

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation,
Petitioner,

v.

Light Guide Innovations LLC,
Patent Owner

Case: IPR2025-01538
U.S. Patent No. 8,267,537

**DECLARATION OF MICHAEL R. KRAMES, PH.D. IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW**

TABLE OF CONTENTS

I.	Introduction.....	1
II.	Qualifications.....	2
III.	Materials Considered.....	3
IV.	Legal Standards	5
	A. Level of Ordinary Skill	6
	B. Prior Art.....	7
	C. Anticipation	8
	D. Obviousness.....	9
V.	Claim Construction.....	11
VI.	The '537 Patent.....	12
	A. Overview	12
	B. Prosecution History and Effective Filing Date	13
	C. The Challenged Claims	14
	D. Person of Ordinary Skill in the Art (“POSITA”).....	14
	E. Priority Date	14
VII.	Overview of the Prior Art.....	15
	A. Liu.....	15
	B. Roberts.....	17
	C. Liu-660	18
VIII.	Ground 1: Claims 1, 3-5, 8, 9, 11, 12, 13, 14, 16, 17, 19, and 20 are obvious over Liu in view of the knowledge of a POSITA.....	21
	A. The Challenged Claims	21
	[13B] “a case supporting the LED module, and comprising a bending part that guides and fixes an end portion of the LED module”	39
IX.	Ground 2: Claims 2, 6, 7, 15, and 18 are rendered obvious by Liu in view of Roberts and the knowledge of a POSITA	51
	A. Overview of the combination; motivation to combine; expectation of success	51

B.	The Challenged Claims	54
X.	Ground 3: Claim 10 is rendered obvious by Liu in view of Liu-660 and the knowledge of a POSITA.....	66
A.	Overview of the combination; motivation to combine; expectation of success	66
B.	The Challenged Claim.....	70
XI.	DECLARATION IN LIEU OF OATH	73

PETITIONER'S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 8,267,537 to Park (“’537 Patent”)
1002	Declaration of Michael R. Krames, PhD, NAE, FIEEE, FIES
1003	Certified Translation of Taiwan Patent No. TWI248538B to Liu and translation certification
1004	U.S. Patent Publication No. 2007/0247414 to Roberts (“Roberts”)
1005	File History Excerpts for U.S. Patent No. 8,267,537 to Park
1006	US Patent Publication No. 2006/0187660 to Liu (“Liu-660”)
1007	Taiwan Patent No. TWI248538B to Liu (“Liu”)
1008	US Patent Publication No. 2007/0065718 to Moon
1009	Taiwan Intellectual Property Office Bibliographic Data Sheet for Taiwan Patent No. TWI248538

I, Michael R. Krames, Ph.D., declare as follows:

I. Introduction

1. I am over the age of 21 and am competent to make this declaration.
2. I have been retained on behalf of Petitioner Hisense USA Corp. to provide my opinions regarding the validity of claims 1-20 (“Challenged Claims”) of U.S. Patent No. 8,267,537 (EX1001, the “’537 patent”). I submit this declaration based on my personal knowledge and in support of Hisense’s *inter partes* review Petition (the “Petition”) against the ’537 patent.
3. I have been asked to provide my independent analysis of the ’537 patent in light of the materials cited below and my knowledge and experience in this field during the relevant period. I have been asked to consider whether the references cited in the Petition render obvious the invention described by the Challenged Claims.
4. I am being compensated at my normal hourly rate for my time. My compensation is not contingent in any way on the content of my analysis or the outcome of this proceeding. I am not and never have been an employee or agent of Hisense.
5. My opinions are based on my study, experience, and background discussed below, informed by my extensive experience regarding the subject matter of the ’537 patent and the related prior art.

II. Qualifications

6. I have over thirty years of experience in compound semiconductors, with an emphasis on wide-bandgap semiconductor materials and devices and specifically including the field of light emitting diodes (“LEDs”). I have extensive experience in R&D and manufacturing settings, creating innovative LEDs and LED-based products for various solid-state lighting applications. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) and a Fellow of the Illuminating Engineering Society (IES), and a member of the U.S. National Academy of Engineering (NAE).

7. Currently, I am the President of Arkesso LLC, which is a consulting firm specializing in wide bandgap semiconductors and applications.

8. From 2009 to 2015, I was the Chief Technology Officer at Soraa, Inc, where I worked with Nobel Prize winner Shuji Nakamura and other key innovators from the University of California, Santa Barbara, to develop leading LED products for professional directional lighting by creating a new LED materials platform based on bulk gallium-nitride substrates (GaN-on-GaN).

9. I was also the Executive Vice President of Advanced Laboratories at Philips Lumileds/Lumileds Lighting and was a design engineer and engineering scientist at Hewlett Packard Co. While at Philips Lumileds/Lumileds Lighting (from 1999-2009), I developed key innovations behind the LUXEON high power LED

platform and managed the advanced technology roadmaps, identified Auger recombination as the primary loss mechanism in InGaN-based LEDs, and designed LED solutions for the iMac, iPhone Flash, digital imaging, and general illumination. My contributions there also led to the first automotive LED headlights for the Audi R8.

10. I am a named inventor on 176 U.S. granted patents in the fields of LEDs and wide bandgap semiconductors and am a named author on over 100 publications in these fields.

11. In 1989, I earned a Bachelor of Science in Electrical Engineering with High Honors from the University of Texas in Austin, TX.

12. In 1995, I earned a Ph.D. in Electrical Engineering from the University of Illinois at Urbana-Champaign in Urbana, IL, under the supervision of Prof. Nick Holonyak, Jr., the original inventor of the LED.

13. My Curriculum Vitae is provided as Appendix A, which contains further details on my education, experience, publications, and other qualifications.

III. Materials Considered

14. As described in more detail below, based on my experiences, I understand and know the capabilities of a person of ordinary skill in the art of the '537 patent in 2006, when the application to which the '537 patent claims priority was filed. I have relevant personal knowledge and experience, in addition to working directly with

many such persons in these fields during that time frame.

15. I have also relied on my review and analysis of the prior art cited in the Petition, information provided to me in connection with this case, and information I have independently reviewed.

16. In forming my opinions, I have been asked to review the '537 patent including the specification and the Challenged Claims. I have also considered the materials cited herein, including those itemized in the Table of Exhibits that precedes this declaration.

17. My opinions are based on the materials I reviewed and my knowledge and professional judgment. My opinions have also been guided by my understanding of how a person of ordinary skill in the art would have understood the claims of the '537 patent in the relevant time frame.

18. I also understand from counsel that the prior art references cited herein qualify as prior art under U.S. law.

19. In my analysis below, emphasis in my citations has been added unless otherwise noted. Likewise, annotations to images and figures (typically highlighting of various colors) have been added unless otherwise noted.

20. I reserve the right to supplement and amend any of my opinions in this declaration based on documents, testimony, and other information that becomes available to me after the date of this declaration.

IV. Legal Standards

21. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.

22. I have been informed that there are two ways in which prior art may render a patent claim unpatentable. First, I have been informed that the prior art can “anticipate” a claim. Second, I have been informed that the prior art can render a claim “obvious” to a person of ordinary skill in the art. I understand that a claim is patentable if it was not anticipated and would not have been obvious by the prior art at the effective filing date of the patent. In this declaration, I only address obviousness.

23. I have been informed that a dependent claim is a patent claim that refers back to another patent claim. I have been informed that a dependent claim includes all of the limitations of the claim to which it refers.

24. I have been asked to provide my opinions as to whether the cited prior art renders obvious the Challenged Claims of the ’537 patent from the perspective of a person of ordinary skill in the art at the ’537 patent’s earliest possible effective filing

date in 2006, as described in more detail below.

25. I have been informed that in *inter partes* review proceedings, such as this one, the party challenging the patent bears the burden of proving unpatentability by a preponderance of the evidence. I understand that a preponderance of the evidence means “more likely than not.”

26. For purposes of this declaration, I have been asked to provide my opinions on issues regarding unpatentability. I have been informed of the following legal standards, which I have applied in forming my opinions.

A. Level of Ordinary Skill

27. I understand that my assessment of the claims of the ’537 patent must be undertaken from the perspective of what would have been known or understood by a person having ordinary skill in the art, reading the ’537 patent on its priority date and in light of the specification and file history of the ’537 patent. I will refer to such a person as a “POSITA.”

28. I understand that my analysis and opinions expressed in this declaration must be rendered based on the perspective of a POSITA as of the priority date of the ’537 patent. I also understand that a POSITA is a hypothetical person who is presumed to know the relevant art at the time of the alleged invention claimed in the ’537 patent.

29. I further understand that in determining the level of ordinary skill in the

art, I am to consider factors including:

- the type of problems encountered in the art or field of invention,
- prior art solutions to those problems,
- the rapidity with which innovations are made,
- sophistication of the technology, and
- the educational level of active workers in the field.

30. I have been instructed to assume a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

31. I understand that a POSITA is a person of ordinary creativity, but not an automaton, and that a POSITA can often fit multiple patents or prior art references together like pieces of a puzzle as a result of this ordinary creativity. I also understand that I may consider the inferences and creative steps that a POSITA would employ. In addition, I understand that a POSITA would necessarily have been capable of understanding the scientific and engineering principles applicable to the pertinent art. I also understand that when I consider what would have been obvious to a POSITA, I am not considering what would have been obvious to me at the time, nor to the inventors, judges, laymen, those skilled in other arts, or to geniuses in the art.

B. Prior Art

32. I have been advised and understand that the information used to evaluate whether an invention was new and not obvious when made is generally referred to

as “prior art.” I understand that prior art includes patents and printed publications that existed before the earliest claimed priority date or the earliest filing date of the patent (which I have been informed is also called the “effective filing date”).

33. I have been informed and understand that a patent or published patent application is prior art if it was filed before the effective filing date of the claimed invention.

34. I have also been informed and understand that a printed publication is prior art if it was publicly available before the earliest filing date and could be located by a POSITA exercising reasonable diligence.

C. Anticipation

35. I understand that a patent is invalid as anticipated if each and every feature of the claim is found, expressly or inherently, in a single item of prior art. I understand that anticipation by inherent disclosure is appropriate only when a prior art reference necessarily includes or discloses the unstated claim element. I also understand that the discovery of a new or previously unreported or unappreciated property of a prior art composition, or of a scientific explanation for how a prior art composition operates, does not make the prior art composition patentably new to the entity or person that discovered the new property or mode of operation.

36. For anticipation by a prior art publication or document, I understand that the reference’s description must enable a POSITA to practice the claimed invention

D. Obviousness

37. I understand that a claim may be invalid if the subject matter described by the claim as a whole would have been obvious to a POSITA in view of a prior art reference, or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a POSITA, and that the asserted claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. I further understand that a POSITA is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit and all analogous prior art. I understand that obviousness in an *inter partes* review proceeding is evaluated using a preponderance of the evidence standard, which means that the claims must be more likely obvious than nonobvious.

38. I also understand that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole. I understand that in considering whether an invention for a claimed combination would have been obvious, I may assess whether there are apparent reasons to combine known elements in the prior art in the

manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSITA. I also understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or in a different one, so that if a POSITA can implement a predictable variation, the variation is likely obvious;
- If a technique has been used to improve one device, and a POSITA would have recognized that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- "Common sense" teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSITA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSITA is also a person of ordinary creativity, not an automaton;

- A patent claim can be proved obvious by showing that the claimed combination of elements was “obvious to try,” particularly when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSITA would have had good reason to pursue the known options within his or her technical grasp; and
- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

39. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the effective filing date is December 29, 2006, and that I should assume this is the date of invention for the Challenged Claims. My opinions regarding the appropriate skill level of a POSITA would not change if I assumed a later date of invention, e.g., if the alleged invention is not entitled to a December 29, 2006 filing date.

V. Claim Construction

40. I understand that claim terms in an IPR are generally interpreted according to their ordinary and customary meaning. I further understand that the claims are read in light of the patent’s specification and that claims themselves often provide significant guidance as to the meaning of a particular term. I also understand that extrinsic evidence may be helpful when construing a claim term, but that it is less relevant than the intrinsic evidence and is often unreliable.

41. The prior art discussed herein would disclose and/or obviate the

Challenged Claims under any reasonable constructions, and thus, I believe no formal claim constructions are required.

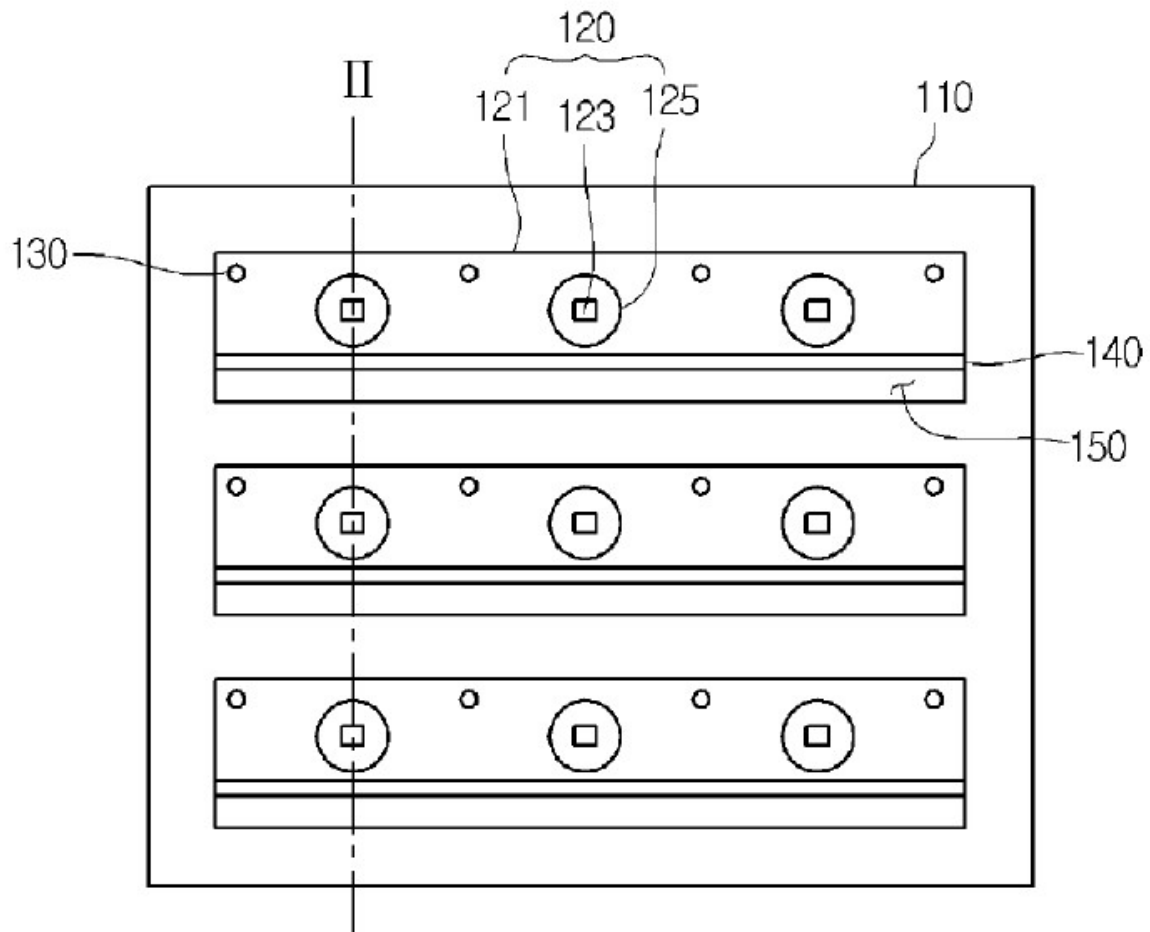
VI. The '537 Patent

A. Overview

42. The Abstract of the '537 Patent states that the patent describes a “backlight unit” having a light emitting diode (LED) module comprising an LED, a case supporting the LED module and comprising a bending part that guides and fixes an end portion of the LED module, and a fixing part fixing the LED module to the case.” EX1001, Abstract. The '537 Patent discloses that “in order to disassemble the case 10 and separate the LED modules 20 from the case 10, it is inconvenient in that many fixing parts 30 must be separated from the LED modules 20.” EX1001, 1:34-37. “Accordingly, a backlight unit, in which the LED module 20 can be easily separated from the case 10 and replaced with new ones, is required.” EX1001, 1:42-44.

43. The '537 Patent discloses “a backlight unit according to the embodiment comprises a case 110, an LED module 120, a fixing part 130, and a bending part 140.” EX1001, 2:33-45. Fig. 3 of the '537 Patent is reproduced below.

[Fig. 3]



EX1001, Fig. 3.

44. The '537 Patent describes that “[t]he case 110 supports the LED module 120, and is formed with a bending part 140 for guiding and fixing an end portion of the LED module 120.” EX1001, 2:49-51.)

B. Prosecution History and Effective Filing Date

45. I understand that the prosecution of the '537 patent at the USPTO was minimal.

46. I also understand that Petitioner describes the conduct before the USPTO

in more detail. I do not repeat that discussion here.

C. The Challenged Claims

47. I understand that Petitioner is challenging claims 1-20 (collectively, the “Challenged Claims”). Claims 1 and 13 are independent claims.

D. Person of Ordinary Skill in the Art (“POSITA”)

48. After considering the factors identified above regarding the level of ordinary skill in the art and my own experience in the field of the ’537 patent, in my opinion a POSITA as of December 29, 2006 would have had 2 or 3 years of experience in LED-based lighting device design and fabrication as well as at least a bachelor’s degree in a relevant field (e.g., mechanical engineering), or alternatively would have an equivalent combination of advanced education and practical experience, such as an advanced degree that is based on work involving LED-based lighting device design and fabrication.

49. A POSITA would have been knowledgeable regarding backlighting devices that use LEDs.

50. Additional techniques and tools understood by a POSITA are discussed in this Declaration.

E. Priority Date

51. I have been instructed to assume that the ’537 patent is entitled to a December 29, 2006, priority date based on a priority claim to a Korean application. EX1001, cover (30).

VII. Overview of the Prior Art

52. I understand that the Petition addresses the following grounds:

Ground	Claims	Challenge
1	1, 3, 4, 5, 8-9, 11-14, 16-17, 19, and 20	Obviousness over Liu and the knowledge of a POSITA
2	2, 6, 7, 15 and 18	Obviousness over Liu in view of Roberts and the knowledge of a POSITA
3	10	Obviousness over Liu in view of Liu-660 and the knowledge of a POSITA

53. I provide a brief overview of the prior art references identified in Petitioner's grounds below. Each reference discussed below and relied upon in the grounds is analogous prior art and in the same field of endeavor as the '537 Patent.

A. Liu

54. I understand that Taiwan Patent No. TWI248538 to Liu ("Liu") was filed on July 13, 2004, published as TW200602716A on January 16, 2006, and issued on February 1, 2006. I understand that EX1007 is the original Taiwanese version of Taiwan Patent No. TWI248538. I also understand that EX1009 provides a bibliographic data sheet from the Taiwan Intellectual Property Office ("TIPO") regarding Taiwan Patent No. TWI248538. Furthermore, I understand that Exhibit 1003 ("EX1003-Liu") provides a certified translation, including the translation certificate, of TWI248538 to Liu (EX1007). I understand that Liu is prior art.

55. Liu discloses “a light source assembly structure of a backlight module,” and “the structure includes at least one light source assembly and one backboard,” wherein the “light source assembly includes at least one light-emitting device and one board, “[t]he backboard has at least one protrusion part,” and “[t]he board is detachably installed on the backboard and is tightly held by the backboard and the protrusion part.” EX1003-Liu, 3, 8. Fig. 5 of Liu is reproduced below:

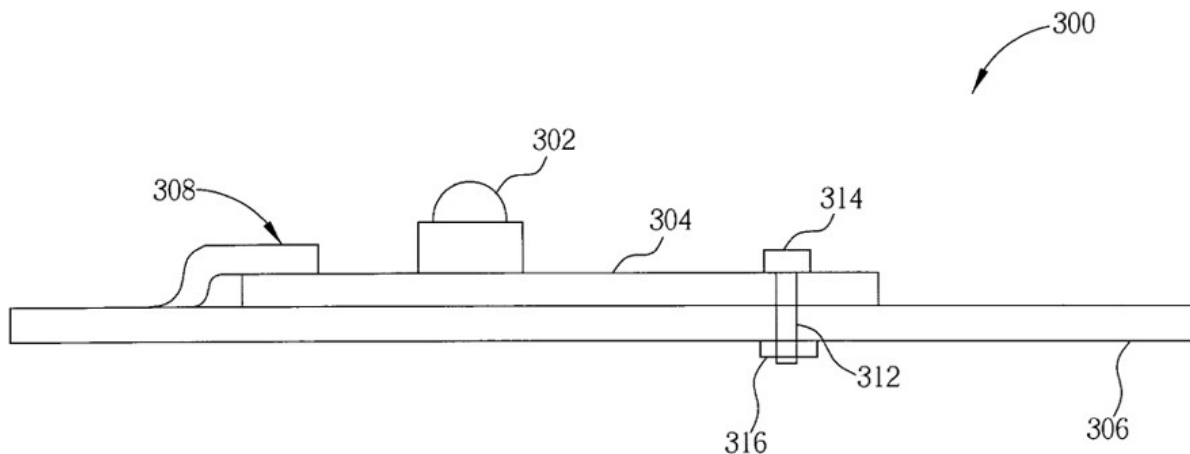


FIG. 5

EX1003-Liu, Fig. 5.

56. “As shown in FIG. 5, the LED light source assembly structure 300 of the present invention comprises an LED light source 302, a board 304 supporting the LED light source 302, and a backboard 306.” EX1003-Liu, 13. “The LED light source 302 is welded to the surface of the board 304.” EX1003-Liu, 13. Liu further discloses an improved device where “[t]he backboard has at least one protrusion part ... [w]herein the board is detachably installed on the backboard and the board is

tightly held by the backboard and the protrusion part.” EX1003-Liu, 8.

B. Roberts

57. I understand that U.S. Patent Publication No. 2007/0247414 to Roberts (EX1004, “Roberts”) was filed on April 21, 2006. I understand Roberts qualifies as prior art.

58. Roberts discloses a “lighting panel according to some embodiments of the invention includes at least one tile, or an LED module having one or more LEDs mounted thereon” (EX1004-Roberts, ¶13). Roberts explains the benefits of using printed circuit boards for electrical connections for the LEDs and reflective materials to improve LCD backlight units. EX1004-Roberts, ¶¶60-62, 77-79. Roberts discloses a “solid state lighting tile 10 [that] may include thereon a number of solid state lighting elements 12 arranged in a regular and/or irregular one- or two-dimensional array. The tile 10 may include, for example, a printed circuit board (PCB) on which one or more circuit elements, such as discrete light emitting components, may be mounted.,” as illustrated in Fig. 1 reproduced below. EX1004-Roberts, ¶60.

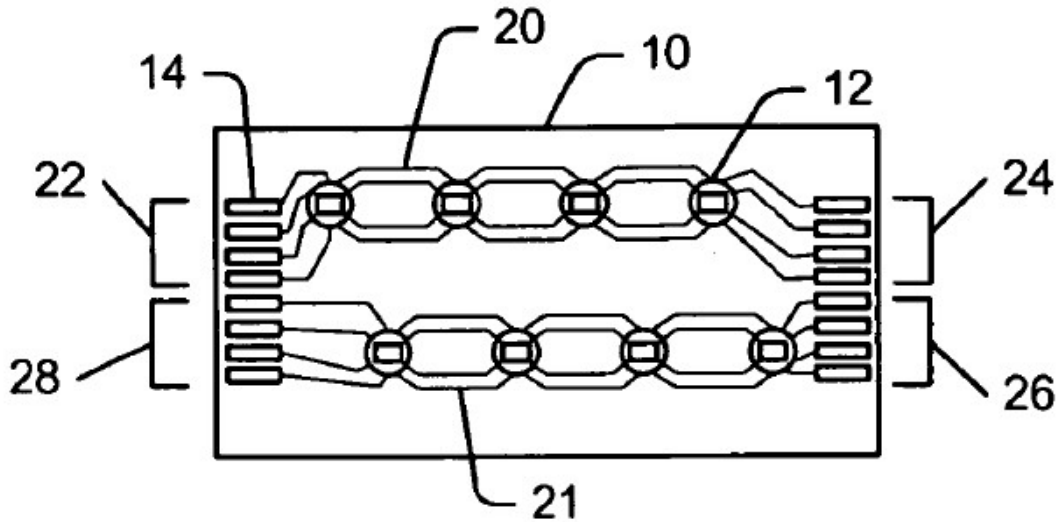


FIGURE 1

EX1004-Roberts, Fig. 1.

59. Roberts discloses that “a tile 10 may include a metal core PCB (MCPCB) including a metal core having thereon a polymer coating on which patterned metal traces (not shown) may be formed.” EX1004-Roberts, ¶60. Roberts also discloses that “[i]n order to provide and/or improve light recycling in the lighting panel 40, a reflector sheet 50 may be provided on the same side of the tile 10 as the lighting elements 12.” EX1004-Roberts, ¶77. Roberts discloses that “in addition to reflecting incident light, the reflector sheet 50 may help disperse the incident light so that it is reflected in a random direction (i.e. a lambertian reflector), which may improve the uniformity of the lighting panel 40.” EX1004-Roberts, ¶79.

C. Liu-660

60. I understand that US Patent Publication No. 2006/0187660 to Liu (“Liu-660”) was published on August 24, 2006 and filed on July 15, 2005. I understand

that Liu-660 qualifies as prior art. I also understand that Liu-660 and Liu share the same solo inventor, Pang-Hsuan Liu, and Liu-660 provides a related disclosure regarding a backlight module for an LED display. EX1006-Liu-660, Abstract. Specifically, Liu discloses a “device for fastening the lighting units in a backlight module,” and a “rigid board [that] partially laps over the adjacent lighting unit or units.” EX1006-Liu-660, Abstract.

61. Liu-660 discloses and illustrates a “backlight module 2 [] composed of a backboard 21 and a plurality of lighting units 22 arranged in equal space and in parallel to one another on the backboard 21” and “[e]ach lighting unit 22 comprises a plurality of lighting elements 221 and a metal board 222 carrying the lighting elements 221.” EX1006-Liu-660, ¶17.



62. Liu-660 further discloses that “when the rigid metal board 23 is moved and configured between two adjacent metal boards 222, the two sides of the rigid metal board 23 with good rigidity lap over the adjacent portions of the metal boards 222,” and “when the bolts 241 are passed through the holes 231 of the concave portion 232 and the holes 211 of the backboard 21, and locked together with nuts 242 (not shown in the figure), the rigid metal board 23 can be fastened on the backboard 21.” EX1006-Liu-660, ¶19. “[T]he strength of the compressing provided by the rigid metal board 23 can fasten the adjacent boards 222 on the backboard 21.” EX1006-

VIII. Ground 1: Claims 1, 3-5, 8, 9, 11, 12, 13, 14, 16, 17, 19, and 20 are obvious over Liu in view of the knowledge of a POSITA

A. The Challenged Claims

Claim 1: [1Pre]: A backlight unit comprising:

63. Liu renders obvious the claimed “*backlight unit*.”¹ Liu discloses “a light source assembly structure of a **backlight module**.” EX1003-Liu, 3. Liu discloses that “[a]mong the various key components of LCDs, the **backlight module** used to supply light has a significant impact on the overall luminous efficacy of the LCD,” and “[w]hen the **backlight module** itself has excellent luminous efficacy, it can not only improve the brightness of the LCD, but also provide flexibility in the design and manufacturing of other components in the LCD.” EX1003-Liu, 5.

64. Thus, Liu in view of the knowledge of a POSITA renders obvious claim [1Pre].

[1A]: a *light emitting diode (LED) module* comprising an *LED*²

65. Liu in view of the knowledge of a POSITA renders obvious the claimed “a *light emitting diode (LED) module* comprising an *LED*.”

¹ Italicized text appearing in quotes herein is used to identify claim language, unless otherwise noted.

² All colorized text emphases herein are annotations added by Petitioner, unless otherwise noted.

66. Liu discloses “an LED light source assembly structure 300 in a backlight module according to a third embodiment of the present invention,” in Fig. 5 reproduced below. EX1003-Liu, 13.

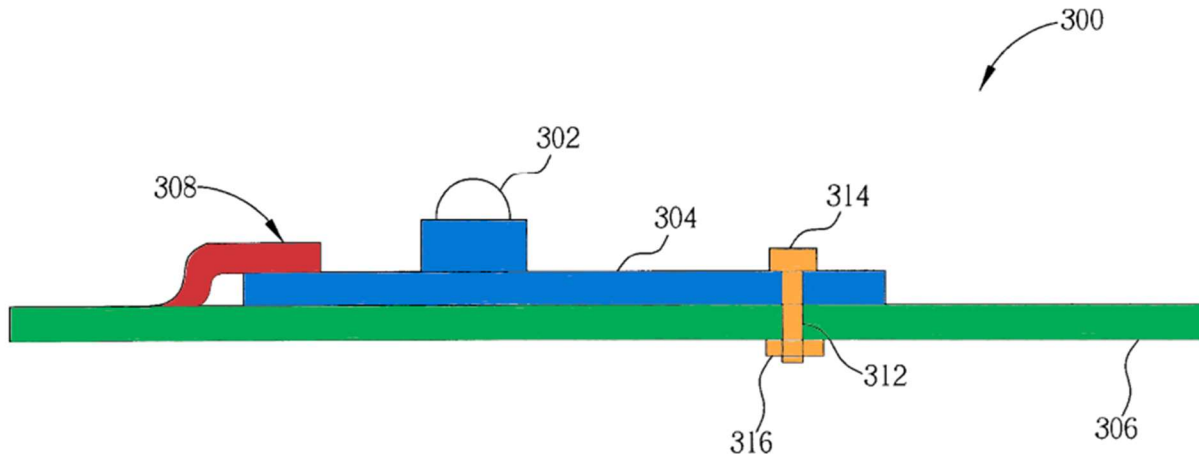


FIG. 5

EX1003-Liu, Fig. 5.³

67. “As shown in FIG. 5 above, the LED light source assembly structure 300 of the present invention comprises **an LED light source 302**, a **board 304** supporting **the LED light source 302**.” EX1003-Liu, 13

68. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [1A].

³ All colorization appearing in the figures herein are annotations added by Petitioner, unless otherwise noted.

[1B] a case supporting the LED module, and comprising a bending part that guides and fixes an end portion of the LED module

69. Liu in view of the knowledge of a POSITA renders obvious “a case supporting the LED module, and comprising a bending part that guides and fixes an end portion of the LED module.”

70. Liu states that a problem with prior art is that “it requires the use of bolts 18 and nuts 22 for assembly, which is too complicated during assembly and results in an increase in various labor and material costs,” and “[p]articularly in some large backlight modules, where dozens or hundreds of LED light sources are installed, the number of bolts and nuts used must be considerable, further highlighting this problem.” EX1003-Liu, 7.⁴ Accordingly, Liu discloses an improved device where “[t]he backboard has at least one protrusion part ... [w]herein the board is detachably installed on the backboard and the board is tightly held by the backboard and the protrusion part.” EX1003-Liu, 8.

⁴ The '537 Patent address a similar problem to the problem identified in Liu. More particularly, the '537 Patent states that “it is inconvenient in that many fixing parts 30 must be separated from the LED modules 20” to service the unit. EX1001, 1:35-36. Thus, the '537 Patent proposes that “a backlight unit, in which the LED module 20 can be easily separated from the case 10 and replaced with new ones, is required.” EX1001, 1:42-44.

71. Liu discloses that “[s]ince the material of the backboard itself is elastic, the board can be detachably installed on the backboard. At the same time, **at least one corner or at least one side** of the board is tightly held by the backboard and the at least one protrusion part. By utilizing the clamping force applied to the board by the backboard and the protrusion part, the board can not only be tightly held onto the backboard, but the contact surface between the board and the backboard will also be intact and good.” EX1003-Liu, 8. Liu further teaches the claimed “*bending part that guides and fixes*” as Liu discloses embodiments that “concurrently use the stamped protrusion part and the backboard to **tightly hold the sides and corners of the board** to achieve the same purpose, and the number of boards installed on the backboard and the number of LED light sources installed on the board can be adjusted according to actual conditions without any special restrictions.” EX1003-Liu, 13. This is further illustrated in Liu’s Fig. 5 below:

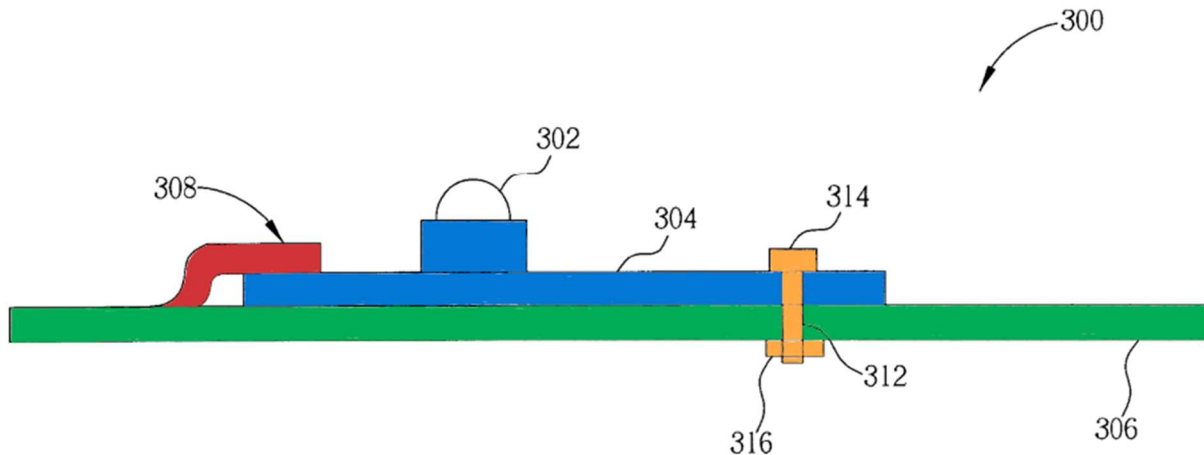


FIG. 5

EX1003-Liu, Fig. 5.

72. As shown above in Fig. 5, Liu discloses that the at least one protrusion part is a “**stamped protrusion part 308**” and that there is a “clamping force” applied “by the **backboard 306** and the **stamped protrusion part 308**.” EX1003-Liu, 13-14. Liu further discloses that in some embodiments, “the backboard and the first protrusion part are integrally formed.” EX1003-Liu, 21. Liu also discloses “the material of the backboard 106 can be stainless steel.” EX1003-Liu, 9. Accordingly, a POSITA would have understood that the “first protrusion part” in Liu is elastic, as it is formed from the same elastic material as the backboard. Similar to Liu, the ’537 patent discloses that its “bending part 140 may be formed by bending an area corresponding to an opening 150 of the case 110.” EX1001, 2:55-57. It would have been obvious to a POSITA that Liu’s integrally formed “first protrusion part” would exhibit the elastic properties of the backboard.

73. A POSITA would have understood based on Liu's disclosure of "the clamping force applied to the board by the backboard and the protrusion part," that the "elastic" "protrusion part" can bend such that **"the board is detachably installed on the backboard."** This understanding would have been background knowledge possessed by a person having ordinary skill in the art. A POSITA would have understood, based on Liu's disclosure, that a "protrusion part" (claimed "*bending part*") would guide and fix the board (claimed "*LED module*") in order to achieve Liu's teaching that "the board is detachably installed on the backboard and the board is tightly held by the backboard and the protrusion part." EX1003-Liu, 8. Liu further teaches that "the contact surface between the board 304 and the backboard 306 will be **intact and good due to the clamping force applied to the board 304 by the backboard 306 and the stamped protrusion part 308.**" EX1003-Liu, 13-14. A POSITA would have understood, based on Liu's disclosure, that in order for the "stamped protrusion part 308" (claimed "*bending part*") to provide the "intact and good" "contact surface," it would guide and fix the "board 304" (claimed "*LED module*") to the backboard 306 (claimed "case"). EX1003-Liu, 13-14.

74. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [1B].

[1C] "a *fixing part* fixing the *LED module* to the *case*"

75. Liu in view of the knowledge of a POSITA renders obvious "*a fixing part*

fixing the **LED module** to the **case**.

76. Liu discloses:

In addition to at least one stamped protrusion part 308, the backboard 306 also has at least one **bolt hole 312**. Therefore, the **board 304** is not only tightly held by the **backboard 306** and the stamped protrusion part 308, but is also fastened onto the backboard 306 by the **bolt 314** and the **nut 316**. In this case, the contact surface between the board 304 and the backboard 306 will be intact and good due to the clamping force applied to the board 304 by the backboard 306 and the stamped protrusion part 308 and the force when the **bolt 314** is locked to the **nut 316**.

EX1003-Liu, 13-14.

77. As shown in Fig. 5, reproduced below, **bolt 314** and **nut 316** (claimed “fixing part”) can be fastened through the **bolt hole 312** to help in fixing the **board 304** (claimed “LED module”) to the **backboard 306** (claimed “case”). *Id.*

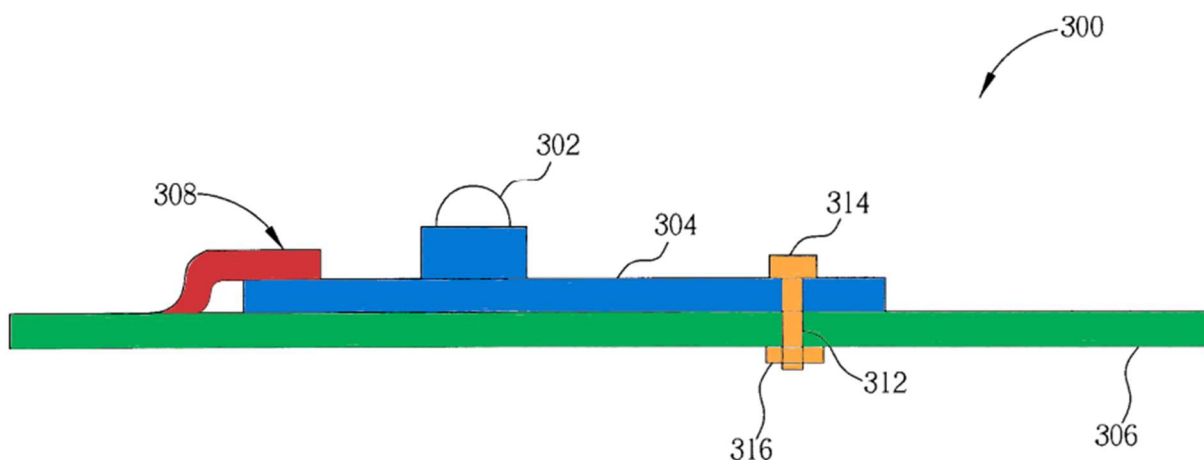


FIG. 5

78. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [1C].

79. Accordingly, it is my opinion that Liu in view of the knowledge of a POSITA renders obvious all limitations, [1Pre]-[1C], of claim 1.

Claim 3: “The backlight unit as claimed in claim 1, wherein the bending part has a length substantially identical to or shorter than a length of the LED module, and is located corresponding to a fixing position of the LED module.”

80. Liu in view of the knowledge of a POSITA renders obvious the claimed “*the bending part has a length substantially identical to or shorter than a length of the LED module, and is located corresponding to a fixing position of the LED module.*”

81. As shown below in Fig. 5, Liu discloses a stamped protrusion part 308 (claimed “*bending part*”), but, given the side perspective of Fig. 5, its length in comparison to the length of the board 304 (claimed “*LED module*”) is not illustrated.

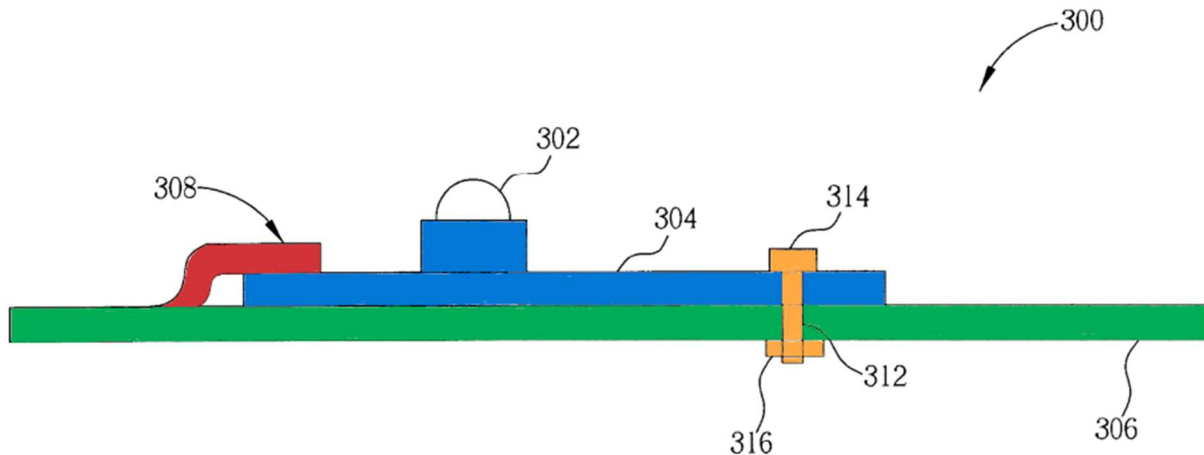


FIG. 5

EX1003-Liu, Fig. 5.

82. However, Fig. 3 of the Liu, reproduced below, shows another embodiment in which the “backboard has at least one stamped protrusion part 108” and, as shown in Fig. 3, the “stamped protrusion part 108” (claimed “*bending part*”) has a length that is shorter than the board 104 (claimed “*LED module*”). EX1003-Liu, Fig. 3. Liu further discloses “At the same time, at least one corner or at least one side of the board is tightly held by the backboard and the at least one protrusion part.” EX1003-Liu, 8.

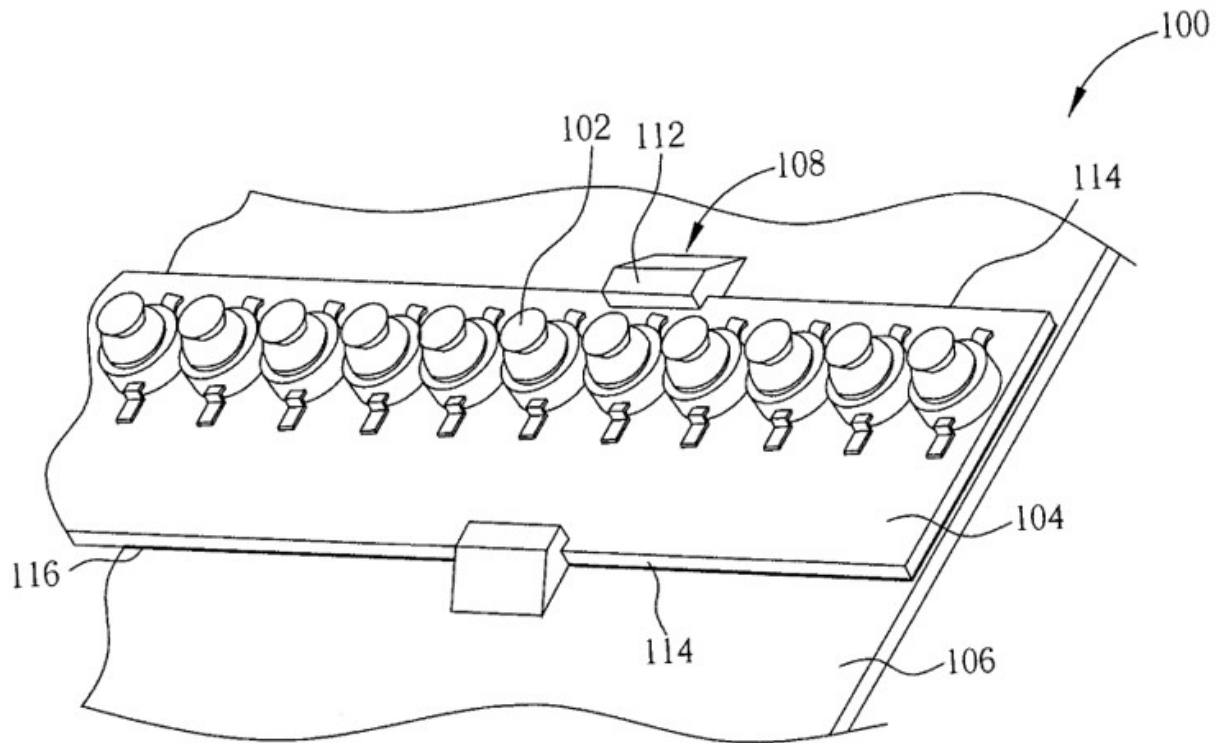


FIG. 3

EX1003-Liu, Fig. 5.

83. Accordingly, it would have been obvious to a POSITA in view of Liu's disclosures for Liu's "stamped protrusion part 308" (claimed "*bending part*") to be arranged on at least one corner of the board, and thus have a length shorter length than "board 304" (claimed "*LED module*").

84. Liu also discloses that "the board 304 is . . . tightly held by the backboard 306 and the stamped protrusion part 308," EX1003-Liu, 13. Thus, as shown above in Fig. 5, Liu teaches that the stamped protrusion part 308 (claimed "*bending part*") is located "*corresponding to a fixing position*" of the board 304 (claimed "*LED*")

85. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 3.

Claim 4: “The backlight unit as claimed in claim 1, wherein the bending part comprises at least one bent area formed corresponding to a fixing position of the LED module.”

86. Liu in view of the knowledge of a POSITA renders obvious the claimed “*the bending part comprises at least one bent area formed corresponding to a fixing position of the LED module.*” As shown below in Fig. 5, Liu discloses a stamped protrusion part 308 (claimed “*bending part*”) that comprises “*at least one bent area,*” as indicated in the annotations included below.

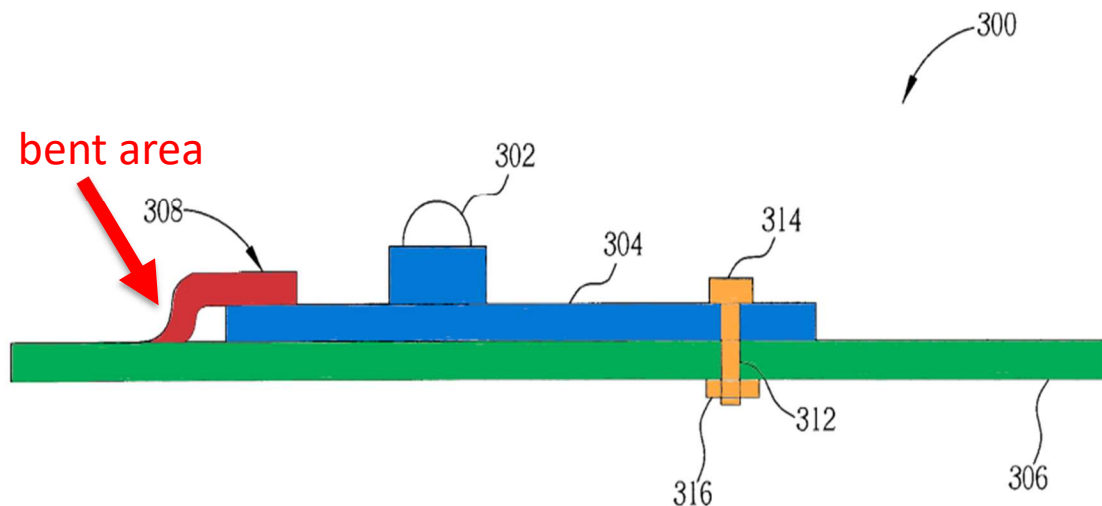


FIG. 5

EX1003-Liu, Fig. 5.

87. Fig. 5 shows that the “stamped protrusion part 308” (claimed “*bending part*”) comprises a bent area. Additionally, Liu discloses that “the board is

detachably installed on the backboard and the board is tightly held by the backboard and the protrusion part.” EX1003-Liu, 8. Accordingly, Liu teaches that the stamped protrusion part 308 (claimed “*bending part*”) is located “*corresponding to a fixing position*” of the board 304 (claimed “*LED module*”)

88. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 4.

Claim 5: “The backlight unit as claimed in claim 1, wherein the case is formed of a Steel Use Stainless (SUS) material.”

89. Liu in view of the knowledge of a POSITA renders obvious the claimed “*wherein the case is formed of a Steel Use Stainless (SUS) material.*” Liu discloses “the material of the backboard 106 can be **stainless steel**, aluminum, aluminum alloy, or galvanized steel plate.” EX1003-Liu, 9. A POSITA would have understood that the claimed “*Steel Use Stainless (SUS) material*” is a type of stainless steel. It was well known to those of skill in the art in 2006 that Steel Use Stainless (SUS) material is a type of stainless steel. This is exemplified by the disclosure in US Patent Publication No. 2007/0065718 to Moon, filed March 24, 2006, which discloses that “case cover 400 is **made of a SUS (Steel Use Stainless) material, a kind of stainless steel material** according to Japan Industrial Standards.” EX1008-Moon, ¶35. As disclosed in Moon, it was well known to a POSITA in 2006 that SUS was a type of stainless steel. As Liu discloses the use of stainless steel for the backboard 106 (claimed “*case*”), it teaches the use of the claimed “*Steel Use Stainless (SUS) material.*”

90. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 5.

Claim 8: “The backlight unit as claimed in claim 1, wherein the fixing part fixes the LED module to the case in another end area of the LED module in which the bending part is not formed.”

91. Liu in view of the knowledge of a POSITA renders obvious the claimed “*wherein the fixing part fixes the LED module to the case in another end area of the LED module in which the bending part is not formed.*”.

92. As shown in Fig. 5, reproduced below, bolt 314 and nut 316 (claimed “*fixing part*”) can be fastened to help in fixing the board 304 (claimed “*LED module*”) to the backboard 306 (claimed “*case*”). The bolt 314 and nut 316 are fastened to an end of board 304 that is opposite to the end of the board 304 (claimed “*another end area of the LED module*”) that is clamped by the stamped protrusion part 308 (claimed “*bending part*”).

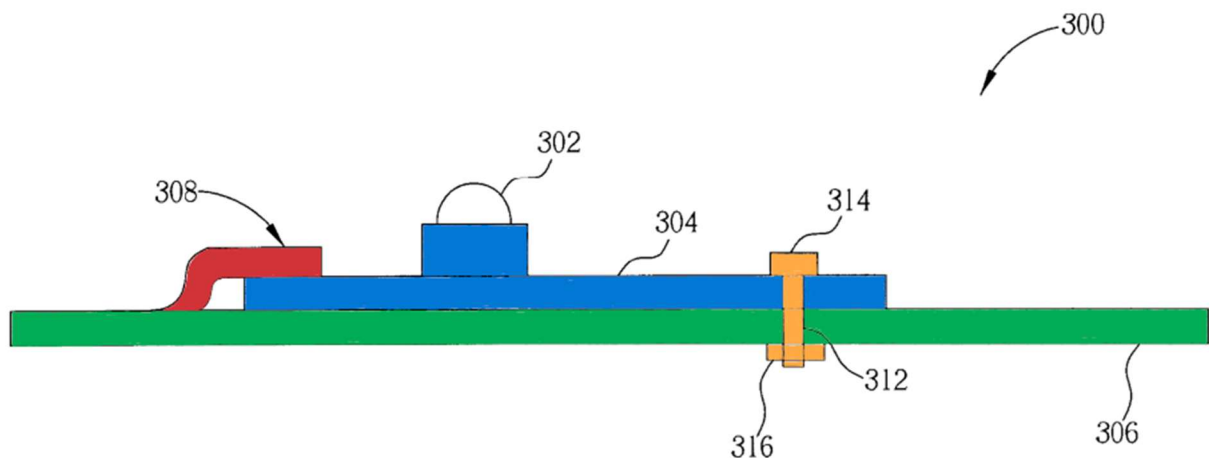


FIG. 5

EX1003-Liu, Fig. 5.

93. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 8.

Claim 9: “The backlight unit as claimed in claim 1, wherein the bending part is integrated with the case.”

94. Liu in view of the knowledge of a POSITA renders obvious the claimed “*wherein the bending part is integrated with the case.*” Liu discloses that “backboard 106 [claimed “*case*”] has at least one stamped protrusion part 108” (claimed “*bending part*”). EX1003-Liu, 9. Liu further discloses that in some embodiments, “the backboard and the first protrusion part are integrally formed.” EX1003-Liu, 21. Accordingly, a POSITA would have understood that the bending part is integrated with the case.

95. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 9.

Claim 11: “The backlight unit as claimed in claim 1, wherein the LED module is formed as the plural number, and at least one LED module comprises a plurality of LEDs.”

96. Liu in view of the knowledge of a POSITA renders obvious the claimed “wherein the LED module is formed as the plural number, and at least one LED module comprises a plurality of LEDs.

97. Liu discloses that “[a]s shown in FIG. 4, the LED light source assembly 200 of the present invention comprises at least one LED light source 202.” EX1003-Liu, 11. In the embodiment shown in Fig. 4, reproduced below, the board 204 comprises 11 LEDs:

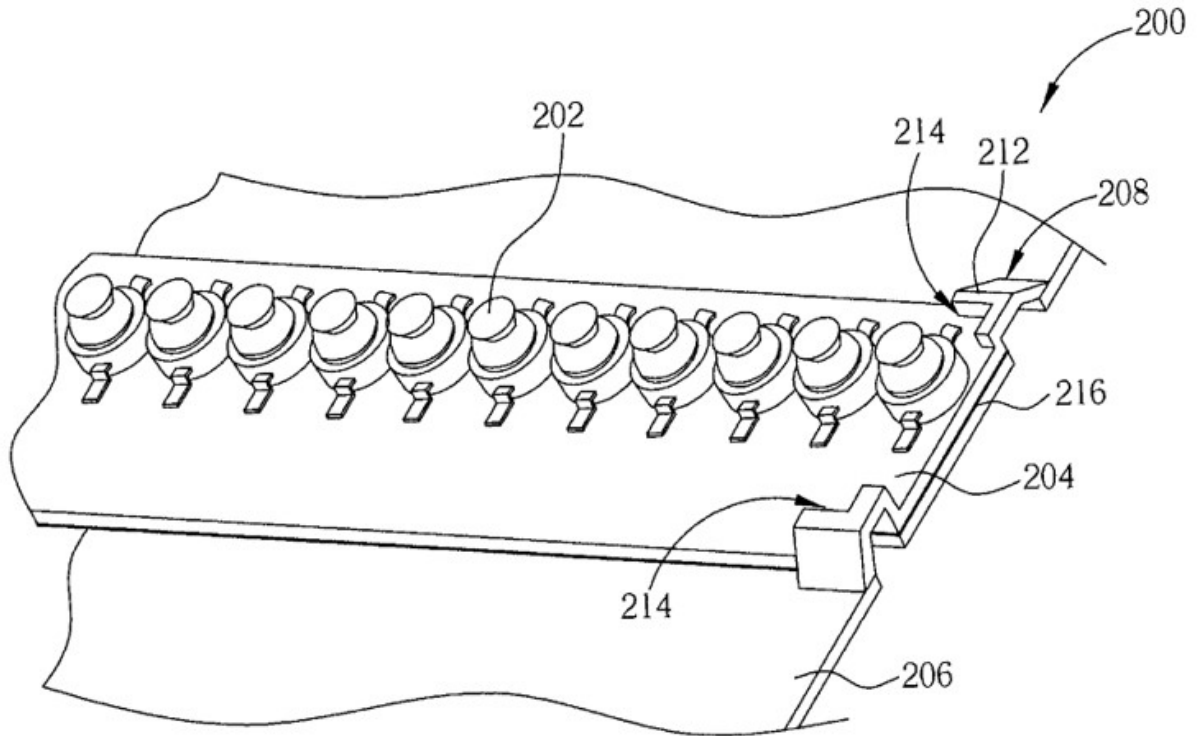


FIG. 4

EX1003-Liu, Fig. 4

98. Liu also discloses, “[a]s shown in FIG. 5, the LED light source assembly structure 300 of the present invention comprises an LED light source 302.” EX1003-Liu, 13. As POSITA would have understood from Liu’s teachings that the LED light source assembly structure 300 embodiment shown in Fig. 5 would have been configured with multiple LED light sources 302.

99. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 11.

Claim 12: “The backlight unit as claimed in claim 1, wherein the LED module is formed as the plural number, and each LED module comprises an LED.”

100. Liu in view of the knowledge of a POSITA renders obvious the claimed “*wherein the LED module is formed as the plural number, and each LED module comprises a plurality of LEDs.*”

101. Liu discloses, “[a]s shown in FIG. 5, the LED light source assembly structure 300 of the present invention comprises an LED light source 302.” EX1003-Liu, 13. Fig. 5 is reproduced below:

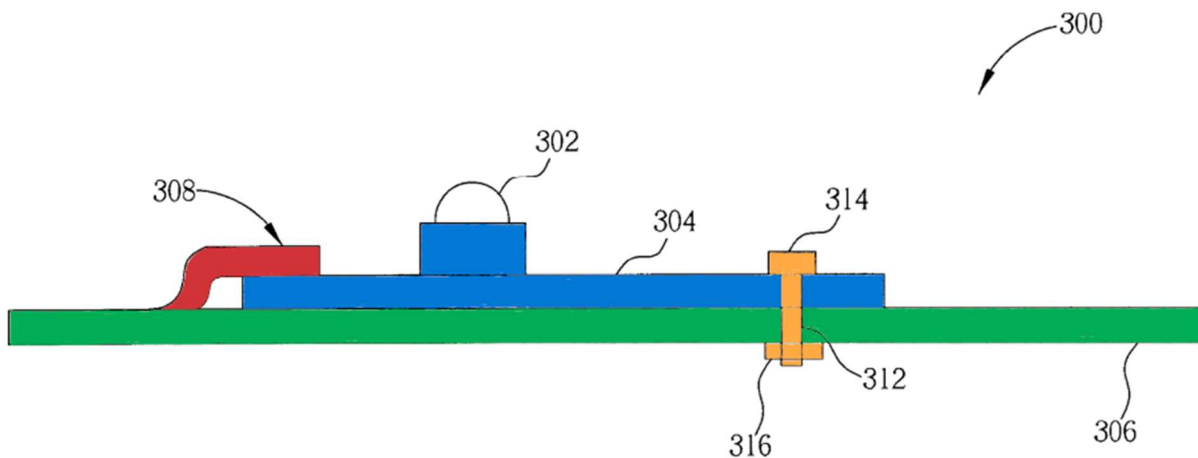


FIG. 5

EX1003-Liu, Fig. 5.

102. Accordingly, a POSITA would have understood from Liu’s teachings that the LED light source assembly structure 300 embodiment shown in Fig. 5 would have been configured with an LED light source 302. Liu further discloses that “the number of boards [claimed “*LED modules*”] installed on the backboard and the

number of LED light sources installed on the board can be adjusted according to actual conditions without any special restrictions.” EX1003-Liu, 13. Thus, Liu teaches its “board” (claimed “*LED module*”) can be “*formed as the plural number.*” *Id.*

103. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 12.

Claim 13: [13Pre] “A display device comprising”

104. Liu in view of the knowledge of a POSITA renders obvious the claimed “*display device.*” Liu discloses that “[t]he present invention discloses a light source assembly structure, especially a light emitting diode (LED) light source assembly structure used in a liquid crystal display (LCD) backlight module.” EX1003-Liu, 5. Liu discloses that “[a]mong the various key components of LCDs, the backlight module used to supply light has a significant impact on the overall luminous efficacy of the LCD,” and “[w]hen the backlight module itself has excellent luminous efficacy, it can not only improve the brightness of the LCD, but also provide flexibility in the design and manufacturing of other components in the LCD.” EX1003-Liu, 5.

105. Thus, Liu in view of the knowledge of a POSITA renders obvious claim [13Pre].

[13A] “a backlight unit comprising a light emitting diode (LED) module comprising an LED”

106. Liu in view of the knowledge of a POSITA renders obvious the claimed “a backlight unit comprising a light emitting diode (LED) module comprising an LED.”

107. Liu discloses “an LED light source assembly structure 300 in a backlight module according to a third embodiment of the present invention,” in Fig. 5 reproduced below. EX1003-Liu, 13.

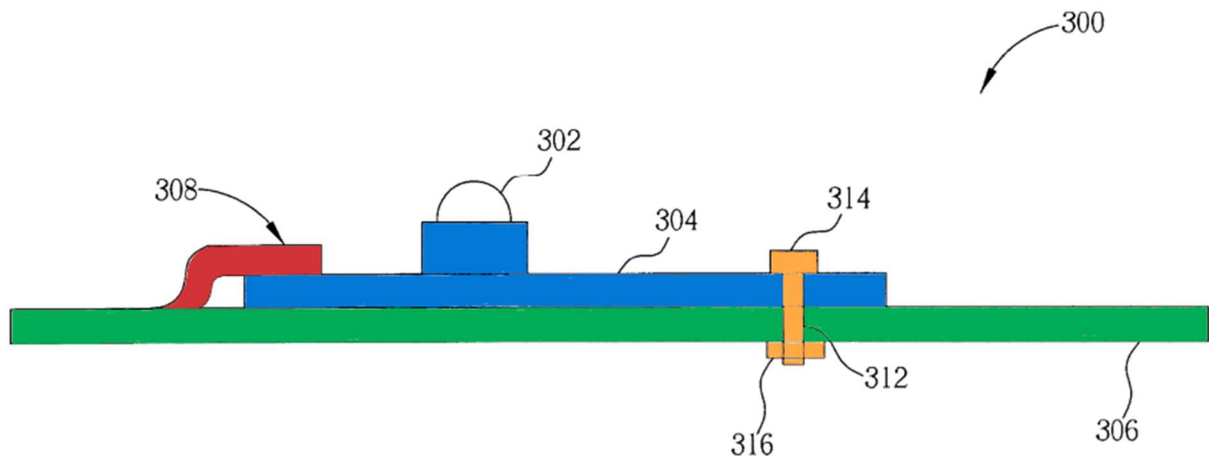


FIG. 5

EX1003-Liu, Fig. 5.

108. “As shown in FIG. 5, the LED light source assembly structure 300 of the present invention comprises an LED light source 302, a board 304 supporting the LED light source 302.” EX1003-Liu, 13.

109. Thus, Liu in view of the knowledge of a POSITA renders obvious claim

[13B] “a **case** supporting the **LED module**, and comprising a **bending part** that guides and fixes an end portion of the **LED module**”

110. Liu in view of the knowledge of a POSITA renders obvious the claimed “a **case** supporting the **LED module**, and comprising a **bending part** that guides and fixes an end portion of the **LED module**.”

111. Liu discloses that a problem with prior art is that “it requires the use of bolts 18 and nuts 22 for assembly, which is too complicated during assembly and results in an increase in various labor and material costs,” and “[p]articularly in some large backlight modules, where dozens or hundreds of LED light sources are installed, the number of bolts and nuts used must be considerable, further highlighting this problem.” EX1003-Liu, 7. Accordingly, Liu discloses an improved device where “[t]he **backboard** has at least one **protrusion part** ... [w]herein the **board** is detachably installed on the **backboard** and the board is tightly held by the backboard and the protrusion part.” EX1003-Liu, 8.

112. Liu discloses that “[s]ince the material of the backboard itself is elastic, the board can be detachably installed on the backboard. At the same time, **at least** one corner or **at least one side** of the board is tightly held by the backboard and the at least one protrusion part. By utilizing the clamping force applied to the board by the backboard and the protrusion part, the board can not only be tightly held onto the backboard, but the contact surface between the board and the backboard will also be

intact and good.” EX1003-Liu, 8. Liu further teaches the claimed “*bending part that guides and fixes*” as Liu discloses embodiments that “concurrently use the stamped protrusion part and the backboard to **tightly hold the sides and corners of the board** to achieve the same purpose, and the number of boards installed on the backboard and the number of LED light sources installed on the board can be adjusted according to actual conditions without any special restrictions.” EX1003-Liu, 13.

113. This is further illustrated in Liu’s Fig. 5 below.

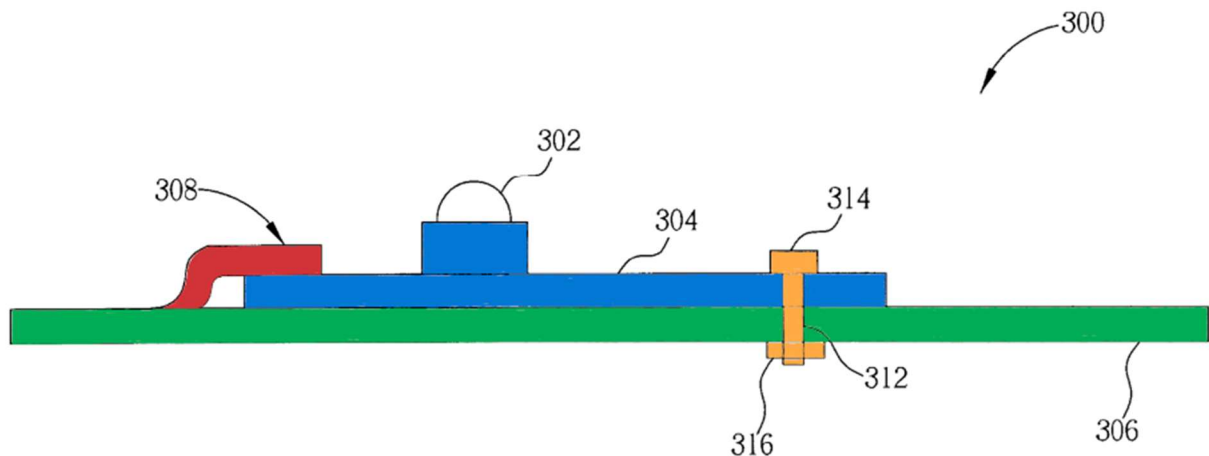


FIG. 5

EX1003-Liu, Fig. 5.

114. In Fig. 5, Liu discloses that the at least one protrusion part is a “**stamped protrusion part 308**” and that there is a “clamping force” applied “by the **backboard 306** and the **stamped protrusion part 308**.” EX1003-Liu, 13-14. Liu further discloses that in some embodiments, “the backboard and the first protrusion part are integrally

formed.” EX1003-Liu, 21. Liu also discloses “the material of the backboard 106 can be stainless steel.” EX1003-Liu, 9. Accordingly, a POSITA would have understood that the “first protrusion part” in Liu is elastic, as it is formed from the same elastic material as the backboard. Similar to Liu, the ’537 patent discloses that “case 110 may be formed of a Steel Use Stainless (SUS) material,” and “bending part 140 may be integrated with the case 110 in the manufacturing process of the case 110.” EX1001, 2:57-60. It would have been obvious to a POSITA that Liu’s integrally formed “**first protrusion part**” would exhibit the elastic properties of the **backboard**.

115. A POSITA would have understood based on Liu’s disclosure of “the clamping force applied to the board by the **backboard** and the **protrusion part**,” that the “elastic” “**protrusion part**” can bend such that “the **board** is detachably installed on the **backboard**.” EX1003-Liu, 8. In *KSR Int’l Co. v. Teleflex, Inc.*, the Supreme Court held the obviousness analysis should consider the “background knowledge possessed by a person having ordinary skill in the art.” 550 U.S. 398 (2007). A POSITA would have understood, based on Liu’s disclosure, that a “**protrusion part**” would guide and fix the **board** (claimed “*LED module*”) in order to achieve Liu’s disclosure that “the **board** is detachably installed on the **backboard** and the **board** is tightly held by the **backboard** and the **protrusion part**.” EX1003-Liu, 8. This is further illustrated in Liu’s Fig. 5 below:

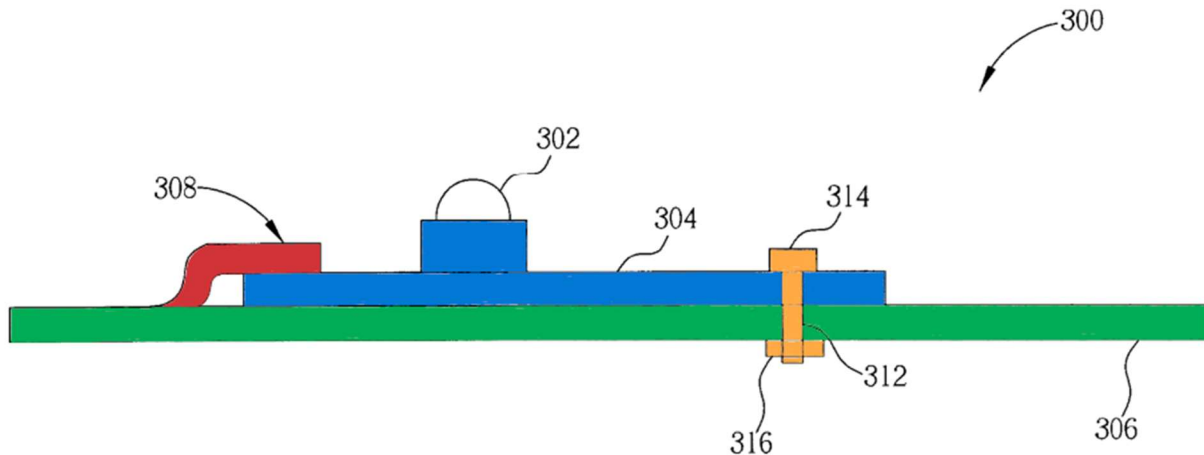


FIG. 5

EX1003-Liu, Fig. 5.

116. In the embodiment shown above in Fig. 5, Liu discloses that the at least one **protrusion part** is a “at least one **stamped protrusion part 308**” and that there is a “clamping force applied between the **board 304** by the **backboard 306** and the **stamped protrusion part 308**.” EX1003-Liu, 13-14.

117. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [13B].

[13C] “a **fixing part fixing the **LED module** to the **case**”**

118. Liu in view of the knowledge of a POSITA renders obvious “a **fixing part** fixing the **LED module** to the **case**.”

119. As shown in Fig. 5, reproduced below, **bolt 314** and **nut 316** can be fastened through the **bolt hole 312** (claimed “**fixing part**”) to help in fixing the **board 304** (claimed “**LED module**”) to the **backboard 306** (claimed “**case**”).

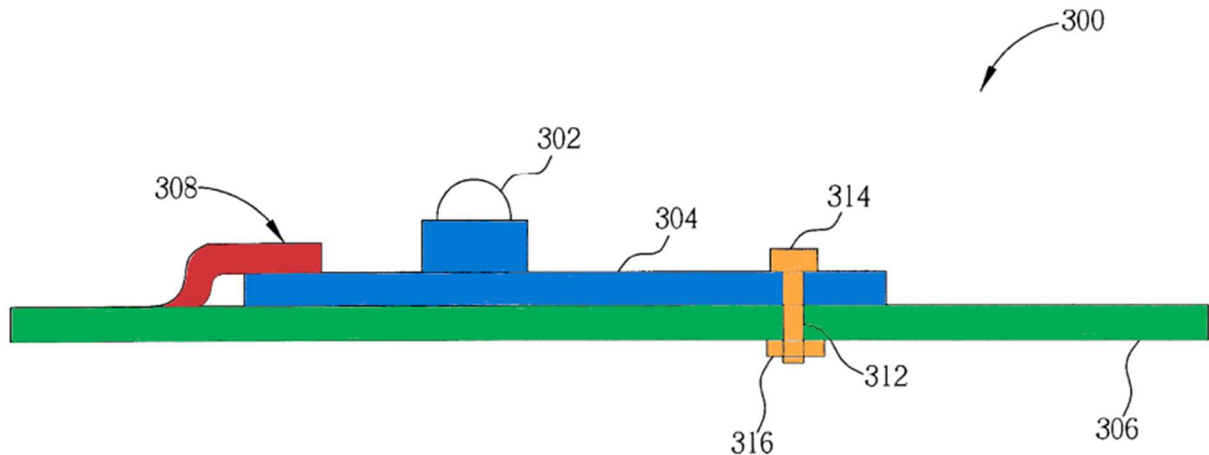


FIG. 5

EX1003-Liu, Fig. 5.

120. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [13C].

[13D] “a display part displaying an image”

121. Liu in view of the knowledge of a POSITA renders obvious “*a display part displaying an image.*” In Fig. 8, reproduced below, Liu illustrates an “an operational view of the LED light source assembly structure in the backlight module of the present invention when applied to an LCD 400.” EX1003-Liu, 15.

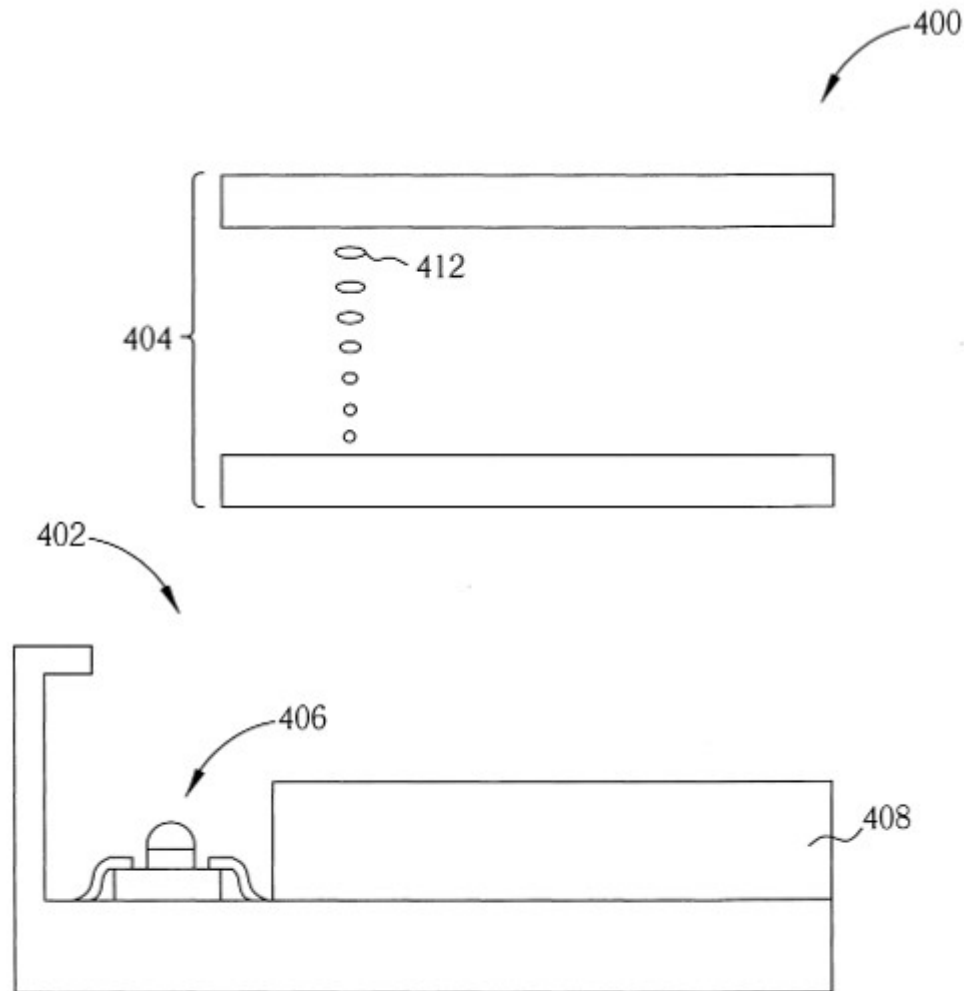


FIG. 8

EX1003-Liu, Fig. 8

122. Liu discloses:

As shown in FIG. 8, the LCD 400 comprises a backlight module 402 and an LCD panel 404 disposed thereon. The backlight module 402 comprises not only an LED light source assembly structure 406 but also at least one light guide plate 408. The LED light source assembly structure 406 can be any LED light source

assembly structure disclosed in the present invention. **The light emitted from the LED light source assembly 406 is emitted into the light guide plate 408 and then through an optical mechanism (not shown) inside the light guide plate 408 to become a uniform surface light source, and then directed to the LCD panel 404 before finally producing an image after continuous refraction of the liquid crystal molecules 412 in the LCD panel 404.**

EX1003-Liu, 15.

123. Thus, Liu teaches an “LCD panel 404” (claimed “*display*”) for “producing an image” (claimed “*displaying an image.*”). EX1003-Liu, 15.

124. Thus, Liu in view of the knowledge of a POSITA renders obvious limitation [13D].

125. Accordingly, it is my opinion that Liu in view of the knowledge of a POSITA renders obvious all limitations, [13Pre]-[13D], of claim 13.

Claim 14: “The display device as claimed in claim 13, wherein the display part is a liquid crystal panel.”

126. Liu in view of the knowledge of a POSITA renders obvious “*wherein the display part is a liquid crystal panel.*” Liu discloses that “[t]he present invention discloses a light source assembly structure, especially a light emitting diode (LED) light source assembly structure used in a liquid crystal display (LCD) backlight module.” EX1003-Liu, 5. Furthermore, Liu discloses that Fig. 8 provides “an operational view of the LED light source assembly structure in the backlight module of the present invention when applied to an LCD 400.” EX1003-Liu, 15.

127. Accordingly, it is my opinion that, Liu in view of the knowledge of a POSITA renders obvious claim 14.

Claim 16: “The display device as claimed in claim 13, wherein the bending part has a length identical to or shorter than a length of the LED module, and is located corresponding to a fixing position of the LED module.”

128. Liu in view of the knowledge of a POSITA renders obvious the claimed “the bending part has a length identical to or shorter than a length of the LED module, and is located corresponding to a fixing position of the LED module.” As shown below in Fig. 5, Liu discloses a stamped protrusion part 308 (claimed “bending part”), but, given the side perspective of Fig. 5, its length in comparison to the length of the board 304 (claimed “LED module”) is not illustrated.

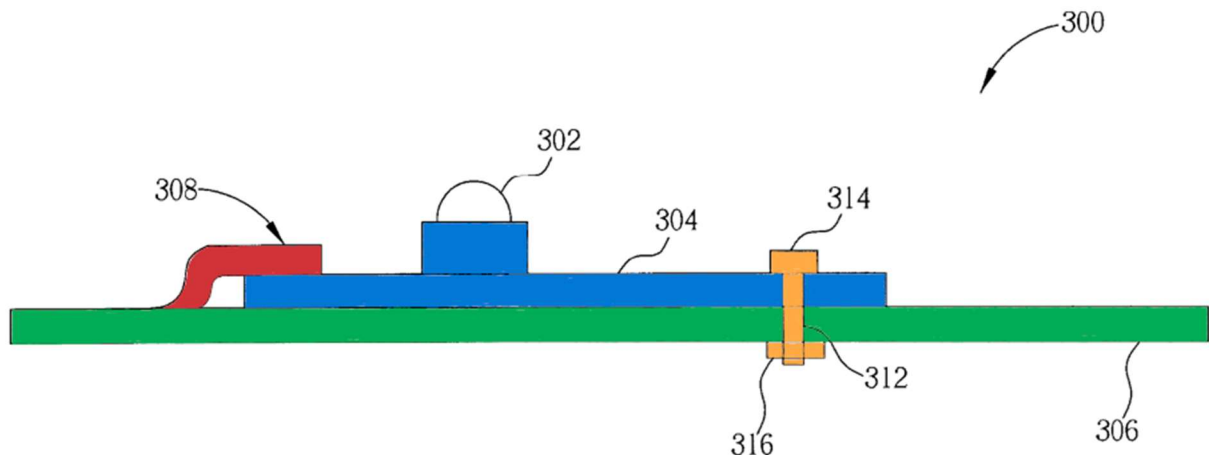


FIG. 5

EX1003-Liu, Fig. 5.

129. However, Fig. 3 of the Liu, reproduced below, shows another embodiment

in which the “backboard has at least one stamped protrusion part 108” and, as shown in Fig. 3, the “stamped protrusion part 108” (claimed “*bending part*”) has a length that is shorter than the board 104 (claimed “*LED module*”). EX1003-Liu, Fig. 3. Liu further discloses “At the same time, **at least one corner** or **at least one side** of the board is tightly held by the backboard and the at least one protrusion part.” EX1003-Liu, 8.

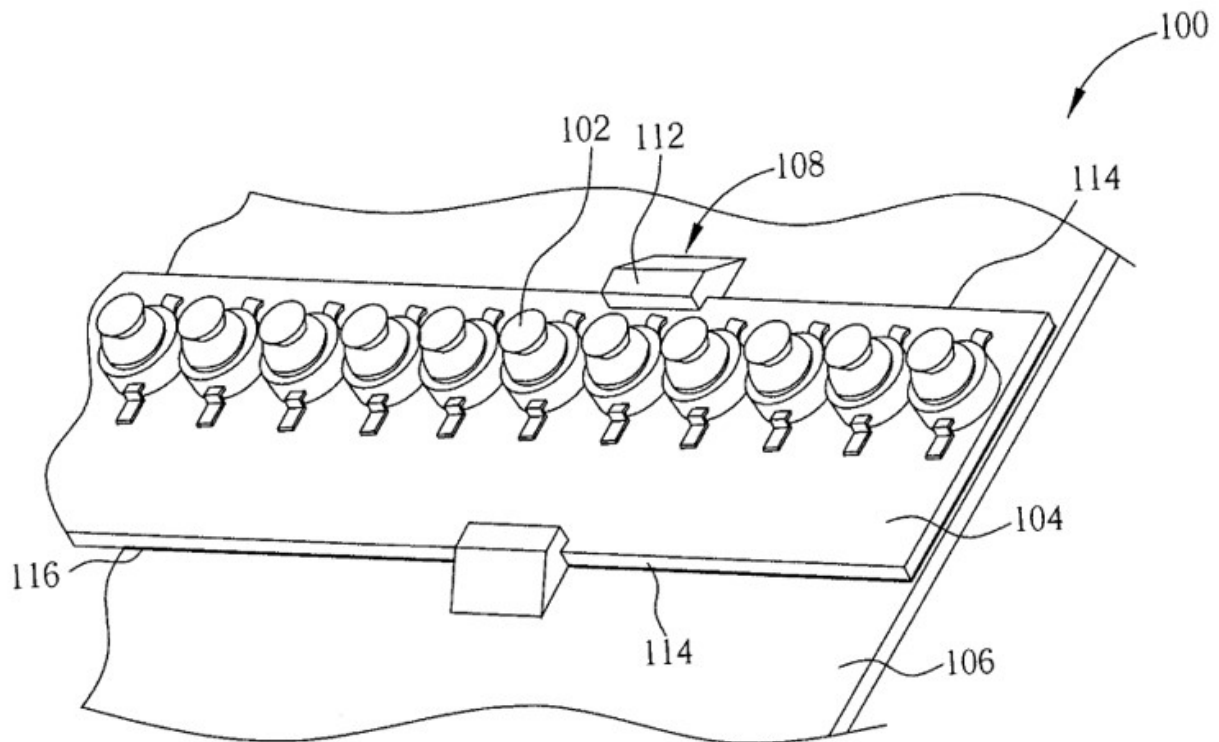


FIG. 3

EX1003-Liu, Fig. 3

130. Accordingly, it would have been obvious to a POSITA for Liu’s “stamped protrusion part 308” (claimed “*bending part*”) to be arranged on at least one corner

of the board, in which it would have a length shorter length than “board 304” (claimed “*LED module*”).

131. Liu also discloses that “the board 304 is . . . tightly held by the backboard 306 and the stamped protrusion part 308,” EX1003-Liu, 13. Thus, as shown in Fig. 5 above, Liu teaches that the stamped protrusion part 308 (claimed “*bending part*”) is located “*corresponding to a fixing position*” of the board 304 (claimed “*LED module*”).

132. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 16.

Claim 17: “The display device as claimed in claim 13, wherein the bending part comprises at least one bent area formed corresponding to a fixing position of the LED module.”

133. Liu in view of the knowledge of a POSITA renders obvious the claimed “*the bending part comprises at least one bent area formed corresponding to a fixing position of the LED module.*” As shown below in Fig. 5, Liu discloses a stamped protrusion part 308 (claimed “*bending part*”) comprising “*at least one bent area,*” as highlighted in the annotations provided below.

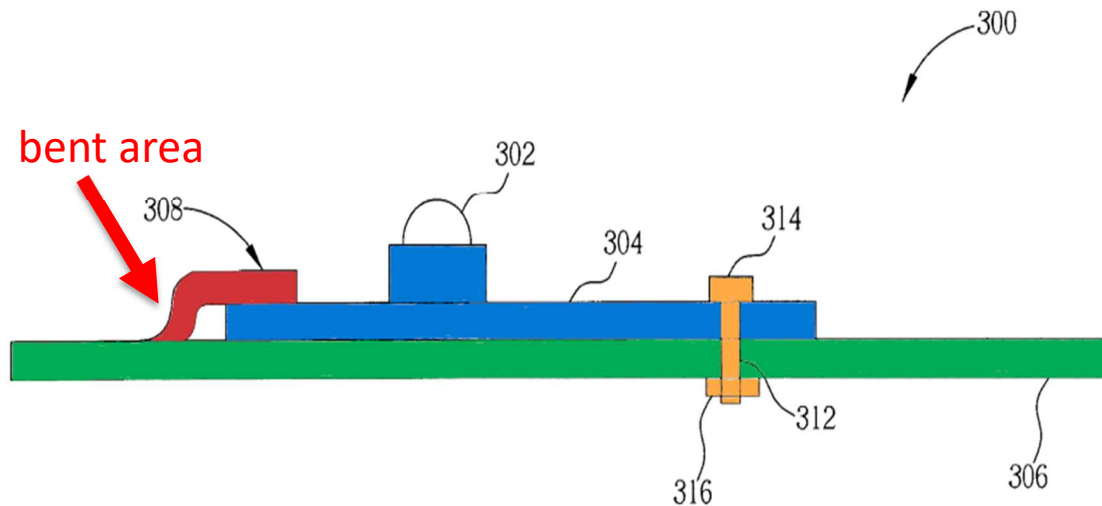


FIG. 5

EX1003-Liu, Fig. 5.

134. As shown above in Fig. 5, the stamped protrusion part 308” (claimed “*bending part*”) is bent to accommodate the board 304 (claimed “*LED module*”), and Liu discloses that the “the board is detachably installed on the backboard and the board is tightly held by the backboard and the protrusion part.” EX1003-Liu, 8. Accordingly, Liu teaches that the stamped protrusion part 308 (claimed “*bending part*”) is located “*corresponding to a fixing position*” of the board 304 (claimed “*LED module*”).

135. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 17.

Claim 19: “The display device as claimed in claim 13, wherein the fixing part fixes the LED module to the case in another end area of the LED module in which the bending part is not formed.”

136. Liu in view of the knowledge of a POSITA renders obvious the claimed “wherein the fixing part fixes the LED module to the case in another end area of the LED module in which the bending part is not formed.” As shown in Fig. 5, reproduced below, bolt 314 and nut 316 (claimed “fixing part”) can be fastened to help in fixing the board 304 (claimed “LED module”) to the backboard 306 (claimed “case”) and the bolt 314 and nut 316 (claimed “fixing part”) are fastened to the backboard 306 (claimed “case”) on the end of the board 304 (claimed “LED module”) that is opposite to end of the board 304 (claimed “LED module”) that provides the stamped protrusion part 308 (claimed “bending part”).

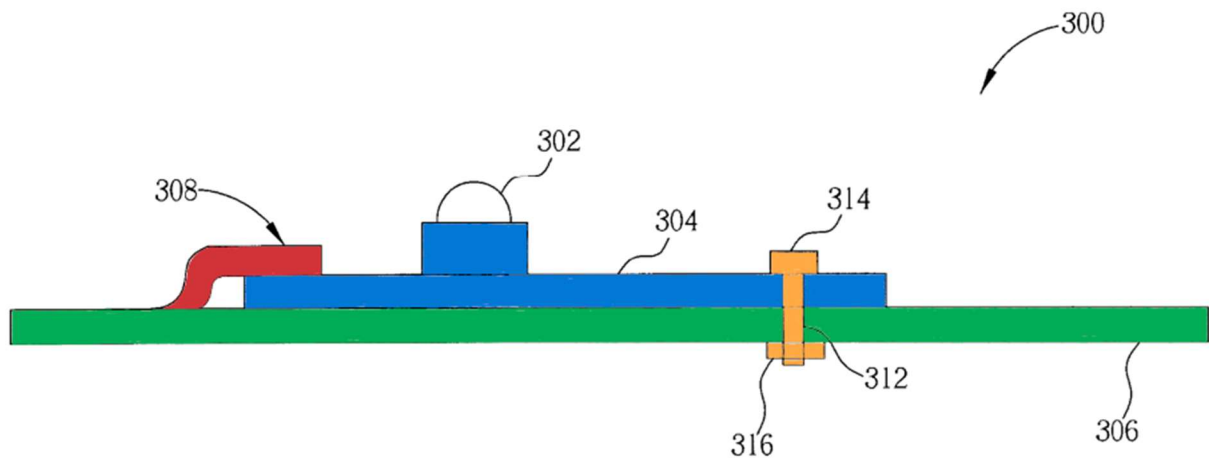


FIG. 5

EX1003-Liu, Fig. 5.

137. Thus, Liu in view of the knowledge of a POSITA renders obvious claim

Claim 20: “The display device as claimed in claim 13, wherein the bending part is formed integrally with or separately from the case.”

138. Liu in view of the knowledge of a POSITA renders obvious the claimed “*wherein the bending part is formed integrally with or separately from the case.*” Liu discloses that “backboard 106 [claimed “*case*”] has at least one stamped protrusion part 108” (claimed “*bending part*”). Liu further discloses that in some embodiments, “the backboard and the first protrusion part are integrally formed.” EX1003-Liu, 21. Accordingly, a POSITA would have understood that the bending part is formed integrally with the case.

139. Thus, Liu in view of the knowledge of a POSITA renders obvious claim 20.

IX. Ground 2: Claims 2, 6, 7, 15, and 18 are rendered obvious by Liu in view of Roberts and the knowledge of a POSITA

A. Overview of the combination; motivation to combine; expectation of success

140. Ground 2 relies on Liu in view of Roberts and addresses claims 2, 6, 7, 15, and 18. Liu explains that “[w]hile improving the luminous efficacy of the backlight module, improving the luminous efficacy of the light-emitting device is a commonly used improvement solution.” EX1003-Liu, 5. Liu further discloses that “the industry has invested manpower and other resources in order to design and manufacture suitable products that not only meet the needs of LCD products, but also meet the

requirements in terms of luminous efficacy and heat dissipation performance.”

EX1003-Liu, 6.

141. Similar to Liu’s disclosure of a “a light emitting diode (LED) light source assembly structure used in a liquid crystal display (LCD) backlight module” (EX1003-Liu, 5), Roberts discloses a “lighting panel according to some embodiments of the invention includes at least one tile, or an LED module having one or more LEDs mounted thereon” (EX1004-Roberts, ¶13). Roberts explains the benefits of using printed circuit boards for electrical connections for the LEDs and reflective materials to improve LCD backlight units. EX1004-Roberts, ¶¶60-62, 77-79. Roberts discloses a “solid state lighting tile 10 [that] may include thereon a number of solid state lighting elements 12 arranged in a regular and/or irregular one- or two-dimensional array. The tile 10 may include, for example, a **printed circuit board (PCB)** on which one or more circuit elements, such as discrete light emitting components, may be mounted.” EX1004-Roberts, ¶60. Roberts discloses that “a tile 10 may include a metal core PCB (MCPCB) including a metal core having thereon a polymer coating on which patterned metal traces (not shown) may be formed.” EX1004-Roberts, ¶60.

142. Roberts further discloses that the LEDs “may be covered by an encapsulant 14, which may be clear and/or may include light scattering particles, phosphors, and/or other elements to achieve a desired emission pattern, color and/or intensity.”

EX1004-Roberts, ¶¶66. Accordingly, a POSITA would have understood that encapsulating Robert's LEDs would improve the emissions from the LEDs.

143. Roberts discloses that “[i]n order to provide and/or improve light recycling in the lighting panel 40, a reflector sheet 50 may be provided on the same side of the tile 10 as the lighting elements 12.” EX1004-Roberts, ¶¶77. Roberts disclose that “in addition to reflecting incident light, the reflector sheet 50 may help disperse the incident light so that it is reflected in a random direction (i.e. a Lambertian reflector), which may improve the uniformity of the lighting panel 40.” EX1004-Roberts, ¶¶79. Accordingly, Roberts teaches that the adding the “reflector sheet 50” to the “lighting panel 40” improves the uniformity of the image displayed by the “lighting panel 40.” EX1004-Roberts, ¶¶77-79.

144. Based on the foregoing a POSITA would have been motivated to improve Liu's LED module based on Robert's teachings regarding a printed circuit board, encapsulants (“mold parts”) for the LEDs, and reflective sheets to improve electrical connectivity for the LEDs, the emissions from the LEDs, and the uniformity of the image with reflective sheets. A POSITA would have seen benefits in configuring Liu to have easily connected LEDs and LEDs that provide a brighter and more uniform reflection of light from the reflective sheets. *Id.* “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is

obvious.” *KSR*, 550 U.S. at 417. In other words, this combination would have involved “the mere application of a known technique”—Robert’s teachings regarding a printed circuit board and reflective sheets —“to a piece of prior art”—Liu’s LED module—that is “ready for the improvement.”

145. A POSITA would have reasonably expected to succeed in making the combination because POSITAs were aware of the benefits of using printed circuit boards, encapsulants (“mold parts”) for the LEDs, and reflective sheets for LEDs. These components were commonly considered by a POSITA in designing LCD backlight modules.

B. The Challenged Claims

Claim 2: “The backlight unit as claimed in claim 1, wherein the LED module comprises a printed circuit board, the LED on the printed circuit board, and a mold part on the LED.”

146. Liu in view of Roberts and the knowledge of a POSITA renders obvious the claimed “the LED module comprises a printed circuit board, the LED on the printed circuit board, and a mold part on the LED.”

147. Liu discloses:

In addition, the **board 104** acts not only to support the **LED light source 102** and conduct heat, but also has the function of providing the **LED light source 102** with **electrical connections to other components because various circuits (not shown) are installed thereon**. For this reason, the heat dissipation problem of the LED light

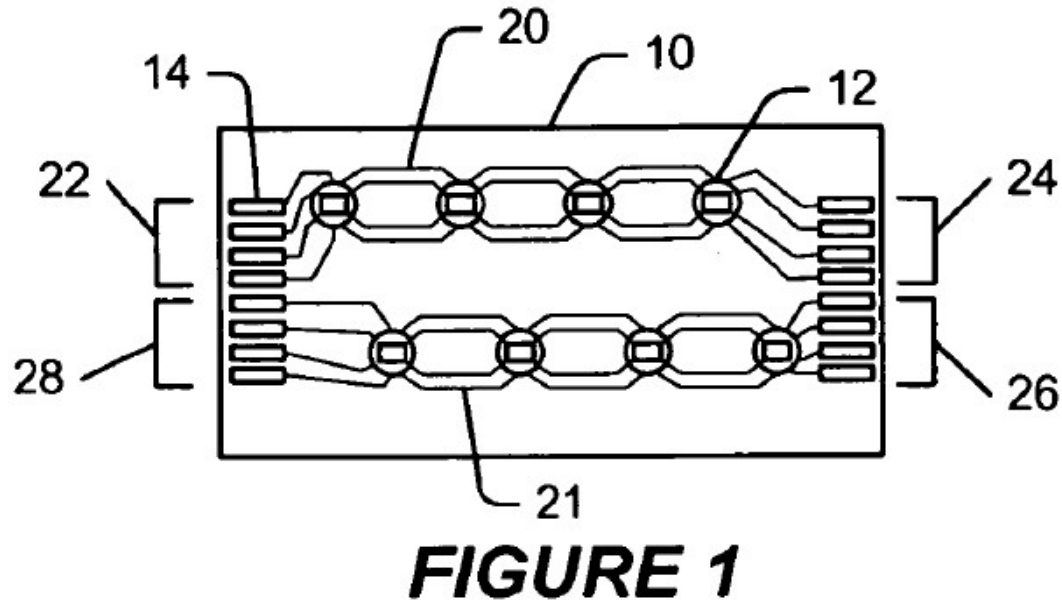
source assembly structure 100 must be properly handled.

If heat dissipation is not handled properly, not only will the circuits (not shown) on the board 104 and the backboard 106 be damaged, but the LED light source 102 may also be easily damaged. Since the structure provided in this embodiment does not use any bolts, there will be no problems such as overly complicated assembly and increased cost.

EX1003-Liu, 11:

148. Although Liu teaches that its board 104 (claimed “*LED module*”) provides “**electrical connections to other components** because various circuits (not shown) are installed thereon,” Liu does not expressly disclose that claimed “*the LED module comprises a printed circuit board, the LED on the printed circuit board.*” However, Roberts expressly discloses a similar backlight unit with an LED module including a printed circuit board. EX1004-Roberts, ¶60. Roberts also discloses a “lighting panel according to some embodiments of the invention includes at least one tile, or an LED module having one or more LEDs mounted thereon.” EX1004-Roberts, ¶13. Specifically, Roberts discloses a “solid state lighting tile 10 may include thereon a number of solid state lighting elements 12 arranged in a regular and/or irregular one- or two-dimensional array. The tile 10 may include, for example, a **printed circuit board (PCB)** on which one or more circuit elements, such as discrete light emitting

components, may be mounted,” as illustrated in Fig. 1, reproduced below. EX1004-Roberts, ¶60.



EX1004-Roberts, Fig. 1.

149. Roberts further discloses that “[i]n the tile 10, four lighting elements 12 are serially arranged in a first path 20, while four lighting elements 12 are serially arranged in a second path 21,” and the “lighting elements 12 of the first path 20 are connected, for example via printed circuits.” EX1004-Roberts, ¶61. Roberts discloses that the “lighting elements 12” are “chip-on-board clusters including one or more LEDs.” EX1004-Roberts, ¶62. Roberts discloses that “a tile 10 may include a metal core PCB (MCPCB) including a metal core having thereon a polymer coating on which patterned metal traces (not shown) may be formed.” EX1004-Roberts, ¶60. Thus, as shown above, Roberts teaches the claimed “*the LED module*

comprises a printed circuit board, the LED on the printed circuit board,” as it discloses that its “a **printed circuit board (PCB)** on which one or more circuit elements, such as discrete light emitting components, may be mounted.” EX1004-Roberts, ¶¶60.

150. It would have been obvious to a POSITA to modify Liu’s board 104 (claimed “*LED module*”), disclosed as providing “electrical connections to other components because various circuits (not shown) are installed thereon,” to implement the printed circuit board described in Roberts to provide the “electrical connections to other components.”

151. As to the claimed, “*mold part on the LED*,” Fig. 5 of Liu discloses LED light source 302. EX1003-Liu, Fig. 5. Although Liu’s light source 302 shown in Fig.5 does not distinguish LED chip and a mold on the LED chip, POSITA would have understood that light source 302 would have included an encapsulant on the LED chip (claimed “a mold part on the LED”).

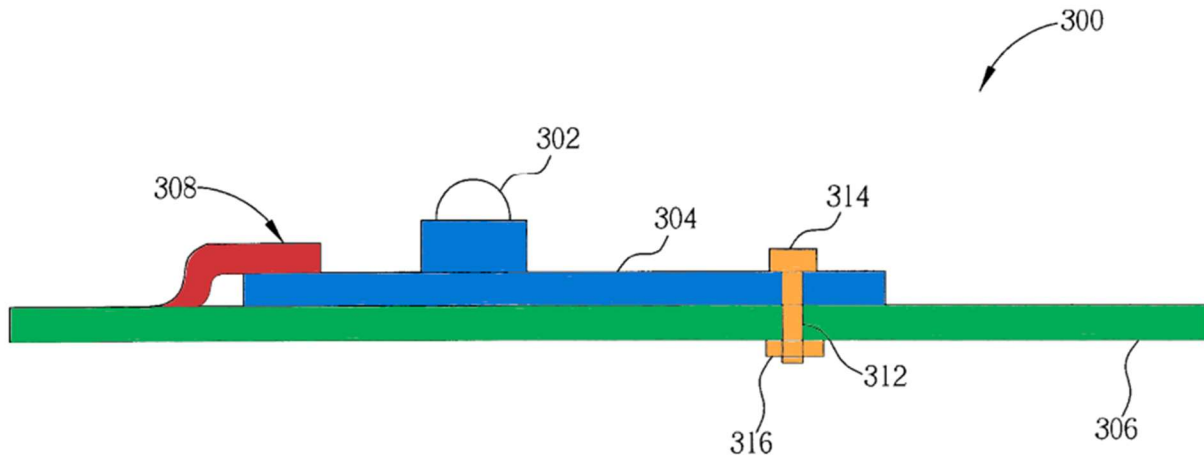


FIG. 5

EX1003-Liu, Fig. 5.

152. Specifically, Roberts discloses that the LEDs “may be covered by an encapsulant 14, which may be clear and/or may include light scattering particles, phosphors, and/or other elements to achieve a desired emission pattern, color and/or intensity.” EX1004-Roberts, ¶66. Accordingly, it would have been obvious to a POSITA, in view of Robert’s teachings, to encapsulate the Liu’s LED light source (i.e. provide the claimed “*mold part on the LED*”) to improve the emissions from the LED.

153. Thus, Liu in view of Roberts and the knowledge of a POSITA renders obvious limitations claim 2.

Claim 6: “The backlight unit as claimed in claim 1, comprising a reflective sheet on the LED module comprising an opening such that the LED is exposed.”

Claim 7: “The backlight unit as claimed in claim 6, wherein the reflective sheet reflects light emitted from the LED upward.”

154. Liu in view of Roberts and the knowledge of a POSITA renders obvious the claimed “*comprising a reflective sheet on the LED module comprising an opening such that the LED is exposed,*” and “*wherein the reflective sheet reflects light emitted from the LED upward.*”

155. As explained previously, it would have been obvious to a POSITA to apply Robert’s reflector sheet teachings to Liu with expected success, wherein a reflector sheet is arranged with Liu’s LEDs to improve a lighting panel. Indeed, Roberts explains the benefits of using reflective materials to improve LCD backlight units. EX1004-Roberts, ¶¶77-79. Roberts also discloses that “in addition to reflecting incident light, the reflector sheet 50 may help disperse the incident light so that it is reflected in a random direction (i.e. a Lambertian reflector), which may improve the uniformity of the lighting panel 40.” EX1004-Roberts, ¶79.

156. Roberts further discloses that “[i]n order to provide and/or improve light recycling in the lighting panel 40, a **reflector sheet 50** may be provided on the same side of the tile 10 as the lighting elements 12.” EX1004-Roberts, ¶77. Fig. 5A of Roberts, reproduced below, illustrates the “**reflector sheet 50.**”

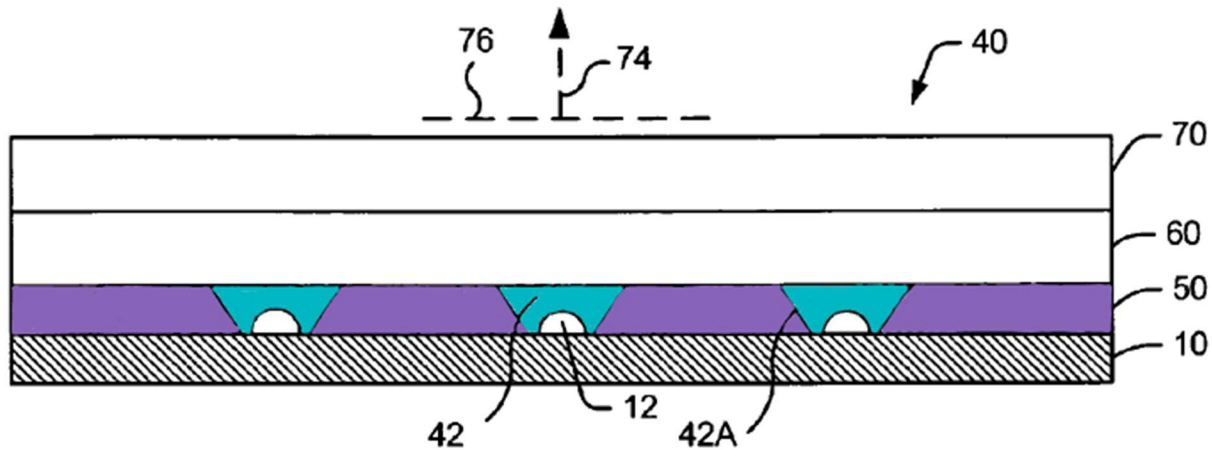


FIGURE 5A

EX1004-Roberts, Fig. 5A.

157. Roberts further discloses that “**reflector sheet 50** may include a **plurality of apertures 42** therein, which **apertures 42** may align with the lighting elements 12 on the tile 10.” EX1004-Roberts, ¶79. Roberts disclosure of a “**reflector sheet 50**” teaches the claimed “*reflective sheet on the LED module*” and its “**plurality of apertures 42**” teaches the claimed “*opening such that the LED is exposed.*” Further, as shown in FIG. 5A, above, “*the reflective sheet reflects light emitted from the LED upward.*” Indeed, a POSITA would have understood that the reflection by the reflector sheet 50 would have included “*upward,*” as it improves the uniformity of the image.

158. Thus, Liu in view of Roberts and the knowledge of a POSITA renders obvious claims 6-7.

Claim 15: “The display device as claimed in claim 13, wherein the LED module comprises a printed circuit board, the LED on the printed circuit board, and a mold part on the LED.”

159. Liu in view of Roberts and the knowledge of a POSITA renders obvious the claimed “*the **LED module** comprises a printed circuit board, the **LED** on the printed circuit board, and a mold part on the **LED**.*” Liu discloses:

In addition, the board 104 acts not only to support the LED light source 102 and conduct heat, but also has the function of providing the LED light source 102 with electrical connections to other components because various circuits (not shown) are installed thereon. For this reason, the heat dissipation problem of the LED light source assembly structure 100 must be properly handled. If heat dissipation is not handled properly, not only will the circuits (not shown) on the board 104 and the backboard 106 be damaged, but the LED light source 102 may also be easily damaged. Since the structure provided in this embodiment does not use any bolts, there will be no problems such as overly complicated assembly and increased cost.

EX1003-Liu, 11.

160. Although Liu teaches that its board 104 (claimed “*LED module*”) provides “**electrical connections to other components** because various circuits (not shown) are installed thereon,” it does not expressly disclose that claimed “*the LED module comprises a printed circuit board, the LED on the printed circuit board.*” However, Roberts expressly discloses a similar backlight unit with an LED

module including a printed circuit board. Specifically, Roberts discloses a

“lighting panel according to some embodiments of the invention includes at least one tile, or an LED module having one or more LEDs mounted thereon.” EX1004-Roberts, ¶13. Roberts also discloses a “solid state lighting tile 10 may include thereon a number of solid state lighting elements 12 arranged in a regular and/or irregular one- or two-dimensional array. The tile 10 may include, for example, a **printed circuit board (PCB)** on which one or more circuit elements, such as discrete light emitting components, may be mounted.,” as illustrated in Fig. 1, reproduced below. EX1004-Roberts, ¶60.

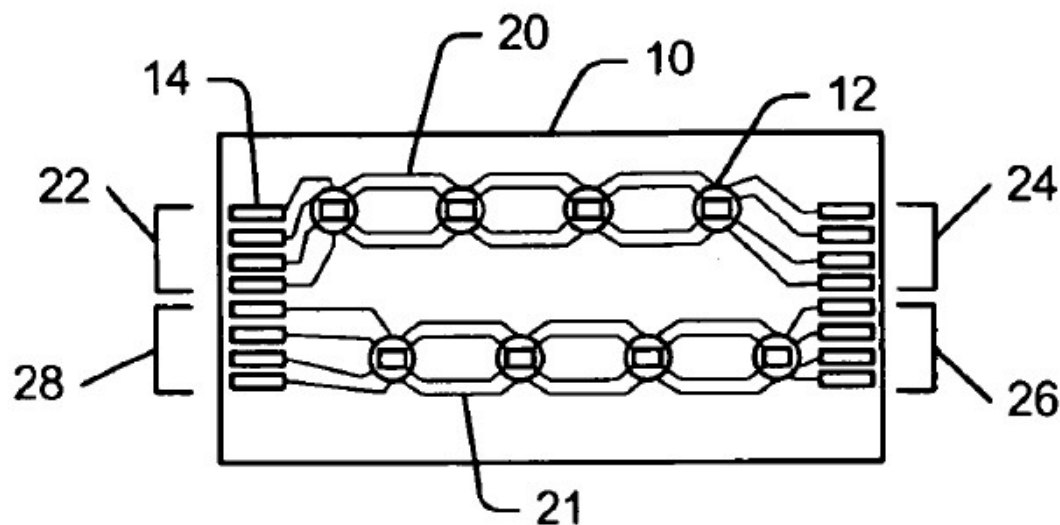


FIGURE 1

EX1004-Roberts, Fig. 1.

161. Roberts further discloses that “[i]n the tile 10, four lighting elements 12 are serially arranged in a first path 20, while four lighting elements 12 are serially

arranged in a second path 21,” and the “lighting elements 12 of the first path 20 are connected, for example via printed circuits.” EX1004-Roberts, ¶61. Roberts discloses that the “lighting elements 12” are “chip-on-board clusters including one or more LEDs.” EX1004-Roberts, ¶62. Roberts discloses that “a tile 10 may include a metal core PCB (MCPCB) including a metal core having thereon a polymer coating on which patterned metal traces (not shown) may be formed.” Thus, Roberts teaches the claimed “*the LED module comprises a printed circuit board, the LED on the printed circuit board*” as it discloses that its “a **printed circuit board (PCB)** on which one or more circuit elements, such as discrete light emitting components, may be mounted.” EX1004-Roberts, ¶¶60.

162. It would have been obvious to a POSITA to modify Liu’s board 304 (claimed “*LED module*”), disclosed as providing “electrical connections to other components because various circuits (not shown) are installed thereon,” to implement the printed circuit board described in Roberts to provide the “electrical connections to other components.”

163. As to the claimed, “*mold part on the LED*,” Fig. 5 of Liu discloses LED light source 302. EX1003-Liu, Fig. 5. Although Liu’s light source 302 shown in Fig. 5 does not distinguish LED chip and a mold on the LED chip, a POSITA would have understood that light source 302 would have included an encapsulant on the LED chip (claimed “*a mold part on the LED*”).

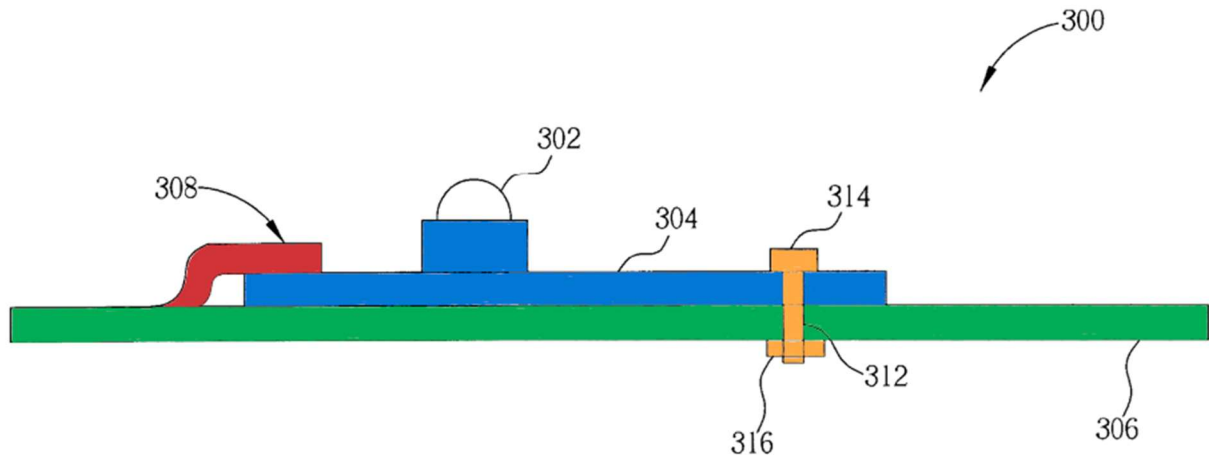


FIG. 5

EX1003-Liu, Fig. 5.

164. Specifically, Roberts discloses that the LEDs “may be covered by an encapsulant 14, which may be clear and/or may include light scattering particles, phosphors, and/or other elements to achieve a desired emission pattern, color and/or intensity.” EX1004-Roberts, ¶166. Accordingly, it would have been obvious to a POSITA to encapsulate the Liu’s LED light source (i.e. provide the claimed “*mold part on the LED*”) to improve the emissions from the LED.

165. Thus, Liu in view of Roberts and the knowledge of a POSITA renders obvious claim 15.

Claim 18: “The display device as claimed in claim 13, comprising a reflective sheet on the LED module comprising an opening such that the LED is exposed.”

166. Liu in view of Roberts and the knowledge of a POSITA renders obvious the claimed “*comprising a reflective sheet on the LED module comprising an*

opening such that the LED is exposed.”

167. As explained previously, it was obvious to a POSITA to apply Robert’s reflector sheet teachings to Liu with expected success, wherein a reflector sheet is arranged with Liu’s LEDs to improve a lighting panel. Indeed, Roberts explains the benefits of using reflective materials to improve LCD backlight units. EX1004-Roberts, ¶¶77-79. Roberts also discloses that “in addition to reflecting incident light, the **reflector sheet 50** may help disperse the incident light so that it is reflected in a random direction (i.e. a Lambertian reflector), which may improve the **uniformity** of the lighting panel 40.” EX1004-Roberts, ¶79.”

168. Roberts further discloses that “[i]n order to provide and/or improve light recycling in the lighting panel 40, a **reflector sheet 50** may be provided on the same side of the tile 10 as the lighting elements 12.” EX1004-Roberts, ¶77. Fig. 5A of Roberts, reproduced below, illustrates the “**reflector sheet 50**.”

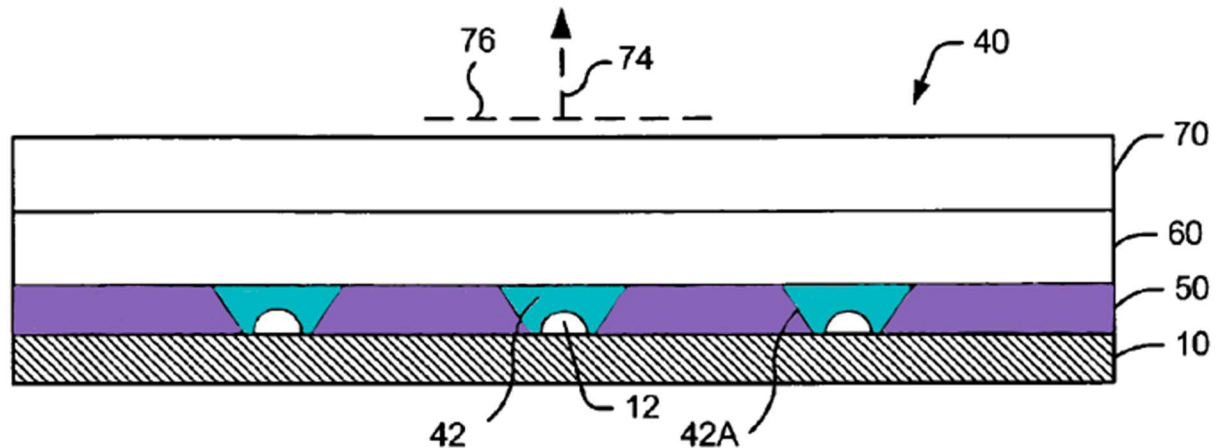


FIGURE 5A

EX1004-Roberts, Fig. 5A.

169. Roberts further discloses that “**reflector sheet 50** may include a **plurality of apertures 42** therein, which **apertures 42** may align with the lighting elements 12 on the tile 10.” EX1004-Roberts, ¶79. Roberts disclosure of a “**reflector sheet 50**” teaches the claimed “*reflective sheet on the LED module*” and its “**plurality of apertures 42**” teaches the claimed “*opening such that the LED is exposed.*”

170. Thus, Liu in view of Roberts and the knowledge of a POSITA renders obvious claim 18.

X. Ground 3: Claim 10 is rendered obvious by Liu in view of Liu-660 and the knowledge of a POSITA

A. Overview of the combination; motivation to combine; expectation of success

171. Ground 3 relies on Liu in view of Liu-660 and addresses claim 10. Liu-660 and Liu share the same solo inventor, Pang-Hsuan Liu. Liu explains that

“[w]hile improving the luminous efficacy of the backlight module, improving the luminous efficacy of the light-emitting device is a commonly used improvement solution.” EX1003-Liu, 5. Liu further discloses that “the industry has invested manpower and other resources in order to design and manufacture suitable products that not only meet the needs of LCD products, but also meet the requirements in terms of luminous efficacy and heat dissipation performance.” EX1003-Liu, 6.

172. Similar to Liu’s disclosure of a “a light emitting diode (LED) light source assembly structure used in a liquid crystal display (LCD) backlight module” (EX1003-Liu, 5), Liu-660 discloses various embodiments of “backlight module[s]” having LEDs (EX1006-Liu-660, ¶7). Liu-660 discloses that “backlight module 2 is composed of a backboard 21 and a plurality of lighting units 22 arranged in equal space and in parallel to one another on the backboard 21” and “[e]ach lighting unit 22 comprises a plurality of lighting elements 221 and a metal board 222 carrying the lighting elements 221.” EX1006-Liu-660, ¶17. Fig. 2A of Liu-660, reproduced below, illustrates these components of the backlight module 2.

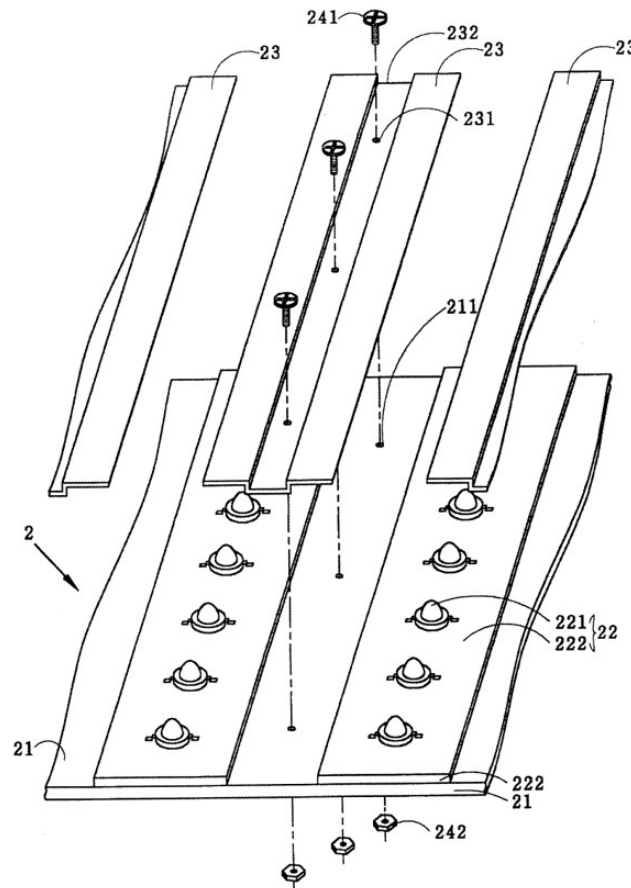


FIG. 2A

EX1006-Liu-660, Fig. 2A.

173. Liu-660 further discloses that “when the rigid metal board 23 is moved and configured between two adjacent metal boards 222, the two sides of the rigid metal board 23 with good rigidity lap over the adjacent portions of the metal boards 222,” and “when the bolts 241 are passed through the holes 231 of the concave portion 232 and the holes 211 of the backboard 21, and locked together with nuts 242 (not shown in the figure), the rigid metal board 23 can be fastened on the backboard 21.”

EX1006-Liu-660, ¶19. Liu-660 further discloses that “the strength of the compressing provided by the rigid metal board 23 can fasten the adjacent boards 222

on the backboard 21.” EX1006-Liu-660, ¶19. As shown in Fig. 2A above, the rigid board 23 is separated from the case, backboard 21.

174. Based on the foregoing a POSITA would have been motivated to improve Liu’s LED module with the Liu-660s teachings regarding a member separate from the case (rigid board 23) to help exert a compressing force between the LED modules (lighting unit 22) and the case (backboard 21). A POSITA would have seen benefits in configuring Liu to quickly and easily secure the LED modules with the separate member, rigid board 23, taught in Liu-660. *Id.* “[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious.” *KSR*, 550 U.S. at 417. In other words, this combination would have involved “the mere application of a known technique”—Liu-660’s teachings regarding using a separate member to hold the LED module—“to a piece of prior art”—Liu’s LED module—that is “ready for the improvement.”

175. A POSITA would have reasonably expected to succeed in making the combination because POSITAs were aware of the technique of using separate members to hold LED modules, as taught by Liu-660. These components were commonly considered by a POSITA in designing backlight modules, as taught by Liu-660.

B. The Challenged Claim

Claim 10: “The backlight unit as claimed in claim 1, wherein the bending part is formed with a member separated from the case.”

176. Liu in view of Liu-660 and the knowledge of a POSITA renders obvious the claimed “*wherein the bending part is formed with a member separated from the case.*”

177. As established in Ground 1, claim 9, Liu expressly discloses an embodiment where “*the bending part is integrated with the case.*” However, Liu does not expressly disclose a “*bending part*” that “*formed with a member separated from the case,*” as recited in claim 10. Nonetheless, the related reference of Liu-660, which shares the same inventor as Liu, discloses a “*bending part*” that “*formed with a member separated from the case.*”

178. As shown in Fig. 2A of Liu-660 reproduced below, Liu-660 discloses that “backlight module 2 is composed of a backboard 21 and a plurality of lighting units 22 arranged in equal space and in parallel to one another on the backboard 21” and “[e]ach lighting unit 22 comprises a plurality of lighting elements 221 and a metal board 222 carrying the lighting elements 221.” EX1006-Liu-660, ¶17.



179. Liu-660 discloses that “when the rigid metal board 23 is moved and configured between two adjacent metal boards 222, the two sides of the rigid metal board 23 with good rigidity lap over the adjacent portions of the metal boards 222,” and “when the bolts 241 are passed through the holes 231 of the concave portion 232 and the holes 211 of the backboard 21, and locked together with nuts 242 (not shown in the figure), the rigid metal board 23 can be fastened on the backboard 21.”

71

on the backboard 21.” EX1006-Liu-660, ¶19. As shown in Fig. 2A above, the “rigid board 23” is a member separated from the case. Further, Liu-660 discloses that “**the rigid board exerts a compressing strength** to fasten the adjacent lighting unit or units onto the backboard.” EX1006-Liu-660, ¶8. Thus, Liu-660 teaches the claimed a “*bending part*” that is “*formed with a member separated from the case.*”

180. As discussed above in ¶¶171-175, it would have been obvious to improve Liu’s LED module with the Liu-660’s teachings regarding a member separate from the case (rigid board 23) to help exert a compressing strength between the LED modules (lighting unit 22) and the case (backboard 21). A POSITA would have seen benefits in configuring Liu to quickly and easily secure the LED modules with the separate member, rigid board 23, as taught in Liu-660. *Id.* Both the “stamped protrusion part 308” in Liu and the “rigid board 23” in Liu-660 serve to clamp the LED module to the case. *Compare* EX1003-Liu, 8 (“By utilizing the clamping force applied to the board by the backboard and the protrusion part, the board can not only be tightly held onto the backboard, but the contact surface between the board and the backboard will also be intact and good”), *with* EX1006-Liu-660, ¶8 (“the rigid board exerts a compressing strength to fasten the adjacent lighting unit or units onto the backboard .”). Accordingly, improving Liu’s “stamped protrusion part 308” with Liu-660’s “rigid board 23” would have been a simple substitution and obvious to one of skill in the art.

181. Thus, Liu in view of Liu-660 and the knowledge of a POSITA renders obvious claim 10.

XI. DECLARATION IN LIEU OF OATH

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 § 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. If called to testify as to the truth of the matters stated herein, I could and would testify competently.

I declare under penalty of perjury that the foregoing is true and correct.

September 16, 2025



Michael R. Krames, Ph.D.

Appendix A

MICHAEL KRAMES, PhD, NAE, FIEEE, FIES

San Francisco Bay Area
+1 650-823-4007 (M) ▪ mkrames@arkesso.com



C-LEVEL EXECUTIVE IN PHOTONICS AND SEMICONDUCTORS: TECHNOLOGY, PRODUCT, AND GALLIUM NITRIDE EXPERT

Accomplished R&D Professional with 25+ years of experience in photonics including LEDs and wide bandgap semiconductors. Extensive experience in R&D and manufacturing settings, creating some of the most innovative LEDs for solid-state lighting. Tech team builder, overseeing design, fabrication, characterization, and integration. Work in major companies in the opto semiconductor market, including Hewlett-Packard, Philips and innovative start-ups. PhD in Electrical Engineering. Member of the National Academy of Engineering. IEEE and IES Fellow.

Overview

- Recruit top-performing professionals and make critical hires of technology experts.
- Manage large teams of up to 40, including globally distributed teams across the U.S. and Europe.
- Create unique strategic plans and product roadmaps for innovative technologies.
- Maintain strong partnerships with research institutions to develop industry-leading products.
- Oversee intellectual property (IP) portfolios and file dozens of successful patent applications.

Selected Core Competencies

R&D • Team Leadership • Strategic Planning • Photonics Technologies • Device Design • Speaker
Investment & Fundraising • Recruitment • Project Management • Multimillion USD Budgets • IP Portfolios

PROFESSIONAL EXPERIENCE

ARKESSO LLC – Palo Alto, CA – 2015-present

President

Strategic technology, investment and intellectual property development and consulting for wide bandgap semiconductor technologies and applications, including expert work in patent litigation.

CURRENT CHEMICALS INC – Cleveland, OH – 2025-present

Board of Directors

Guide strategy and growth for a U.S. manufacturer of critical materials and rare-earth compounds serving industrial, high-tech, and defense markets.

IBEAM MATERIALS INC – Sante Fe, NM – 2019-present

Board of Directors

Guide and govern Los Alamos National Lab start-up for depositing semiconductor grade gallium nitride on large area, flexible amorphous materials with application to flexible lighting systems and displays.

SEABOROUGH RESEARCH BV – Amsterdam, NL – 2015-present

Senior Advisor

Drive materials research and development programs for lighting applications using nano materials, focused on advancing the overall solid-state lighting industry in terms of energy savings and performance capability

PROFESSIONAL EXPERIENCE (CONTINUED)

MOMENTUM CAPITAL BV – Amsterdam, NL – 2016-2019, 2025-present

Principal

Technology scouting, assessment, and due diligence for growth market venture financing with a global view and emphasis on clean technology and energy sectors.

SORAA INC – Fremont, CA – 2009-2015

Chief Technology Officer (CTO)

First Management Team member hired to work with Nobel Prize Winner Shuji Nakamura and other key innovators from the University of California, Santa Barbara, to develop leading LED products for professional directional lighting using a brand-new LED materials platform: GaN-on-GaN. Established the GaN-on-GaN LED technology direction and performance roadmaps. Spearheaded projects to commercialize the technology and built successful LED and Product teams from the ground up to implement these. Directly involved in venture and strategic fundraising including successful Series B & C venture capital funding worth more than \$100M.

- Created the world's first LED to surpass halogen and the most efficient light-emitting diodes in the world.
- Built a strong intellectual property portfolio, resulting in more than 140 issued patents for Soraa.
- Developed practical strategies for the use of bulk GaN substrate, improving LED performance 10X.
- Supervised bulk GaN ammonothermal growth team and secured strategic investment to cover burn.
- Recruited a core team of talented technology professionals and made critical hires of senior executives.
- Developed LED roadmaps and oversaw innovation from substrate and epitaxy to fabrication and packaging.
- Established the value of higher color quality in products, including color and whiteness rendering.
- Successful implementation of a research contract with Penn State to advance the state of art for LED lighting.

PHILIPS LUMILEDS / LUMILEDS LIGHTING (Originally an HP-Philips Joint Venture) – San Jose, CA – 1999-2009

Executive Vice President, Advanced Laboratories

Formed and managed an R&D laboratory focused on designing groundbreaking LED technologies. Recruited and hired high-performing team, including employees from HP / Agilent Labs. Managed a 40-member department and a budget of up to \$20M. Coordinated with engineering, marketing, product development, and sales teams across the U.S. and Europe. Oversaw technology transfers and managed IP. Developed prototypes for next-generation, solid-state light emitters. Led development of ceramic phosphor technologies.

- Developed the critical LUXEON high power LED platform and managed the technology roadmaps.
- Identified Auger-Meitner recombination as primary loss mechanism in InGaN-based LEDs.
- Designed LED technologies for the iMac, iPhone Flash, digital imaging, and general illumination.
- Created the first automotive LED headlights for the Audi R8, creating new technology breakthroughs.
- Produced a strong intellectual property (IP) portfolio of groundbreaking innovations.
- Oversaw the European phosphor research teams and partners, including nitride-based phosphors
- Spearheaded the creation of thin film flip-chip LED technology and designed new ceramic phosphors.

HEWLETT PACKARD CO, Optoelectronics Division – San Jose, CA – 1995-1999

Design Engineer and Engineering Scientist

Developed innovative, high-energy LED technologies for traffic signal, road lighting, and automotive applications. Developed high-power LED products using novel device structures and epitaxial layer design.

- Worked with teams to develop the world's first high-power LEDs, expanding from milli-Watts to Watt-class.
- Successfully developed the first LED to surpass 100 lumens per Watt.
- Re-engineered LED chip design for red and amber emitters, delivering groundbreaking performance.
- Delivered record-setting performance for visible-spectrum LEDs with 55%+ external quantum efficiency.

EXPERT TESTIFYING EXPERIENCE (LAST 5 YEARS)

Case Description	Role	Jurisdiction	Testimony
SEOUL SEMICONDUCTOR CO., LTD. and SEOUL VIOSYS CO., LTD. (Plaintiffs) vs. TECHNICAL CONSUMER PRODUCTS, INC. (Defendant)	Expert witness for TCP	UNITED STATES DISTRICT COURT FOR THE DISTRICT OF DELAWARE	Deposition testimony Aug 21, 2025
Luminex International Company Ltd. (Petitioner) vs. Signify Holding BV (Patent Owner)	Expert witness for Signify	U.S. PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD	Deposition testimony Mar 13, 2025
Feit Electric Company, Inc. (Plaintiff) vs. LEDVANCE, LLC (Defendant)	Expert witness for LEDVANCE	UNITED STATES DISTRICT COURT EASTERN DISTRICT OF KENTUCKY	Deposition testimony Jan 10, 2025
Signify NA Corp. & Signify Holding BV (Plaintiffs) vs. LEPRO Innovation Inc. et al. (Defendants)	Expert witness for Signify	UNITED STATES DISTRICT COURT DISTRICT OF NEVADA	Deposition testimony Oct 2, 2024
ALSI Holdings, LLC (Plaintiff) vs. Current Lighting Solutions, LLC, and HLI Solutions, Inc. (Defendants)	Expert witness for Current	UNITED STATES DISTRICT COURT WESTERN DISTRICT OF TEXAS WACO DIVISION	Deposition testimony Aug 14, 2023
CAO Lighting, Inc., (Plaintiff) vs. GE Lighting, Inc., General Electric Co., and Consumer Lighting (U.S.), LLC d/b/a GE Lighting (Defendants)	Expert witness for GE	UNITED STATES DISTRICT COURT DISTRICT OF DELAWARE	Trial testimony June 8, 2023
Wolfspeed, Inc. & Ideal Industries Lighting, LLC d/b/a Cree Lighting (Petitioners) v. CAO Lighting, Inc. (Patent Owner)	Expert witness for Wolfspeed	U.S. PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD	Deposition testimony May 15, 2023
CAO Lighting, Inc., (Plaintiff) vs. GE Lighting, Inc., General Electric Co., and Consumer Lighting (U.S.), LLC d/b/a GE Lighting (Defendants)	Expert witness for GE	UNITED STATES DISTRICT COURT DISTRICT OF DELAWARE	Jury trial testimony Feb 16, 2023
CAO Lighting, Inc., (Plaintiff) vs. GE Lighting, Inc., General Electric Co., and Consumer Lighting (U.S.), LLC d/b/a GE Lighting (Defendants)	Expert witness for GE	UNITED STATES DISTRICT COURT DISTRICT OF DELAWARE	Deposition testimony May 25, 2022
Seoul Semiconductor Co., Ltd., and Seoul Viosys Co., Ltd. (Plaintiffs/Counter-Defendants) v. Satco Products, Inc. (Defendant/Counter-Plaintiff)	Expert witness for Satco	UNITED STATES DISTRICT COURT EASTERN DISTRICT OF NEW YORK	Deposition testimony December 2, 2021
Satco Products, Inc. (Petitioner) v. Seoul Semiconductor Co., Ltd. (Patent Owner), IPR2021-00230	Expert witness for Satco	U.S. PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD	Deposition testimony August 20, 2021

Satco Products, Inc. (Petitioner) v. Seoul Viosys Co., Ltd. (Patent Owner), IPR2020-00750	Expert witness for Satco	U.S. PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD	Deposition testimony April 23, 2021
Satco Products, Inc. (Petitioner) v. Seoul Semiconductor Co., Ltd. (Patent Owner), IPR2020-00410	Expert witness for Satco	U.S. PATENT AND TRADEMARK OFFICE BEFORE THE PATENT TRIAL AND APPEAL BOARD	Deposition testimony March 4, 2021

EDUCATION

UNIVERSITY OF ILLINOIS: URBANA-CHAMPAIGN – Urbana, IL

PhD in Electrical Engineering • Master of Science in Electrical Engineering

Research Assistant • Solid State Devices Laboratory • Electro-Optic Systems

Laboratory Teaching Assistant • Department of Electrical and Computer Engineering

PhD.: Native Oxidation of Area-Selective-Disordered AlGaAs-GaAs: Deep Oxide Structures for Device Applications

Master: Volume Holographic and Surface-Relief Transmission Gratings in Wavelength-Division-Multiplexing Receivers

UNIVERSITY OF TEXAS – Austin, TX

Bachelor of Science in Electrical Engineering, with High Honors

Outstanding Student Summer Program (Sandia Nationals Labs, 1988)

MIT Executive Education Courses, 2006

MEMBERSHIPS AND LEADERSHIP

- National Academy of Engineering (2025-)
- IEEE Fellow • IEEE Consultants Network of Silicon Valley
- Chair, IEEE Nick Holonyak, Jr. Medal (2023-2024)
- IES Fellow • University of Texas at Austin ECE Academy of Distinguished Alumni
- U.S. Department of Energy Solid-State Lighting Roundtable
- Panelist, Basic Energy Sciences Workshop on Solid-State Lighting
- Chair, SPIE Photonics West conferences on LEDs (2016-)
- Organizing Committee, Phosphor & Quantum Dots Industry Forum (2016-)
- Executive Committee, CS Mantech (2021-)

PUBLICATIONS

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9. ***Saturation Mechanisms in Common LED Phosphors***; Van de Haar, M-A., Tachikirt, M., Berends A. C., Krames M.R., Meijerink, A., and Rabouw, F.T.; (2021) *ACS Photonics* 8, 6, 1784–1793.
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38. **Research challenges to ultra-efficient inorganic solid-state lighting**; Phillips, J.M., Coltrin, M.E., Crawford, M.H., Fischer, A.J., Krames, M.R., Mueller-Mach, R., Mueller, G.O., Ohno, Y., Rohwer, L.E.S., Simmons, J.A., Tsao, J.Y.; (2007) Laser and Photonics Reviews, 1 (4), pp. 307-333.
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57. **Performance and application of high power ultraviolet AlGaInN light emitting diodes**; Han, J., Jeon, S.-R., Gherasimova, M., Su, J., Cui, G., Peng, H., Makarona, E., He, Y., Song, Y.-K., Nurmikko, A.V., Zhou, L., Goetz, W., Krames, M.; (2004) Proceedings of SPIE - The International Society for Optical Engineering, 5530, art. no. 08, pp. 61-68.
58. **Growth, characterization, and application of high power III-nitride ultraviolet emitters**; Han, J., Jeon, S.-R., Gherasimova, M., Song, Y.-K., Nurmikko, A.V., Zhou, L., Goetz, W., Krames, M.; (2004) Proceedings - Electrochemical Society, 6, pp. 183-191.
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PRESENTATIONS (RECENT)

1. **The unspoken challenge for linear fluorescent retrofits - and a solution**, Roy S.; Krames M. R.; 17th Int'l Symposium on Science & Technology of Lighting (LS:17); Toulouse, FR (2022)
2. **UV-C LEDs for Germicidal/Virucidal Applications**, Krames M. R.; U.S. Dept. of Energy Solid-State Lighting R&D Workshop – GUV Panel; Virtual (2022)
3. **UV-C Technology Roadmap**, Krames M. R.; Strategies In Light; Virtual (2021)
4. **UV-C Advancements Enable Innovative Germicidal Uses Displacing Lamps In Some Scenarios**; Krames M. R.; LedsMagazine Webinar; Virtual (2021)
5. **Ultra-Violet Germicidal Irradiation (UVGI): LEDs vs. Hg Lamps**; Krames M. R.; U.S. Dept. of Energy GUV R&D Discussion; Virtual (2020)
6. **Converters for Illumination: New Approaches and Applications**; Krames, M.; Phosphors & Quantum Dots Industry Forum; Virtual (2020)
7. **Gallium Nitride and the Transformation of the Lighting Industry**; Krames, M.; Stanford Optical Society Seminar; Stanford University, Stanford, CA (2020)
8. **How LEDs are Changing the World**; Krames, M.; UT ECE Colloquia Seminar; University of Texas, Austin, TX (2018)
9. **Status and Prospects for GaN-based LEDs / Lasers and Their Applications**; Krames, M.; Optics & Photonics International Congress: LEDIA'17; Yokohama, JP (2017)
10. **Legacy: The Birth of Solid-State Lighting in Silicon Valley**; Krames, M.; Invited Seminar at Lumileds; San Jose, CA (2017)
11. **The Solid-State Lighting Revolution: Technologies that will Shape the Future of Lighting**; Krames, M.; SPIE Photonics West – Panel Presentation; San Francisco, CA (2017)

12. ***The Challenge for Bulk Nitride Materials***; Krames, M.; Workshop on Ultra-Precision Processing for Wide Bandgap Semiconductors (WUPP); Monterey, CA (2017)
13. ***Status and Future Prospects for Visible-Spectrum LEDs***; Krames, M.; Society for Information Display – Display Week; San Jose, CA (2016)
14. ***LEDs for Lighting Applications: Past, Present, and Future***; Krames, M.; IEEE Photonics Society – Santa Clara Valley Chapter; Santa Clara, CA (2016)
15. ***What is Next for LEDs?***; Krames, M.; Strategies in Light; Santa Clara, CA (2016)
16. ***Opportunities for Down-Converters – Lighting Device Perspective***; Krames, M.; Phosphor Global Summit & Quantum Dot Forum; Newport Beach, CA (2016)
17. ***Challenges for Power Electronics in Solid-State Lighting***; Krames, M.; ARPA-e CIRCUITS Workshop; Washington, DC (2016)
18. ***Triumph of GaN Lighting***; Krames, M.; UC Berkeley ECE Seminar; Berkeley, CA (2015)

PATENTS (U.S. only)

- | | | |
|-----|------------|---|
| 1) | 12,369,438 | System and method for providing color light sources ... |
| 2) | 12,286,576 | Luminescent composition |
| 3) | 12,107,113 | Var. composition ternary compound semi. alloys, structures, and devices |
| 4) | 11,879,085 | Converter system |
| 5) | RE49,677 | Reusable nitride wafer, method of making, and use thereof |
| 6) | 11,725,783 | Circadian-friendly LED light source |
| 7) | 11,662,067 | LED lamps with improved quality of light |
| 8) | 11,611,023 | System and method for selected pump LEDs with multiple phosphors |
| 9) | 11,605,618 | LED array for in-plane optical interconnects |
| 10) | 11,511,071 | Circadian-friendly LED light sources |
| 11) | 11,287,090 | Circadian-friendly LED light source |
| 12) | 11,233,181 | Converter system |
| 13) | 11,162,026 | Converter system |
| 14) | 11,105,473 | LED lamps with improved quality of light |
| 15) | 10,955,608 | Circadian-friendly LED light sources |
| 16) | 10,900,615 | Circadian-friendly LED light source |
| 17) | 10,847,625 | Indium-gallium-nitride structures and devices |
| 18) | 10,830,405 | Sunlight-based large area light source and large area luminaire |
| 19) | 10,700,244 | System and method for selected pump LEDs with multiple phosphors |
| 20) | 10,693,041 | High-performance LED fabrication |
| 21) | 10,677,981 | Large area light source and large area luminaire |
| 22) | 10,557,595 | LED lamps with improved quality of light |
| 23) | 10,553,754 | Power light emitting diode and method with uniform current density |
| 24) | 10,529,902 | Small LED source with high brightness and high efficiency |
| 25) | 10,436,422 | Multi-function active accessories for LED lamps |
| 26) | 10,324,250 | Circadian-friendly LED light sources |
| 27) | 10,312,422 | Light emitting devices with optical elements and bonding layers |
| 28) | 10,312,404 | Semi. light emitting device growing active layer on textured surface |
| 29) | 10,290,775 | Luminescent ceramic for a light emitting device |
| 30) | 10,168,009 | LED lamps with improved quality of light |

- 31) 10,147,850 System and method for providing color light sources in proximity to predetermined wavelength conversion structures
- 32) 10,139,056 LED lamps with improved quality of light
- 33) 10,137,277 Circadian-friendly LED light source
- 34) 10,115,865 High-performance LED fabrication
- 35) 10,087,550 Reusable nitride wafer, method of making, and use thereof
- 36) 10,084,121 Small LED source with high brightness and high efficiency
- 37) 10,076,633 Circadian-friendly LED light source
- 38) 9,995,439 Glare reduced compact lens for high intensity light source
- 39) 9,722,148 Luminescent ceramic for a light emitting device
- 40) 9,677,723 LED lamps with improved quality of light
- 41) 9,660,152 System and method for selected pump LEDs with multiple phosphors
- 42) 9,653,554 Reusable nitride wafer, method of making, and use thereof
- 43) 9,650,723 Large area seed crystal for ammonothermal crystal growth and method
- 44) 9,640,724 III-nitride LED with double heterostructure light emitting region
- 45) 9,618,183 Apportioning optical projection paths in an LED lamp
- 46) 9,589,792 High quality group-III metal nitride crystals, methods of making, and methods of use
- 47) 9,583,683 Light emitting devices with optical elements and bonding layers
- 48) 9,583,678 High-performance LED fabrication
- 49) 9,564,553 Power LED and method with uniform current density operation
- 50) 9,435,525 Multi-part heat exchanger for LED lamps
- 51) 9,419,189 Small LED source with high brightness and high efficiency
- 52) 9,410,664 Circadian friendly LED light source
- 53) 9,368,695 LED lamps with improved quality of light
- 54) 9,360,190 Compact lens for high intensity light source
- 55) 9,359,260 Luminescent ceramic for a light emitting device
- 56) 9,293,667 System and method for selected pump LEDs with multiple phosphors
- 57) 9,293,644 Power LED and method with uniform current density operation
- 58) 9,267,661 Apportioning optical projection paths in an LED lamp
- 59) 9,117,944 Semiconductor light emitting devices grown on composite substrates
- 60) D736,724 LED lamp with accessory
- 61) D736,723 LED lamp
- 62) 9,046,227 LED lamps with improved quality of light
- 63) D730,302 Heat sink
- 64) 9,000,450 Grown photonic crystals in semiconductor light emitting devices
- 65) 8,985,794 Providing remote blue phosphors in an LED lamp
- 66) 8,933,644 LED lamps with improved quality of light
- 67) 8,911,518 Method and system for dicing substrates containing gallium and nitrogen material with conductive core via structures
- 68) 8,905,588 System and method for providing color light sources in proximity to predetermined wavelength conversion structures
- 69) 8,884,517 Illumination sources with thermally-isolated electronics
- 70) 8,847,252 III-nitride LED with double heterostructure light emitting region
- 71) 8,846,423 Bonding an optical element to a light emitting device

- 72) 8,748,923 Wavelength-converted semiconductor light emitting device
- 73) 8,748,912 Common optical element for an array of phosphor converted LEDs
- 74) 8,740,413 System and method for providing color light sources in proximity to
predetermined wavelength conversion structures
- 75) 8,729,559 Method of making bulk InGaN substrates and devices thereon
- 76) 8,686,458 Power light emitting diode and method with current density operation
- 77) 8,679,869 Contact for a semiconductor light emitting device
- 78) 8,628,985 Light emitting devices with improved light extraction efficiency
- 79) 8,597,967 Method and system for dicing substrates containing gallium and
nitrogen material
- 80) 8,502,465 Power light emitting diode and method with current density operation
- 81) 8,492,244 Methods for relaxation and transfer of strained layers and structures
fabricated thereby
- 82) 8,486,771 Methods of forming relaxed layers of semi. materials, semi. structures,
devices and engineered substrates including same
- 83) 8,482,104 Method for growth of indium-containing nitride films
- 84) 8,481,408 Relaxation of strained layers
- 85) 8,471,280 Silicone based reflective underfill and thermal coupler
- 86) 8,455,913 Package-integrated thin film LED
- 87) 8,450,754 Series connected flip chip LEDs with growth substrate removed
- 88) 8,445,929 Wavelength-converted semiconductor light emitting device
- 89) 8,415,694 Light emitting devices with improved light extraction efficiency
- 90) 8,334,543 III-V light emitting device including a light extracting structure
- 91) 8,334,155 Substrate for growing a III-V light emitting device
- 92) 8,288,186 Substrate for growing a III-V light emitting device
- 93) 8,278,674 Luminescent ceramic element for a light emitting device
- 94) 8,203,153 III-V light emitting device including a light extracting structure
- 95) 8,174,025 Semiconductor light emitting device including porous layer
- 96) 8,163,575 Grown photonic crystals in semiconductor light emitting devices
- 97) 8,153,475 Back-end processes for substrates re-use
- 98) 8,114,692 Light source including a wavelength-converted semi. LED and a filter
- 99) 8,105,852 Method of forming a composite substrate and growing a III-V light
emitting device over the composite substrate
- 100) 8,080,828 Low profile side emitting LED with window layer and phosphor layer
- 101) 8,067,254 Common optical element for an array of phosphor converted LED
- 102) 8,062,916 Series connected flip chip LEDs with growth substrate removed
- 103) 8,053,905 Compliant bonding structures for semiconductor devices
- 104) 8,049,234 Light emitting devices with improved light extraction efficiency
- 105) 8,039,866 Mount for a semiconductor light emitting device
- 106) 7,981,767 Methods for relaxation and transfer of strained layers and structures
fabricated thereby
- 107) 7,902,564 Multi-grain luminescent ceramics for light emitting devices
- 108) 7,888,691 Light source including a wavelength-converted semi. LED and a filter
- 109) 7,880,186 III-nitride light emitting device with DH light emitting region
- 110) 7,875,984 Compliant bonding structures for semiconductor devices

111)	7,875,533	Package-integrated thin film LED
112)	7,863,631	A1InGaP LED having reduced temperature dependence
113)	7,808,011	Semi. light emitting devices including in-plane light emitting layers
114)	7,804,100	Polarization-reversed III-nitride light emitting device
115)	7,791,096	Mount for a semiconductor light emitting device
116)	7,675,084	Photonic crystal light emitting device
117)	7,663,148	III-nitride light emitting device with reduced strain light emitting layer
118)	7,642,108	LED including photonic crystal structure
119)	7,626,210	Low profile side emitting LED
120)	7,601,989	LED with porous diffusing reflector
121)	7,544,525	AllnGaP LED having reduced temperature dependence
122)	7,514,721	Luminescent ceramic element for a light emitting device
123)	7,491,565	III-nitride light emitting devices fabricated by substrate removal
124)	7,488,621	Package-integrated thin film LED
125)	7,442,965	Photonic crystal light emitting device
126)	7,419,839	Bonding an optical element to a light emitting device
127)	7,408,201	Polarized semiconductor light emitting device
128)	7,402,840	Selective filtering of wavelength-converted semi. light emitting devices
129)	7,361,938	Luminescent ceramic for a light emitting device
130)	7,341,878	Wavelength-converted semiconductor light emitting device
131)	7,294,862	Photonic crystal light emitting device
132)	7,279,718	LED including photonic crystal structure
133)	7,279,345	Method of forming LEDs with improved light extraction efficiency
134)	7,268,371	Light extraction from a semiconductor LED via chip shaping
135)	7,256,483	Package-integrated thin film LED
136)	7,244,630	A1InGaP LED having reduced temperature dependence
137)	7,221,000	Reverse polarization light emitting region for a semiconductor LED
138)	7,122,839	Semiconductor LEDs with graded composition light emitting layers
139)	7,087,941	III-phosphide light emitting devices with thin active layers
140)	7,064,355	Light emitting diodes with improved light extraction efficiency
141)	7,053,419	Light emitting diodes with improved light extraction efficiency
142)	7,026,663	Selective filtering of wavelength-converted semiconductor LEDs
143)	7,015,054	Semiconductor light emitting device and method
144)	7,012,279	Photonic crystal light emitting device
145)	6,995,389	Heterostructures for III-nitride light emitting devices
146)	6,992,334	Multi-layer highly reflective ohmic contacts for semiconductor devices
147)	6,989,555	Strain-controlled III-nitride light emitting device
148)	6,956,246	Resonant cavity III-nitride LEDs fabricated by growth substrate removal
149)	6,946,309	III-Phosphide and III-Arsenide flip chip light-emitting devices
150)	6,903,376	Selective placement of QWs in flipchip LEDs for improved light extract.
151)	6,849,472	Nitride semiconductor device with reduced polarization fields
152)	6,847,057	Semiconductor light emitting devices
153)	6,844,571	III-nitride light-emitting device with increased light generating capability
154)	6,800,500	III-nitride light emitting devices fabricated by substrate removal
155)	6,784,463	III-Phospide and III-Arsenide flip chip light-emitting devices

156)	6,744,077	Selective filtering of wavelength-converted semi. light emitting devices
157)	6,683,327	Nucleation layer for improved light extract. from light emitting devices
158)	6,649,440	Aluminum indium gallium nitride-based LED having thick epitaxial layer for improved light extraction
159)	6,646,292	Semiconductor light emitting device and method
160)	6,642,652	Phosphor-converted light emitting device
161)	6,576,488	Using electrophoresis to produce a conformally coated phosphor-converted light emitting semi.
162)	6,570,190	LED having angled sides for increased side light extraction
163)	6,525,335	Light emitting semi. devices including wafer bonded heterostructures
164)	6,521,914	III-Nitride LED with increased light generating capability
165)	6,514,782	Method of making a III-N LED with increased light generating capability
166)	6,504,171	Chirped multi-well active region LED
167)	6,486,499	III-nitride light-emitting device with increased light generating capability
168)	6,420,199	Methods for fabricating light emitting devices having aluminum gallium indium nitride structures and mirror stacks
169)	6,323,063	Forming LED having angled sides for increased side light extraction
170)	6,320,206	LEDs having wafer bonded AlGaInN structures and mirror stacks
171)	6,280,523	Thickness tailoring of wfr. bonded AlxGayInzN struct.'s by laser melting
172)	6,229,160	Light extraction from a semi. light-emitting device via chip shaping
173)	6,133,589	AlGaInN-based LED having thick epi layer for improved light extraction
174)	6,046,465	Buried reflectors for light emitters in epi. mat'l & method for producing
175)	5,779,924	Ordered interface texturing for a light emitting device
176)	5,400,354	Laminated upper cladding structure for a light-emitting device