includes “a dial [that] allows a user to select one or more color temperatures from a scale 3414[, which can] include different color temperatures of white light.” *Id.*-41:65-42:1. Roberge Fig. 34i is a depiction of a manual CCT switch.

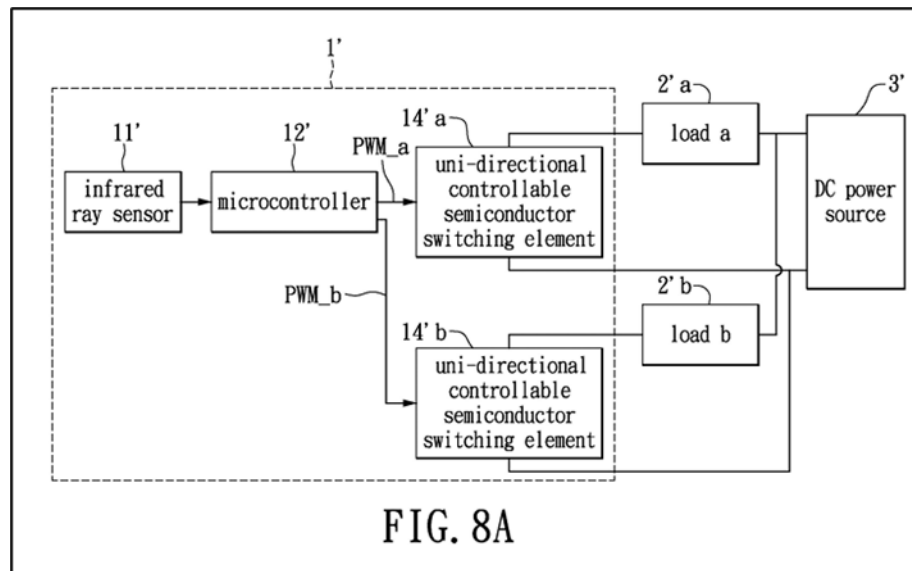


Id.-Fig. 34i.

65. During the following decade, the LED lighting industry made enormous improvements in optimizing the CCT of indoor and outdoor lighting. For example, on December 22, 2014—five years before the alleged invention of the '302 Patent—Luminex disclosed in a patent application that issued as U.S. Patent No. 9,345,112 (the "'112 Patent", Ex.1012) a color-tunable CCT light fixture. The invention of Luminex's '112 Patent goes far beyond simple mechanical switches that are inaccessible when installed. Luminex's '112 Patent discloses a light fixture with a microcontroller-based switch that uses infrared ray sensors to detect a user's instructions regarding the desired value of CCT. Other possible switch configurations are also described, including a button switch. For example, the touchless switch such as an infrared ray, or a direct touch switch such as a push button, generates a sensing signal that results in controlling "the color temperature of the blended light" output of the '112 Patents' LED light fixture. '112 Patent, 10:43-45. The '112 Patent discloses a range of CCT values, ranging from 3000 K to 5700 K, that can be selected with the microcontroller based switch. *Id.*-6:47-7:11.

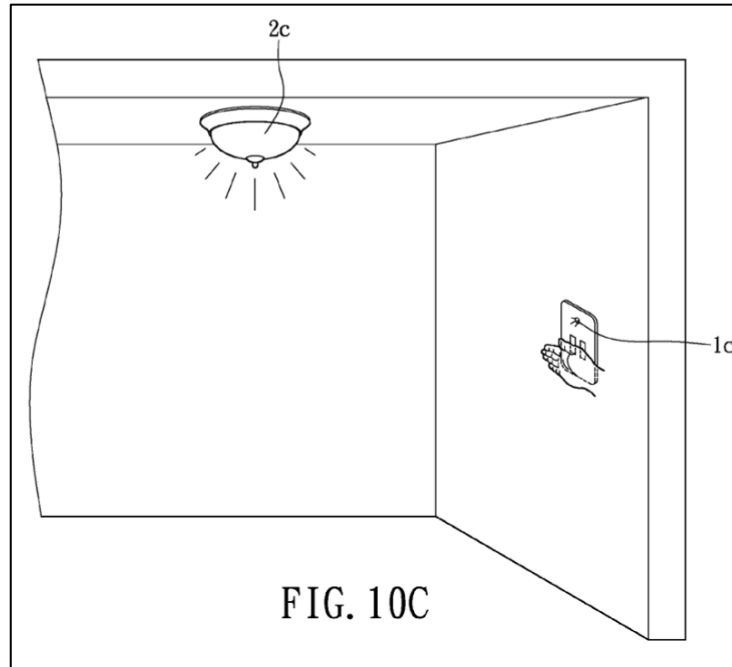
66. The invention disclosed in Luminex's '112 Patent enables the blending of the light produced by two sets of LEDs having different CCT values in order to create a third CCT value that is determined by: (1) the CCTs of the two

sets of LEDs, and (2) the ratios of power level respectively delivered to each of the two sets of LEDs. This method is known as CCT or, as described earlier, “white light” tuning. Luminex’s ’112 Patent performs “color temperature tuning [by] controlling different levels of electric power transmission to the two lighting loads [reversely and complementary] 2a [LEDs of a first temperature] and 2b [LEDs of a second temperature] by controlling” the power delivered to the LEDs as shown in Fig. 8A below. Ex.1012-8:4-8, Fig. 8A.



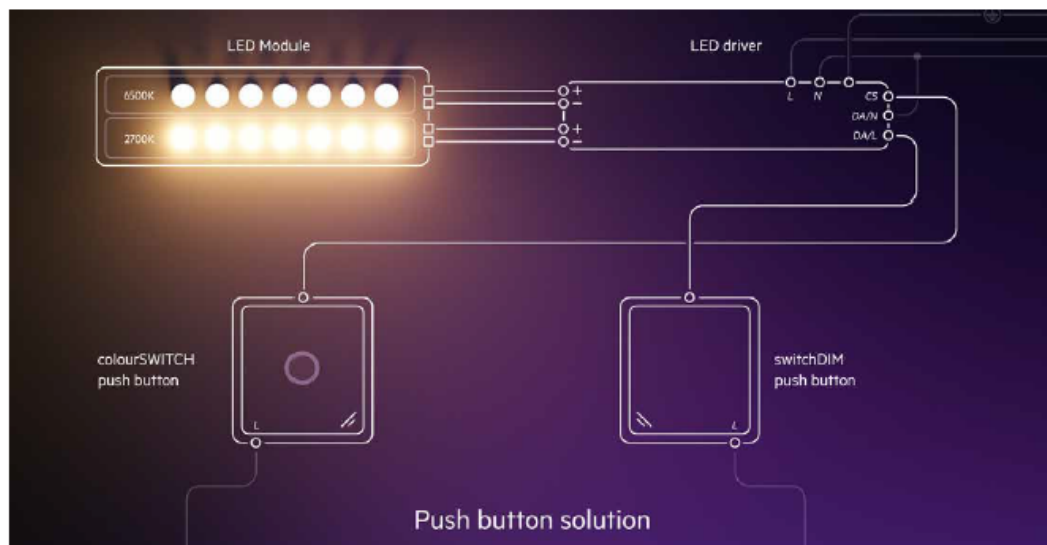
Id.-Fig. 8A.

67. Luminex’s ’112 Patent also presents “a wall switch construction electrically connected to a ceiling light for the performance of three working modes” in Fig. 10C. *Id.*-22:19-21. By waving a hand in front of the wall switch 1c, a user can “select a desired illumination color temperature” of the light fixture 2c. *Id.*-22:19-39.



Id.-Fig. 10C.

68. In addition to patents, such fixtures were common commercially. [*See, e.g., “Tunable White technology At a Glance”, Tridonic, March 2019, EX-1019 at p. 8 (reproduced below)*].



The combination of switchDIM and colourSWITCH buttons makes it easy to adjust the illuminance and colour temperature. The light can be dimmed using switchDIM, the proportion of cool white and warm white light can be mixed and customized with colourSWITCH.

69. In short, tuning the CCT of a LED luminaire with a manual switch was well known in the art at least as early as 2000, well before the filing date in 2020. As described below, Jeswani and Edwards both disclose this feature as well, as the other claimed features of the '302 Patent.

70. These features are further shown in the prior art which is at issue in this proceeding.

C. White LED Lighting Requires One or More Phosphors to Generate Red, Orange, Yellow, and Green Light From a Blue LED Source

71. All white-light LEDs generate white light by converting blue light generated by a blue LED into white light with one or more layers (thin films) of one or more phosphors. Because the energy of a blue photon is higher than that for red, orange, or yellow light, for example, this process of “wavelength conversion” is also known in the lighting community as “down conversion”. Wavelength conversion was first commercialized for interior lighting in connection with the development of fluorescent lamps that were introduced by General Electric at the New York World’s Fair in 1939.

72. Because the fluorescent lamp is based on converting ultraviolet (UV) light, emitted by a gaseous plasma within the lamp, into white light, it was necessary for the mixture of phosphors (required to obtain high quality white light) to be physically supported by the cylindrical glass enclosure of the fluorescent

lamp. Consequently, the light (photons) emitted by the plasma within the lamp must travel a distance, albeit short (up to ~1 cm) to reach the phosphor film coating the interior of the lamp's cylindrical glass enclosure

73. The concept of converting light of one wavelength (or color) to another (or a mixture of colors to produce white) with phosphors pre-dates the discovery of LEDs (the first red LEDs!) by decades. The first color TVs, for example, entailed the “writing” of the desired image with red, green, and blue (RGB) phosphor dots inside a cathode ray tube (CRT) with a beam of electrons from an “electron gun”. When the rapidly-moving electron beam struck a red phosphor dot or bar, for example, a pulse of red light visible to an observer was emitted. Through electronic control of the electron beam position on the inside front surface of the CRT, full-color images (including white) were created.

74. It is not surprising, therefore, that the first LEDs to generate white light did not have a film comprising one or more phosphors *on the surface of the LED(s)*. Of course, wavelength-conversion phosphors were not necessary when the first red and orange LEDs became commercially available because a large number of applications then and now (bar code readers, automobile brake lights, signs, etc.) required only a single color. When the first blue LEDs became available, systems for depositing precise mixtures of phosphor onto the LED front (or top) surface were not immediately available. Consequently, the phosphor or phosphor

mixture was initially provided through deposition onto an optically-transparent material such as glass or a polymer. Although this phosphor-coated surface was located in proximity to the blue LED itself, it was not in contact with the LED surface.

75. Consequently, early in the development of LED lighting (and, to an extent, today) the blue LEDs were physically separated from the wavelength conversion medium which is typically a phosphor or a mixture of phosphors. This is the case with Edwards (discussed below) which employs a wavelength conversion component 10 to convert the blue light emitted by the arrays of blue LEDs into white light.

76. Most current LED lighting products employ LEDs having the phosphor(s) applied directly separately to each LED. Both types of LEDs – those having the phosphor on a surface of the blue LED, and those for which the phosphor is separated from the blue LED – have distinct advantages and drawbacks. The primary advantage of applying the phosphor(s) directly to the blue LED is cost. Furthermore, integrating the phosphor with a blue-emitting diode yields an intense source of white light in a compact package. One disadvantage of integrating the phosphor with the blue LED is that each LED appears to an observer as a very bright “point”, as opposed to soft, diffused light. For this reason, a linear array or “string” of white LEDs is suitable only for specific applications

such as holiday lights or undercounter lighting which cannot be seen directly by an observer. That is, linear arrays of single white LEDs, spaced in a linear fashion, are generally not acceptable for general interior illumination unless the light from each white LED is diffused. Most interior lighting products, therefore, such as troffers employ a diffuser so as to improve the spatial uniformity of the light generated by the luminaire.

77. In summary, white LEDs having phosphor(s) applied onto a blue diode surface or separated from that surface have virtually identical properties, with the exception of the quality of light emitted by each white LED. Nevertheless, the reduced cost of manufacturing the former of these was the deciding factor in making integrated blue diode/phosphor white LEDs the current standard in the industry.

D. Serial Connections of Linear LED Fixtures were Well Known in the Art

78. Linear fixtures were commonly used in larger spaces such as offices or other common areas or to illuminate cabinets or shelving. To avoid having to provide individual connections for each lamp, fixtures were designed to be “daisy chained”, with each fixture providing power and/or data to an adjoining fixture.

79. For example, U.S. Patent No. 9,964,289 to Pearson *et al.* (“Pearson”, Ex.1013), discloses linear lights which can be connected serially. Pearson discloses:

An LED light fixture having adjacent interconnected light fixture modules, each comprising a power system extrusion and LED light module body attachable to the power system extrusion, female and male end caps at opposite ends of each extrusion and respectively including a female electrical connector and a male electrical connector, a male electrical connector being configured to plug into the female electrical connector of an adjacent extrusion, and a power box component having a female electrical connector configured to plug into a male electrical connector of a male end cap.

Ex.1013-Abstract.

80. Figure 1 of Pearson illustrates the connected LED fixtures.

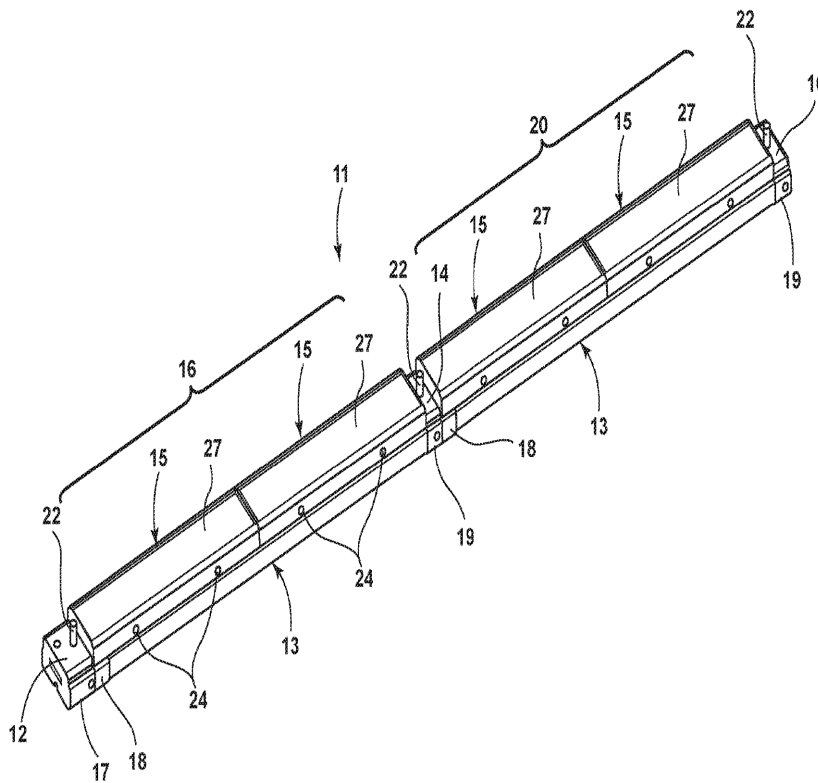


FIG. 1

Ex.1013-Fig.1.

81. Similarly, U.S. Patent No. 8,764,220 to Chan (“Chan”, Ex.1014) discloses a series of daisy-chained LED modules that can be connected together to deliver electrical power from one luminaire (light fixture) to another. Chan discloses:

A linear light emitting diode (“LED”) light fixture includes LED modules that interface with one another to provide a substantially continuous array of LED's. This

continuous array allows for substantially uniform light output from the LED light fixture. The LED modules can interface with one another via one or more connectors, which allow two or more LED modules to be electrically and mechanically coupled together. The connectors may be disposed beneath the LED's so that the connectors are not visible when the LED modules are coupled together. The connectors may be disposed along opposite ends of the modules to allow for end-to-end configurations of the modules and/or alongside ends of the modules to allow for angled or curved configurations of the modules. The LED modules can be powered via one or more wires, magnets, or clips, which are coupled to a power source.

Ex.1014-Abstract.

82. Further, as described below, Both Edwards and May disclose serially-connected LED light fixtures that are capable of adjusting color temperature.

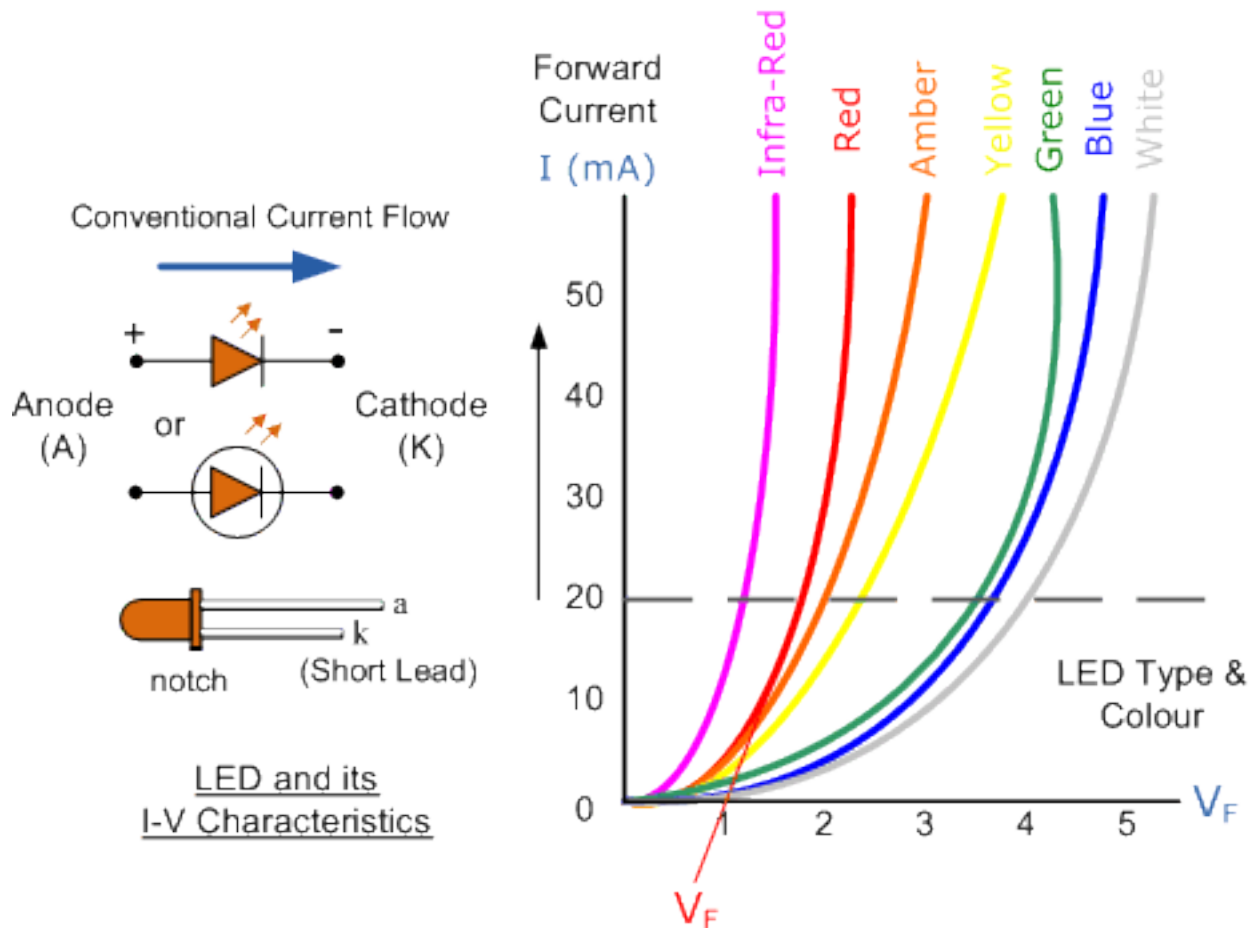
E. Basic Electrical Circuits Typically Employed in Driving Linear Arrays of LEDs

1. Series Electrical Connections of Linear LED Arrays

83. In order to understand and interpret the claims of the '302 Patent, a few comments regarding the principles of circuit design, and particularly those circuits intended for driving LEDs, might be helpful. LEDs are light emitters requiring a voltage of the proper polarity and magnitude to function as designed. Like all components in electrical circuits (such as resistors and capacitors), LEDs are characterized by a voltage-current ("V-I") graph which is generally known as a V-I characteristic. Such a characteristic shows the dependence of the current flowing through the LED on the voltage impressed across the LED. In the figure

shown below (from the “electronics tutorial” Website given below), several V-I characteristics representative of those for LEDs of differing colors are given. Also shown in the figure is the symbol for an LED and the required polarity of the voltage which is known in the LED field as “forward biasing” of the LED. Lastly, it should be mentioned that “ V_F ” on the abscissa of the graph below refers to the “forward” voltage which is simply a reminder of the polarity of the voltage imposed on an LED.

84. All LEDs have similar V-I characteristics but those manufactured from different sources, or having different structures, will have slightly different V-I characteristics. The importance of a V-I characteristic is this: once a particular value of either the LED voltage (V) *or* electrical current (I) is specified by a circuit designer, the other is “locked-in” by the V-I characteristic of a given LED. In other words, a circuit designer does not have control over V and I separately. A second fundamental aspect of the V-I characteristic, evident in the graphs at right in the figure below, is that it is not linear for any LED.



Ex.1018, “*The Light Emitting Diode*”, Electronics Tutorials

(https://www.electronics-tutorials.ws/diode/diode_8.html).

85. For most LED arrays, the individual LEDs in the array are generally connected in series – that is, end-to-end – as shown, for example, in Fig. 35 of Edwards (reproduced below). Edwards will be described in detail later in this report but, for our present purposes, Fig. 35 is helpful in showing two sets of series-connected LEDs denoted 820 and 822 which are driven by a constant current power supply.

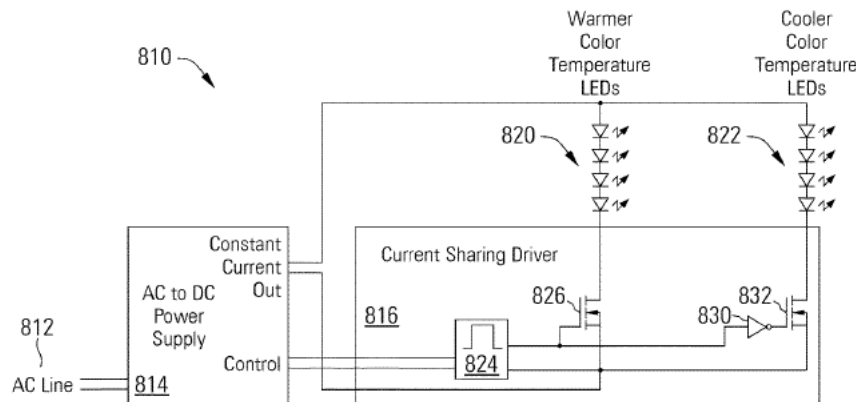


FIG. 35

Ex.1006-Fig. 35.

86. For an array of LEDs connected in series (and all assumed to be essentially identical): 1) the *current flowing through* all of the LEDs in the linear array or “string” must be the same (required by Kirchoff’s Current Law), and 2) the *voltage difference appearing across* each LED is also the same. Consequently, the design of circuits for powering LEDs will focus on establishing a specific value of the voltage V_o across each LED in a linear array having a specific number of LEDs in the string. Specifying V_o immediately defines the current I_o flowing through the entire linear array. Similarly, one has the option of initially defining I_o which automatically sets the value of V_o . At the risk of belaboring the point, it must be emphasized that once V_o (or I_o) is specified, the other variable is dictated by the V-I characteristic of the LED chosen for the circuit.

87. Another important point to be made is that once V_o (or I_o) is set, the output optical power (luminance) of each LED is also set because luminance of an LED is dictated by the current flowing through that LED. In short, V , I , and luminance of an LED are linked inextricably.

88. In view of the above considerations, it is clear that increasing the number of LEDs in a series-connected array increases the voltage that must appear across the entire array. That is, the voltage across each LED in the array will remain the same and, therefore, the voltage that must be impressed (imposed) across the entire linear array will be $V_o \times N$, where V_o is the voltage drop across each LED and N is the total number of the LEDs in the array. This simple relationship, which shows that only the voltage across the entire array varies linearly with N , assumes that the designer wishes to maintain a constant value of luminance from each LED as the linear array is lengthened.

2. Current and Voltage Dividers

89. The above discussion is concerned only with a single linear array of LEDs. For the patents of interest in this matter, however, providing electrical power to at least two linear arrays is of interest. In this situation, it is desirable to have only a single power supply which supplies sufficient voltage and/or current to drive two or more arrays.

90. Therefore, the circuitry designed for driving two or more linear arrays, for which each array consists of different LEDs, generally employs one or more “current dividers” or “current splitters” to allow different values of current to flow in each array. Another motivation for “dividing” the current produced by a single source is to adjust the CCT perceived by the human eye when the luminance of two arrays in proximity to one another is changed when the current through the two LED arrays is varied.

91. Figure 35 of Sadwick (reproduced below) shows one current splitter circuit that can be employed to apportion the current, produced by a single DC power supply, between LED arrays 820 and 822. Notice that the driver 816 is termed the “Current Sharing Driver”. The principles behind current dividers and current splitters assumes an important role in the ‘302 Patent and the Prior Art discussed in the remainder of this report.

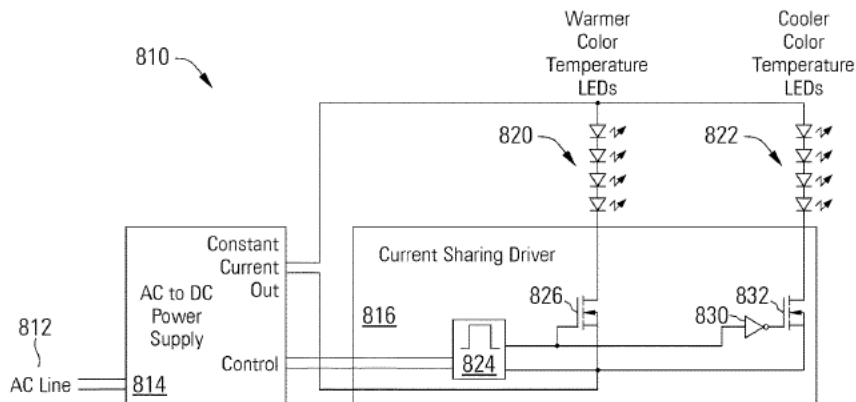


FIG. 35

Ex.1006-Fig.35.

VIII. Overview of the Asserted Prior Art

A. Edwards

92. U.S. Patent No. 9,995,440 to Edwards issued June 12, 2018 and I understand it, therefore, to be prior art to the '302 Patent. Edwards is directed to an “apparatus for personalized lighting systems, including a power supply” and “a number of solid state lights” Ex.1005-Abstract.

Edwards describes the structure and operation of a luminaire having one or more arrays of LEDs and “wavelength conversion portions” which convert the light emitted by the LEDs into white light:

The wavelength conversion portions 20a, 20b-1, and 20b-2 comprise photoluminescence materials which absorb a portion of the excitation light emitted by the LEDs 21 and re-emit light of a different color. The substrate 160 comprises separate arrays of LEDs 21, where each array

of LEDs 21*a*, 21*b* correspond to each respective one of the different wavelength conversion portions 20*a*, 20*b*-1, and 20*b*-2.

Ex.1005-5:48-55.

93. As illustrated in FIGs. 1(b) and 1(c) (reproduced below), Edwards is able to control the CCT value of the light produced by the luminaire by combining the light emanating from one or more “wavelength conversion portions”. The overall description of the luminaire’s operation is summarized in Cols. 5 and 6:

As noted above, the wavelength conversion component 10 has at least two or more regions with different photoluminescent materials located remotely to a respective array of solid-state light sources and operable to convert at least a portion of the light generated by the plurality of solid-state light sources to light of a different wavelength, wherein the emission product of the device comprises combined light generated by the plurality of light sources and the two or more regions of the wavelength conversion component. By differentially controlling the power to each of the different regions, the linear lighting arrangement 260 can be dimmably [*sic*] controlled while also being able to control the color temperature of the final light product from the linear lighting arrangement 260.

Ex.1005-5:60-6:7

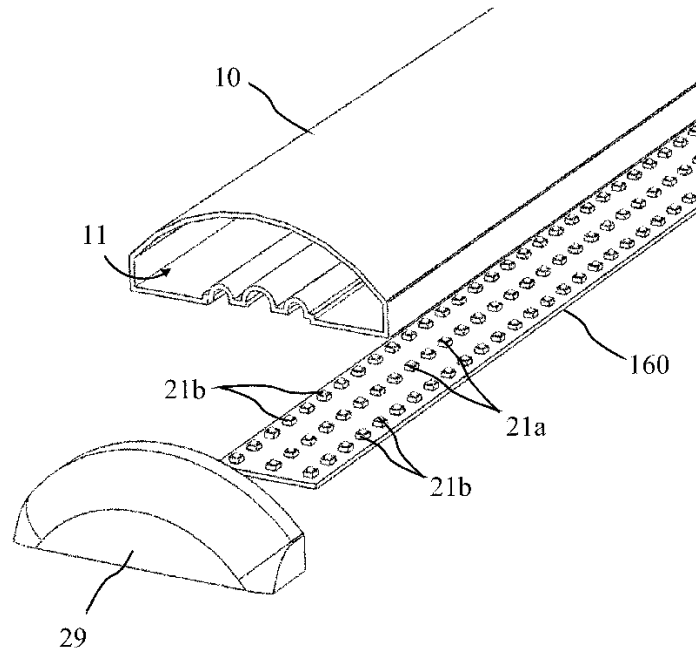


FIG. 1B

Ex.1005-Fig. 1B.

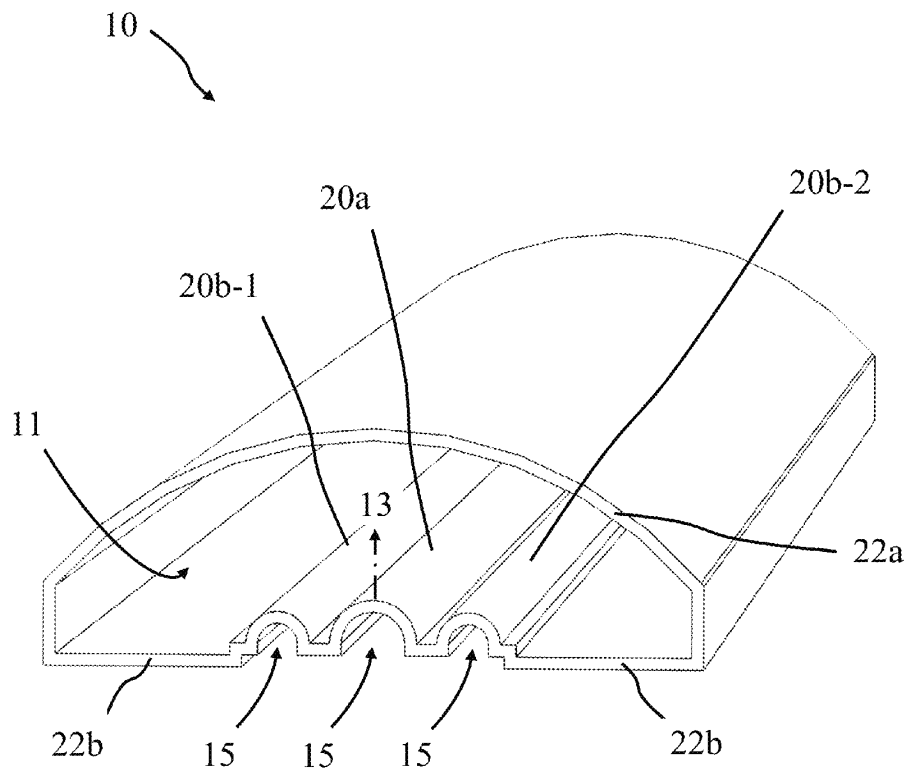


FIG. 1C

Ex.1005- Fig. 1C

94. In the system of Edwards: “the final light emission is controlled by the color temperature switch 215b, where a cooler light emission is produced by shifting a higher proportion/ratio of the power to the LEDs 21a that corresponds to portion 20a (cool white light) and shifting a lower proportion/ratio of the power to

the LEDs 40 21b-1 and 21b-2 that corresponds to portions 20b-1 and 20b-1 (warm white light).” Ex.1005-13:35-41. Through this mechanism, the fixture of Edwards can control the overall color temperature through a spectrum of different color temperatures.

95. One concludes that the luminaire described by Edwards offers performance (with respect to the generation of light of two or more CCT values, dimming capability, etc.) comparable to that for a lamp of similar structure but comprising LEDs in which the phosphor(s) is (are) applied directly to the surface of a blue LED..

96. Edwards also discloses that fixtures may be serially connected. Edwards discloses that the case holding the lamp may “further comprise an electrical connector 1309 (e.g., plug) extending past the length of the body 1301 on one end, and a recessed complementary socket (not shown) configured to receive a connector on another end” and “this allows several linear lamps 1300 to be connected in series to cover a desired area.” Ex.1005-15:52-58.



Ex.1005-Fig. 8A.

B. Sadwick

97. Sadwick was published October 17, 2019 and is prior art to the '302 Patent. Sadwick is directed to an “an apparatus for personalized lighting systems.” Ex.1006-Abstract. Sadwick introduces a “a solid state lighting ‘bar’ 30 which can be used as a replacement for a fluorescent tube.” Ex.1006¶0044.

98. As shown in Figure 35 below, the lighting system of Sadwick “powers ... two banks 820, 822” having different color temperatures and through

“rapid switching of current between the two banks 820, 822 and balancing the duty cycle that apportions current between the two banks ... an apparent color temperature can be produced anywhere between the 2200K warm white and the 6500K cool white that can be free of flicker.” Ex.1006¶0194. Notice the importance in Sadwick of apportioning current between the two banks (of LEDs).

99. Figure 35 of Sadwick (reproduced below) is a schematic diagram of an electrical circuit designed to drive two sets of LEDs connected electrically in series. According to Sadwick “The LEDs or light sources can be of any color, temperature, luminance, size, etc., and can use any suitable power levels.” Ex.1006¶0044.

100. It should also be noted that the particular circuit below, as well as those of Figs. 5-7, 36, and 37, employ square driving pulses 824 to repeatedly turn-on and turn-off the LED strings 820 and 822. Doing so is often employed in LED driving circuits to minimize power consumption.

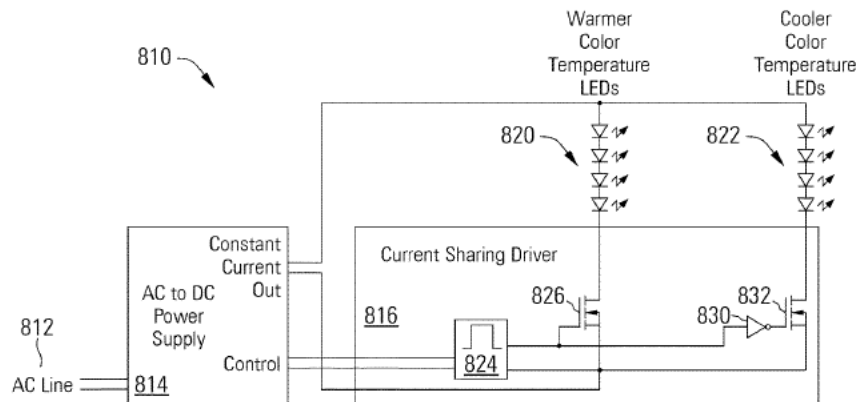


FIG. 35

Ex.1006-Fig.35.

C. Jeswani

101. U.S. Patent No. 10,683,969 to Jeswani was filed on May 17, 2018, issued on June 16, 2020, and is, therefore, prior art to the '302 Patent. As described above, CCT switching or “tuning” was well-known in the LED lighting community before the filing of the '302 Patent. Jeswani, for example, presents a lamp “that can have at least one interface on the lamp body for a selectable lumens and selectable correlated color temperature (CCT)” Ex.1007-Abstract. Jeswani also describes an “interface on the lamp housing 100 for selecting a lumen [brightness] setting and for selecting a correlated color temperature (CCT) setting for the light being emitted by the light engine 60 of the downlight 100.” Ex.1007-8:19-22. Switches for user-selection of lamp brightness (expressed in lumens (LM)) and the color temperature (CCT) value are illustrated below in Fig. 1B of Jeswani. Note

that both the luminance and CCT switches allow for three values of both parameters to be selected.

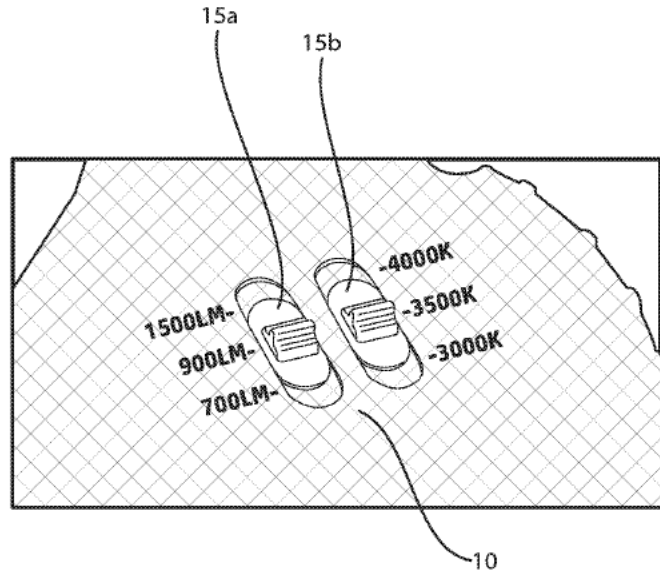


FIG. 1B

Ex.1007-Fig. 1B.

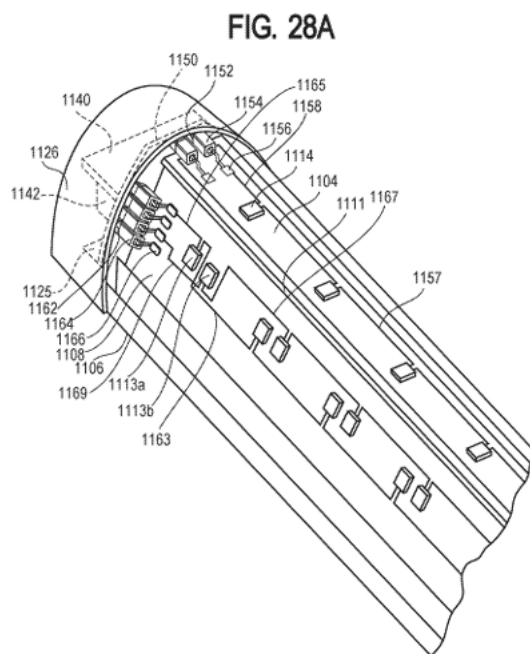
D. May

102. May was published February 7, 2019 and is, therefore, prior art to the '302 Patent. May describes a networked LED “lighting system” which comprises “elongated linear lamps having an LED luminary as a source of illumination and configured to operate as a node of an automated networked lighting system.” Ex.1008-Abstract.

103. May discloses a system of interleaved LEDs emitting light having different CCT values. Specifically, May describes “a series of LED emitter pairs located at regularly spaced intervals in a row along the length of the board” and

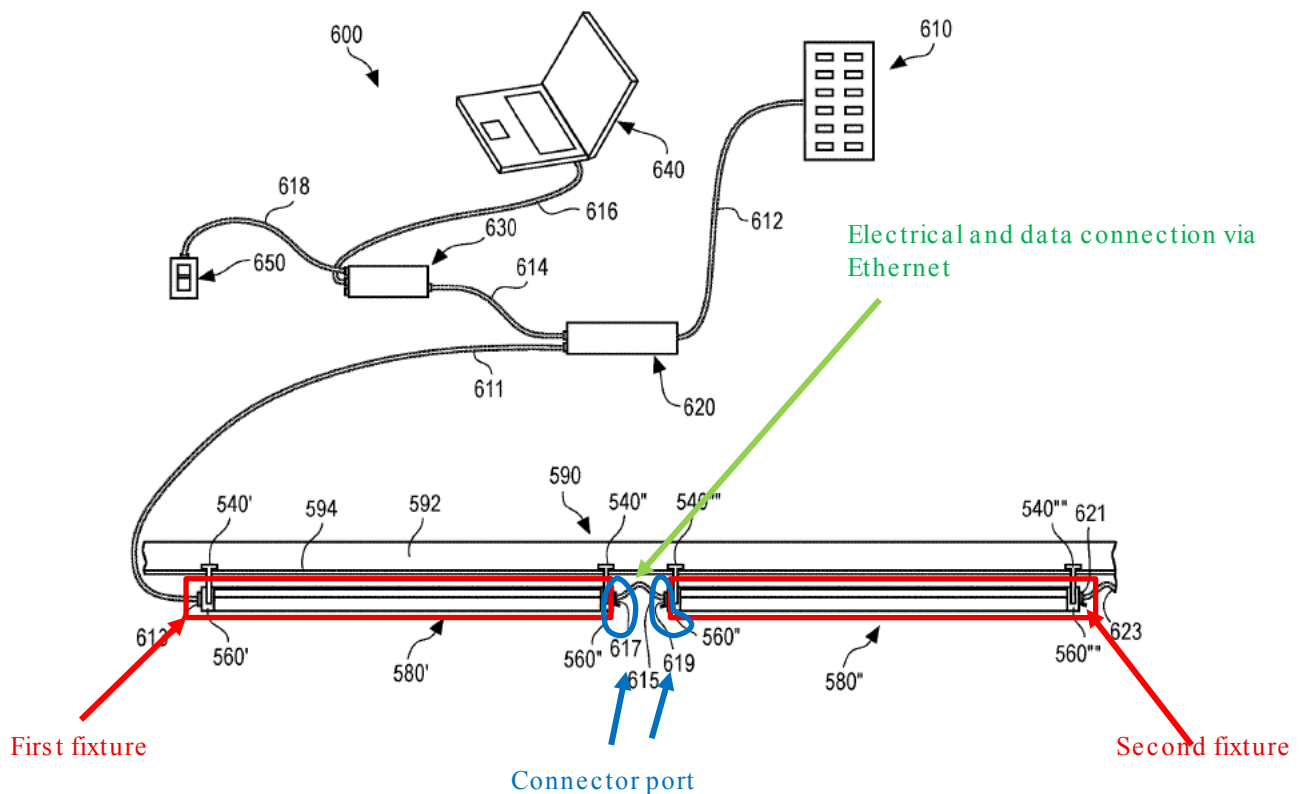
that “consist of a first string of LED emitters with a color temperature in a first range, and a second string of LED emitters with a color temperature in a second range.” Ex.1008¶0231. As confirmed in Fig. 28a, May presents one or more linear arrangements of LEDs, comprising pairs of LEDs having two distinct CCT values.

Id.



105. As a second example, May also states that, in a system of multiple lamps, “[p]ower and data is communicated from the switch and to the serially connected LED lamps over cable 611 and the intermediate jumper cables” and “lamps are networked to each other by a jumper cable 615 having a male plug at each end mated with the corresponding Ethernet jack in the end wall of end cap assemblies 560’ and 560”.” Ex.1008¶¶0190,191. Figure 22 shown below (and annotated) illustrates the electrical interconnections and the Ethernet-based control system May envisions for controlling a network of lamps.

FIG. 22



Ex.1008-Fig.22-Annotated.

I. GROUND 1- CLAIMS 1, 2, 4-7 AND 9-20 ARE OBVIOUS OVER EDWARDS IN VIEW OF SADWICK

1. Independent Claim 1:

1. [1pre] A linear light-emitting diode (LED) lighting apparatus, comprising:

106. Edwards satisfies every aspect of the preamble. For example, Edwards states:

Embodiments of the present invention pertain to linear lamps that utilize solid-state light emitting devices, typically LEDs (Light Emitting Diodes).

Ex.1005-4:55-57

107. In addition, Fig. 1B of Edwards illustrates “a linear light-emitting diode (LED) lighting apparatus”. As described by Edwards:

FIGS. 1A-C illustrate a surface mountable wraparound linear lighting arrangement 260 according to embodiments of the invention. The surface mountable lighting arrangement 260 includes a hollow integrated wavelength conversion component 10 and a substrate 160 having multiple arrays of LEDs 21.

Ex.1005-5:32-37.

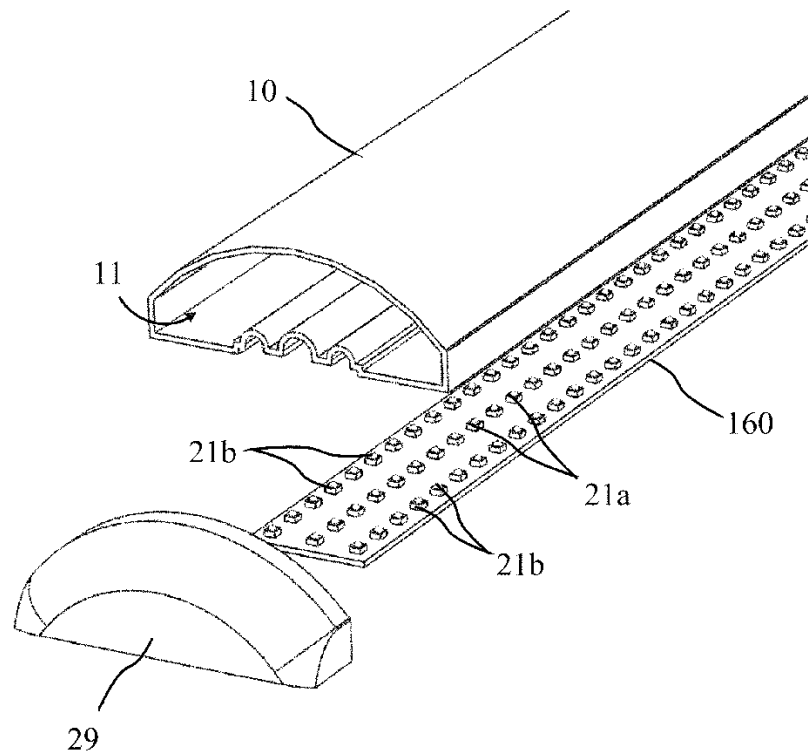


FIG. 1B

2. [1a] an array of light emitting diodes (LEDs) having a first length, wherein the array of LEDs comprises:

108. Edwards also satisfies this limitation. As shown by Fig. 1B of Edwards, reproduced and annotated below, the particular embodiment shown has a linear array comprising LEDs 21a and 21b. Each of the three rows of LEDs are described individually as arrays but the claim language also allows the three arrays to collectively represent a single array. Edwards notes that “[t]he substrate 160 comprises separate arrays of LEDs 21.” Ex.1005-5:52-53.

109. The red box in the annotated version of Fig. 1B below shows the largest linear array described by Edwards, comprising LEDs 21a and 21b.

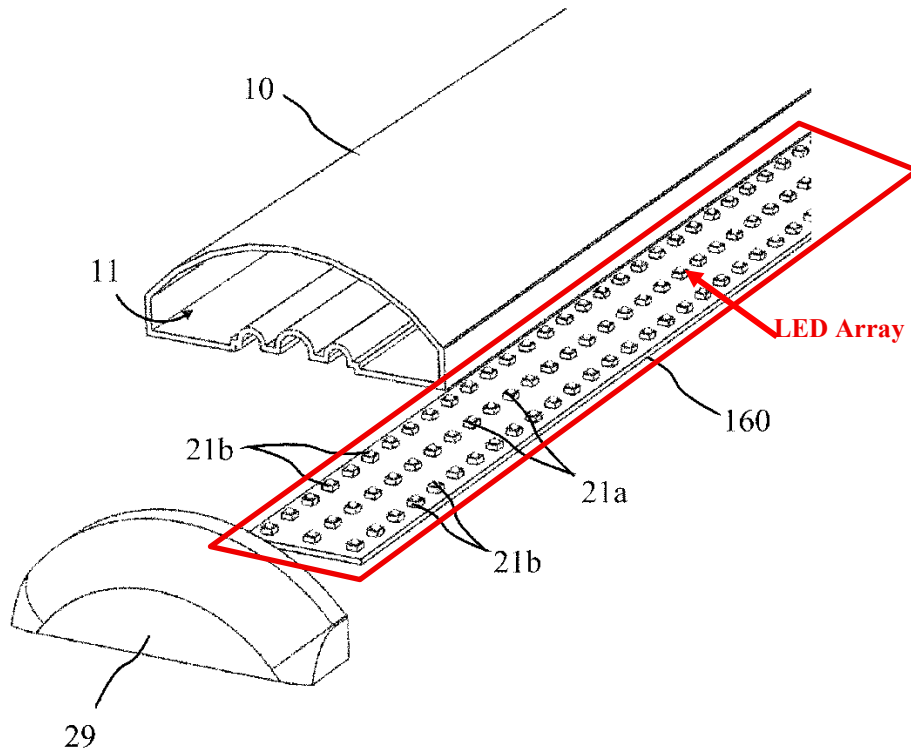


FIG. 1B

Ex.1005-Fig.1B-Annotated.

3. [1b] a first plurality of LEDs configured to produce a first light having a first color temperature, wherein the first plurality of LEDs aligns within a first linear shape;

110. Edwards satisfies or renders obvious this limitation, either alone or in combination with Sadwick. Edwards clearly describes “a first plurality of LEDs

configured to produce a first light having a first color temperature” [emphasis added]. Consider Edwards’ description of the production of white light having a “first color temperature” (and a second color temperature):

FIGS. 1A-C illustrate a surface mountable wraparound linear lighting arrangement 260 according to embodiments of the invention. The surface mountable lighting arrangement 260 includes a hollow integrated wavelength conversion component 10 and a substrate 160 having multiple arrays of LEDs 21. For linear applications, the wavelength conversion component 10 and the substrate 160 having the LEDs 21 are elongated components. The integrated wavelength conversion component 10 includes multiple wavelength conversion regions with different photo-luminescent materials (e.g., for a first light emission color, more typically first color temperature), including a central wavelength conversion portion 20a having a first photo-luminescent material and one or more other outer wavelength conversion portions 20b-1 and 20b-2 that correspond to a different photo-luminescent material (e.g., for a second light emission color, more typically a second color temperature).

Ex.1005-5:32-48.

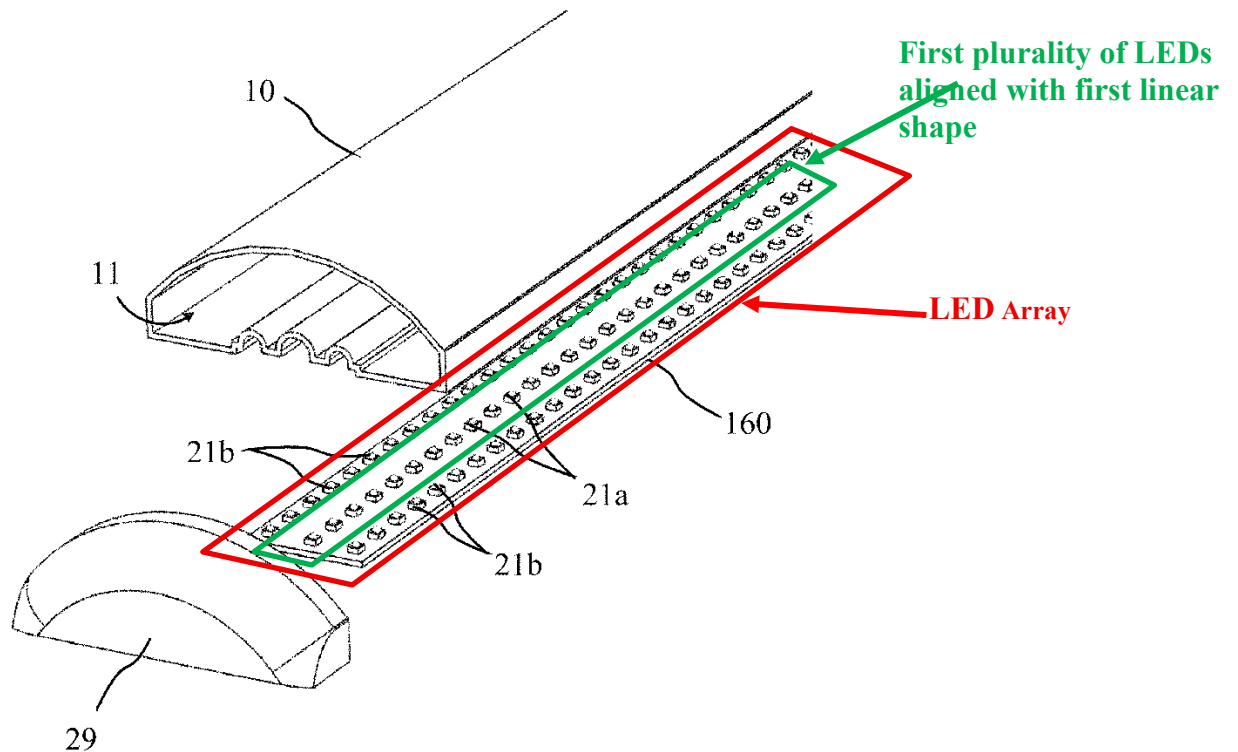


FIG. 1B

Ex.1005-Fig. 1B-Annotated.

111. Therefore, Edwards introduces a first set of LEDs 21a and a second set of LEDs 21b (shown in annotated FIG. 1B above), each arranged in a linear fashion and each set producing a different color temperature through an associated wavelength conversion portion 20a or 20b.

112. Edwards describes the LED arrays as follows: “The substrate 160 comprises separate arrays of LEDs 21, where each array of LEDs 21a, 21b correspond to each respective one of the different wavelength conversion portions

20a, 20b-1, and 20b-2.” Ex.1005-5:52-55. The first plurality of LEDs, denoted by the green arrow and rectangle in annotated Fig. 1B above, are aligned “within a first linear shape”. As discussed earlier in this report (Sect. VIII), the LED arrays described by Edwards employ LEDs having the same structure as those manufactured over at least the past decade and differ only in the location of the phosphor film that converts blue light into visible light of longer wavelengths – red, orange, yellow, and green:

One or more array of solid-state light emitters (e.g., LEDs 21) are mounted on the circuit board 160. Each solid-state light emitter 21 can comprise a gallium nitride-based blue light emitting LED operable to generate blue light with a dominant wavelength of 455 nm-465 nm. The LEDs 21 can be configured as an array, e.g., in a linear array....

Id., 6:60-65.

The integrated wavelength conversion component 10 includes one or more photoluminescence materials (e.g., phosphor materials) which absorb a portion of the excitation light emitted by the LEDs 21a, 21b and re-emit light of a different color (wavelength). In some embodiments, the LED chips generate blue light and the phosphor(s) absorbs a percentage of the blue light and re-emits yellow light or a combination of green and red light, green and yellow light, green and orange or yellow and red light.

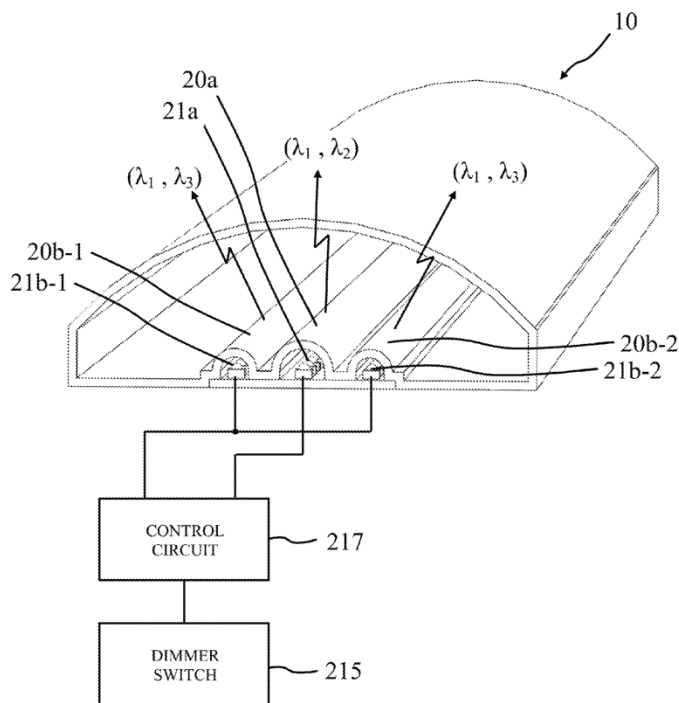
Id., 6:8-17.

113. Figure 3A of Edwards, reproduced below, illustrates the conversion of blue light, from the linear arrays of blue LEDs, into light of different colors in

“multiple wavelength conversion regions”. The result is to produce white light of a “first color temperature” or a “second color temperature”:

The integrated wavelength conversion component 10 includes multiple wavelength conversion regions with different photo-luminescent materials (e.g., for a first light emission color, more typically first color temperature), including a central wavelength conversion portion 20a having a first photo-luminescent material and one or more other outer wavelength conversion portions 20b-1 and 20b-2 that correspond to a different photo-luminescent material (e.g., for a second light emission color, more typically a second color temperature).

Ex.1005-5:41-48.



Ex.1005-Fig. 3A.

114. Edwards further describes:

The wavelength conversion component is operable to absorb a proportion of the blue light λ_1 generated by the LEDs and convert it to light of a different wavelength by a process of photoluminescence (e.g., first portion converts light to λ_2 and the one or more second portions converts light to λ_3).... Thus, light of wavelength λ_2 is generated by the first region (portion 20 a) and light of wavelength λ_3 is generated by the one or more second regions (portions 20 b-1, 20 b-2). The CCT of the emission product from the device is a combination of the CCT of the light generated by the LED (λ_1), the CCT of the light (α_2) generated by the first region, and the CCT of the light (α_3) generated by the second region.

Ex.1005-11:6-23.

115. The Greek letter lambda in Fig. 3A above indicates the peak wavelengths of light produced by wavelength conversion portions 20a, 20b-1, and 20b-2.

116. Thus, each of the LEDs 21a provides a first color temperature when its emitted light is passed through the corresponding wavelength conversion component for the LEDs 20a and each of the LEDs 21b provides a second color temperature when their emitted light is passed through the second wavelength conversion portion 20b.

The wavelength conversion portions 20a, 20b-1, 20b-2 are positioned remotely to the plurality of arrays of blue light emitting LEDs (blue LEDs) 21b-1, 21a, and 21b-2. The wavelength conversion component 10 comprises a first portion 20a composed of a first photo-luminescent material and one or more second portions 20b-1, 20b-2 composed of a second photo-luminescent material.

Ex.1005-10:49-55.

117. In summary, white light having a “first color temperature” and a “second color temperature” is produced in Edwards with blue LEDs and phosphors which convert the blue light into various visible light colors. Together, these colors result in light that is perceived by the human eye as white light having a particular CCT value. This is precisely the same process described in claim element [1b]. Although the phosphors of Edwards are not applied directly to an upper surface of the blue diode, I see nothing in the claim language that requires phosphors to reside in contact with the blue LED. In addition, I can find no discussion in the specification of the '302 Patent regarding the location of the phosphors for each (or any) LED. .

118. Therefore, Edwards' LEDs function in precisely the same manner as that of all other white-light LEDs – namely, blue LEDs producing white light from combinations of phosphors..

119. For the purposes of the claim element, each “LED” may be one of the LEDs 21a (first plurality) or LEDs 21b (second plurality) or an LED (21a and 21b) in combination with a respective corresponding wavelength conversion component (20a and 20b).

120. Neither the language of Claim 1[b] (“a first plurality of LEDs configured to produce a first light having a first color temperature”) nor the '302

Patent specification identify any LED wavelength conversion materials (e.g., phosphors) or the manner in which any LED is constructed. The ‘302 Patent specification does not exclude blue LEDs separated by a small distance from its phosphor. Furthermore, the ‘302 Patent specification and claims do not require that the LEDs in a “string” be the same in any respect. The text of the specification simply requires certain specifications for the entire string. For example:

To control the color temperature output of the linear LED light fixture, the light fixture may include multiple strings of LEDs in the LED array that produce light at multiple color temperatures. That is, for example, the linear LED light fixture may include two distinct linear strings of LEDs, such that one linear string of LEDs has a first color temperature, meaning it produces light at one color temperature (e.g., 3000 Kelvin), and a second linear string of LEDs has a second color temperature, meaning it produces light at another color temperature (e.g., 4000 Kelvin). Reference to producing light at a particular color temperature generally means producing light within a range approximate a color temperature value.

Ex.1001-4:51-60.

121. The above text tells a POSA what the optical characteristics of a “string” of LEDs, *viewed in the aggregate*, must be. POSAs with experience will recognize that specifying CCT, luminance, etc., at the “string” level, opens the door to a range of design options because white light can be synthesized from a group of blue, yellow, orange, and red LEDs. Furthermore, the efficiencies of red, orange, and yellow LEDs are considerably higher than the efficiency of blue light converted in a yellow phosphor, orange phosphor(s), or a red phosphor. The

reasons for this statement are grounded primarily in what is known as the quantum efficiency for the color down-conversion process.

122. Edwards discusses the fact that LEDs were (and are today) available in different colors (red, orange, yellow, and even green) and would, even without one or more phosphors, be capable of generating white light from, for example, LED array 21*a*. Ex.1005-6:25-30. Edwards states:

As is evident, the invention may be practiced using any combination of LEDs 21 that produce different colors of light. For example, another embodiment may include an array of LEDs 21 that comprise both blue LEDs and red LEDs.

Ex.1005-6:25-29.

123. A POSA is very familiar with the fact that white light can be produced when various colors from the visible spectrum are combined. Consequently, it is not necessary that the LEDs in arrays 21*a*, 21*b*-1, or 21*b*-2 all be blue LEDs. Neither is it necessary for the light emitted by the LEDs to be converted in wavelength, regardless of whether the phosphor is applied directly to the LED or not. Instead, if blue, red, yellow, orange and yellow LEDs, arranged by a POSA in a linear array and intermixed, would appear to an observer as being white.

124. In short, the '302 Patent specification and claims place few requirements on the LED that comprise a "string". In my opinion, therefore, separating a blue LED from a phosphor by a small distance or inserting several

different color LEDs in a string to “synthesize” light that is perceived by the human eye as white are both viable options to satisfy the claim language.

125. Additionally, while the LEDs may produce light of a different color temperatures through the wavelength conversion components, Edwards discloses that the sets of LEDs themselves may emit different colors, with one group being red, and another group being blue, and would thus produce light having different color temperatures directly from the dies. Ex.1005-6:25-30. Therefore the red and blue LEDs could be arranged in lines 21a and 21b so as to realize Edwards’s goal of providing different color temperatures.

126. For the above reasons, it is my opinion that Edwards meets all requirements of limitation [1b] of the ‘302 Patent.

127. However, should the PTAB rule that the LED array 21a and wavelength conversion region 20a of Edwards do not satisfy the Claim [1b] language: “a first plurality of LEDs configured to produce a first light having a first color temperature” because the wavelength conversion phosphors of Edwards are not in direct contact with the blue LED, then it would be obvious to a POSA to combine Edwards with Sadwick.

128. In the discussion to follow, it is assumed that the blue LED-phosphor arrangement of Edwards is found to not meet the language of claim element [1b]: “a first plurality of LEDs configured to produce a first light having a first color

temperature”. In this case, a POSA would wish to insert Sadwick’s disclosure of “phosphor coated” LEDs into Edwards. Ex.1006¶0263.

129. Indeed, Sadwick shows in Fig. 35 (reproduced below) “two banks 820, 822, which, as a non-limiting example, can each be series strings of white LEDs, such as, but not limited to, a string 820 of 2200 degree Kelvin warm white LEDs and a string 822 of 6500 degree Kelvin cool white LEDs.” Ex.1006¶0194.

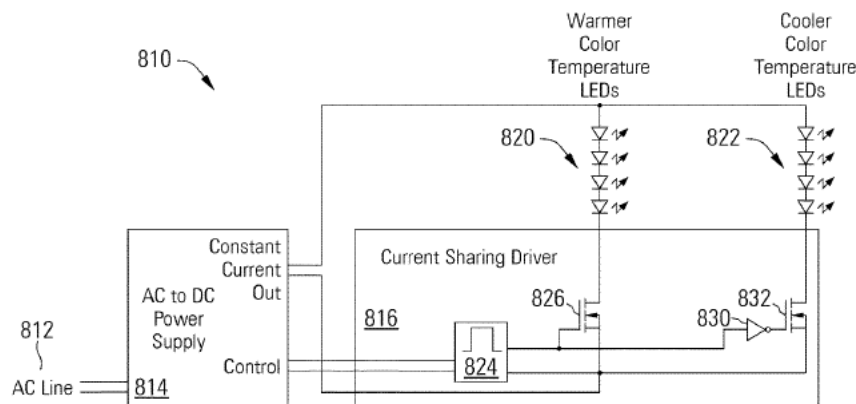


FIG. 35

Ex.1006-Fig. 35.

130. Although the phosphor-coated, integrated wavelength conversion component 10 of Edwards has the advantage of not requiring a diffuser, its manufacturing and materials cost would present significant drawbacks for commercialization, and a POSA would definitely be motivated to replace it with Sadwick’s LEDs for which the desired phosphor mixture is integrated into the LED itself and its packaging.

131. Long before the priority date for the '302 Patent, a POSA would be aware of the cost and manufacturing advantages of employing white LEDs having the same CCT value in arrays for a luminaire. A number of vendors manufacturing such white LEDs were available at that time and at present. The primary incentive for employing the integrated wavelength conversion component 10 of Edwards in a commercial product is the diffuse, spatially-uniform light produced by Edwards' component 10. Also, the luminaire described by Edwards allows for the blue LED arrays to be "swapped out" easily which may be of value in certain office building or public school applications.

132. Overall, however, the higher cost of manufacturing Edwards' luminaire is, for many commercial products, the deciding factor in a POSA's decision to employ the white LEDs of Sadwick in Edwards' luminaire. In this way, the integrated wavelength conversion component 10 can be simply discarded – the substitution is straightforward and thus a POSA could make the modification with more than a reasonable expectation of success.

4. [1c] a second plurality of LEDs configured to produce a second light having a second color temperature different from the first color temperature, wherein the second plurality of LEDs align within a second linear shape;

133. Edwards meets this limitation and renders it obvious either alone or in combination with Sadwick.

134. All of the comments made above with respect to claim element [1b] are applicable to claim element [1c]. Specifically, Edwards introduces a first set of LEDs 21a and a second set of LEDs 21b, each arranged in a linear fashion and each set producing a different color temperature through an associated wavelength conversion portion 20a or 20b. Consider Edwards' description of the production of white light having a "second color temperature":

FIGS. 1A-C illustrate a surface mountable wraparound linear lighting arrangement 260 according to embodiments of the invention. The surface mountable lighting arrangement 260 includes a hollow integrated wavelength conversion component 10 and a substrate 160 having multiple arrays of LEDs 21. For linear applications, the wavelength conversion component 10 and the substrate 160 having the LEDs 21 are elongated components. The integrated wavelength conversion component 10 includes multiple wavelength conversion regions with different photo-luminescent materials (e.g., for a first light emission color, more typically first color temperature), including a central wavelength conversion portion 20a having a first photo-luminescent material and one or more other outer wavelength conversion portions 20b-1 and 20b-2 that correspond to a different photo-luminescent material (e.g., for a second light emission color, more typically a second color temperature).

Ex.1005-5:32-48.

135. Specifically, the blue arrow and blue rectangular box of Fig. 1b of Edwards, annotated and reproduced below, show a second plurality of LEDs (LED array 21a) aligned within (or having) a second linear shape.

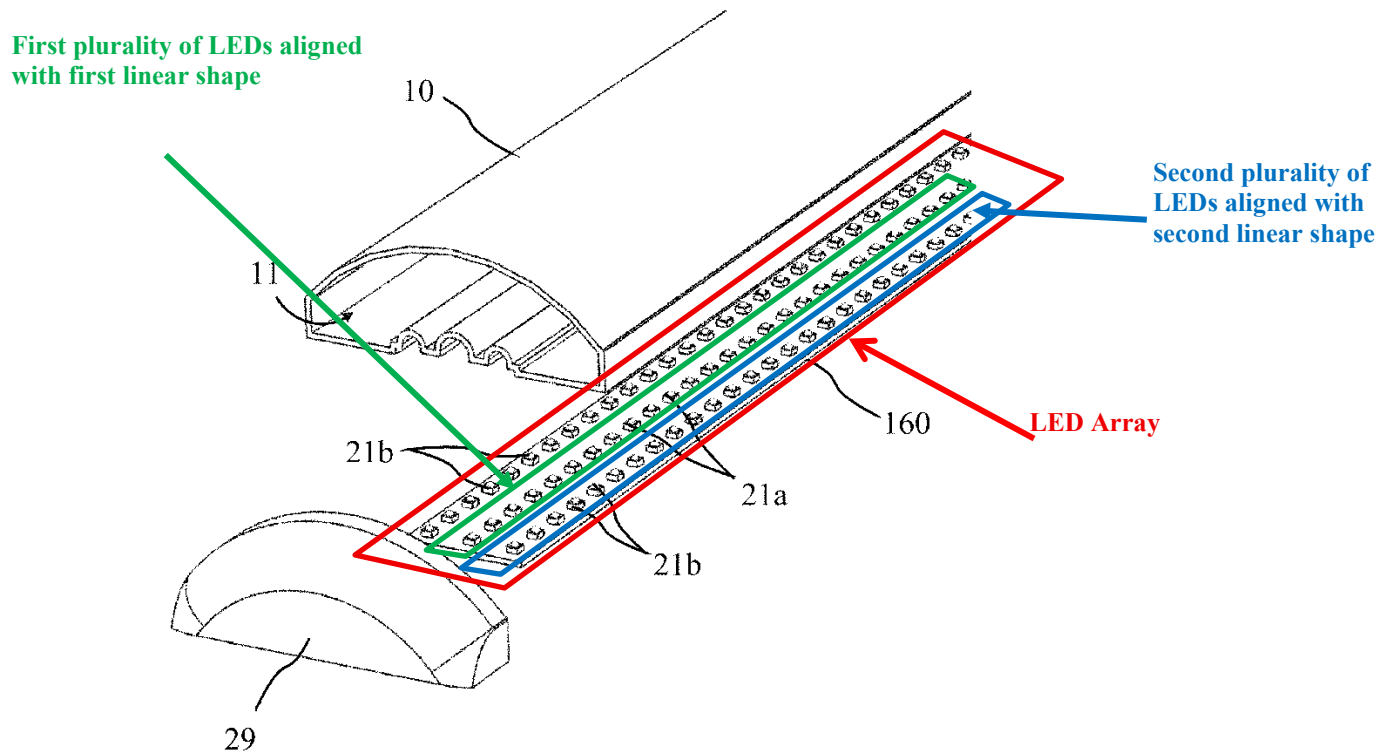
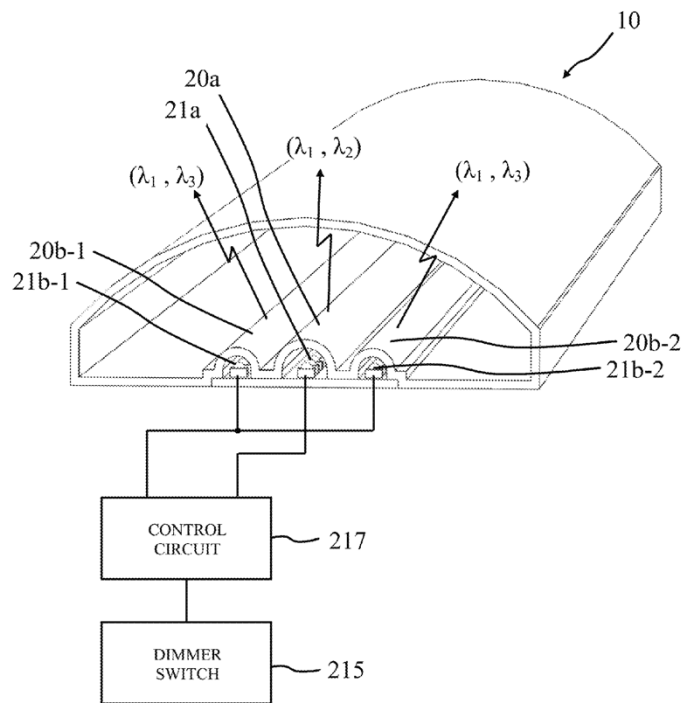


FIG. 1B

Ex.1005-Fig. 1B-Annotated. *See also* Ex. 1005-11:6-23.

136. It is clear, therefore, that Edwards dedicates LED arrays 21b-1 and 21b-2 and wavelength conversion portions 20b-1 and 20b-2, respectively, to the generation of white light having a *second* value of the color temperature (CCT). Figure 3A of Edwards (reproduced below) illustrates the locations of the three linear LED arrays and their corresponding wavelength conversion portions.



Ex.1005-Fig. 3A.

137. For the above reasons, it is my opinion that Edwards meets all requirements of limitation [1c] of the ‘302 Patent.

138. However, should the PTAB rule that the LED array 21b-1 (or 21b-2) and wavelength conversion region 20b-1 (or 20b-2) of Edwards do not satisfy the Claim [1c] language: “a second plurality of LEDs configured to produce a second light having a second color temperature different from the first color temperature” because the wavelength conversion phosphors of Edwards are not in direct contact with the blue LED, then it would be obvious to a POSA to combine Edwards with

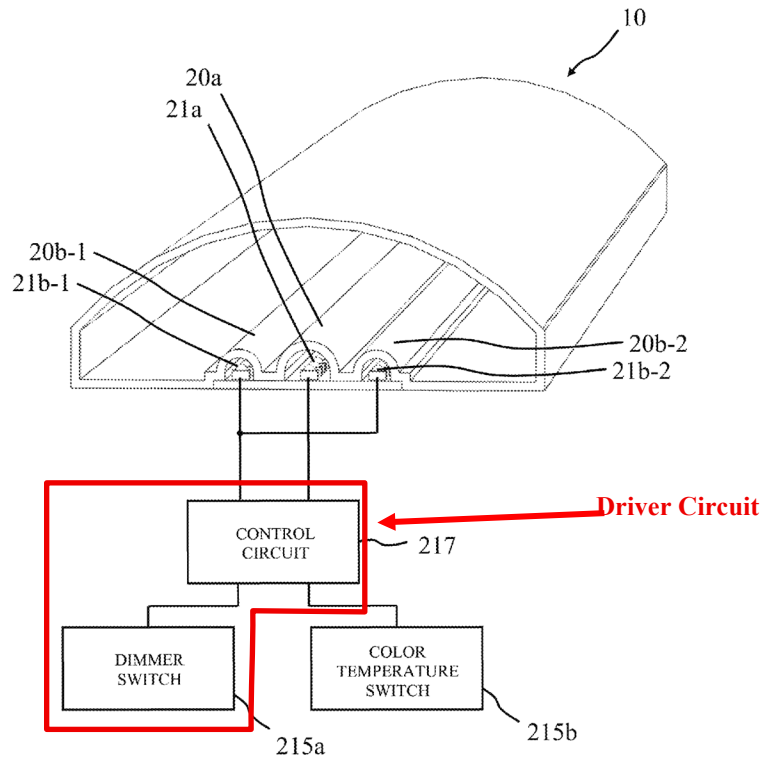
Sadwick to incorporate Sadwick's disclosure of phosphor coated LEDs for the same reasons that I described above with respect to element 1[b].

5. [1d] a driver circuit configured to output a plurality of currents;

139. Edwards meets this limitation, either alone or in combination with Sadwick.

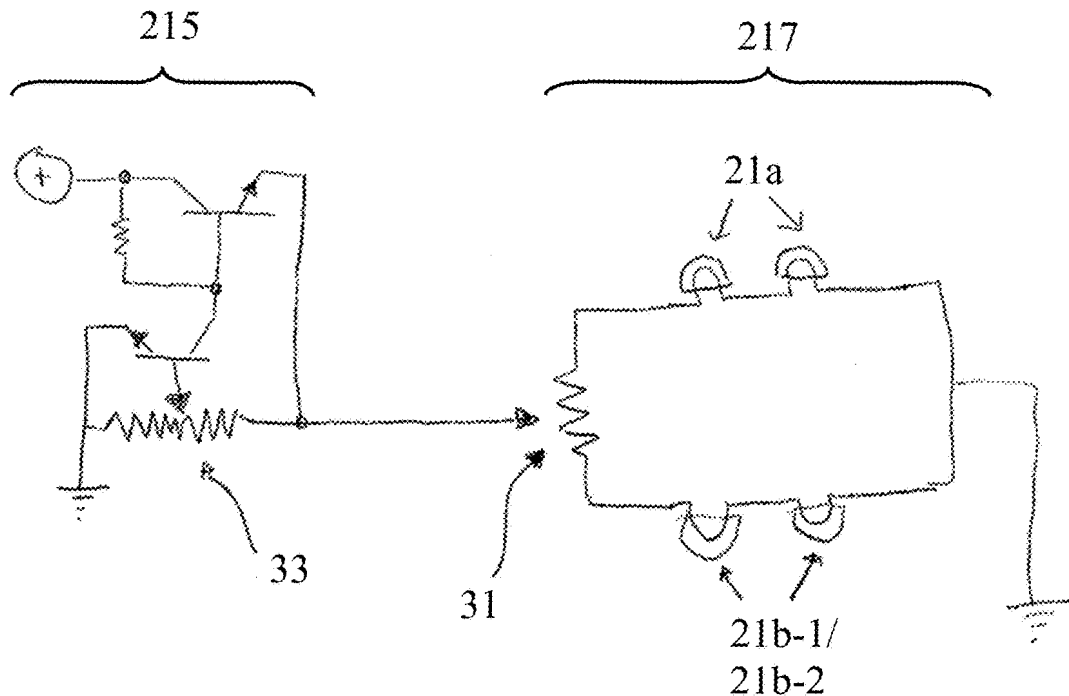
140. Figures 5 and 6 of Edwards provide circuits that produce a "plurality of currents" to drive the arrays of Fig. 1B discussed earlier.

141. Particularly, the control circuit 217, either alone or in combination with the dimmer switch 215a acts as a driver circuit.



Ex.1005-Fig. 3B-Annotated.

142. Figure 5 illustrates one example of the dimmer switch and control circuit which together can provide a plurality of currents.



Ex.1005-Fig.5.

143. The operation of the combined circuit is described below.

The dimmer switch portion 215 of the driver circuit comprises a potentiometer/variable resistor 33 for controlling the relative amount of power to be applied to the LED arrays. The output voltage to be applied to the control circuit 217 therefore controls the brightness of the LED arrays.

Ex.1005-14:1-5.

144. The voltage source at upper left in the above diagram is denoted by the “+” symbol. The circuit above produced “a plurality of currents” when the

variable resistor 33 is varied to control the current provided provided to the LEDs 21a and 21b.

145. Furthermore, the control circuit 217 also provides a plurality of currents to the LEDs 21, based on the current received from the dimmer switch 215.

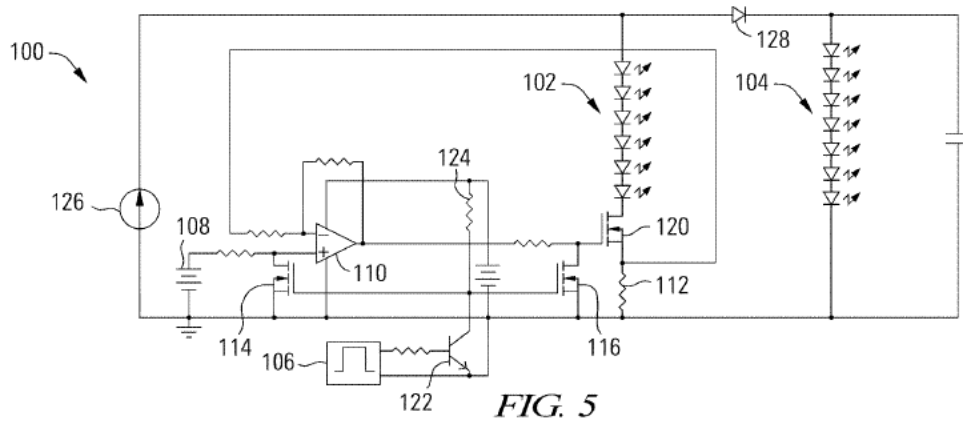
146. As discussed below, the variable resistor 31 acts as what is known in electrical circuits as a “current divider” that determines the relative currents flowing through LEDs 21a, 21-b/1, and 21-b/2 for the purpose of controlling both luminance and color temperature. The choice of current provided to each linear array of LEDs also determines the voltage that appears across each series-connected LED array and, therefore, the voltage imposed on each individual LED.

147. In my opinion, therefore, this limitation is met by Edwards.

148. To the extent that this limitation is not found to be met by Edwards, a more detailed and sophisticated driver circuit is provided by Sadwick which describes a “current driver” and/or a “variable constant current driver” for driving its LEDs to control brightness. Ex.1005¶¶0053,0057. A POSA would understand readily that these circuits are capable of producing a wide range (“plurality”) of currents which flow through the linear diode arrays 102 and 104.

149. Sadwick also describes a “current control circuit which can be used to set the current level through one or more one or more strips/arrays/strings/etc. 102,

104 of solid state light sources in general including but not limited to LEDs, OLEDs, QLEDs, etc.... The current through an SSL string 102 is measured by a current sensor 112 and is fed back to the inverting input of the amplifier 110, where it is compared with the current set point voltage 108.” Ex.1006¶0048.



Ex.1006-Fig. 5.

150. Similarly, with respect to its Fig. 35 embodiment, Sadwick specifically notes that an “AC to DC power supply 814 converts an AC input 812 to produce a constant current output used that can be dimmable for example but not limited to 0 to 10 V dimming (*i.e.*, the constant current is adjustable and dimmable based on the dimming input).” Ex.1006¶0194.

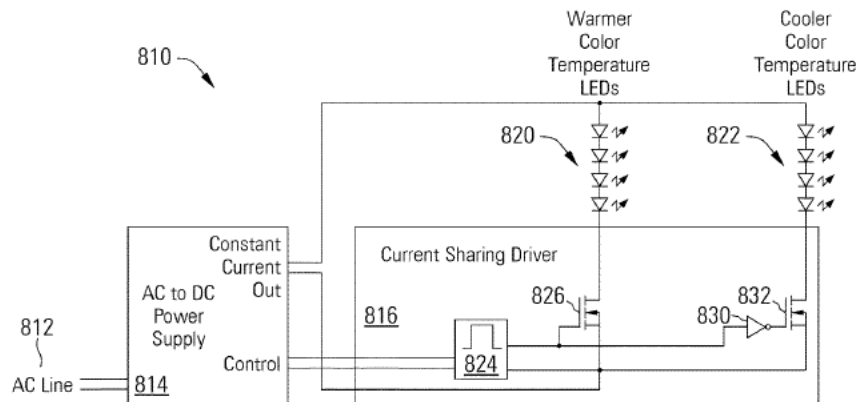


FIG. 35

Ex.1006-Fig. 35.

151. Each of the above embodiments entails an electrical driver “configured to provide a plurality of currents.”

152. A POSA could implement either the driver circuit 814 of Sadwick for the purpose of providing currents to the control circuit of 217 Edwards, or alternatively incorporate the entirety of the circuit of Figure 35 in its entirety, replacing the LEDs as well.

153. A POSA would be motivated to modify the design of Edwards with any of the adjustable current circuits of Sadwick, including the current divider circuits of Sadwick and/or the variable/adjustable current drivers with a reasonable expectation of success because such components have been available since the earliest radio circuits.

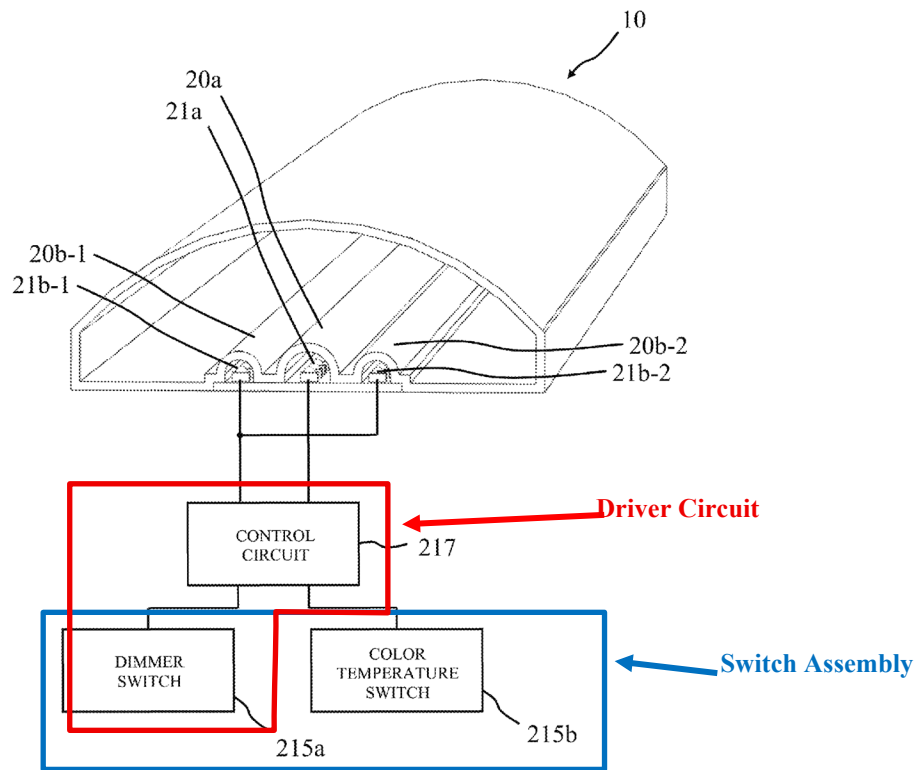
154. The current control devices of Sadwick would allow for more granular control of power and current levels and allow for Edwards to implement additional control mechanisms for controlling brightness. Including the current control features of Sadwick in Edwards would be a combination of known features to obtain a predictable result. Because the circuits of Edwards and Sadwick use standard and known components, a POSA could easily implement the current control circuit of Sadwick in Edwards to control the brightness of the circuit and thus would have a reasonable expectation of success.

6. [1e] a switch assembly configured to couple to the driver circuit, wherein the switch assembly comprises:

155. Edwards also meets this limitation. Edwards states that the dimmer switch 215a and color temperature switch 215b act as a switch assembly that is coupled to the control circuit 217. Specifically, Edwards states that “independent controls can be applied to separately control both the dimming level of the lighting device as well as its color temperature.” Ex.1005-13:24-35. A POSA would immediately recognize that the most widely-used circuit components for “controls” to specify the “dimming level” are dimming switches which combine a simple single-pole, single throw switch with a potentiometer (variable resistor). Consequently, two dimming switches in tandem (similar to the circuitry of Fig. 5 of Edwards) would constitute a switch assembly. In such an arrangement, one or

more dimmer switches 215a would act as both a component of the driver and a component of the switch.

156. Edwards describes Fig. 3B as a “linear lighting device having control circuitry to dimmably adjust the linear lighting in conjunction with adjustments to its control temperature.” Ex.1005-4:38-41. Consequently, a POSA would understand dimmer switch 215a and color temperature switch 215b to be part of Edwards’ luminaire (fixture).



Ex.1005-Fig.3B-Annotated

7. [1f] a first switch configured to cause the driver circuit to output one of the plurality of currents;

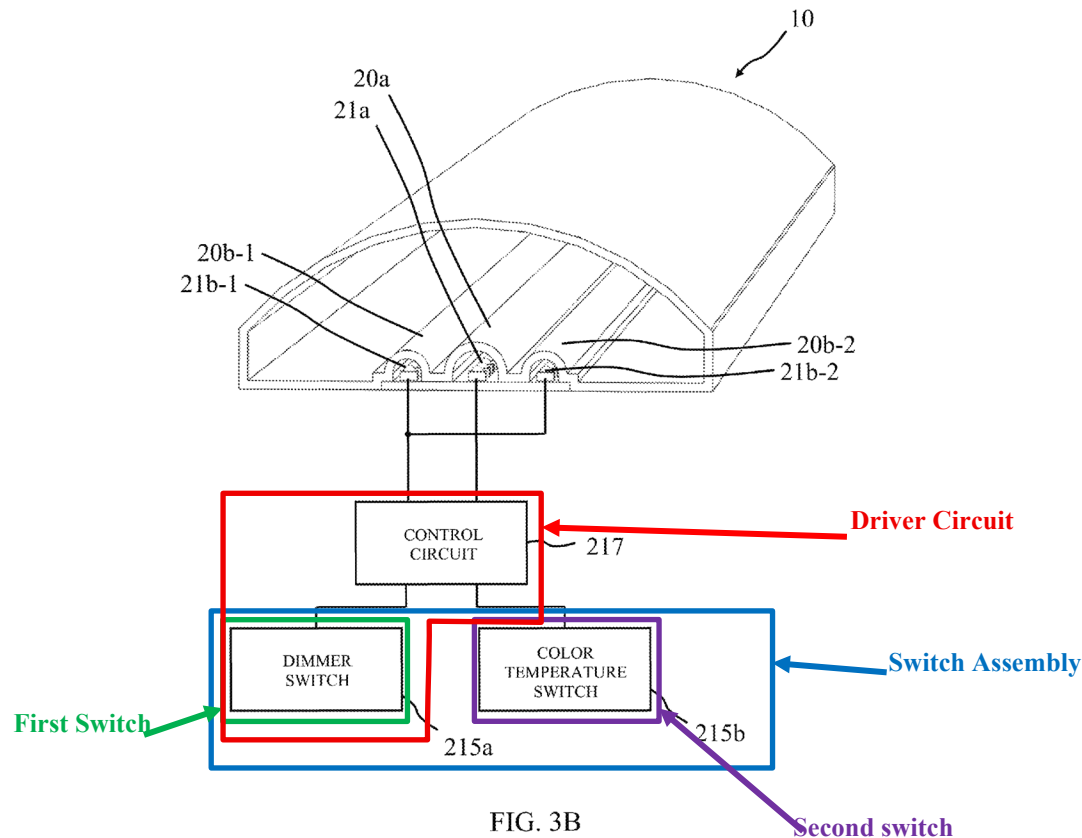
157. Edwards meets this limitation in the form of the dimmer switch 215a which, integrated into one or more current dividers such as that shown in Fig. 5 of Edwards, will provide a “plurality of currents” which, in turn controls the overall brightness level. Edwards states that “operation of the dimmer switch 215a will change the overall amount of power to be collectively provided to the 30 LEDs 21a, 21b-1, and 21b-2” and that “the overall brightness of the light is controlled by dimmer switch 215a.” Ex.1005-13:29-35. As described above adjustment of the resistor 33 through the dimmer switch 215a controls the overall current provided to the LEDs and thus a plurality of currents is provided. Ex.1005-14:1-5.

158. The ability to continuously vary or “tune” the current in the LEDs meets the claim element language of providing a “plurality of currents”.

159. To the extent that this is not taught by Edwards, as I describe above for element 1[d] a POSA would find it obvious to use the current control features of Sadwick to control brightness in Edwards.

160. As I discuss above with respect to element 1[d], Sadwick discloses a similar dimmer function that can adjust between a plurality of currents. As set forth for element 1[d] a POSA would be motivated to control the brightness of Edwards using one or more of the current control mechanisms of Sadwick and so doing

would output a plurality of currents. In so doing the current control would be responsive to the dimmer switch 215a of Edwards.

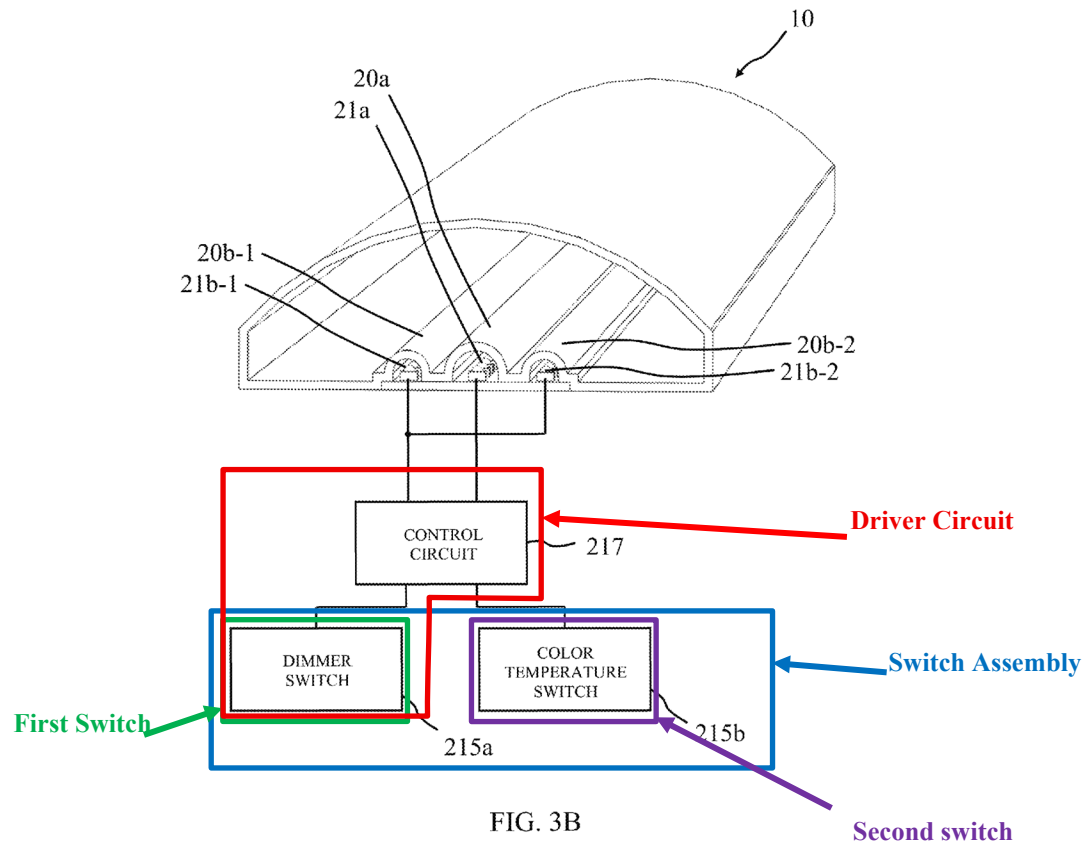


Ex.1005-Fig.3B-Annotated.

8. [1g] a second switch configured to cause the one of the plurality of currents to couple to the first plurality of LEDs, the second plurality of LEDs, or both; and

161. Edwards also meets this claim element language, which is the second switch, 215b, which controls the color temperature.

162. Edwards discloses that the dimmer switch 215 as including color temperature switch 215b which controls the current to each set of LEDs for the purpose of controlling the overall color temperature.



Ex.1005-Fig.3B-Annotated.

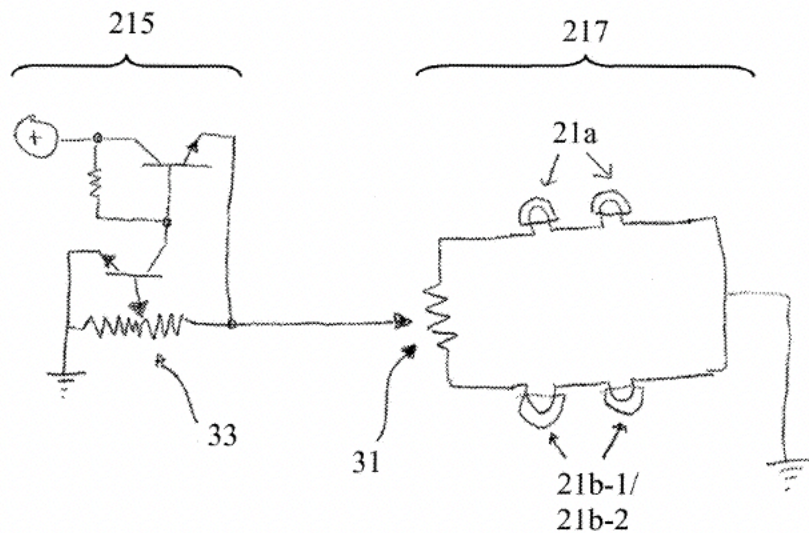
163. Specifically, Edwards states that “[t]he color temperature of the final light emission is controlled by the color temperature switch 215b, where a cooler light emission is produced by shifting a higher proportion/ratio of the power to the LEDs 21a that corresponds to portion 20a (cool white light) and shifting a lower

proportion/ratio of the power to the LEDs 40 21b-1 and 21b-2 that corresponds to portions 20b-1 and 20b-1 (warm white light).” Ex.1005-13:35-42.

164. Edwards states that the current supplied to each set of LEDs may be turned off entirely, and therefore “the combination of the emission product may be modified, for example, by altering the drive currents of the LED arrays....the CCT of the emission product may correspond to a cool bluish white color when the entirety of the plurality of LEDs is turned on and shift towards a warm yellowish white color as the second set of LEDs corresponding to the second region (e.g., region generating light with a CCT corresponding to a cool blueish white) of the wave length conversion component are turned off.” Ex.1005-12:6-20.

165. A POSA would understand that, by controlling the overall current from the driver circuit and specifying the proportion of the total available current to be made available to each individual set of LEDs, Edwards is “coupling” the required plurality of currents to the LED strings.

166. As described previously, Edwards states that such simple current distribution circuitry can include “resistor 31 [which] is configured as a potential divider and is used to select the relative drive currents I_A and I_B to achieve selected correlated color temperature (CCT).” Ex.1005-14:17-19.



Ex.1005-Fig. 5

167. In describing Figure 5 of Edwards, Edwards explains that

The control circuit 217 comprises a variable resistor 31 R_w for controlling the relative drive currents I_A and I_B to the first and second LED arrays 21 a and 21 b-1/21 b-2. The LEDs of each of the first and second LED arrays 21 a and 21 b-1/21 b-2 are connected in series and the LED arrangements connected in parallel to the variable resistor 31. The variable resistor 31 is configured as a potential divider and is used to select the relative drive currents I_A and I_B to achieve a selected correlated color temperature (CCT).

Ex.1005-14:10-19.

168. In Fig. 5 of Edwards above, the two branches of control circuit 217 contain LED arrays 21a, 21b-1, and 21b-2. In this clever circuit design, therefore, variable resistor 31 acts as a current divider. Accordingly, through the

mechanisms of Figure 5 the “plurality of currents” provided by the driver circuit of Edwards is coupled to either the first or second plurality of LEDs or both.

169. Similarly Figures 6 and 7 incorporate current dividers that can be used for controlling the color temperature. Either of these circuits could similarly perform the function of controlling color temperature in Edwards so as to meet claim element 1[g].

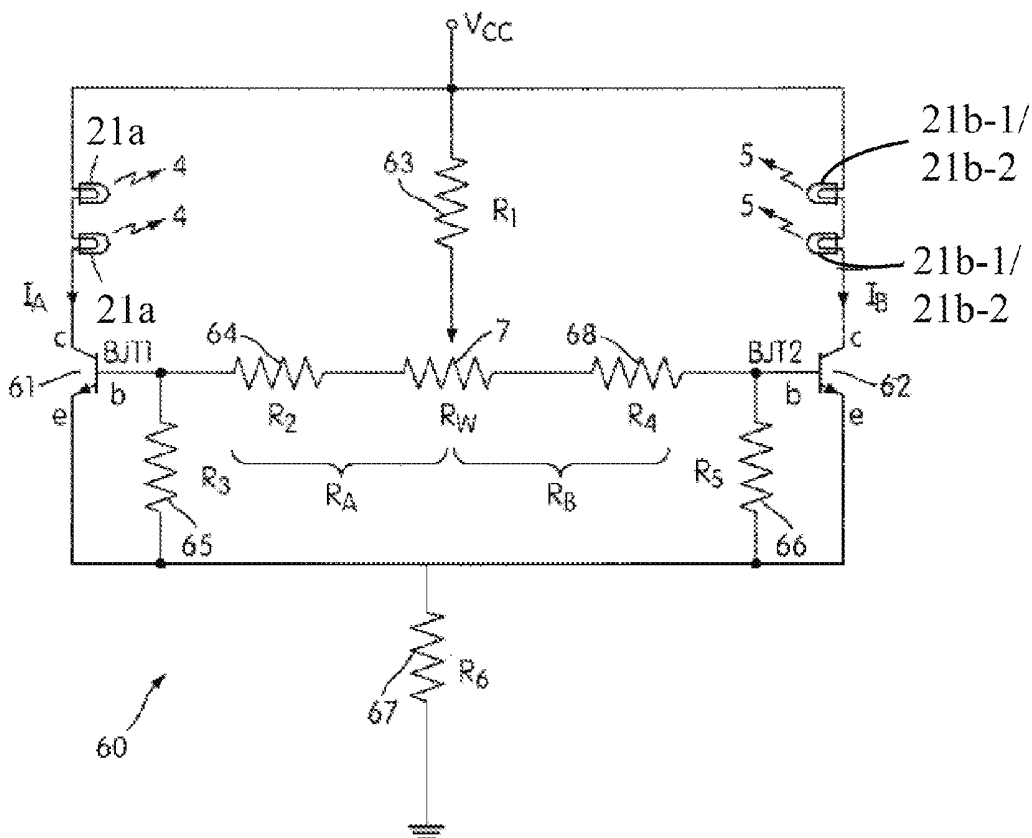
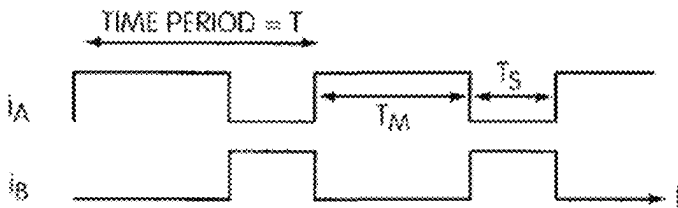


FIG. 6

Ex.1005-Fig.6.



Ex.1005-Fig.7.

170. Sadwick incorporates current dividers for controlling color temperature by coupling one of its pluralities of currents to the first plurality of LEDs, second plurality of LEDs, or both. Figure 35 of Sadwick (reproduced below) shows one current splitter circuit that can be employed to apportion the current, produced by a single DC power supply, between LED arrays 820 and 822. Notice that the driver 816 is termed the “Current Sharing Driver”. The principles

behind current dividers and current splitters assume an important role in the '302 Patent and the Prior Art discussed in the remainder of this report.

171. The circuitry shown in Fig. 35 of Sadwick (reproduced below) includes the “Current Sharing Driver” 816 which serves the purpose of controlling the percentage of the current, produced by the power supply 814, that flows through LED arrays 820 and 822. A POSA would recognize that the driver 816 is a current splitter that divides or “splits” the current made available by the power supply. As Sadwick describes:

FIG. 35 depicts a non-limiting example schematic of a 2-channel current splitter 810 for SSL lighting. Current is time-divided between two banks 820, 822 of solid state lighting of any type, alternately lighting one and then the other. This can be used to tune the apparent color temperature of white LEDs, for example, or can be used to blend colors or different types of lighting.

Ex.1006¶0194.

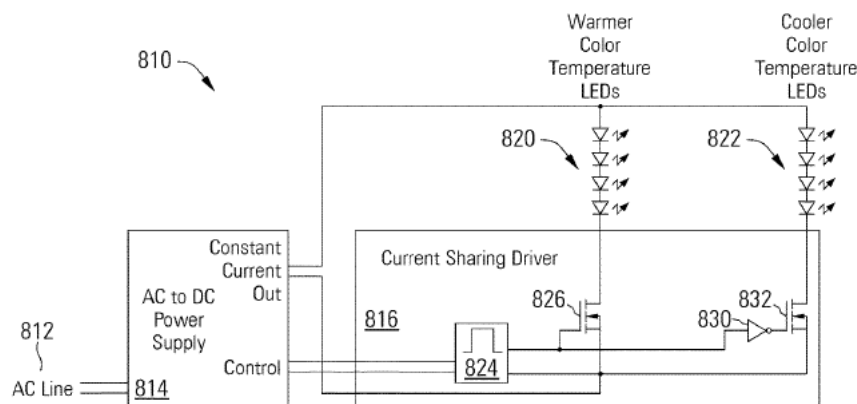


FIG. 35

Ex.1006-Fig.35.

172. The current splitter shown by Sadwick in Fig. 35 above is known as a “time splitter”. That is, it “splits” current in time by rapidly turning on and off the LED arrays. The frequency at which this is done is sufficiently high that the observer perceives the light from each LED array to be constant. In this way, the time-averaged current of the two LED arrays can be divided continuously between the two LED arrays. The advantage of this current-splitting technique is that, at any given time, only one of the two arrays is “on”. Sadwick describes this current splitter in the following way:

FIG. 35 depicts a non-limiting example schematic of a 2-channel current splitter 810 for SSL lighting. Current is time-divided between two banks 820, 822 of solid state lighting of any type, alternately lighting one and then the other. This can be used to tune the apparent color temperature of white LEDs, for example, or can be used to blend colors or different types of lighting.

Ex.1006¶0194.

173. Sadwick explains that this splitter “powers ... two banks 820, 822” having different color temperatures and that through “rapid switching of current between the two banks 820, 822 and balancing the duty cycle that apportions current between the two banks ... an apparent color temperature can be produced anywhere between the 2200K warm white and the 6500K cool white that can be free of flicker.” Ex.1006¶0194.

174. In my opinion, therefore, Edwards or Edwards combined with Sadwick meets the limitation that “the plurality of currents” must be “coupled” by a switch “to the first plurality of LEDs, second plurality of LEDs or both”. As discussed earlier, the switches, variable resistors, and current dividers of Edwards or the “time splitters” of Sadwick (in which current is switched on and off in a manner chosen to apportion current between linear arrays (strings) of LEDs) serve to “couple” current to the first and second plurality of LEDs and apportion that current between the two (or more) pluralities.

175. As I describe above for elements 1[a] and 1[d] it would be obvious to a POSA use the current control mechanism of Sadwick with the disclosure of Edwards. For similar reasons, it would also have been obvious to use the color temperature control mechanism of Sadwick in combination with Edwards’s color temperature control switch 215b. Doing so would meet this limitation.

9. [1h] wherein the linear LED lighting apparatus is configured to electrically couple to an additional linear LED lighting apparatus having a second length different than the first length by a scale factor, wherein the additional linear LED lighting apparatus is configured to produce a third light having the first color temperature via a third plurality of LEDs or a fourth light having the second color temperature via a fourth plurality of LEDs.

176. Edwards discloses this limitation. Specifically, Edwards shows that fixtures can be serially connected, with each fixture providing power to the next fixture.

177. It should first be mentioned that Edwards states that the lighting fixture and electronics may be placed in a “case 1307” and that “[t]he case 1307 may further comprise an electrical connector 1309 (e.g., plug) extending past the length of the body 1301 on one end, and a recessed complimentary socket (not shown) configured to receive a connector on another end”. The full text is:

The linear lamp 1300 comprises an elongated thermally conductive body 1301 fabricated from, for example, die cast aluminum. The form factor of the body 1301 is configured to be mounted with a standard linear lamp housing. The body 1301 further comprises a first recessed channel 1304, wherein a rectangular tube-like case 1307 containing some electrical components (e.g., electrical wires) of the linear lamp 1300 may be situated. The case 1307 may further comprise an electrical connector 1309 (e.g., plug) extending past the length of the body 1301 on one end, and a recessed complimentary socket (not shown) configured to receive a connector on another end. This allows several linear lamps 1300 to be connected in series to cover a desired area. Individual linear lamps 1300 may range from 1 foot to 6 feet in length.

Ex.1005-15:46-60.

178. The points to be emphasized are: 1) electrical connector 1309 and the recessed complementary socket allow for “several linear lamps 1300 to be connected in series”, and 2) the individual lamps connected in series may range in length from 1-6 feet. One skilled in the art would recognize that Edward’s limit of six feet in length is by no means a fixed upper limit. More importantly, Edwards states that the lamps connected in series may differ in length so as to accommodate the requirements of a particular lighting installation. The ceiling space to be occupied by luminaires, for example, will naturally differ from installations in warehouses to those in office buildings, hotels, and schools. Consequently, a POSA is very familiar with the necessity of having linear lamp fixtures available in different lengths. It is also essential that one or more electrical connections be available on each fixture for electrically connecting the set of fixtures in series. Otherwise, it would be necessary to “run” 120 VAC, single-phase power to each fixture separately. One does not need to be a POSA to recognize that the cost of such a requirement would be prohibitive. Lastly, it is obvious to anyone that the difference in length between linear lamp fixtures can be described by a “scale factor”. Edwards further discloses that “[i]ndividual linear lamps 1300 may range from 1 foot to 6 feet.” Ex.1005-15:59. A POSA would understand that a six-foot fixture and a one-foot fixture vary in size by a scale factor—e.g., a six-foot fixture and a one-foot fixture have a different length by a scale factor of six.

179. Consequently, given that Edwards discloses the connection of multiple fixtures in sequence, a POSA would understand that all of the structures in a first connected fixture would also be present in another connected fixture, including those I discuss for elements 1[pre]-1[g].

180. Finally, a POSA would also understand (in light of the earlier discussion concerning claim elements 1[pre]-1[h]) that a second fixture electrically connected to the first fixture would necessarily be able to produce “a third light having the first color temperature via a third plurality of LEDs or a fourth light having the second color temperature via a fourth plurality of LEDs.” That is the “third light having the first color temperature via a third plurality of LEDs” would correspond to the light produced by the first plurality of LEDs of the first fixture and the “fourth light having the second color temperature via a fourth plurality of LEDs” would correspond to the second light produced by the second plurality of LEDs of the first fixture. In plain language, the ability to electrically connect linear lamp fixtures (or any lamp fixture, for that matter) in series allows for an installer to produce light from the second fixture, and the following fixtures in series, having the same characteristics as that generated by the first lamp fixture.

2. 2. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions.

181. This limitation is also met by in Edwards. A POSA would understand that a color temperature switch 215b, which controls the color temperature would necessarily have a plurality of selectable positions.

182. Further as described above for element 1(h) the color temperature switch 215b can be used to change the color temperature between multiple settings. Edwards discloses that the dimmer switch includes an “on” position (Ex.1005-13:6-8) and that the color temperature switch would similarly have selectable positions, which control the fixture’s color temperature. Also, as discussed for claim element 1(g), the color temperature switch adjusts the resistor 31 for the purpose of controlling the distribution of current between the pluralities of LEDs.

183. Electrical switches have been available in a wide variety for more than 75 years and those most attractive for the “second switch” might be a rotary, slide, or multipole toggle switch and electronically-controllable versions of each. Any POSA would be quite familiar with these and other switches.

184. To the extent that it is not expressly disclosed, a POSA would be motivated to add multiple selectable positions to the color temperature switch 215b with a reasonable expectation of success because switches continue to be essential to the proper functioning of any electrical system. As described briefly in the

Technical Background section of this report, electrical switches have been known and manufactured since the 19th century in a variety of forms. Such a modification would be the combination of known elements to obtain predictable results.

3. 4. The linear LED lighting apparatus of claim 1, wherein the first color temperature corresponds to 3000 Kelvin and the second color temperature corresponds to 4000 Kelvin.

185. This claim element is rendered obvious by Edwards or Edwards in view of Sadwick.

186. Edwards presents 4000K as a potential color temperature for one of the pluralities of LEDs, noting “[v]arious percentages of the LEDs can be turned on/off for the different warm white settings, e.g., where 25% are on for a very warm white setting, such that a 4K lumen fixture would shift from 4000K CCT at full 40001 ms to 2200KCCT at > 10001 ms.” Ex.1005-13:9-13. In other words, the CCT can be varied between 4000 K and 2200 K at will.

187. Edwards also discloses that color temperatures of 3000K are desirable, noting that “[c]olor temperatures over 5,000 K are called cool colors (blueish white), while lower color temperatures (2,700-3,000 K) are called warm colors (yellowish white through red).... Typical incandescent light bulbs generate light of a warm yellowish white hue (e.g., 2,700-3,000K).” Ex.1005-2:49-62.

188. For LED lighting products, 3000 K and 4000 K are two of the most common CCT settings available. The lower of these, 3000 K, is desirable because

the light is perceived by the human eye as being similar to that produced by incandescent lighting.

189. Consequently, a POSA would be motivated to incorporate a combination of 3000 K LEDs (for the first set of LEDs) and 4000 K LEDs (for the second plurality of LEDs) in Edwards. Because both of these CCT values were well known and commonly used in LED lighting products, it would be obvious to choose 3000 K and 4000 K to be included in a set of CCT values.

190. While Edwards renders obvious this limitation on its own, to the extent that it is determined that Edwards does not render obvious a first set of LEDs with a 3000K color temperature it would certainly be obvious to combine Edwards with Sadwick. Sadwick discloses “connections 936 can go to two separate LED channels” having a color temperature such as “3000K.”

Ex.1006¶0201.

191. A POSA would be motivated to incorporate a combination of 3000K LEDs (for the first set of LEDs) into the disclosure of Edwards with a reasonable expectation of success. Such a combination would be a combination of known elements to provide predictable results. Given that 3000K was a well known and commonly used LED temperature, a POSA would expect them to work correctly to provide color temperatures between 3000K and 4000K. Accordingly, on the basis of Edwards, Sadwick, and the experience of a POSA with LED lighting products,

the choice of 3000 K and 4000 K as CCT values selectable with a switch would be obvious.

- 4. 5. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions, wherein each of the plurality of selectable positions is configured to cause the switch assembly to send a respective signal to the driver circuit, wherein the respective signal is configured to cause the driver circuit to output the one of the plurality of currents that corresponds to a current position of the plurality of selectable positions.**

192. Edwards discloses or renders obvious this limitation. Edwards discloses that the “dimmer switch portion 215 of the driver circuit comprises a potentiometer/variable resistor 33 for controlling the relative amount of power to be applied to the LED arrays. The output voltage to be applied to the control circuit 217 therefore controls the brightness of the LED arrays.” Ex.1005-14:1-5.

193. As Edwards notes above: “dimmer switch portion 215 of the driver circuit comprises a potentiometer/variable resistor 33 *for controlling the relative amount of power to be applied to the LED arrays.*” (emphasis added). As described elsewhere in this report, the variable resistors 31 and 33 in Fig. 5 of Edwards, for example, will, when inserted into a current divider circuit, result in the production of the “plurality of currents” that the claim requires. Furthermore, if the switch(es)

has “selectable positions”, such as a slide or rotary switch, each position of the switch will correspond to a particular value of current.

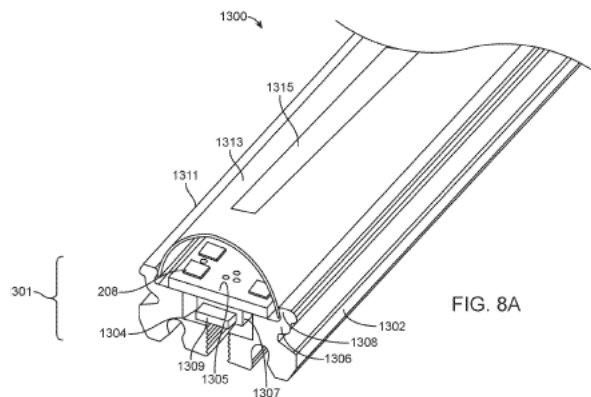
194. To the extent that this feature is not disclosed by Edwards, it would be obvious in view of Sadwick. Sadwick discloses that “the remote fluorescent lamp replacement ballast can use or receive control signals/commands from, for example, but not limited to any or all of wired, wireless...vibrational, and/or PLC, etc., combinations of these, etc...” Ex.1006¶0344. Such a component could easily be adapted to Edwards, with the control signal being sent from the color temperature switch 215b to cause the circuit of Edwards to change the color temperature.

195. A POSA would be motivated to implement control signals into Edwards with a reasonable expectation of success. The use of a control signal to modify the operation of an LED light was a common and favored way of controlling LED lights and allowed for more granular control. To the extent not already disclosed, including control signals would improve the ease of use of the system of Edwards and would be well within the understanding and capabilities of a POSA.

5. **6. The linear LED lighting apparatus of claim 1, comprising a housing comprising an interior volume configured to hold the driver circuit, the first plurality of LEDs, and the second plurality of LEDs.**

196. Edwards also discloses this limitation. As discussed earlier in this report, Edwards discusses in column 15 that the LED linear lamp LEDs and electronics are installed in a “body” which is to be mounted within standard housing, as is the case for most commercial luminaires: “The linear lamp 1300 comprises an elongated thermally conductive body 1301... The form factor of the body 1301 is configured to be mounted with a standard linear lamp housing.” Ex.1005-15:46-49. Figure 8A (reproduced below) shows the body 1301 which is designed “to be mounted with a standard linear lamp housing.”

197. Consequently, Edwards meets claim 6 by providing the required housing.



Id.-Fig. 8A.

6. 7. The linear LED lighting apparatus of claim 6, wherein the housing comprises a length greater than or equal to 24 inches.

198. Edwards meet this limitation because Edwards explicitly states that: “[i]ndividual linear lamps 1300 may range from 1 foot to 6 feet.” Ex.1005-15:59. Of course a POSA would understand that the housing which holds LED lamps would necessarily be larger than the LED lamps themselves.

7. 9. The linear LED lighting apparatus of claim 1, comprising at least one electrical connection configured to transmit electricity from the lighting apparatus to at least one other lighting apparatus.

199. As discussed above, the LED lamp fixtures of Edwards are designed to be connected in series (or parallel, if desired) and provide power to the next fixture or luminaire.. Edwards discloses that the case 1307 “may further comprise an electrical connector 1309 (e.g., plug) extending past the length of the body 1301 on one end, and a recessed complimentary socket (not shown) configured to receive a connector on another end” and that “[t]his allows several linear lamps 1300 to be connected in series to cover a desired area.” Ex.1005-15:53-58. A POSA would understand from this disclosure that electricity is being transmitted. Indeed, any electrical connection would necessarily entail that electricity is transmitted.

8. Independent Claim 10:

200. For my analysis, I considered that independent claim 10 overlaps substantially with claim 1 in that it describes a modular lighting system with multiple connected fixtures. Indeed, claim 10 differs from claim 1 in that: (a) it only requires LEDs of only a single CCT value for the first fixture; (b) it expressly describes the features of the connected second fixture; and (c) it additionally describes certain structural elements of the second fixture.

1. Claim Elements [10a]-[10g]

201. As I describe above, the preamble of claim 10 (Claim 10[pre]) recites a lighting system, which is shown by the structures of claim 1 generally and thus is met by Edwards in view of Sadwick.

202. Additionally, the following features are substantially identical between claim 1 and claim 10 and accordingly for these elements of claim 10 these limitations are rendered obvious by Edwards in view of Sadwick based on the disclosures and analysis for the corresponding elements in claim 1, which I incorporate by reference into my analysis.

Claim Feature	Claim 10	Claim 1
A lighting apparatus that is modular	10[a]	1[pre](Lighting apparatus) 1[h] modular

Claim Feature	Claim 10	Claim 1
plurality of LEDs having first color temperature, and in linear form factor	10[b]	1[b]
driver outputting plurality of currents	10[c]	1[d]
Switch assembly	10[d]	1[e]
Switch for outputting current	10[e]	1[f]
Switch for coupling first plurality of currents to LEDs	10[f]	1[g]
Connector for adjoining fixture	10[g]	1[h]

2. Claim Elements [10h]-[10n]

203. Claim elements 10[h]-10[n] additionally recite features in the second fixture that correspond to features in the first fixture. As I describe with respect to claim element 1[h] Edwards discloses a connector port that enables a similar fixture varying in size by a scale factor to be connected and thus the features of claim elements 10[i]-10[n] are similarly rendered obvious by Edwards in view of

Sadwick according to the disclosures and analysis that I have presented for the claim elements below which are incorporated by reference.

Features on Second LED	Claim 10	Claim 1
A lighting apparatus that is modular and larger than first apparatus	10[h]	1[a](Lighting apparatus) 1[h] modular/larger
plurality of LEDs having first color temperature, and in linear form factor	10[i]	1[b]
driver outputting plurality of currents	10[j]	1[d]
Switch assembly	10[k]	1[e]
Switch for outputting current	10[l]	1[f]
Switch for coupling first plurality of currents to LEDs	10[m]	1[g]
Connector for adjoining fixture	10[n]	1[h]

3. [10i] a second plurality of light-emitting diodes (LEDs) arranged within a second linear form factor and having a second number of LEDs, each LED of the second plurality of LEDs associated with the first color temperature, wherein the second number is greater than the first number by a scale factor;

204. In addition to the common subject matter from claim element 1[b] identified for claim element **10[i]** this claim element additionally states that the “second number” of the “second plurality of LEDs” is greater than the “first number” of the “first number” of LEDs by a scale factor.

205. As I discuss for claim 1[h] above Edwards discloses that connected LED arrays may be connected and may vary in length by a scale factor. *See also* Ex.1005-15:59. Furthermore, the disclosure of Edwards shows the LEDs as being evenly spaced.

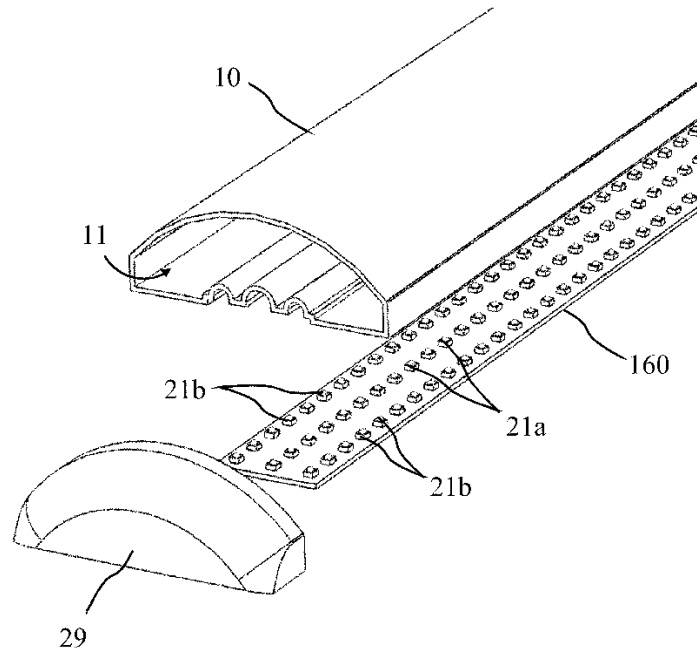


FIG. 1B

Id.-Fig. 1B.

206. As shown above, the individual LEDs are spaced at regular intervals in the LED array.

207. Indeed, the optimal spacing between individual LEDs in a linear LED fixture or luminaire is determined by several considerations. The first of these is the expected height above the floor for the location of the luminaire. Specifically, light from a LED, like all light sources, diverges as it propagates away from the luminaire because of optical diffraction. Therefore, the spacing between adjacent LEDs in a ceiling-mounted luminaire will be determined by measurements conducted by an illumination engineer. These measurements will determine what is

the maximum value of the spacing between LEDs that will guarantee spatial uniformity of the light intensity at the floor (or a specified height above the floor) while also providing the required intensity.

208. My point is that the spacing between the LEDs in any luminaire, including those comprising linear arrays of LEDs, is set by the product specifications and does not change with the length of the luminaire. One concludes, therefore, that the number of LEDs N in a given linear array will increase linearly with the length of that array. Similar comments apply to any other arrays, having different LEDs, within the luminaire.

209. Thus, a POSA would understand that the number of LEDs in each fixture would scale with the length of the fixture. Accordingly, a POSA would understand that the “second number” of LEDs in the second fixture is greater than the “first number” of LEDs in the first fixture by a scale factor as the regular distribution of LEDs would be spread over a proportionately larger distance. To the extent this relationship is not expressly disclosed, it is obvious. A POSA would be motivated to add this feature with a reasonable expectation of success. Having the number of LEDs scale with the length of the fixture merely a selection from a finite number of known predictable solutions.

4. [10m] couple the one of the second plurality of currents to the second plurality of LEDs, wherein the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor; and

210. In addition to the subject matter from claim element 1[g] identified for claim element 10[m] this element recites that “the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor”

211. As I discussed previously for claim element 10[i] a POSA would understand that the number of LEDs in fixture of Edwards would be proportional to the length of the fixture. A POSA would understand that for a given brightness level (lumens output) that the current sent to each LED fixture would be proportional to the number of LEDs and, accordingly, would rise linearly with the length of the fixture and, therefore, the scale factor.

212. In view of the above considerations, a POSA will conclude that the current delivered to a second fixture would be greater than the current delivered to the LEDs of the first fixture by that same scale factor.

213. If the number of LEDs in the “first plurality” of LEDs is denoted N_1 and the number of LEDs in the “second plurality” is denoted N_2 , then the scale factor is given by N_2/N_1 .

214. If a particular current (I_1) is required to power N_1 LEDs in the first lighting fixture (luminaire), it is obvious to a POSA that a current $I_2 = I_1 \times N_2/N_1$

will be required to power N_2 diodes in the second lighting fixture (assumed to be identical to those in the first lighting fixture).

215. Another way of saying this is that current scales up linearly with the number of individual LED lights.

216. A specific illustration of this is as follows. In order to distribute current among and within “strings” of LEDs efficiently, the LEDs comprising a string are typically connected electrically in series. Consequently, the same current flows through each LED in an individual string.

217. However, once the length of the string is fixed by an electrical or illumination engineer, multiple strings will be electrically connected and driven in parallel, even if they are arranged serially. Thus a longer fixture (such as disclosed in Edwards) would be understood to include multiple strings arranged serially but connected in parallel. As described below, amount of current needed for such a fixture is proportionate to the number of strings.

218. To the extent not expressly disclosed already in Edwards and/or Sadwick, the typical way of extending the length of a linear LED fixture is to include multiple strings that are assembled serially but electrically connected in parallel. Doing so simplifies the manufacturing of fixtures of different lengths by avoiding longer strings of LEDs or drivers capable of delivering different voltages.

219. For example, the *Energy Star Program for Decorative Light Strips*, Version 1.5, December 2011(Ex. 1020) defines safety standard for longer light strips.¹ It specifically defines a system in which longer fixtures comprise of smaller series strips (“string”) with the series strips connected in parallel. A “series block” is defined in the standard as:

A number of lamps connected in series, or utilizing a series connection. Additional series blocks can be added to the circuit (i.e., decorative light string) utilizing parallel connections (e.g., a 70-lamp light string could have two 35-lamp series blocks connected in parallel).
Ex. 2020-p.1

220. In summary, a POSA would understand that the longer fixtures of Edwards would include multiple strings connected electrically in parallel.

221. Further, as described in U.S. Patent Publication 2017/0314743 to Del Castillo (“Del Castillo”, Ex.1010) when linear fixtures are assembled, individual LEDs are connected in strings in series but the strings are connected to each other in parallel. Del Castillo notes : “LEDs can ... be used to retrofit traditional

¹ Ex. 1020 is available for download at https://www.energystar.gov/products/spec/decorative_light_strings_specification_version_1_5_pd (EX. 2021) at the link labeled “ENERGY STAR Final Version 1.5 DLS Specification.” Based on the comments on the web page which note “The Version 1.5 specification was finalized on December 27, 2011 and took effect immediately” I would understand this document to have been available to the public at the end of 2011.

fluorescent light fixtures by installing LED bulbs in the troffers that were originally designed for fluorescent bulbs” and in such linear replacement systems, “[t]he LED bulbs are *typically configured as strings of series - connected LEDs coupled in parallel.*” Ex.1010¶¶003-4.(emphasis added).

222. Similarly, U.S. Patent Publication No. 2004/0062041 to Cross (“Cross”, Ex.1011) discusses strings in LEDs that are arranged serially but electrically connected in parallel:

Where more than one series of LED circuits are employed, the additional series of LEDs may be connected in parallel or in series with non-conductive materials. For example two serial strings of LEDs can employ non-conductive sleeves into which the ends of each opposing string is pressed. In this case, separate voltage source lead wires would be incorporated that lead back to the common voltage source connected to the end cap as previously described.

Ex.1011¶¶0025.

223. Accordingly the standard approach to extending a linear fixture to accommodate more LEDs is to use individual strings that are arranged linearly but connected electrically in parallel.

224. Edwards illustrates the use of parallel connected LED strings in Fig. 6, for example, Edwards presents a circuit diagram for a three-branch current divider driven by the voltage V_{CC} . (As an aside, the voltage source could be a

current source – voltage and current sources are equivalent and interchangeable in circuit design). At least two strings of LEDs, 21a and 21b-1/21b-2 are shown, but a POSA understands immediately that this, and any, current divider can be extended to an indefinite number N of strings (as described by Sadwick; N is an integer).

225. Furthermore, Sadwick states that solid state light emitters “including but not limited to LEDs , OLEDs , QDs , etc. may be *put in series, parallel or combinations of series and parallel, parallel and series, etc.*” Ex.1006¶0340 (emphasis added). As discussed in detail previously in this report, extensively, as exemplified by Figs. 5-7, 35, 36, and 38-40, provides multiple LED strings connected in parallel. Accordingly, Sadwick teaches both generally that LEDs may be connected in parallel and describes several specific implementations of connecting LED strings in parallel.

226. In summary, Edwards provides for multiple strings of LEDs connected in parallel, and Sadwick extends the principle to arbitrarily large values of strings N.

227. As described above when creating fixtures of any length (such as disclosed in Edwards) multiple strings are arranged serially but connected electrically in parallel. This circuit design has been adopted by industry, with the benefit of limiting the voltage (V_{CC} of Fig. 6, Edwards) that would be required for an excessively long string of LEDs. A POSA implementing the longer fixtures

disclosed in Edwards understand that such a fixture would include strings electrically connected in parallel and that the number of strings would scale linearly with the length of the fixture.

228. Consequently, a POSA would be motivated to extend the fixture of Edwards by including multiple strings of LEDs connected in parallel as disclosed in either Sadwick or Edwards itself and known in the art. Such a practice would be necessary to limit the amount of voltage needed for a very long string of LEDs, by instead using multiple smaller strings of LEDs and to comply with known electrical and safety practices such as those in the Energy Star disclosure . Such an arrangement would be a selection from a finite number of known solutions to obtain a predictable result. Such a practice was as noted in Del Castillo, typical and a POSA would have a reasonable expectation of success as such changes are standard electrical design principles known to a POSA.

229. The number of strings would be expected to scale proportionally with the length of the fixture. An eight foot fixture, therefore, would have twice as many LED strings as a four foot fixture.

230. Accordingly, the amount of current necessary to drive those additional strings in parallel to a particular brightness (lumens output) would scale according to the number of strings and the scale factor. To summarize, “the one of the

second plurality of currents is greater than the one of the first plurality of currents by the scale factor”.

231. Accordingly this limitation is obvious over Edwards in view of Sadwick.

5. [10n] a second extender port configured to couple with the first extender port to combine the first modular lighting apparatus and the second modular lighting apparatus to traverse the first linear distance and the second linear distance.

232. This limitation is met by Edwards. Edwards discloses “The case 1307 may further comprise an electrical connector 1309 (e.g., plug) extending past the length of the body 1301 on one end, and a recessed complimentary socket (not shown) configured to receive a connector on another end.” Ex.1005-15:53-58. Accordingly, the connector of the second fixture constitutes a “second extender port” and the first and second fixtures traverse the first linear distance across which they are placed and connected. To the extent that this second connector is not determined to be a “port,” it would be obvious to include a port in the connector a connection through which two devices connect electrically would be considered a port. To the extent not explicitly disclosed a POSA would be motivated to add this feature with a reasonable expectation of success. Including a “port” in a connector would merely be a selection from a finite number of known predictable solutions.

- 9. 11. The linear LED lighting system of claim 10, wherein the first switch assembly is configured to receive a signal to cause the first driver circuit to output the one of the first plurality of currents.**

233. This limitation is met by Edwards in view of Sadwick. Particularly, Sadwick discloses that “[t]he remote fluorescent lamp replacement ballast can use or receive control signals/commands from, for example, but not limited to any or all of wired, wireless...vibrational, and/or PLC, etc., combinations of these, etc...” Ex.1006¶0344. A POSA would be motivated to implement control signals into Edwards with a reasonable expectation of success. The use of a control signal to modify the operation of an LED light was a common and favored way of controlling LED lights. Including control signals would improve the ease of use of the system of Edwards and would be well within the understanding and capabilities of a POSA.

- 10. 12. The linear LED lighting system of claim 11, wherein the signal is received via a wired connection.**

234. *See* claim 11 describing a wired connection implemented in Edwards.

- 11. 13. The linear LED lighting system of claim 11, wherein the signal is received via a mechanical switch.**

235. As I describe above for element 1(g) the color temperature switch 215b can be used to change the color temperature between multiple settings. Edwards discloses that the dimmer switch includes an “on” position (Ex.1005-13:6-8). Further as described for elements 1(d) and 1(g) the switch is able to adjust

a physical resistor. Accordingly, a POSA would understand that Edwards discloses a mechanical switch. Additionally, as described in Edwards the color temperature switch physically adjusts the resistor 31. *Id.*-14:11-19. To the extent that it is not disclosed a POSA would be motivated to utilize a mechanical control for the color temperature switch 215b with a reasonable expectation of success. Such a modification would merely be a selection from a finite number of known predictable solutions.

12. 14. The linear LED lighting system of claim 11, wherein the signal comprises a wireless signal.

236. This feature is obvious over Edwards in view of Sadwick, which discloses wireless control. Sadwick discloses that “the remote fluorescent lamp replacement ballast can use or receive control signals/commands from, for example, but not limited to any or all of wired, wireless...vibrational, and/or PLC, etc., combinations of these, etc...” Ex.1006¶0344. A POSA would be motivated to implement wireless controls from Sadwick that would enable a wireless signal to be sent with a reasonable expectation of success. Wireless controls were a common and favored way of controlling LED lights. Including wireless controls would improve the ease of use of the system of Edwards and would be well within the understanding and capabilities of a POSA.

13. 15. The linear LED lighting system of claim 10, wherein the first driver circuit comprise a current regulator.

237. This feature would be obvious over Edwards in view of Sadwick, which discloses a current regulator. Sadwick discloses that “[t]he current source 126 can comprise, but is not limited to, a current power supply, a current driver, a constant current driver and/or power supply, a variable constant current driver and/or power supply, a dimmable current driver and/or power supply, etc.” Ex.1006¶0049. A POSA would understand that a “constant current driver” or “variable constant current driver” would necessarily include a current regulator to control the current as this would be a standard and necessary component for those drivers. A POSA would further be motivated to include the constant current driver or variable constant current driver of Sadwick in Edwards with a reasonable expectation of success. Such a system allows for better and more stable regulation of electrical operation and avoidance of damage to the LEDs. Incorporation of the current regulator of Sadwick in the system of Edwards would be the combination of known elements to obtain a predictable result. Given that constant current and variable constant current components were common a POSA would easily be able to adapt them to the system of Edwards.

14. **16. The linear LED lighting system of claim 10, wherein the first extender port is configured to electrically couple the first modular lighting apparatus to the second modular lighting apparatus.**

238. *See 1[h]*

15. **17. The linear LED lighting system of claim 10, wherein each LED of the first plurality of LEDs receives a same amount of current via the one of the first plurality of currents that each LED of the second plurality of LEDs receives via the one of the second plurality of currents.**

239. As I describe for 10[m] a POSA would understand that each LED would receive approximately the same current, with the current being sent to each of the plurality of LEDs being proportional to the number of LEDs. Accordingly, the amount of current that is used to light any particular LED to a specific brightness will be the same between the first and second pluralities of LEDs.

16. Independent Claim 18

240. Independent claim 18 overlaps substantially with claim 1 in that it recites a modular lighting system with multiple connected fixtures. However, it differs in that (a) it expressly recites the features of the second fixture; and (b) it additionally recites certain current characteristics.

241. Claim 18[pre] recites a lighting system, which is shown by the structures of claim 1 generally.

1. Claim elements 18[a]-18[k]

242. The following features are substantially identical between claim 1 and claim 18 and accordingly for these elements of claim 18 these limitations are rendered obvious by Edwards in view of Sadwick based on the disclosures and analysis for the corresponding elements in claim 1, which are incorporated by reference.

Claim Feature	Claim 18	Claim 1
A lighting apparatus that is modular	18[a]	1[pre](Lighting apparatus) 1[h] modular
LED array	18[b]	1[a]
First plurality of LEDs having first color temperature, and in linear shape	18[c]	1[b]
Second plurality of LEDs with second color temperature	18[d]	1[c]
Second plurality of LEDs are in linear shape	18[e]	1[c]

Claim Feature	Claim 18	Claim 1
driver outputting plurality of currents	18[f]	1[d]
Switch assembly	18[g]	1[e]
First switch for outputting current	18[h]	1[f]
Second switch for coupling first plurality of currents to LEDs	18[i]	1[g]
Second switch can cause currents to couple to first plurality of LEDs	18[j]	1[g]
Second switch can cause currents to couple to second plurality of LEDs	18[k]	1[g]

2. [18l] cause half of the first portion of the one of the first plurality of currents to couple to each LED of the first plurality of LEDs and each LED of the second plurality of LEDs; and

243. As I explain above for element 1[g] Edwards discloses the entirety of a range of potential current distributions, from all of the current going to the first

set of LEDs and second set of LEDs and all ranges in between. Ex.1005-12:8-20.

A POSA would understand that a system that can shift between all current going to one set of LEDs and all going to the second and all ranges in between would necessarily be able to produce half the current to the first and half going to the second.

244. Additionally, Edwards notes that “in some embodiments, 100% utilization of all LEDs is implemented at a full ‘on’ position for the dimmer switch (both warm and cool are on at same time). ...”

245. A system in which maximum current levels are going to both sets of LEDs at the same time would entail sending half of the overall current to each set of LEDs and thus be within the scope of the claims.

246. To the extent sending equal amounts of current is not expressly disclosed, it is obvious. A POSA would be motivated to send half of the current to each set of LEDs to set a color temperature halfway between the maximum and minimum with a reasonable expectation of success. In the normal course of use the range halfway between the two maximums would be a typical and commonly-used application of the disclosed variable color temperature. Given that Edwards discloses both having all current go to the first set of LEDs and all current going to the second set of LEDs, it would be reasonable and predictable that a user might want a light setting where half goes to each as one of the commonly used

applications for the varying light distribution. Having the half the current go to each set of LED would a selection from a finite number of known predictable solutions.

3. Independent Claim 18 -Claim elements 18[m]-18[w]

247. Claim elements 18[m]-18[w] additionally recite features in the second fixture that correspond to features in the first fixture. As I discuss above with respect to claim element 1[h] Edwards discloses a connector port that enables a similar fixture varying by a scale factor to be connected and thus the features of claim elements 18[m]-18[w] are similarly rendered obvious by Edwards in view of Sadwick according to the disclosures and analysis for the claim elements below which are incorporated by reference. With respect to claim elements 18[m]-18[w] the third and fourth pluralities of LEDs in the second fixture respectively correspond to the first and second pluralities of LEDs of the first fixture. Similarly the second plurality of currents of the second fixture corresponds to the first plurality of currents of the first fixture.

Claim Feature of Second Fixture	Claim 18	Claim 1
A lighting apparatus that is modular	18[m]	1[pre](Lighting apparatus) 1[h] modular
LED array	18[n]	1[a]

Claim Feature of Second Fixture	Claim 18	Claim 1
Third plurality of LEDs having first color temperature, and in linear shape	18[o]	1[b]
Fourth plurality of LEDs with second color temperature	18[p]	1[c]
Fourth plurality of LEDs in linear shape	18[p]	1[c]
driver outputting plurality of currents	18[q]	1[d]
Switch assembly	18[r]	1[e]
Third Switch for outputting current	18[s]	1[f]
Fourth switch for coupling first plurality of currents to LEDs	18[t]	1[g]

Claim Feature of Second Fixture	Claim 18	Claim 1
Fourth switch can cause currents to couple to third plurality of LEDs	18[u]	1[g]
Fourth switch can cause currents to couple to fourth plurality of LEDs	18[v]	1[g]

4. [18o] wherein the third plurality of LEDs is longer than the first plurality of LEDs;

248. In addition to the incorporated disclosure from element 1[b], claim limitation 18[o] additionally recites that the third plurality of LEDs is longer than the first plurality of LEDs on the first fixture. As I have described with respect to element 1[h] the fixtures and their lengths of LEDs vary by a scale factor, which would cause the third plurality of LEDs to be longer than the first plurality of LEDs. For example, a fixture twice as long in which the LEDs are evenly spaced will have a longer plurality of LEDs.

5. [18p] wherein the fourth plurality of LEDs is longer than the second plurality of LEDs;

249. In addition to the incorporated disclosure from element 1[b], claim limitation 18[p] additionally recites that the fourth plurality of LEDs is longer than

the second plurality of LEDs on the first fixture. As set forth with respect to 1[h] the fixtures and their lengths of LEDs vary by a scale factor, which would cause the fourth plurality of LEDs to be longer than the second plurality of LEDs. For example, a fixture twice as long in which the LEDs are evenly spaced will have a longer plurality of LEDs.

6. [18w] cause half of the second portion of the one of the second plurality of currents to couple to each LED of the third plurality of LEDs and each LED of the fourth plurality of LEDs.

250. As I discuss for element for 18[l] Edwards discloses or renders obvious that the second switch of each LED fixture can send half of its current to the first plurality of LEDs of each fixture [*i.e.*, the “third plurality of LEDs”] and half of its current to the second plurality of LEDs of each fixture [*i.e.*, the “fourth plurality of LEDs.”]

17. **19. The linear LED system of claim 18, wherein the first modular lighting apparatus comprises a first connector configured to couple to a second connector part of the second modular lighting apparatus, wherein the first connector and second connector are configured to transmit data between the first modular light apparatus and the second modular lighting apparatus.**

251. This feature is obvious over Edwards in view of Sadwick. As I describe with respect to element 1[h] there are connections between on the LED fixtures of Edwards that enable multiple fixtures to be connected. Sadwick additionally discloses data connections between the fixtures, noting, “[t]he present

device can use combinations of wireless and wired interfaces to control and monitor ...One (or more) of the replacements can be wireless with wired connections from the one (or more) replacement(s) to the other replacements...”

Ex.1006¶0315.

252. A POSA would be motivated to improve the design of Edwards with the data connections of Sadwick by adding data connections to the power connections of Edwards. The data features of Sadwick would allow for an alternate control mechanism and allow for Edwards to implement additional control mechanisms and more easily control connected features. Including the data communication disclosure of Sadwick in Edwards would be a combination of known features to obtain a predictable result. Because data connections were well known in the art, a POSA could easily implement the data connections of Sadwick in Edwards and thus would have a reasonable expectation of success.

18. 20. The linear LED system of claim 18, wherein a first ratio of the one of the second plurality of currents to the one of the first plurality of currents matches a second ratio of a first number of LEDs in the first plurality of LEDs to a second number of LEDs in the third plurality of LEDs.

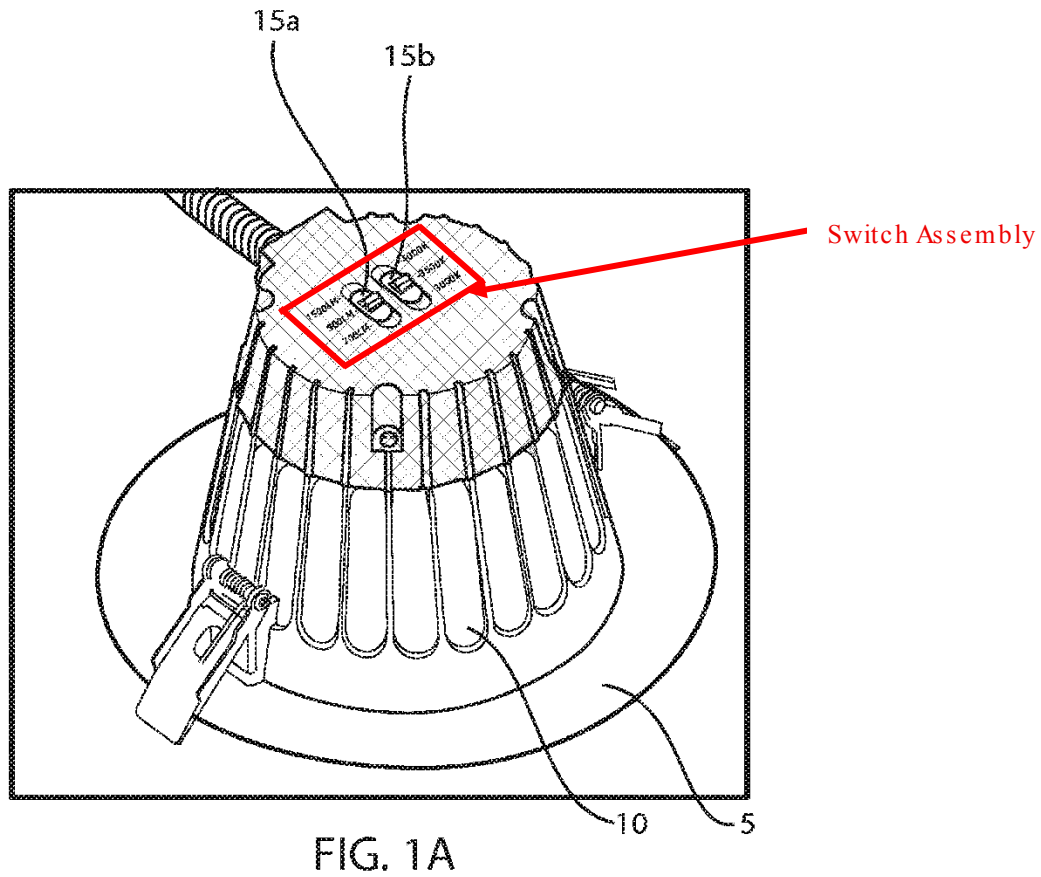
253. As I have described with respect to element 10[m] the ratio of current sent to the second plurality of LEDs (referred to as the second plurality of current) and current sent to the first plurality of LEDs (referred to as the first plurality of currents) is the same as the scale factor between the first and second

fixtures and particularly the number of LEDs and particularly the ratio between the number of LEDs in the second fixture and the number of LEDs in the first fixture.

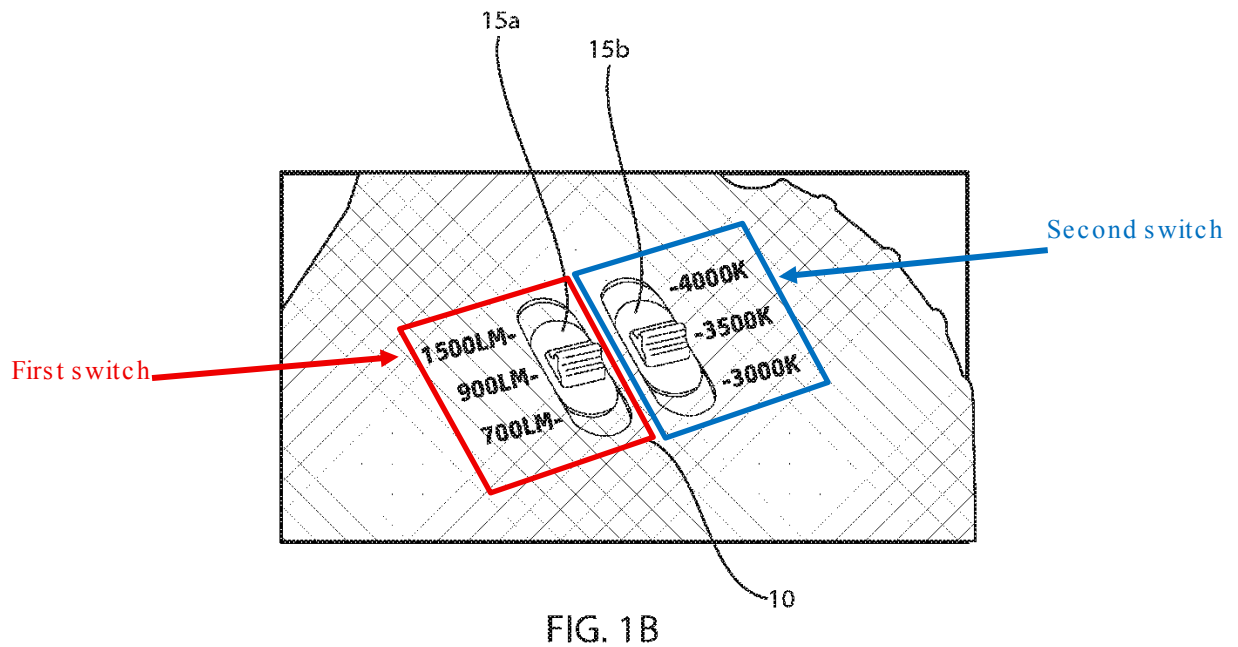
**II. GROUND 2-CLAIMS 2, 3, AND 8 ARE OBVIOUS OVER EDWARDS
IN VIEW OF SADWICK AND FURTHER IN VIEW OF JESWANI**

**19. 2. The linear LED lighting apparatus of claim 1, wherein
the second switch comprises a plurality of selectable
positions.**

254. As described above claim 2 is obvious over Edwards in view of Sadwick. Claim 2 additionally is obvious over Edwards in view of Sadwick and further in view of Jeswani. As described with respect to Ground 1, claim 2 is obvious over Edwards standing alone or Edwards in view of Sadwick. The additional subject matter of claim 2 is additionally disclosed by Jeswani. Jeswani discloses an “interface on the lamp housing 100 for selecting a lumen setting and for selecting a correlated color temperature (CCT) setting for the light being emitted by the light engine 60 of the downlight 100.” Ex.1007-8:19-25. As shown below it includes a plurality of selectable positions.



Ex.1007-1A-Annotated.



Ex.1007-Fig. 1B-Annotated.

255. As shown above the switch assembly of Jeswani includes a plurality of selectable positions. A POSA would be motivated to use the design the CCT and brightness switch assembly of Jeswani in the system of Edwards with a reasonable expectation of success. As both Edwards and Jeswani include switches for brightness and CCT, a POSA would be motivated to use the design of Jeswani to more easily allow the system of Edwards to be controlled and to minimize the physical profile of those controls. Such a combination would be the combination of known elements in known ways to achieve a predictable result. Because the insertion of physical controls were well known in the art a POSA would have a reasonable expectation of success in adding the physical controls of Jeswani.

20. 3. The linear LED lighting apparatus of claim 2, wherein the plurality of selectable positions comprises:

a first position configured to cause the switch assembly to couple the one of the plurality of currents to the first plurality of LEDs;

a second position configured to cause the switch assembly to couple the one of the plurality of currents to the second plurality of LEDs; and

a third position configured to cause the switch assembly to couple a first portion of the one of the plurality of currents to the first plurality of LEDs and a second portion of the one of the plurality of currents to the second plurality of LEDs.

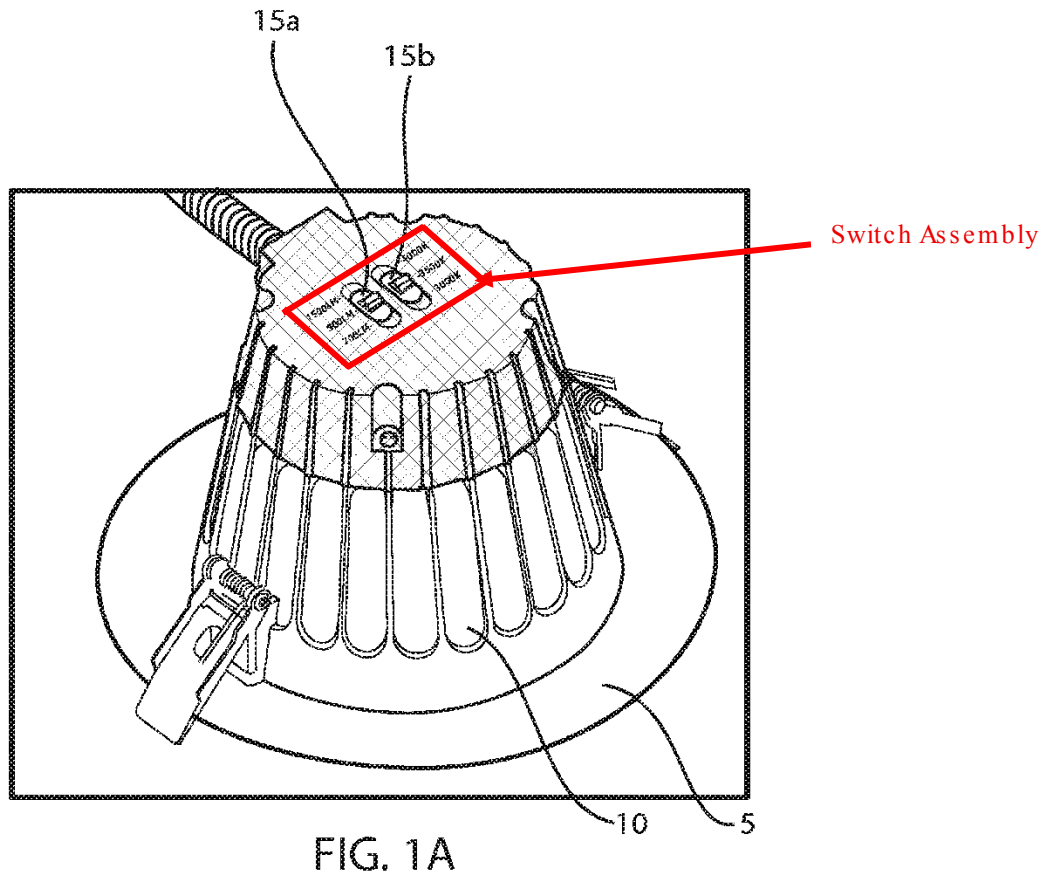
256. As described above for claim 2, Jeswani discloses a CCT control with three of selectable positions. Ex.1007-8:19-25, Fig. 1B. Jeswani further teaches that individual strings of LEDs may be turned on for the highest temperature and for the lowest temperatures it “may energize a different LED string of LEDs 50” but for a middle color temperature, “this light color is achieved by mixing light from both the 2700K and 4000K LEDs” and that “color temperature (CCT) levels of 3000K, 3500K, and 4000K” can be similarly obtained with “20 LEDs of CCT 3000K in 2 parallel strings of 10 LEDs in series, and 20 LEDs of CCT 4000K in 2 parallel strings of 10 LEDs.” Ex.1007-11:23-45. Accordingly a POSA would understand that the three positions in Jeswani Figure 1B labeled 3000K, 3500K, and 4000K respectively send current to the first set of LEDs, second set of LEDs, or both.

257. A POSA would be motivated to combine this with the functionality for controlling the current distribution disclosed in Edwards as described for claim 3 of Ground 1 with the physical switch of Jeswani.

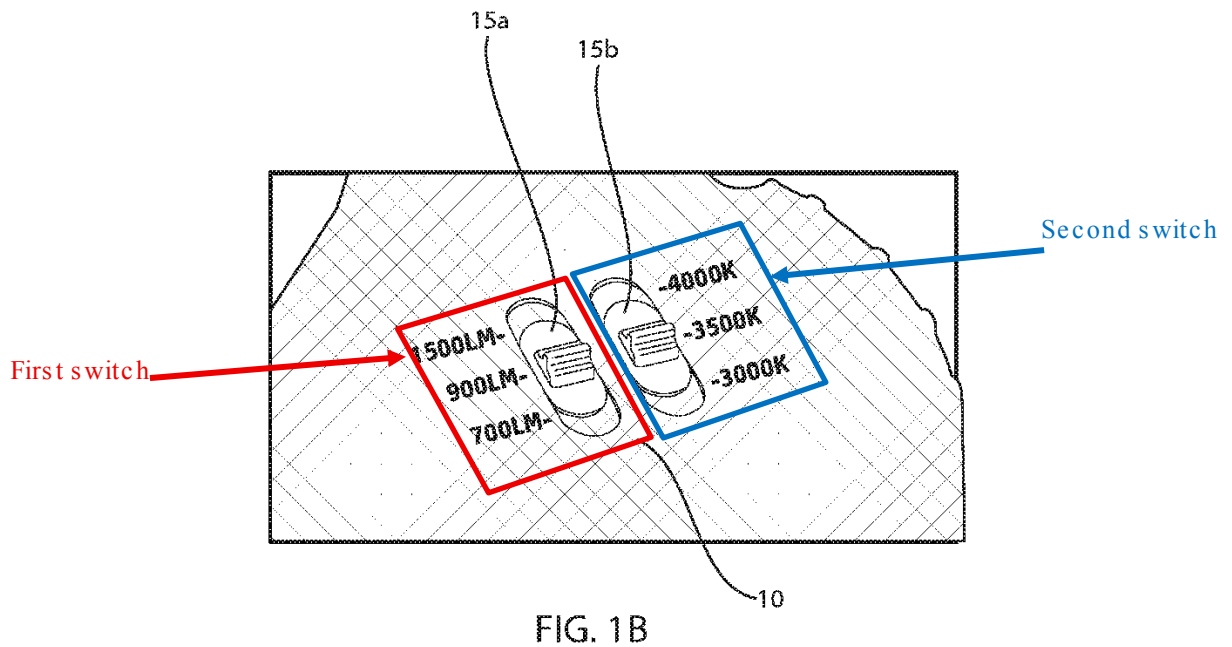
21. 8. The linear LED lighting apparatus of claim 6, wherein the switch assembly is configured to be positioned in a receptacle of the housing, and wherein the switch assembly is configured to be flush with a surface of the housing when positioned in the receptacle.

258. Claim 8 is obvious over Edwards in view of Sadwick and further in view of Jeswani. As I describe with respect to Ground 1, claim 6 is obvious over Edwards standing alone or Edwards in view of Sadwick

259. The additional subject matter of claim 8 is disclosed by Jeswani. Jeswani discloses an “interface on the lamp housing 100 for selecting a lumen setting and for selecting a correlated color temperature (CCT) setting for the light being emitted by the light engine 60 of the downlight 100.” Ex.1007-8:19-25.



Ex.1007-1A-Annotated.



Ex.1007-Fig. 1B-Annotated.

260. As shown in Figure 1B, the switch assembly of Jeswani is positioned in a receptacle of the housing and is flush with a surface of the housing as shown above where there are open receptacles in which the switches slide. A POSA would thus understand the assembly to be in a receptacle of the housing and flush with the surface of the housing.

261. A POSA would be motivated to use the physical design the CCT and brightness switch assembly of Jeswani in the system of Edwards with a reasonable expectation of success. As both Edwards and Jeswani include separate controls for brightness and CCT, a POSA would be motivated to use the design of Jeswani to more easily allow the system of Edwards to be controlled and to minimize the physical profile of those controls. Such a combination would be the combination of known elements in known ways to achieve a predictable result. Because the insertion of physical controls was well known in the art a POSA would have a reasonable expectation of success in adding the physical controls of Jeswani.

III. GROUND 3: CLAIMS 1-14 AND 16-20 ARE OBVIOUS OVER MAY IN VIEW OF JESWANI

262. For the reasons set forth below, the claims are obvious over May in view of Jeswani.

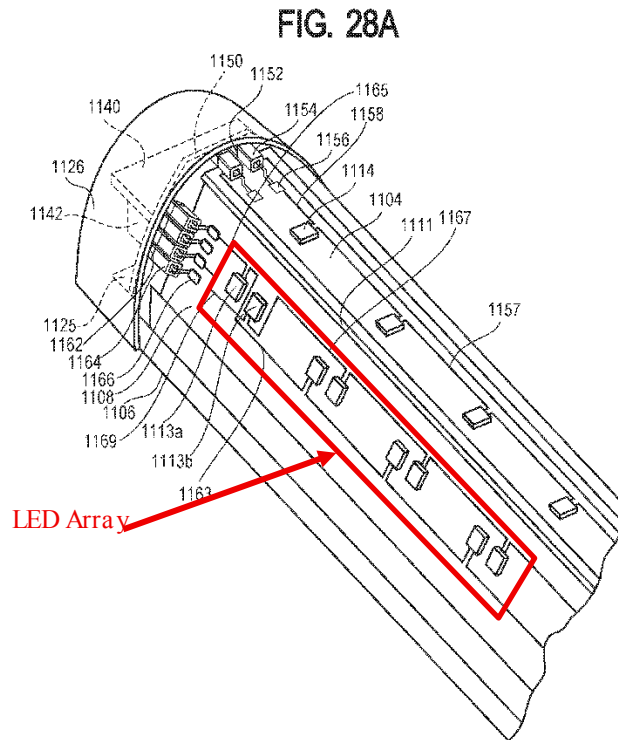
1. Independent Claim 1:

1. [1pre] A linear light-emitting diode (LED) lighting apparatus, comprising:

263. As I describe in my overview May is directed towards LED lighting apparatuses. Particularly, May discloses “An improved LED lighting system is provided for overhead ceiling lighting, as well as for other uses.” Ex.1008-Abstract.

2. [1a] an array of light emitting diodes (LEDs) having a first length, wherein the array of LEDs comprises:

264. May discloses and LED array, which like any structure has a length. May discloses “a linear LED lamp illustrating a further specific implementation of the disclosed subject matter...” with “emitter panels 1108 and 1102 in a V-orientation such that LED emitters 1113 a,b, and 1115 a,b arranged along the length of the emitter panels distribute light generally downward and laterally over a wide area when the lamp is installed in overhead lighting system.” Ex.1008¶0216.



3. [1b] a first plurality of LEDs configured to produce a first light having a first color temperature, wherein the first plurality of LEDs aligns within a first linear shape;

265. As described below, May discloses two pluralities of LEDs, with linearly arranged pairs of LEDs. Each pair includes one LED of the first color temperature and one of the second. Particularly, May discloses that “Linear LED lamps made according to the principles of the disclosed subject matter may also be configured to support automated color tuning and color shifting. The embodiment of lamp 1100 will be used to describe this aspect.” May discloses “emitter boards 1102 and 1108 may include a series of LED emitter pairs located at regularly spaced intervals in a row along the length of the board. Emitter traces connect a

first string of LED emitters in series and a second parallel string of LED emitters in series. As shown in FIG. 28A, the emitter pairs consist of one emitter of each of the two parallel strings of emitter. Emitter traces connect a first string of LED emitters in series and a second parallel string of LED emitters in series.... the boards 1108 and 1102 each consist of a first string of LED emitters with a color temperature in a first range, and a second string of LED emitters with a color temperature in a second range.” Ex.1008¶0231.

266. Accordingly, a POSA would understand that the first LED of each pair of LEDs shown is an LED of a first color temperature and the second pair of LEDs in each pair is a second color temperature. Thus, the first and second pluralities of LEDs are also respectively arranged in a linear shape.



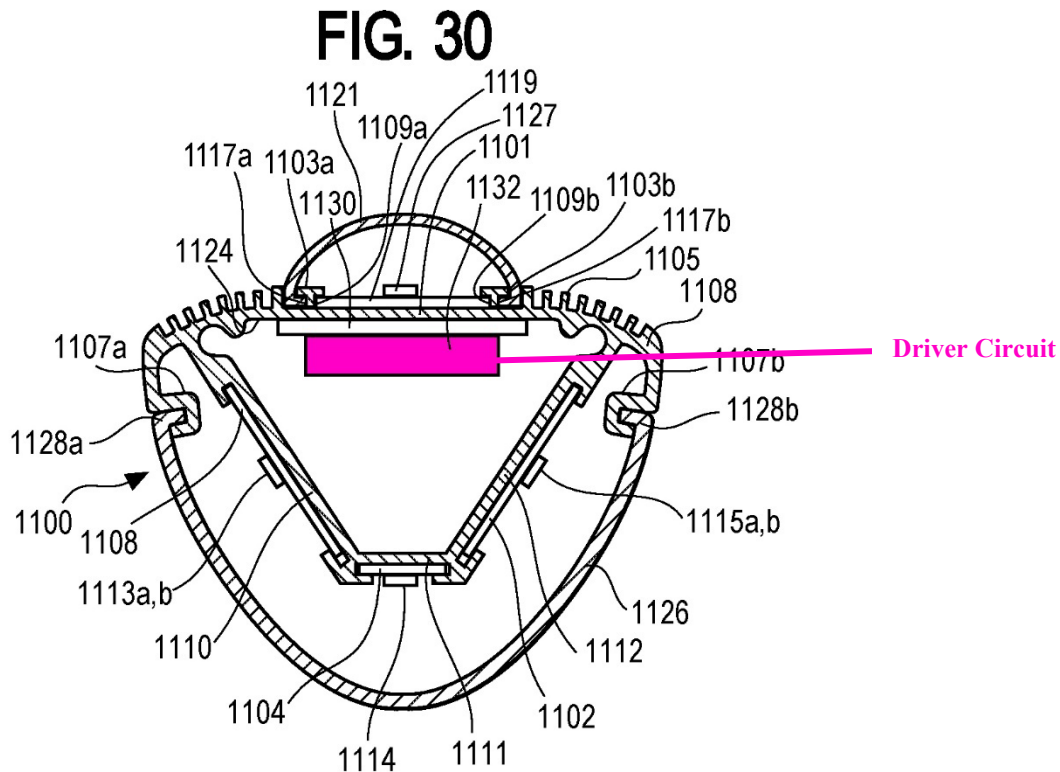
First plurality of LEDs

267. As I describe with respect to element 1(b) May discloses that the second LED of each pair of LEDs are aligned in a linear shape and arranged to produce light with a second color temperature.



5. [1d] a driver circuit configured to output a plurality of currents;

Ex.1008¶0222.



269. The module can “receive instructions from the data communications and to modify aspects of the operation of the LED lamp based on the instructions, such as controlling the brightness, color and other aspects of the LED emitters.” and that the “[c]ontrol module 1132 may include dedicated driver sub-circuits to independently control the magnitude of DC current provided to each string of emitters based on control instructions provided as Ethernet packets from a central management system.” Ex.1008¶0231.

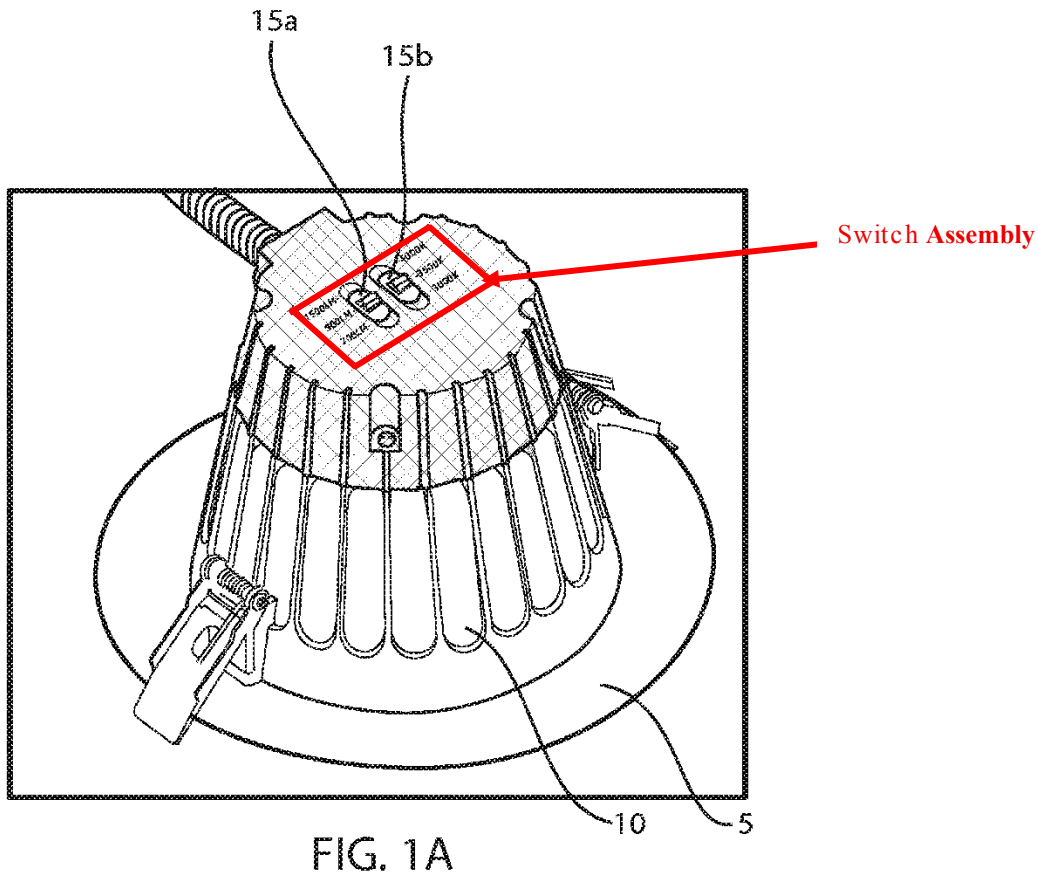
270. From the above quotation, it is clear that the control module includes or may comprise a driver circuit as it includes a group of dedicated driver sub-

circuits. A POSA would understand that the control module, which controls the magnitude of the DC current to the LED arrays, thereby changing the brightness of the lamp 1100, is, indeed, providing a “plurality of currents.”

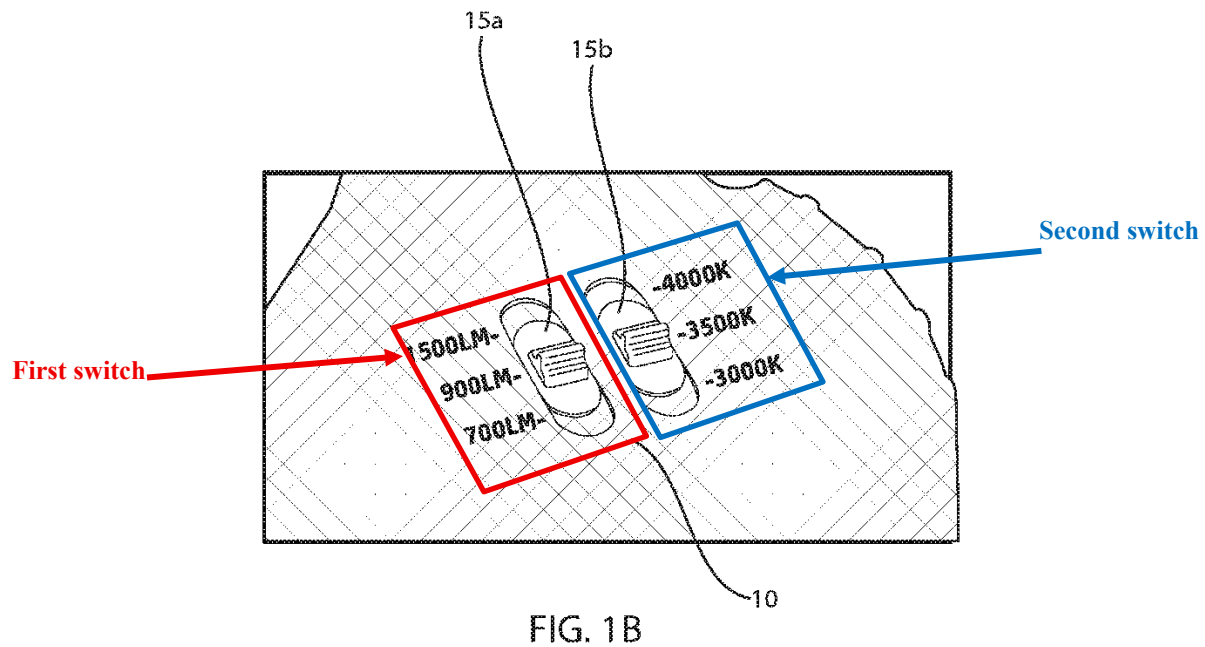
6. [1e] a switch assembly configured to couple to the driver circuit, wherein the switch assembly comprises:

271. This limitation is also satisfied by combining Jeswani with May. As I have described previously, Jeswani provides an “interface on the lamp housing 100 for selecting a lumen setting and for selecting a correlated color temperature (CCT) setting for the light being emitted by the light engine 60 of the downlight 100.”

Ex.1007-8:19-25. These switches, illustrated in FIGs. 1A and 1B of Jeswani (reproduced below), constitute a switch assembly.



Ex.1007-1A-Annotated.



Ex.1007-1B-Annotated.

272. Fig. 6 of Jeswani shows the switch 15a coupled to the driver of Jeswani.

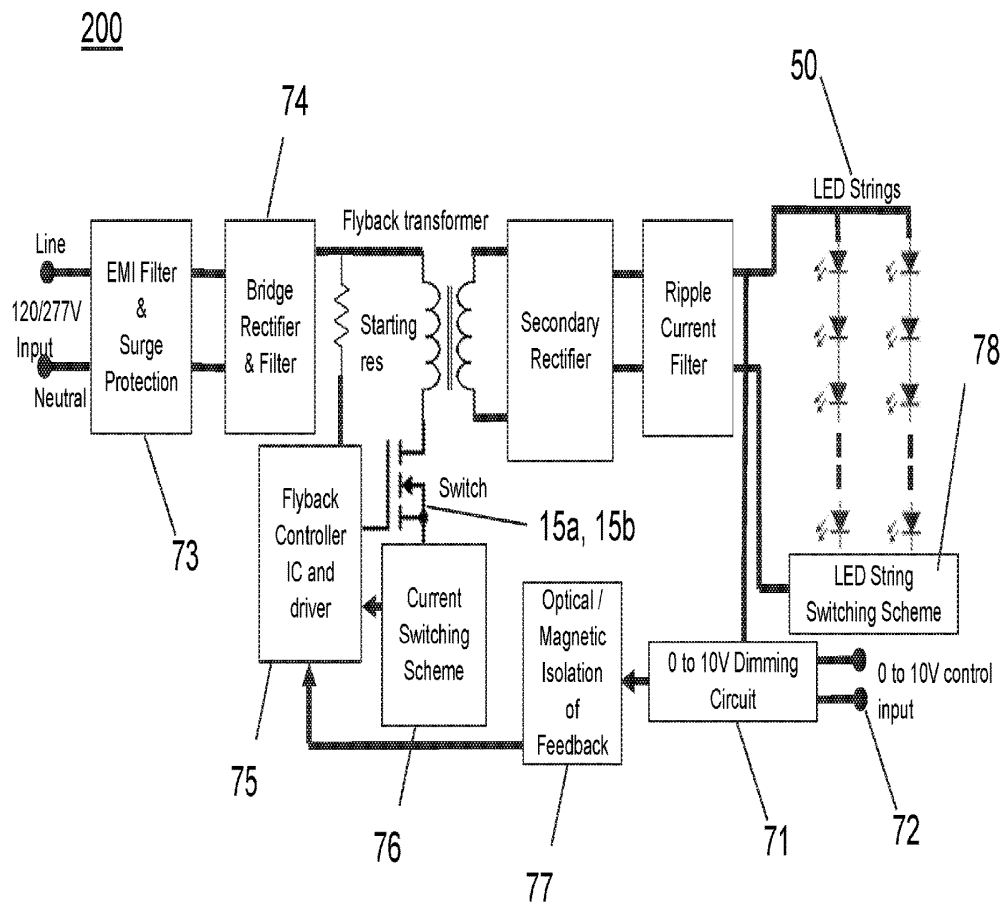


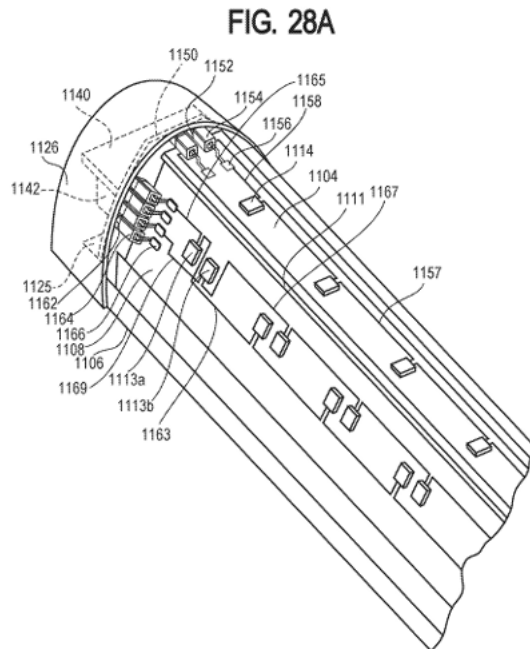
FIG. 6

Ex.1007-Fig.6.

273. In order to provide convenience and multiple operating options to the customer, a POSA would wish to include the external CCT and brightness (i.e., luminance) controls of Jeswani on the outer housing of the lamp 1100 of May. May also states that the control module may “receive instructions from the data communications...such as controlling the brightness, color and other aspects of the LED emitters.” Ex.1008¶0221. Furthermore, having a user-selectable switch for brightness (in addition to that for CCT) on the housing of the lamp would be a valuable feature in the lighting marketplace.

274. In summary, May is concerned with providing control of both the brightness and CCT for its lamps and luminaires. A POSA would be motivated to combine the switch the CCT and brightness controls of May to allow local control of each lamp so that in the event of a network failure or a scenario in which a user cannot send communications electronically, a user could manually modify the color temperature and brightness of the lamps of May with a reasonable expectation of success.

275. Jeswani itself discloses that its fixture may also include the ability to be remotely controlled, thus teaching the advantages to a POSA of including both physical controls and remote controls on a fixture. Ex.1007-14:32-59.



Ex.1008-Fig. 28A.

276. Such an assembly could send control signals to the control module of May based on the position of the brightness and CCT settings of the disclosed switches. Such a modification would be a combination of known elements to obtain a predictable result. Because the installation of manual controls to electronically control devices was well known in the art a POSA could easily add the manual control of Jeswani to May.

7. [1f] a first switch configured to cause the driver circuit to output one of the plurality of currents;

277. As I discuss for 1[e] Jeswani discloses a switch (15a) to control the lumens or brightness of the disclosed lamp and a POSA would find it obvious to combine that switch into May.

278. When integrated within the system of May, this switch would cause the control module to control the brightness of the lamp 1100. May discloses that the control module can “receive instructions from the data communications and to modify aspects of the operation of the LED lamp based on the instructions, such as controlling the brightness, color and other aspects of the LED emitters” and that the “[c]ontrol module 1132 may include dedicated driver sub-circuits to independently control the magnitude of DC current provided to each string of emitters based on control instructions provided as Ethernet packets from a central management system.” Ex.1008¶0231. A POSA would understand that each of the currents sent from one of the sub-circuits can be one of the plurality of currents, or that the combined current sent at any given time, which controls the overall brightness of the lamp can be one plurality of currents.

8. [1g] a second switch configured to cause the one of the plurality of currents to couple to the first plurality of LEDs, the second plurality of LEDs, or both; and

279. As I discuss for element 1[e] Jeswani discloses a switch (15b) to control the color temperature of the disclosed lamp and a POSA would find it

obvious to combine that switch into May. May discloses a control mechanism whereby color temperature is allocated by varying current between the two strings of LEDs:

The color temperature of the output light depends on the relative proportion of light contributed by each emitter string, which is proportional to the drive current transmitted to each string. Thus, if a drive current is provided only to the second emitter string of each board[having a color temperature of 6500K], the lamp will produce light of a CCT of about 6500K. Conversely, if a drive current is only provided to the first emitter string of each board [having a color temperature of 4500K], the lamp will produce light of a CCT of about 4500K. If drive currents are provided to both strings of emitters of each board, the lamp will produce light having a CCT somewhere between 4500K and 6500K, depending on the relative magnitude of the drive current of each LED emitter string.

Ex.1008¶0231.

280. A POSA would understand that sending current to one or the other of the strings of emitters would be “coupling” one of the plurality of currents to that set of emitters.

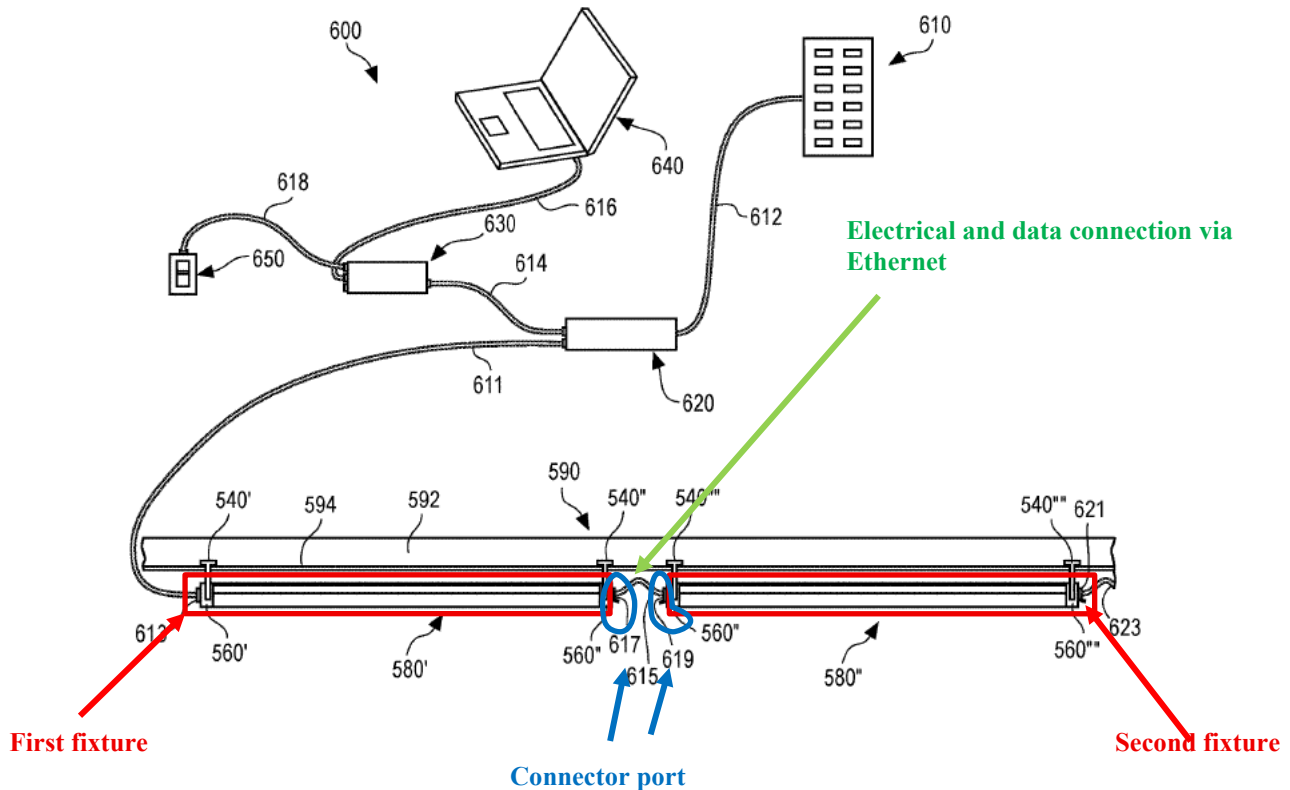
281. As described above, Jeswani uses a similar mechanism to control color temperature. A POSA would thus consider it obvious to combine Jeswani with May to use the color temperature switch of May to control the currents as shown in May. Ex.1007-11:23-35.

9. [1h] wherein the linear LED lighting apparatus is configured to electrically couple to an additional linear LED lighting apparatus having a second length different than the first length by a scale factor, wherein the additional linear LED lighting apparatus is configured to produce a third light having the first color temperature via a third plurality of LEDs or a fourth light having the second color temperature via a fourth plurality of LEDs.

282. May discloses ports and connector in each fixture that enables them to be daisy chained. May discloses “Ethernet communications interface and connector boards provided within first end cap assembly 1126” of the lamp 1100. Ex.1008¶0221. May also discloses that a “second end cap assembly of similar geometry is mounted at the opposite second lamp end” and accordingly a POSA would understand that another Ethernet port is present on the opposite end, consistent with the other embodiments shown (*e.g.* Figs. 15, 21, 23).

283. May further discloses that “a lamp may receive power and data at one end and provide power and/or data to another similarly configured lamp connected in series by a jumper Ethernet cable” Ex.1008¶0113. Particularly, May discloses that in a system of multiple lamps “Power and data is communicated from the switch and to the serially connected LED lamps over cable 611 and the intermediate jumper cables” and “lamps are networked to each other by a jumper cable 615 having a male plug at each end mated with the corresponding Ethernet jack in the end wall of end cap assemblies 560” and 560”.” Ex.1008¶¶0190,191.

FIG. 22



Ex.1008-Fig.22-Annotated

284. A POSA would understand that this arrangement of lamps in series could be applied to the lamp 1100, which a POSA may wish to arrange in series to allow a larger area to be lit. Particularly, May discloses that the embodiments of 28A/B/C may be “deployed in a networked overhead lighting system.”

Ex.1008¶0238. To the extent that May does not expressly disclose that the lamp 1100 embodiment could be so be arranged as in Figure 22, it would be obvious. It

is clear to a POSA that the features in each embodiment are designed to cover a single invention.

285. A POSA would be motivated with a reasonable expectation of success to connect multiple lamps 1100 together to cover additional space. Doing so would be the combination of known elements to obtain a predictable result. Because the functionality of connecting multiple lamps is taught in May and utilizes conventional technology a POSA could apply it to the lamp 1100 with a reasonable expectation of success.

286. Thus, May discloses or renders obvious an electrical connection with a second similar lamp having a third set of LEDs having the first color temperature and a fourth set of LEDs having the second color temperature.

287. May also discloses that the lamps may vary by a scale factor. May teaches that the lamp may be sized “so that the linear LED lamp may be installed in an overhead lighting fixture designed to accept linear lamps of a standardized nominal length, wherein the standardized nominal length is about 2 feet, 3, feet, 4 feet, 6 feet or 8 feet.” Ex.1008-Claim 40. May further discloses that the invention is for “lamp replacement” (¶205) and identifies the lamps to be replaced as “typically ranging from 2 to 8 feet.” Ex.1008¶204.

288. A POSA would understand that a two-foot and eight-foot lamp vary in length according to a scale factor ; for example a two-foot lamp and an eight-foot lamp vary in length by a factor of four.

289. I believe that a POSA would understand this disclosure to cover multiple lamps of different sizes being connected serially. To the extent that May does not expressly teach using lamps of different lengths together, a POSA would be motivated to connect multiple lamps of different size together to cover additional space efficiently, such as a room having a length that is not an even multiple of the size of a larger lamp, with a reasonable expectation of success.

290. For example, a POSA may use multiple eight-foot long lamps and a two-foot long lamp to cover eighteen feet. Doing so would be the combination of known elements to obtain a predictable result. Because the functionality of connecting multiple lamps is taught in May and utilizes conventional technology a POSA could do so with a reasonable expectation of success. Accordingly, May discloses or renders obvious the connection of lamps varying by a scale factor.

2. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions.

291. As I describe for 1[e] the combination of May and Jeswani discloses switches 15a and 15b having a plurality of selectable positions.

3. 3. The linear LED lighting apparatus of claim 2, wherein the plurality of selectable positions comprises:

a first position configured to cause the switch assembly to couple the one of the plurality of currents to the first plurality of LEDs;

a second position configured to cause the switch assembly to couple the one of the plurality of currents to the second plurality of LEDs; and

a third position configured to cause the switch assembly to couple a first portion of the one of the plurality of currents to the first plurality of LEDs and a second portion of the one of the plurality of currents to the second plurality of LEDs.

292. This feature is obvious over May in view of Jeswani. As I describe for 1[e] a the CCT switch of Jeswani includes three selectable positions that can be used to toggle between three color temperatures. Ex.1007-1A, 1B, 8:20-25. Jeswani further teaches that individual strings of LEDs may be turned on for the highest temperature and for the lowest temperatures it “may energize a different LED string of LEDs 50” but for a middle color temperature, “this light color is achieved by mixing light from both the 2700K and 4000K LEDs” and that “color temperature (CCT) levels of 3000K, 3500K, and 4000K” can be similarly obtained with “20 LEDs of CCT 3000K in 2 parallel strings of 10 LEDs in series, and 20 LEDs of CCT 4000K in 2 parallel strings of 10 LEDs.” Ex.1007-11:23-35.

293. As set forth for element 1[g] the circuit of May can also generate varying color temperatures by (a) providing current to only its first emitter string

with a lower color temperature; (b) providing current to only the second emitter string with a higher color temperature; or (c) providing current to both.

Ex.1008¶0231.

294. Given that May and Jeswani provide varying color temperatures through the same overall mechanism, a POSA would be motivated to integrate the adjustable switch of Jeswani so that a first position sends current to only the first emitter string of May, a second position sends current to only the second emitter string of May and a third position sends current to both, with a reasonable expectation of success. Doing so would be the combination of known elements to obtain a predictable result. Because the use of switches to send control signals was conventional technology a POSA could do so with a reasonable expectation of success.

4. 4. The linear LED lighting apparatus of claim 1, wherein the first color temperature corresponds to 3000 Kelvin and the second color temperature corresponds to 4000 Kelvin.

295. As set forth for claim 3, Jeswani discloses the use of higher color temperature LEDs at 4000K and lower temperature LEDs at 3000K. A POSA would be motivated with a reasonable expectation of success to integrate LEDs with these color temperatures into the system of May. A POSA would be motivated to do so because these were common and widely used color temperatures that were commonly purchased by customers. A POSA would look to

the disclosure of Jeswani which is directed to a common goal of controlling color temperature. Doing so would be the combination of known elements to obtain a predictable result. Because these LEDs were widely available conventional technology a POSA could do so with a reasonable expectation of success.

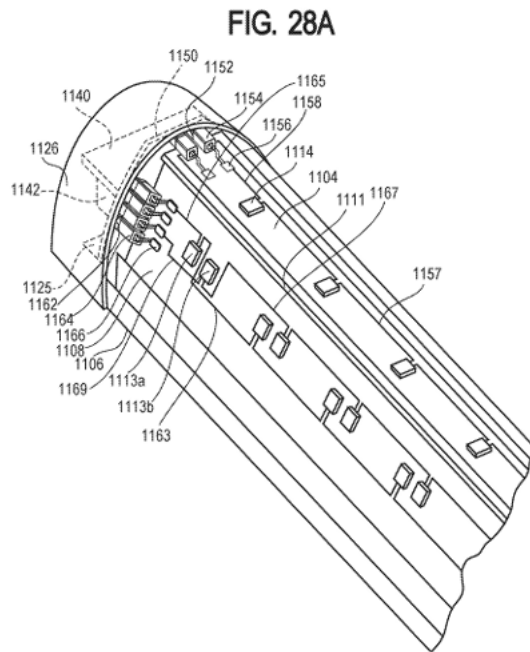
- 5. The linear LED lighting apparatus of claim 1, wherein the second switch comprises a plurality of selectable positions, wherein each of the plurality of selectable positions is configured to cause the switch assembly to send a respective signal to the driver circuit, wherein the respective signal is configured to cause the driver circuit to output the one of the plurality of currents that corresponds to a current position of the plurality of selectable positions.**

296. As set forth for claim 1[g] the control module of May is configured to receive control signals to adjust the current sent to the LED strings and it would be obvious to configure the switch of Jeswani, which includes selectable positions for each color temperature to send those control signals according to the position of the color temperature switch. Ex.1008¶0231.

- 6. The linear LED lighting apparatus of claim 1, comprising a housing comprising an interior volume configured to hold the driver circuit, the first plurality of LEDs, and the second plurality of LEDs.**

297. May discloses a housing which holds the previously discussed control module 1132 and LEDs, 1113a, 1115a. Ex.1008¶0217, 0085 (“FIG. 28A is a side perspective view of a linear LED lamp embodiment with portions cut away to

expose internal components”). Figures 28A and 28C show the LEDs 1113 and control circuit 1132 within the interior volume of the housing.



Ex.-1008-Fig.-28A.

- 7. The linear LED lighting apparatus of claim 6, wherein the housing comprises a length greater than or equal to 24 inches.**

298. May discloses that the lamps may be “2 feet, 3, feet, 4 feet, 6 feet or 8 feet” and “typically ranging from 2 to 8 feet.” Ex.1008¶0204, Claim 82. A POSA would understand that the housing holding the components would at least as large as the lamp.

8. **8. The linear LED lighting apparatus of claim 6, wherein the switch assembly is configured to be positioned in a receptacle of the housing, and wherein the switch assembly is configured to be flush with a surface of the housing when positioned in the receptacle.**

299. As shown below in Figures 1A and 1B the switch assembly of Jeswani is positioned in a receptacle of the housing and is flush with a surface of the housing.

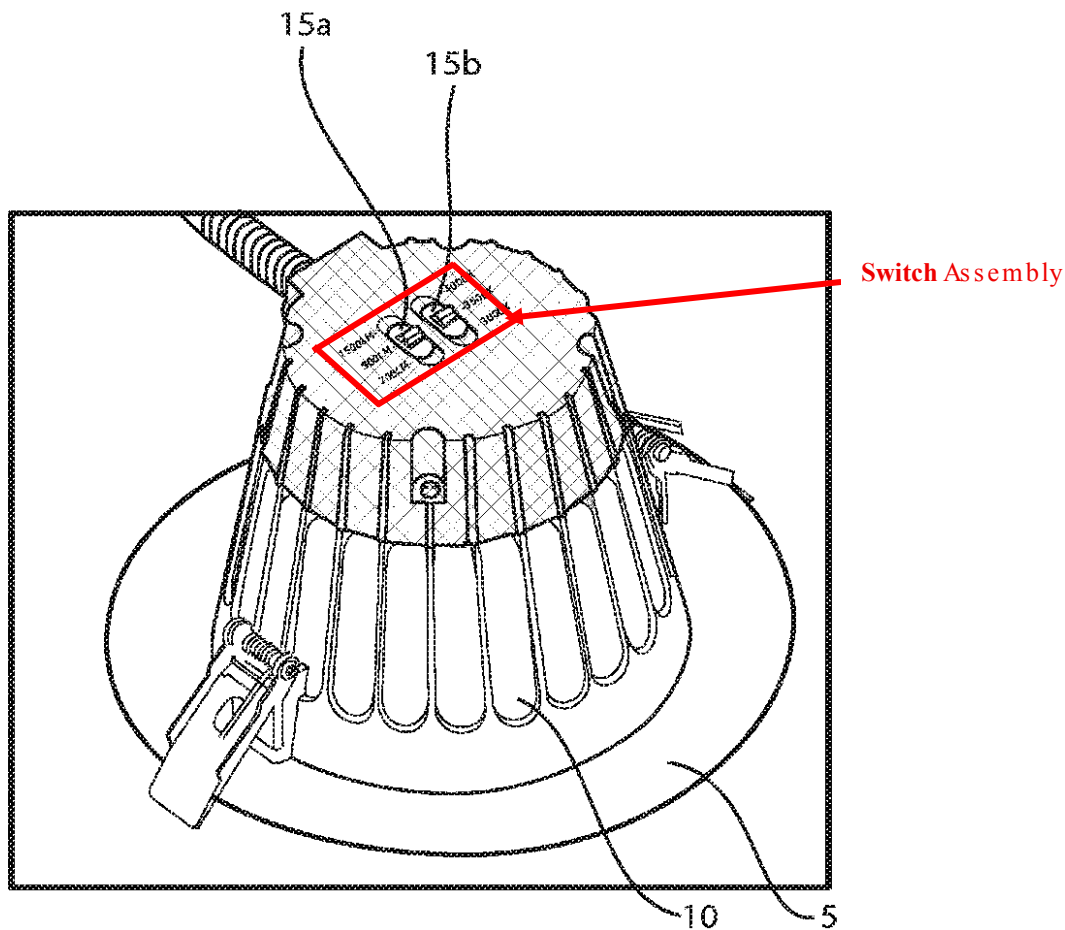


FIG. 1A

Ex.1007-1A-Annotated.

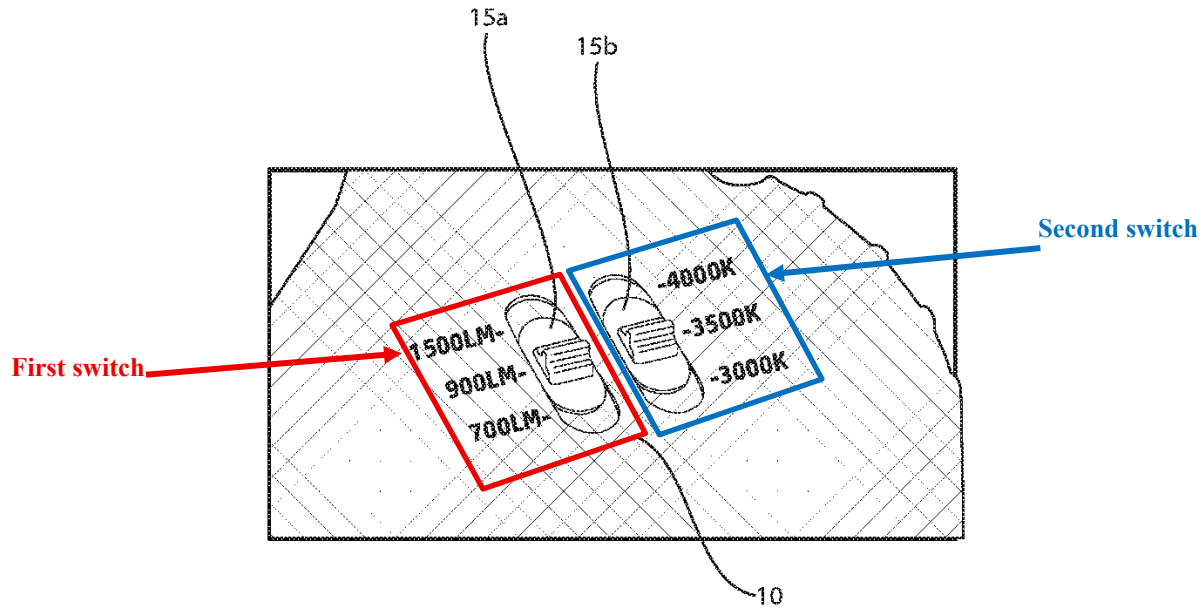


FIG. 1B

Ex.1007-Fig.-1B-Annotated.

9. **9. The linear LED lighting apparatus of claim 1, comprising at least one electrical connection configured to transmit electricity from the lighting apparatus to at least one other lighting apparatus.**

300. As I describe for 1[h] May discloses or renders obvious serially connecting the lamps and providing power from a first lamp to a second lamp.

10. Independent Claim 10:

301. Independent claim 10 overlaps substantially with claim 1 in that it recites a modular lighting system with multiple connected fixtures. However, it differs in that (a) it only recites LEDs of a single color temperature for the first fixture; (b) it expressly recites the features of the connected second fixture; and (c) it additionally recites certain structural elements of the second fixture.

1. Claim Elements [10a]-[10g]

302. Claim 10[pre] recites a lighting system, which is shown by the structures of claim 1 generally.

303. As I describe with respect to Ground 1, the following features are substantially identical between claim 1 and claim 10 and accordingly for these elements of claim 10 these limitations are rendered obvious by May in view of Jeswani based on the disclosures and analysis for the corresponding elements in claim 1, which are incorporated by reference.

Claim Feature	Claim 10	Claim 1
A lighting apparatus that is modular	10[a]	1[pre](Lighting apparatus) 1[h] modular
plurality of LEDs having first color temperature, and in linear form factor	10[b]	1[b]
driver outputting plurality of currents	10[c]	1[d]
Switch assembly	10[d]	1[e]
Switch for outputting current	10[e]	1[f]

Claim Feature	Claim 10	Claim 1
Switch for coupling first plurality of currents to LEDs	10[f]	1[g]
Connector for adjoining fixture	10[g]	1[h]

2. Claim Elements [10h]-[10n]

304. As I described for Ground 1, claim elements 10[h]-10[n] additionally recite features in the second fixture that correspond to features in the first fixture. As described with respect to claim element 1[h] May discloses a connector port that enables a similar fixture varying in size by a scale factor to be connected and thus the features of claim elements 10[i]-10[n] are similarly rendered obvious by May in view of Jeswani based on the disclosures and analysis for the claim elements below which are incorporated by reference.

Features on Second LED	Claim 10	Claim 1
A lighting apparatus that is modular and larger than first apparatus	10[h]	1[a](Lighting apparatus) 1[h] modular/larger

Features on Second LED	Claim 10	Claim 1
plurality of LEDs having first color temperature, and in linear form factor	10[i]	1[b]
driver outputting plurality of currents	10[j]	1[d]
Switch assembly	10[k]	1[e]
Switch for outputting current	10[l]	1[f]
Switch for coupling first plurality of currents to LEDs	10[m]	1[g]
Connector for adjoining fixture	10[n]	1[h]

3. [10i] a second plurality of light-emitting diodes (LEDs) arranged within a second linear form factor and having a second number of LEDs, each LED of the second plurality of LEDs associated with the first color temperature, wherein the second number is greater than the first number by a scale factor;

305. In addition to the common subject matter from claim element 1[b] identified for claim element 10[i] this element additionally recites that the “second number” of the “second plurality of LEDs” is greater than the “first number” of the “first number” of LEDs by a scale factor.

As shown in 1[h] above May discloses that connected LED arrays may be connected and may vary in length by a scale factor. May also discloses that the LEDs are “located at regularly spaced intervals.” Ex.1008¶0231.

306. Indeed, the optimal spacing between individual LEDs in a linear LED fixture or luminaire is determined by several considerations. The first of these is the expected height above the floor for the location of the luminaire. Specifically, light from a LED, like all light sources, diverges as it propagates away from the luminaire because of optical diffraction. Therefore, the spacing between adjacent LEDs in a ceiling-mounted luminaire will be determined by measurements conducted by an illumination engineer. These measurements will determine what is the maximum value of the spacing between LEDs that will guarantee spatial uniformity of the light intensity at the floor (or a specified height above the floor) while also providing the required intensity.

307. My point is that the spacing between the LEDs in any luminaire, including those comprising linear arrays of LEDs, is set by the product specifications and does not change with the length of the luminaire. One concludes, therefore, that the number of LEDs N in a given linear array will increase linearly with the length of that array. Similar comments apply to any other arrays, having different LEDs, within the luminaire.

308. A POSA would thus understand that the number of LEDs in each fixture would scale with the length of the fixture. Accordingly, a POSA would understand that the “second number” of LEDs in the second fixture is greater than the “first number” of LEDs in the first fixture by a scale factor. To the extent this relationship is not expressly disclosed, it is obvious. A POSA would be motivated to add this feature with a reasonable expectation of success. Having the number of LEDs scale with the length of the fixture merely a selection from a finite number of known predictable solutions.

4. [10m] couple the one of the second plurality of currents to the second plurality of LEDs, wherein the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor; and

309. In addition to the subject matter from claim element 1[g] identified for claim element 10[m] this element recites that “the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor”

310. As I discuss for claim element 10[i] a POSA would understand that the number of LEDs in fixture of May would be proportional to the length of the fixture. A POSA would understand that for a given brightness level that the current sent to each LED fixture would be proportional to the number of LEDs and accordingly would go up with the scale factor.

311. In view of the above considerations, a POSA will conclude that the current delivered to a second fixture, would be longer than the first fixture by a “scale factor”, must and accordingly the second current (sent to the LEDs of the second fixture) would be greater than the current to the LEDs of the first fixture by that scale factor.

312. If the number of LEDs in the “first plurality” of LEDs is denoted N_1 and the number of LEDs in the “second plurality” is denoted N_2 , then the scale factor is given by N_2/N_1 .

313. If a particular current (I_1) is required to power N_1 LEDs in the first lighting fixture (luminaire), it is obvious to a POSA that a current $I_2 = I_1 \times N_2/N_1$ will be required to power N_2 diodes in the second lighting fixture (assumed to be identical to those in the first lighting fixture).

314. Another way of saying this is that the current required for a particular brightness (lumens output) scales linearly with the number of LED lights.

315. A specific illustration of this is as follows. In order to distribute current among and within “strings” of LEDs efficiently, the LEDs comprising a string are typically connected electrically in series. Consequently, the same current flows through each LED in an individual string.

316. However, once the length of the string is fixed by an electrical or illumination engineer, multiple strings will be electrically connected and driven in

parallel. Thus a longer fixture (such as disclosed in May) would be understood to include multiple strings arranged serially but connected in parallel. As described below, amount of current needed for such a fixture is proportionate to the number of strings. To the extent not expressly disclosed in May, the typical way of extending the length of a linear LED fixture is to include multiple strings that are assembled serially but electrically connected in parallel. This among other things avoids the challenges of having larger voltage drops across strings of LEDs because too many are aligned in series. It also simplifies manufacturing of fixtures of different lengths by avoiding having to manufacture longer strings or drivers with different voltages.

317. For example, the *Energy Star Program for Decorative Light Strips*, Version 1.5, December 2011(Ex. 1020) defines safety standard for longer light strips. It specifically defines a system in which longer fixtures are comprised of smaller series strips with the series strips connected in parallel. A “series block” is defined in the standard as:

A number of lamps connected in series, or utilizing a series connection.

Additional series blocks can be added to the circuit (i.e., decorative light string) utilizing parallel connections (e.g., a 70-lamp light string could have two 35-lamp series blocks connected in parallel).

Ex. 2020-p.1

318. Accordingly a POSA would understand that the longer fixtures of Edwards would include multiple strings connected electrically in parallel.

319. Further, as described in U.S. Patent Publication 2017/0314743 to Del Castillo (“Del Castillo”, Ex.1010) when linear fixtures are assembled, individual LEDs are connected in strings in series but the strings are connected to each other in parallel. Del Castillo notes : “LEDs can ... be used to retrofit traditional fluorescent light fixtures by installing LED bulbs in the troffers that were originally designed for fluorescent bulbs” and in such linear replacement systems, “[t]he LED bulbs are *typically configured as strings of series - connected LEDs coupled in parallel.*” Ex.1010¶¶003-4.(emphasis added).

320. Similarly, Cross discusses strings in LEDs that are arranged serially but electrically connected in parallel:

Where more than one series of LED circuits are employed, the additional series of LEDs may be connected in parallel or in series with non-conductive materials. For example two serial strings of LEDs can employ non-conductive sleeves into which the ends of each opposing string is pressed. In this case, separate voltage source lead wires would be incorporated that lead back to the common voltage source connected to the end cap as previously described.

Ex.1011¶0025.

321. Accordingly the standard approach for extending a linear fixture is to use individual strings that are arranged linearly but connected electrically in parallel.

322. May discloses the use of LED arrays that are driven separately through separate outputs of a driver, noting “The schematic of FIG. 29 shows the lamp 1200 having three parallel LED arrays 1212, 1214 and 1216. Control node 1202 can include a driver 1208 for precisely controlling the magnitude of DC current transmitted to each LED array, which is proportional to the intensity of light emitted by the LEDs.” Ex.1008¶0211, Fig. 29. While only three channels are shown a POSA would understand that any number of strings could be driven independently. Similarly for the embodiment of Figure 28 May notes “the first and second strings of LED emitters may thus be connected in parallel to a power regulation module and driven independently of each other so that the board 1108 comprises two independently controllable LED emitter arrays.” Ex.1008¶218; Fig. 28.

323. Particularly, May discloses that other combinations of parallel strings may be used, noting “Other wiring designs may be utilized on the end connector board and LED emitter boards allowing many variations of parallel-series electrical connections of the LED emitters.” Ex.1008¶0220, Fig. 28.

324. Accordingly, May teaches both generally that LEDs may be connected in parallel and describes several specific implementations of connecting LED strings in parallel.

325. As described above when creating fixtures of any length (such as disclosed in May) multiple strings are arranged serially but connected electrically in parallel. This circuit design has been adopted by industry, with the benefit of limiting the voltage that would be required for an excessively long string of LEDs. A POSA implementing the longer fixtures disclosed in May would understand that such a fixture would include strings electrically connected in parallel and that the number of strings would scale linearly with the length of the fixture.

326. To the extent not inherently disclosed POSA would be motivated to extend the fixture of May by including multiple strings of LEDs connected in parallel as disclosed in May itself and known in the art. Such a practice would be necessary to limit the amount of voltage needed for a very long string of LEDs, by instead using multiple smaller strings of LEDs and to comply with known electrical and safety practices such as those in the Energy Star disclosure Ex. 1020 . Such an arrangement would be a selection from a finite number of known solutions to obtain a predictable result. Such a practice was as noted in Del Castillo, typical and a POSA would have a reasonable expectation of success as such changes are standard electrical connections within the knowledge of a POSA.

327. The number of strings would be expected to scale proportionally with the length of the fixture. An eight foot fixture would have twice as many strings as a four foot fixture. The amount of current necessary to drive those additional strings in parallel to a particular brightness (lumens output) would scale according to the scale factor and “the one of the second plurality of currents is greater than the one of the first plurality of currents by the scale factor”.

328. Accordingly this limitation is obvious over May in view of Jeswani.

5. [10n] a second extender port configured to couple with the first extender port to combine the first modular lighting apparatus and the second modular lighting apparatus to traverse the first linear distance and the second linear distance.

329. As discussed for element 1[h] multiple lamps can be connected via their Ethernet ports accordingly enabling the first extender port to combine the first modular lighting apparatus and the second modular lighting apparatus to traverse the first linear distance and the second linear distance. Ex.1008¶0113, 190, 191.

11. **11. The linear LED lighting system of claim 10, wherein the first switch assembly is configured to receive a signal to cause the first driver circuit to output the one of the first plurality of currents.**

330. As I describe for element 1[f], 1[g], and 1[h] the control module of the lamp of May can receive data communications over its Ethernet port. A POSA would understand this to be a signal.

12. 12. The linear LED lighting system of claim 11, wherein the signal is received via a wired connection.

331. *See* claim 1[f] and 1 [h] describing a wired Ethernet connection.

13. 13. The linear LED lighting system of claim 11, wherein the signal is received via a mechanical switch.

332. *See* claim 1[e] describing that incorporating the mechanical switch of Jeswani in May is obvious.

14. 14. The linear LED lighting system of claim 11, wherein the signal comprises a wireless signal.

333. This limitation is disclosed by May. May discloses that “the connector board 1130 may include “wireless transceivers, cameras or other devices to support smart LED lighting functionality.” Ex.1008¶0221. May also discloses that the wireless signals may control “one or more operational characteristics” of the lamp. Ex.1008-Claim 22. As described previously the control signals include functionality for “controlling the brightness, color and other aspects of the LED emitters.” Ex.1008¶0222. A POSA would understand that the smart LED functionality would include signals to control the color temperature of the lamp.

15. 16. The linear LED lighting system of claim 10, wherein the first extender port is configured to electrically couple the first modular lighting apparatus to the second modular lighting apparatus.

334. *See* 1[e]

- 16. 17. The linear LED lighting system of claim 10, wherein each LED of the first plurality of LEDs receives a same amount of current via the one of the first plurality of currents that each LED of the second plurality of LEDs receives via the one of the second plurality of currents.**

335. As I describe for element 10[m] and in the background a POSA would understand that each LED would receive approximately the same current, with the current being sent to each of the plurality of LEDs being proportional to the number of LEDs. Accordingly, the amount of current that is used to light any particular LED to a specific brightness will be the same between the first and second pluralities of LEDs.

17. Independent Claim 18

336. As described above, Independent claim 18 overlaps substantially with claim 1 in that it recites a modular lighting system with multiple connected fixtures. However, it differs in that (a) it expressly recites the features of the second fixture; and (b) it additionally recites certain current characteristics.

337. Claim 18[pre] recites a lighting system, which is shown by the structures of claim 1 generally.

1. Claim elements 18[a]-18[k]

338. The following features are substantially identical between claim 1 and claim 18 and accordingly for these elements of claim 18 these limitations are

rendered obvious by May in view of Jeswani based on the disclosures and analysis for the corresponding elements in claim 1, which are incorporated by reference.

Claim Feature	Claim 18	Claim 1
A lighting apparatus that is modular	18[a]	1[pre](Lighting apparatus) 1[h] modular
LED array	18[b]	1[a]
First plurality of LEDs having first color temperature, and in linear shape	18[c]	1[b]
Second plurality of LEDs with second color temperature	18[d]	1[c]
Second plurality of LEDs are in linear shape	18[e]	1[c]
driver outputting plurality of currents	18[f]	1[d]
Switch assembly	18[g]	1[e]

Claim Feature	Claim 18	Claim 1
First switch for outputting current	18[h]	1[f]
Second switch for coupling first plurality of currents to LEDs	18[i]	1[g]
Second switch can cause currents to couple to first plurality of LEDs	18[j]	1[g]
Second switch can cause currents to couple to second plurality of LEDs	18[k]	1[g]

2. [18l] cause half of the first portion of the one of the first plurality of currents to couple to each LED of the first plurality of LEDs and each LED of the second plurality of LEDs; and

339. As I describe for claim element 1[g] May discloses adjusting the relative current sent to its first and second strings of LEDs to only the first string, only the second string, or in ranges in between. Ex.1008¶0231. A POSA would understand this to include a color temperature in the middle in which equal amounts of current are sent to both strings of LEDs. Further, as I describe for

claim 3, Jeswani discloses an arrangement in which a setting on the switch may create a color temperature of 3500 by sending equal amounts of currents to LED groups of 3000K and 4000K. Ex.1007-11:23-35.

340. Thus, a POSA would be motivated with a reasonable expectation of success to utilize the teachings of May or Jeswani to configure the lamp to a color temperature halfway between the minimum and maximum to obtain a color temperature in the middle between first and second color temperatures. Having the half the current go to each set of LEDs would a selection from a finite number of known predictable solutions.

3. Independent Claim 18 -Claim elements 18[m]-18[w]

341. As described above, claim elements 18[m]-18[w] additionally recite features in the second fixture that correspond to features in the first fixture. As described with respect to claim element 1[h] May discloses a connector port that enables a similar fixture varying by a scale factor to be connected and thus the features of claim elements 18[m]-18[w] are similarly rendered obvious by May in view of Jeswani according to the disclosures and analysis for the claim elements below which are incorporated by reference.

342. With respect to claim elements 18[m]-18[w] the third and fourth pluralities of LEDs in the second fixture respectively correspond to the first and second pluralities of LEDs of the first fixture. Similarly, the second plurality of

currents of the second fixture corresponds to the first plurality of currents of the first fixture.

Claim Feature of Second Fixture	Claim 18	Claim 1
A lighting apparatus that is modular	18[m]	1[pre](Lighting apparatus) 1[h] modular
LED array	18[n]	1[a]
Third plurality of LEDs having first color temperature, and in linear shape	18[o]	1[b]
Fourth plurality of LEDs with second color temperature	18[p]	1[c]
Fourth plurality of LEDs in linear shape	18[p]	1[c]
driver outputting plurality of currents	18[q]	1[d]
Switch assembly	18[r]	1[e]

Claim Feature of Second Fixture	Claim 18	Claim 1
Third Switch for outputting current	18[s]	1[f]
Fourth Switch for coupling first plurality of currents to LEDs	18[t]	1[g]
Fourth switch can cause currents to couple to third plurality of LEDs	18[u]	1[g]
Fourth switch can cause currents to couple to fourth plurality of LEDs	18[v]	1[g]

4. [18o] wherein the third plurality of LEDs is longer than the first plurality of LEDs;

343. As described above, in addition to the incorporated disclosure from element 1[b], claim limitation 18[o] additionally recites that the third plurality of LEDs (of the second fixture) is longer than the first plurality of LEDs on the first fixture. As set forth with respect to 1[h] the fixtures and their lengths of LEDs vary by a scale factor, which would cause the third plurality of LEDs to be longer than the first plurality of LEDs.

5. [18p] wherein the fourth plurality of LEDs is longer than the second plurality of LEDs;

344. As described above, in addition to the incorporated disclosure from element 1[b], claim limitation 18[p] additionally recites that the fourth plurality of LEDs is longer than the second plurality of LEDs on the first fixture. Aset forth with respect to 1[h] the fixtures and their lengths of LEDs vary by a scale factor, which would cause the fourth plurality of LEDs to be longer than the second plurality of LEDs.

6. [18w] cause half of the second portion of the one of the second plurality of currents to couple to each LED of the third plurality of LEDs and each LED of the fourth plurality of LEDs.

345. As I describe for 18[l] May and Jeswani discloses or renders obvious that the second switch of each LED fixture can send half of its current to the first plurality of LEDs of each fixture [*i.e.*, the “third plurality of LEDs”] and half of its current to the second plurality of LEDs of each fixture [*i.e.*, the “fourth plurality of LEDs.”]

- 18. 19. The linear LED system of claim 18, wherein the first modular lighting apparatus comprises a first connector configured to couple to a second connector part of the second modular lighting apparatus, wherein the first connector and second connector are configured to transmit data between the first modular light apparatus and the second modular lighting apparatus.**

346. See 1[h] describing how in May the lamps may be connected by Ethernet cables to provide power and data through their Ethernet ports.

- 19. 20. The linear LED system of claim 18, wherein a first ratio of the one of the second plurality of currents to the one of the first plurality of currents matches a second ratio of a first number of LEDs in the first plurality of LEDs to a second number of LEDs in the third plurality of LEDs.**

347. As described for 10[m] the ratio of current sent to the third plurality of LEDs in the second lamp (referred to as the second plurality of currents) and current sent to the first plurality of LEDs in the first lamp (referred to as the first plurality of currents) is the same as the scale factor between the first and second lamps and particularly the ratio between the number of LEDs in the second lamp and the number of LEDs in the first lamp.

IV. GROUND 4- CLAIM 15 IS OBVIOUS OVER MAY IN VIEW OF TESWANI AND FURTHER IN VIEW OF SADWICK

- 20. 15. The linear LED lighting system of claim 10, wherein the first driver circuit comprise a current regulator.**

348. As described for Ground 1, claim 15, Sadwick discloses a “constant current driver” and “variable constant current driver” which entails a current

regulator. Ex.1006¶0049. A POSA would understand that a “constant current driver” or “variable constant current driver” would necessarily include a current regulator to control the current. A POSA would further be motivated to include the constant current driver or variable constant current driver of Sadwick in May with a reasonable expectation of success. Such a system allows for better and more stable regulation of electrical operation and avoidance of damage to the LEDs. Incorporation of the current regulator of Sadwick in the system of May would be the combination of known elements to obtain a predictable result. Given that constant current components were common a POSA would easily be able to adapt them to the system of May.

IX. SECONDARY CONSIDERATIONS

349. There is no evidence of nonobviousness which I am aware that affects—let alone overcomes—the strong cases of obviousness set out above.

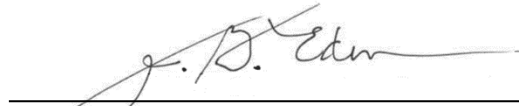
X. CONCLUSION

350. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case 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 of me, I will appear for

cross-examination within the United States during the time allotted for cross-examination.

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

Date: July 19, 2025



J. Gary Eden