

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Astera Manufacturing Ltd.,
and
Chauvet & Sons, LLC

v.

ElectraLED Inc.,
Patent Owner.

Case [To be assigned]
U.S. Patent No. 7,651,245

**DECLARATION OF DR. ZANE COLEMAN IN SUPPORT OF ASTERA
DISTRIBUTION LTD.'s PETITION FOR *INTER PARTES* REVIEW
OF CLAIMS 21-28 OF U.S. PATENT NO. 7,651,245**

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TABLE OF CONTENTS

I.	INTRODUCTION	1
A.	Engagement	1
B.	Background and Qualifications	1
C.	Information Considered.....	4
II.	Background	5
A.	The '245 Patent	5
B.	Prosecution History of the '245 Patent	7
III.	CLAIM CONSTRUCTION AND POSITA DEFINITION.....	8
A.	Claim Construction.....	8
B.	Definition of a Person of Ordinary Skill in the Art.....	8
IV.	Understanding of Legal Standards	9
A.	Anticipation	9
B.	Obviousness.....	10
V.	THE ELEMENTS IN CLAIMS 21-28 OF THE '245 PATENT ARE ANTICIPATED AND RENDERED OBVIOUS BY THE PRIOR ART	13
A.	Ground 1 – Lin Anticipates and Renders Obvious Claims 21-23, 25, and 26	14
1.	Independent Claim 21	17
2.	Dependent Claim 22	39
3.	Dependent Claim 23	41
4.	Dependent Claim 25	44
5.	Dependent Claim 26	47
B.	Ground 2 – Lin in view of Zeng and Lodhie Renders Obvious Claim 24	49
1.	Dependent Claim 24	49
C.	Ground 3 – Lin in view of Moriyama Renders Obvious Claim 27	59
1.	Dependent Claim 27	60
D.	Ground 4 – Lin in View of Nishimoto and Cunningham Renders Obvious Claim 28.....	64
1.	Dependent Claim 28	64
E.	Ground 5 – Chen Anticipates and Renders Obvious Claims 21-23 and 26.....	74
1.	Independent Claim 21	75
2.	Dependent Claim 22	94

3.	Dependent Claim 23	96
4.	Dependent Claim 26	99
F.	Ground 6 – Chen in view of Lodhie Renders Obvious Claim 24.....	101
1.	Dependent Claim 24	101
G.	Ground 7 – Chen in view of Lin Renders Obvious Claim 25.....	106
1.	Independent Claim 25	107
H.	Ground 8 – Chen in view of Moriyama Renders Obvious Claim 27	109
1.	Dependent Claim 27	109
I.	Ground 9 – Chen in View of Nishimoto and Cunningham Renders Obvious Claim 28.....	114
1.	Dependent Claim 28	114
VI.	Certification.....	125

I, Dr. Zane Coleman, declare:

I. INTRODUCTION

A. Engagement

1. I have been retained by Astera Manufacturing Ltd. and Chauvet & Sons, LLC to offer technical opinions relating to US Patent No. 7,651,245 (“**245 Patent**”) (EX1001). And prior art references relating to its subject matter.¹

2. I have no financial interest in either party or in the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis at my standard consulting rate of \$500 per hour. My compensation is not dependent on the outcome of these proceedings or the content of my opinions.

B. Background and Qualifications

3. In 1992, I received a Bachelor of Science degree in Applied Physics, including a Certificate in Optics from the Georgia Institute of Technology. I received my doctorate in Physics at the Loughborough University in the United Kingdom in 1997, focusing on applied rigorous coupled wave diffraction theory to model and analyze recorded edge-lit holograms and their applications as illuminators. My analysis included modeling and measuring optical and thermal

¹ For brevity, when providing citations herein, I will generally refer to the name of the reference, rather than the exhibit number. The exhibit numbers associated with each reference can be found in Appendix A.

properties of illumination systems including Light Emitting Diode (LED) illumination systems.

4. From 1993 to 1997, I worked as an Optical Engineer at ImEdge Technology Inc. While at ImEdge Technology, I conducted research for a start-up company developing holographic illumination technology which included analyzing optical and thermal performance of different recording systems and materials for illumination systems including LED based illumination systems. During this time, I also invented new methods directed to recording edge-lit holograms and edge-lit devices for display and biometric applications; responsible for seven issued patents.

5. From 1997 to 2002, I worked as a Senior Physicist for Motorola Labs. I helped optically design and construct the world's first personal micro-projector (U.S. Patent No. 6,637,896). I also designed optical films for LCDs as well as 3 new optical film products with suppliers, including an optical film with 3M, which was shipped in over 100 million cellular phones. I also analyzed thermal and optical properties of products including developing new measurement techniques. During my time at Motorola, I was an inventor on 4 issued patents and 26 patent disclosures.

6. From 2003 to 2005, I served as the President of Phostech, where my roles included the optical design, analysis, and invention of new diffusing films,

refractive and total internal reflection (TIR) films, optical lenses, projection screens and systems, LCD backlights, lightguides, illuminated signs, head-up displays, and light fixtures.

7. From 2005 to 2006, I was the Manager of Optical Engineering at Fusion Optix Inc. where I helped to develop and prototype micro-replicated, multi-functional optical films, components and lenses for displays and light fixtures through optical modeling, prototyping, analysis, and specification. I designed, installed, and managed the optical film, LED backlight, and light fixture characterization lab including optical, thermal, and environmental characterization. I consulted with the product development group and contributed to the optical design, thermal design, packaging, and accessories for LED light fixtures and other products.

8. From 2006 to 2009, I was the VP of Technology & Director of Technology at Fusion Optix Inc. In this role, I lead the research strategy and transfer of technology to product engineering in a fast-paced small company providing innovation in the display and LED lighting industries. I also oversaw the research and development of optical films, LED backlights, and LED light fixture projects. I also co-developed a Lightfair 2009 Innovation Award-winning light fixture.

9. In 2009, I rejoined Phostech as President and am presently responsible for optical consulting and patent strategy & drafting services. I have been issued 105 patents related to optical components, light fixtures, displays, specialty films and systems, and light emitting devices, and additionally have 9 patent applications pending. A list of these patents along with further details regarding my employment and academic history are included in my *curriculum vitae*, attached as EX1004.

C. Information Considered

10. I have reviewed the '245 Patent and its prosecution history, as well as the other materials referenced in Appendix A. Counsel has informed me that I should consider these materials through the lens of one of ordinary skill in the art related to the '245 Patent, at the time of the earliest purported priority date of the '245 Patent, and I have done so during my review of these materials. I have been asked to assume, for purposes of this Declaration, that the '245 Patent has a priority date of June 13, 2007.

11. My analyses are based on my years of education, research, and work experience, as well as my investigation and study of relevant materials. In my analyses, I have considered the materials that I identify in this Declaration and those listed in Appendix A.

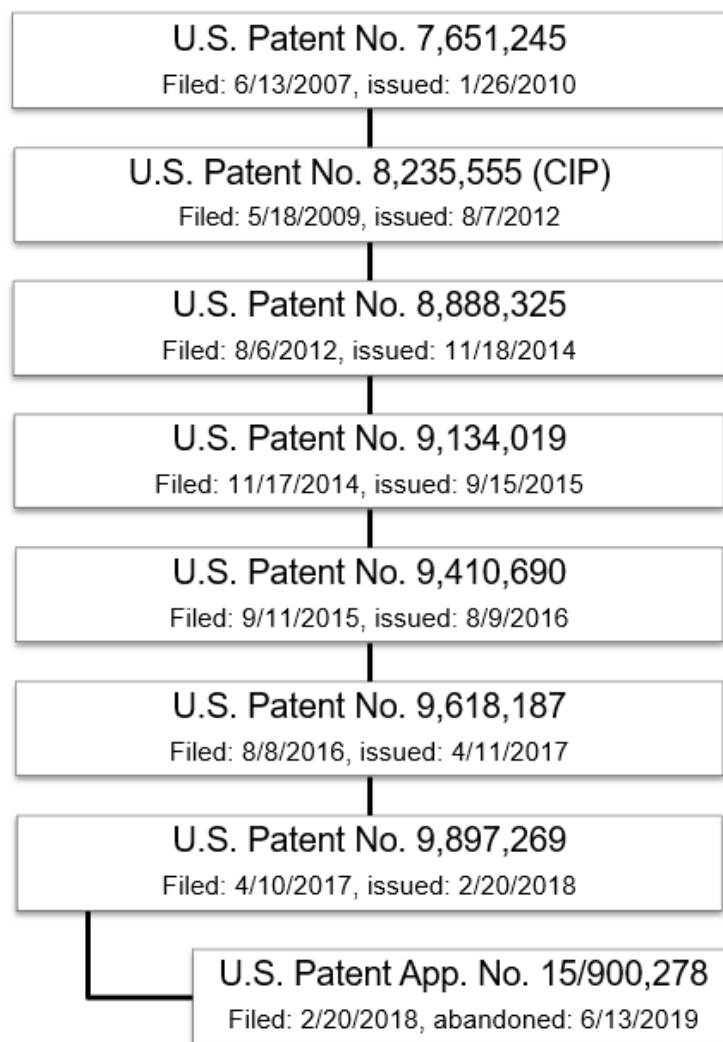
12. I may rely on these and additional materials to respond to arguments raised by the Patent Owner. I may also consider additional documents and information in further analyses—including documents that may not yet have been provided to me.

13. My review and assessment of the materials provided in this proceeding is ongoing, and I will continue to consider any new material as it is provided. I reserve the right to review, supplement, and amend my analyses based on new information and on my continuing review of the materials already provided.

II. BACKGROUND

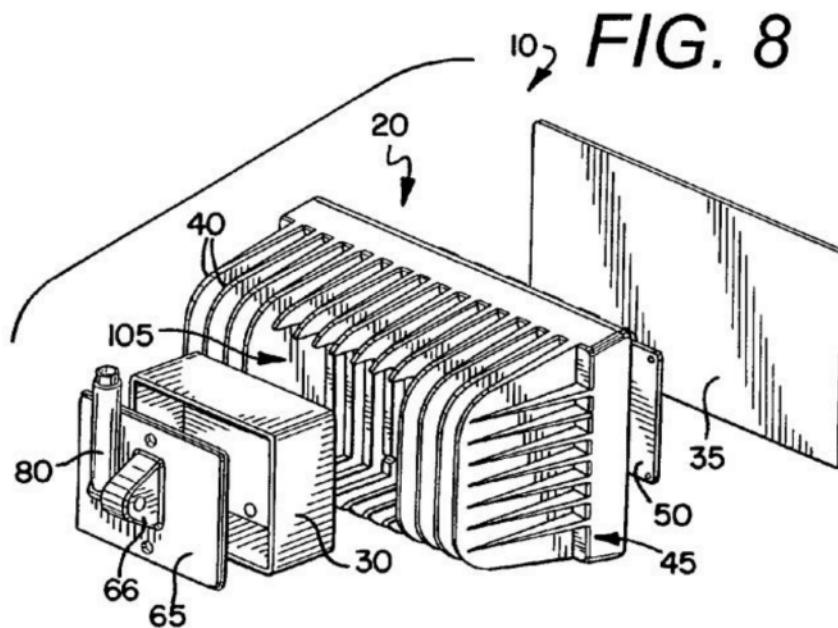
A. The '245 Patent

14. I understand the '245 Patent was filed on June 13, 2007, and issued on January 26, 2010. I also understand that the '974 Patent is part of the following patent family:



15. I have assumed, for purpose of this declaration, that the '245 Patent is entitled to its alleged priority date of June 13, 2007.

16. The '245 Patent is directed to an LED light fixture with an internal power supply and “an arrangement of external fins that dissipate heat generated by the light engine.” ('245 Patent, Abstract.)



(*Id.*, Fig. 8.) The claims focus on physical features of the light fixture. For example, Claim 21 lists several features of the light fixture such as “a housing [with] . . . a frontal lens and an array of fins,” a “light engine having a plurality of light modules,” and “a power supply residing within the rear receptacle.” (*Id.*, Cl. 21.)

B. Prosecution History of the '245 Patent

17. I have reviewed the prosecution history of the '245 Patent. I understand that during prosecution of the '245 Patent, only a single Office Action issued, rejecting the claims based on U.S. Patent App. No. 2005/0128752 (“Ewington”), U.S. Patent No. 7,274,302 (“Stevenson”), and U.S. Patent No. 7,431,477 (“Chou”). (EX1002, '245 Patent File History at 56-61, Non-Final Rejection mailed Jan. 29, 2009.) I understand that in response to the rejection

Patent Owner cancelled the rejected claims and submitted new claims in their place. (*Id.*, 74-80, Non-Final Rejection Response dated July 6, 2009.) I understand that following an Examiner review, a Notice of Allowance was mailed September 9, 2009. (*Id.*, 84-90, Notice of Allowance and Fees Due mailed Sep. 9, 2009.)

III. CLAIM CONSTRUCTION AND POSITA DEFINITION

A. Claim Construction

18. I understand that in an *inter partes* review, claims must be given their ordinary and customary meaning, as understood by one of ordinary skill in the art in light of the specification and prosecution history. I apply that standard in my analysis below to the words and phrases in the claims of the '245 Patent.

B. Definition of a Person of Ordinary Skill in the Art

19. A person of ordinary skill in the art (“**POSITA**”) in the field of the '245 Patent would have had good working knowledge of electrical engineering and LED lighting systems. They would have gained this through an undergraduate degree in electrical engineering, physics, optical engineering, or similar disciplines, along with at least two years of experience working with lighting devices and lighting systems.

20. The more education one has, the less experience needed to attain an ordinary level of skill. Similarly, more experience in the field may serve as a substitute for formal education.

IV. UNDERSTANDING OF LEGAL STANDARDS

A. Anticipation

21. I understand that a patent claim is invalid when the invention that it claims is not new. To establish that a claimed invention is not new (a.k.a., “not novel”), I understand that one may establish that a single publication, or other reference in the prior art discloses (explicitly or inherently) every element required in a patent claim (i.e., all features or “limitations” recited in the patent claim). I understand that a reference in the prior art “anticipates” a claimed invention if that reference discloses, either explicitly or inherently, every element of the claim.

22. I understand that “prior art” and “prior art reference” are legal terms of art referring to, for example, devices, methods, and publications that predate the earliest effective filing date of the claimed invention.

23. I understand that a prior art reference that anticipates a claim may disclose an element or limitation of a patent claim expressly or inherently. A prior art reference discloses an element or limitation of a patent claim inherently when the prior art’s disclosure necessarily requires or implies that the claimed element or limitation be present in the process, machine, manufacture, or composition disclosed. I understand there is still considered to be an inherent disclosure even if the author of the reference did not describe or understand the underlying inherent principle. I understand that one may establish that a prior art reference inherently

discloses a claimed element or limitation through the use of other reference material or through testing.

24. I understand that the description in a written reference does not have to be in the same words as the claim, but all of the requirements of the claim must be there, either stated or necessarily implied, so that a POSITA looking at that one reference would be able to make and use the claimed invention.

25. I understand that any prior art reference that can be considered for purposes of determining whether it anticipates a patent claim may also be used to determine whether the reference renders that claim obvious, as discussed below.

B. Obviousness

26. I understand that, even if a claim is not fully disclosed in a single prior art reference, the patent claim is invalid if the invention would have been obvious to a POSITA at the time of the invention. In particular, I understand that a patent claim is normally invalid as obvious if it would have been an “ordinary innovation” within the relevant field to create the claimed product or method at the time of the invention.

27. I understand that the relevant portion of pre-AIA Section 103, subsection (a) of the Patent Act states:

“A patent may not be obtained through the invention is not identically disclosed or described as set forth in section 102 of this title, if the

differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.”

28. I understand that, by way of example only, a claimed invention is obvious if:

it combines prior art elements according to known methods to yield predictable results;

it simply substitutes one known element for another to obtain predictable results;

it uses a known technique to improve similar devices (methods, or products) in the same way;

it applies a known technique to a known device (method, or product) ready for improvement to yield predictable results;

it was “obvious to try” in that the inventor chose from a finite number of identified, predictable solutions, with a reasonable expectation of success;

known work in one field of endeavor prompted variations of it for use in either the same field or a different one based on design incentives or other market forces and those variations were predictable

to one of ordinary skill in the art; or

some teaching, suggestion, or motivation in the prior art led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

29. When considering obviousness, I understand that I am to: (i) decide the level of ordinary skill in the field that someone would have had at the time the alleged invention was made; (ii) determine the scope and content of the prior art; (iii) determine what differences, if any, existed between the prior art and the Asserted Claims; and (iv) consider objective evidence of non-obviousness (also known as secondary considerations). Further, when considering obviousness, I understand that it is not necessary to seek out precise teachings, and it is permissible to consider the inferences, common sense, and creative steps that a POSITA (who is considered to have an ordinary level of creativity and is not an automaton) would employ.

30. I understand that objective evidence relevant to the issue of obviousness may also be considered. This type of evidence is sometimes referred to as “secondary considerations,” and may include evidence of commercial success, long-felt but unsolved needs, failure of others, and unexpected results. I understand that any secondary evidence must have a nexus to the relevant claims. For example, I understand that commercial success must have a nexus to features

of the alleged invention not disclosed in the prior art, and in particular the prior art references which support an obviousness theory. In other words, I understand that commercial success is material only if it comes from the merits of the claimed invention beyond what the prior art disclosed. With respect to secondary considerations, I understand that Patent Owner bears the burden of proof, and I have seen no evidence to date that any secondary considerations would establish non-obviousness

V. THE ELEMENTS IN CLAIMS 21-28 OF THE '245 PATENT ARE ANTICIPATED AND RENDERED OBVIOUS BY THE PRIOR ART

31. I have been asked to provide an analysis as to whether the elements of Claims 21-28 of the '245 Patent (the “**Challenged Claims**”) are invalid in view of the prior art, particularly TW94204571U (“**Lin**”) (EX1005; EX1006²) and U.S. 7,465,066 (“**Chen**”) (EX1007). I was also asked to consider these references in view of certain additional prior art for some of the limitations of the Challenged Claims, including US2006/0146553 (“**Zeng**”) (EX1009), US5,577,832 (“**Lodhie**”) (EX1008), US2005/0239342 (“**Moriyama**”) (EX1010), WO2005/029185 (“**Nishimoto**”) (EX1011), and US2004/0021859 (“**Cunningham**”) (EX1012).

² Citations to “Lin” refer to the Certified English Translation of TW94204571U, attached as EX1006. Page numbers and line numbers refer to the page and line numbers shown in EX1006.

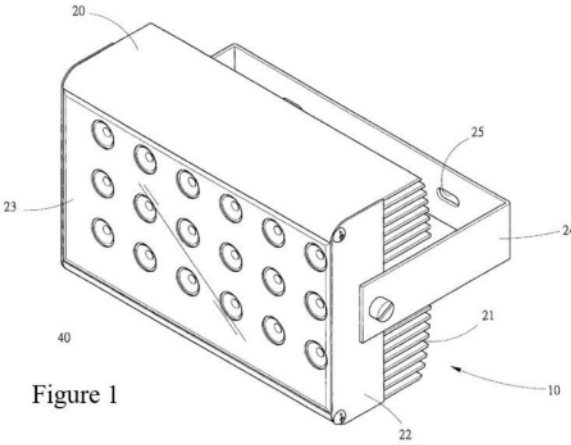
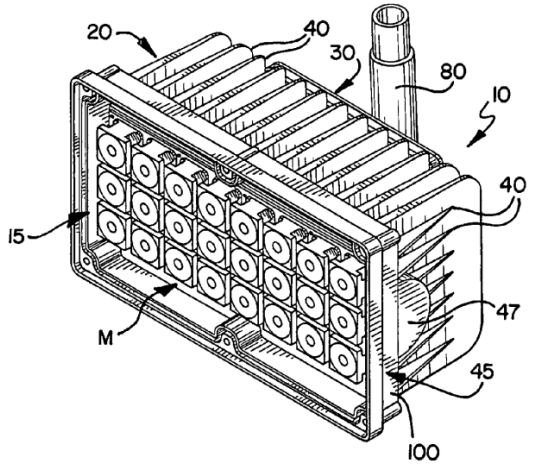
32. My analysis of these prior art references relative to the Challenged Claims—specifically, how and where the prior art references disclose and/or render obvious the limitations of the challenged claims—is provided below. The citations that I have included are not intended to provide an exhaustive list, but rather provide examples of how the references disclose or teach the elements of these claims.

A. Ground 1 – Lin Anticipates and Renders Obvious Claims 21-23, 25, and 26

33. I have reviewed Lin and its certified translation. Lin was filed on March 24, 2005, and published October 11, 2005. I understand Lin is prior art under at least pre-AIA § 102(b). Lin is directed to an LED searchlight including a heat dissipation unit with a plurality of heat dissipation fins.

34. My review of the '245 Patent file history shows that Lin was not considered during prosecution of the '245 Patent.

35. Lin discloses an “LED searchlight” which is nearly identical to the '245 Patent’s LED light fixture:

Lin, Fig. 1	'245 Patent, Fig. 1
 Figure 1	

Lin, Fig. 3

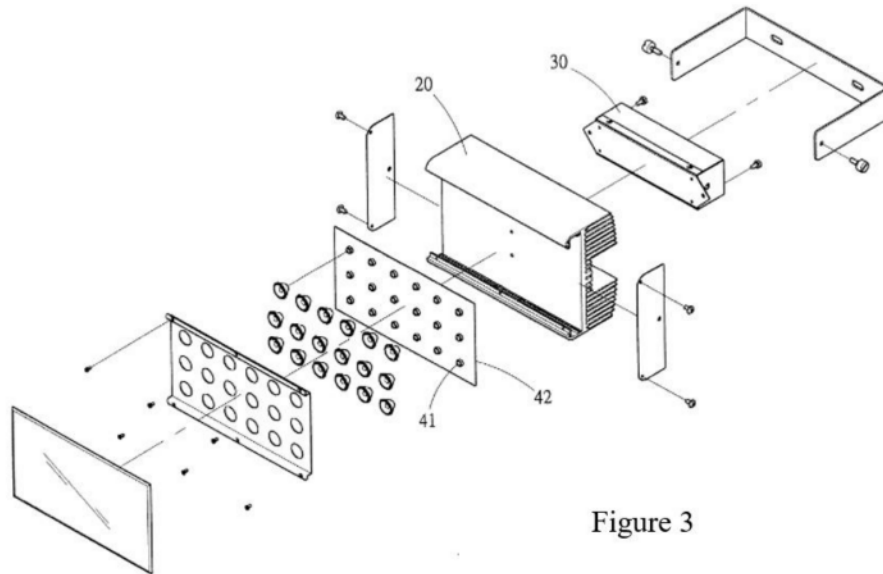
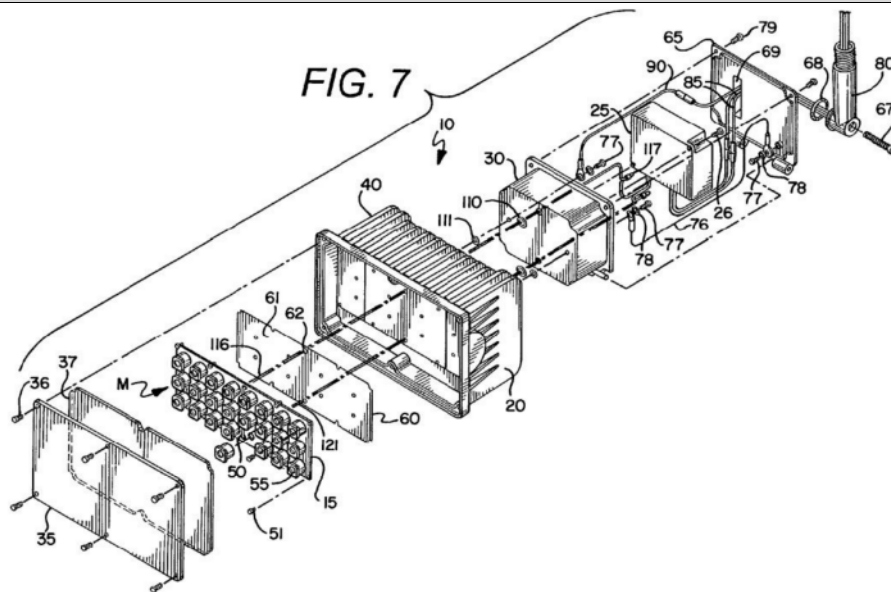


Figure 3

'245 Patent, Fig. 7



(Compare Lin, Figs. 1, 3 with '245 Patent, Figs. 1, 7.) Lin, like the '245 Patent, has a “power supply unit” located in a receptacle defined by “heat dissipation fins” of

different lengths in the “back end” of a “heat dissipation unit.” (Lin, 4:4-10, 4:18-5:10, Figs. 2-3.) Again, looking at the exploded view figures from Lin and the ’245 Patent shown above, especially Lin’s Figure 3 and the ’245 Patent’s Figure 7, it is clear the lighting devices are nearly identical.

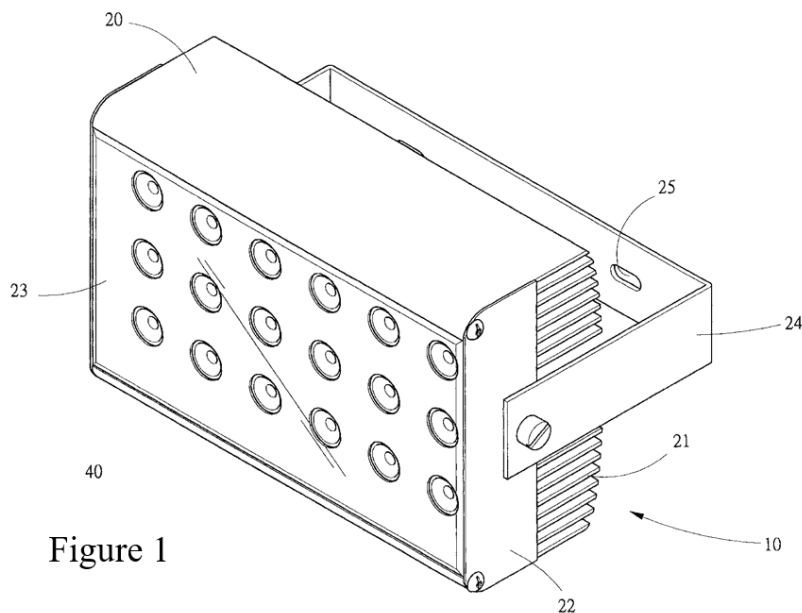
Lin explains that its design serves to “increase the heat energy released during the operation of the searchlight through the heat dissipation fins...thereby prolonging the service life of the LEDs.” (*Id.*, 4:14-16.)

1. Independent Claim 21

36. As viewed by a POSITA, Lin anticipates and renders obvious Claim 21.

21[Pre]: A LED light fixture comprising:

37. To the extent limiting, Lin anticipates and renders obvious Claim 21[pre]. Lin discloses a lighting fixture that is “a searchlight using LEDs with a heat dissipation unit.”:



(Lin, Fig. 1, 3:4-5, 3:29-4:3, Figs. 2-3; *see also infra* Section V(A)(1), Claim 21[B.i-ii].) For example, Lin’s LED searchlight “may further be provided with a grab handle (24)” which makes it easier for users to lift the device or, using the slotted holes in the grab handle, “can be fixed to [a] wall surface” for use as “emergency lighting.” (*Id.*, 6:6-11.)

21[A.i]: a housing including a flange, an internal receiver, a frontal lens, and an array of fins...

38. Lin discloses Claim 21[A.i]. Lin discloses a housing that includes “heat dissipation unit (20)” having a flange, “plurality of heat dissipation fins (21),” “baffle plates (22),” “light-transmissive plate (23),” and “power supply unit (30)”:

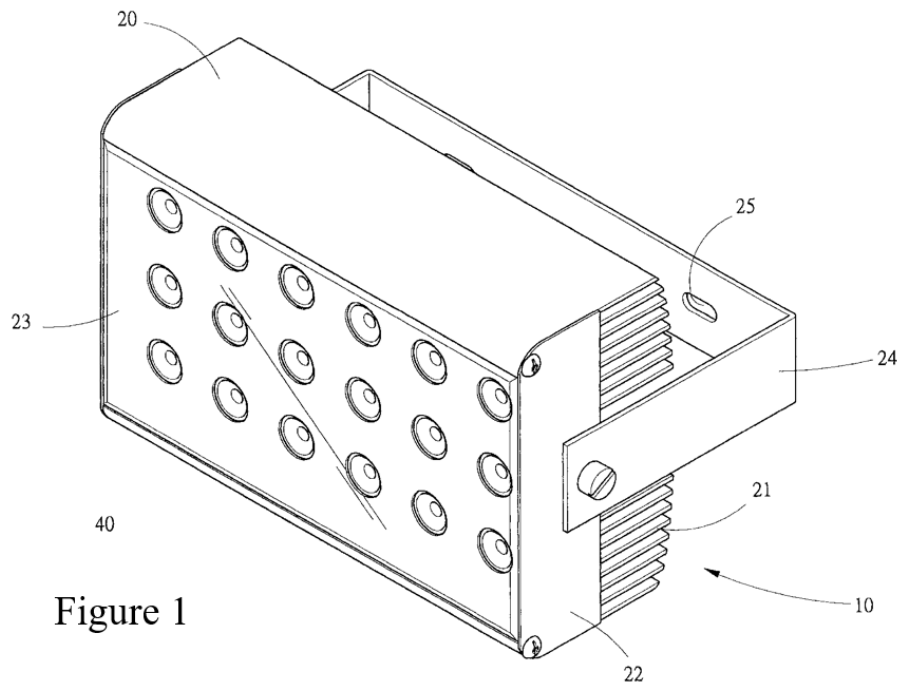


Figure 1

(Lin, Fig. 1; 4:4-10; 4:26-30; 4:33-5:10; *see also* Lin, Figs. 2-3.) Additionally, Lin discloses that “a housing space is formed by the baffle plates (22) on both sides and the light-transmissive plate (23) at the front end as well as the heat dissipation unit (20).” (*Id.*, 4:26-30.) Components of the device are arranged within the housing space including, for example, “light-emitting unit (40),” as shown in Figure 2 of Lin below. (*Id.*, 4:33-5:1.)

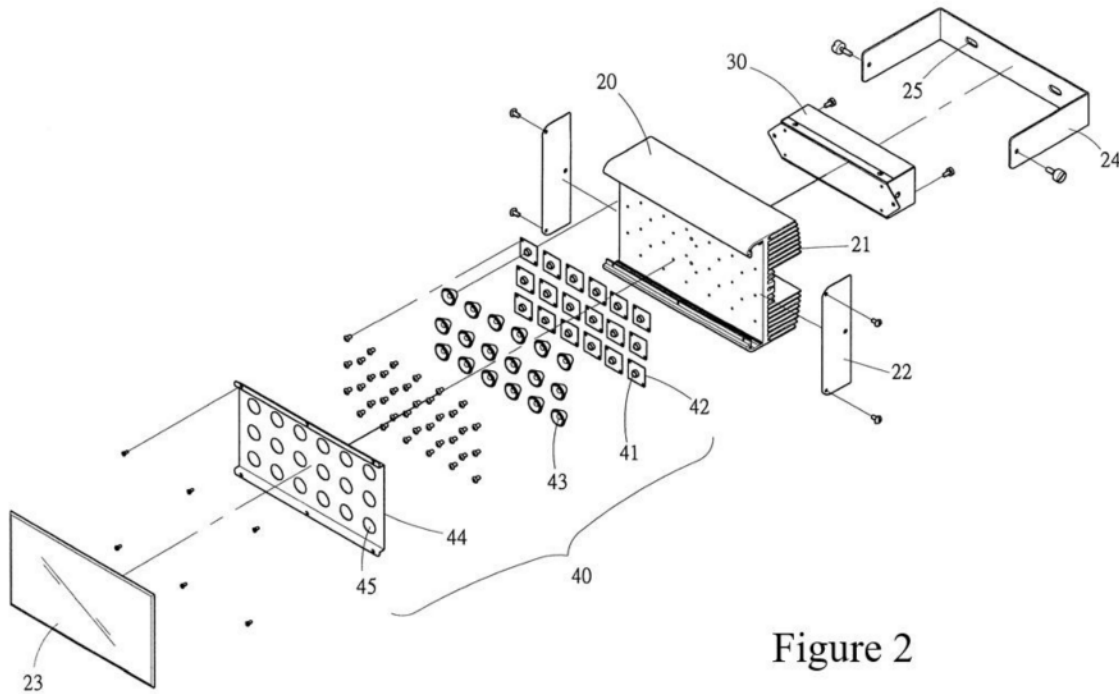


Figure 2

(*Id.*, Fig. 2; *see also* Fig. 3.)

39. **First**, Lin discloses a housing with a flange.³

40. For example, Lin discloses “heat dissipation unit (20)” includes a flange at its “front end” that defines the “housing space” in which the LEDs are arranged and to which the light-transmissive plate (23) (*i.e.*, the frontal lens) is mounted:

³ The '245 Patent does not require any particular flange, and explains that a “flange” simply” defines an “inwardly extending receiver 95” and provides a mounting surface for the lens. ('245 Patent, 4:12-16, Fig 5.) This is precisely what Lin’s “flange” does.

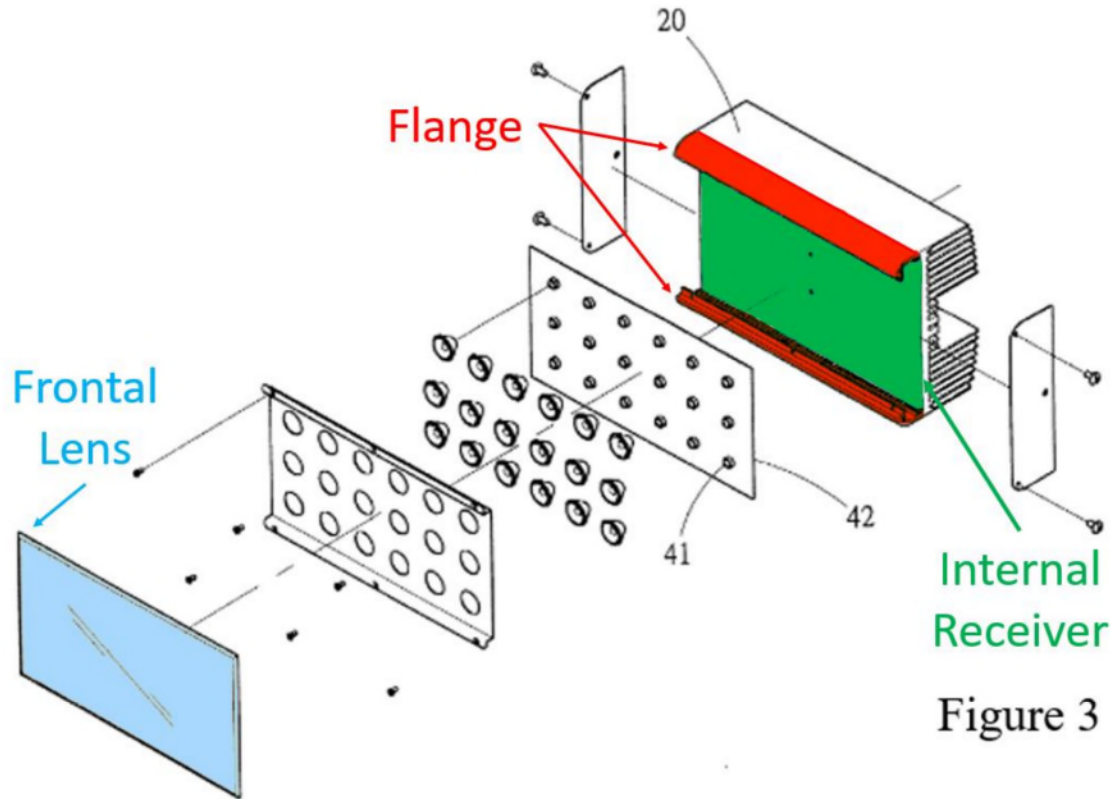


Figure 3

(Lin, 4:26-30, Fig. 3 (annotated); *see also* Fig. 2.) As seen above, Lin’s “flange” is a protrusion or extension on the front of the heat dissipation unit 20, which includes a lip or protrusion for attachment of the “light-transmissive plate (23)” (*i.e.*, frontal lens). (*Id.*, Figs. 1-3.) Looking at Figs. 1-3, Lin shows the light-transmissive plate being secured into the lip or protrusion of the flange, and then held in place once side baffles are attached, preventing the frontal lens from coming out of the flange and lighting device. Moreover, this “flange” in Lin defines a receiving space in Lin, as the circuit board, LEDs, optical components, and cover plate are inserted into the space between the front of the flange and the wall of the heat dissipating unit and installed on the wall. (*Id.*) Moreover, Lin’s

light-transmissive plate 23 (*i.e.*, frontal lens) is “arranged at the front end,”
mounted on the flange, as further seen in Figure 1:

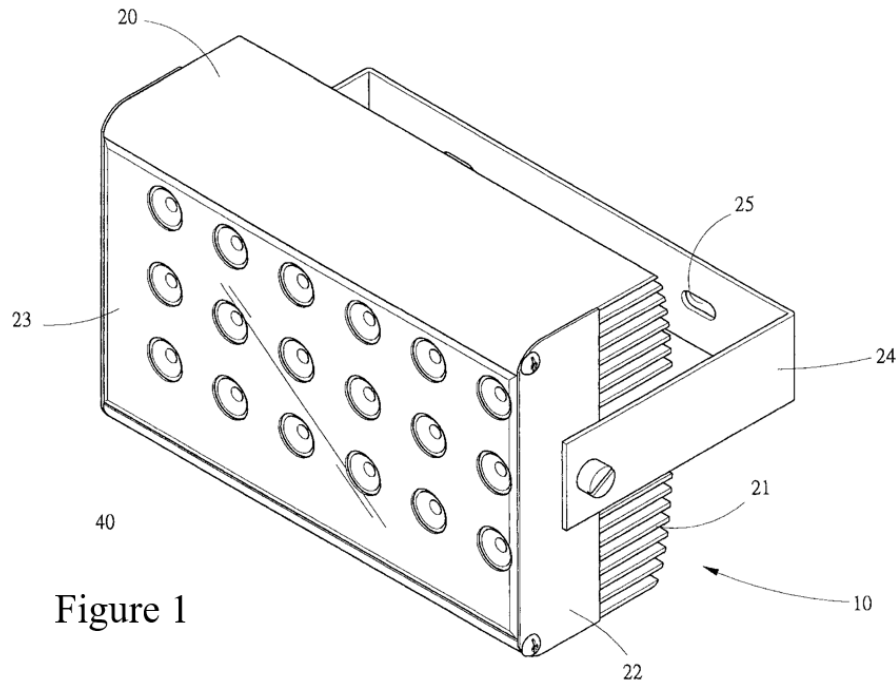
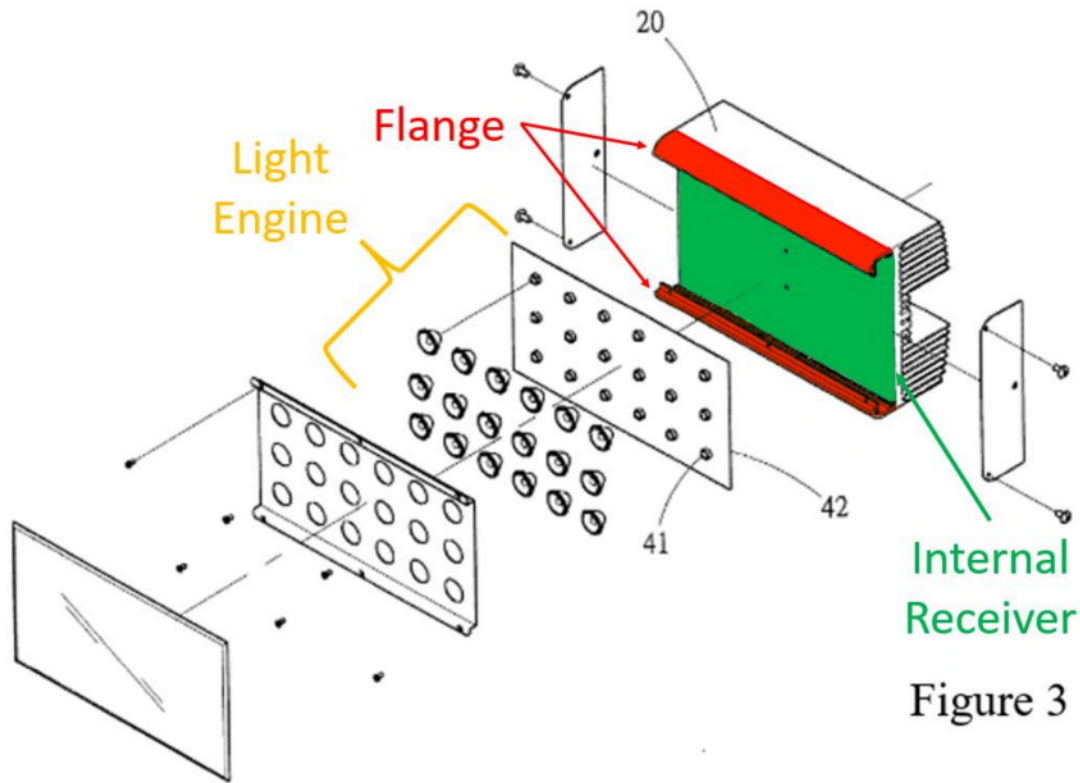


Figure 1

(*Id.*, Fig. 1.)

41. Additionally, Lin discloses a “cover plate (44).” (*Id.*, Fig. 2 (annotated), 5:4-7; *see also* Fig. 3.) Lin explains that “light passes through holes (45) on the cover plate (44) and the light-transmissive plate (23) at the front end of the heat dissipation unit (2) before being released outward.” (*Id.*, 5:11-15; *see also* Figs. 2-3.)

42. **Second**, Lin’s housing includes an internal receiver. As mentioned above, Lin discloses an “internal receiver” on the heat dissipation unit 20 defined by the flange portions at the front end thereof:



(Lin, Fig. 3 (annotated), 4:33-5:10, 6:21-26; *see also* Fig. 2.) Again, as can be seen in Figure 3 above, there is an open area extending inwardly from the flange to the receiver surface (shown in green) that “receives” the light engine components of the circuit board 42 containing the LEDs 41, the optics that go over each LED, and the cover plate. That is, these components are placed into the receiver space so that they can be secured to the LED searchlight device. In particular, this internal receiver which Lin refers to as part of its “housing space” at the front end of the

unit provides a mounting surface for the “light-emitting units” that include LEDs and printed circuit boards. (*Id.*, 4:33-5:10 (noting that the “light emitting unit is arranged in the housing space at the front end of the heat dissipation unit (2)” and is “fixed on the heat dissipation unit (20).”) And, as shown in annotated Figure 2 above, heat dissipation unit 20 has a flat front surface (defined by the flange portions) on which “light-emitting unit (40)” is mounted. (*Id.*, Figs. 2-3.) That is, this flat front surface is the mounting surface for the circuit boards containing the LEDs, and as can be seen, the heat dissipating fins are provided behind this mounting surface. In this manner, when the LEDs are operated, heat from the LEDs will conduct through the mounting surface that the circuit boards contact, and dissipate from the array of fins.

43. **Third**, Lin discloses its housing includes a frontal lens. Lin discloses “light-transmissive plate (23),” or lens, that is “arranged at the front end” of the “heat dissipation unit (20)”:

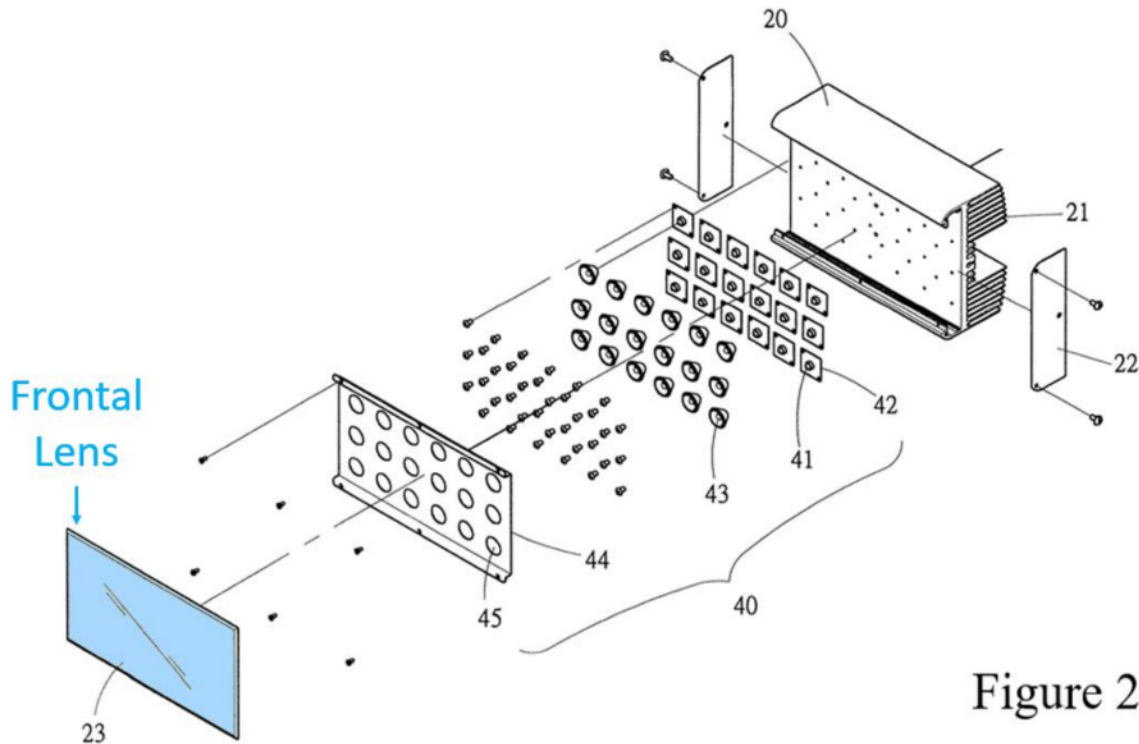
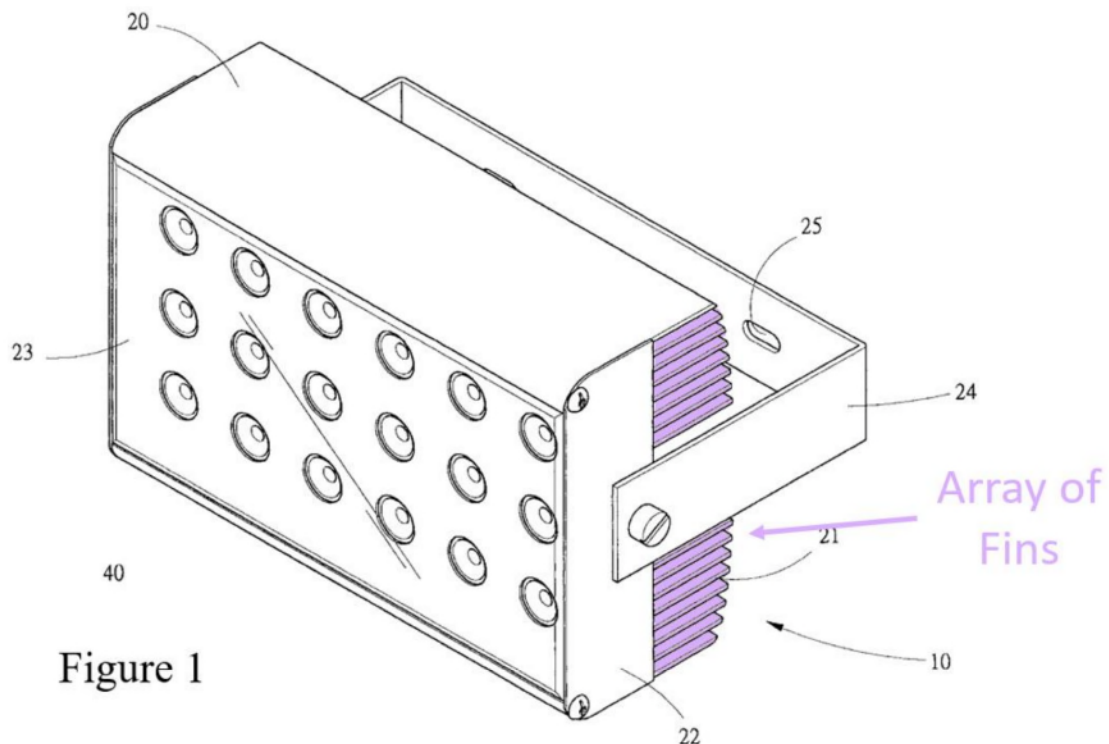
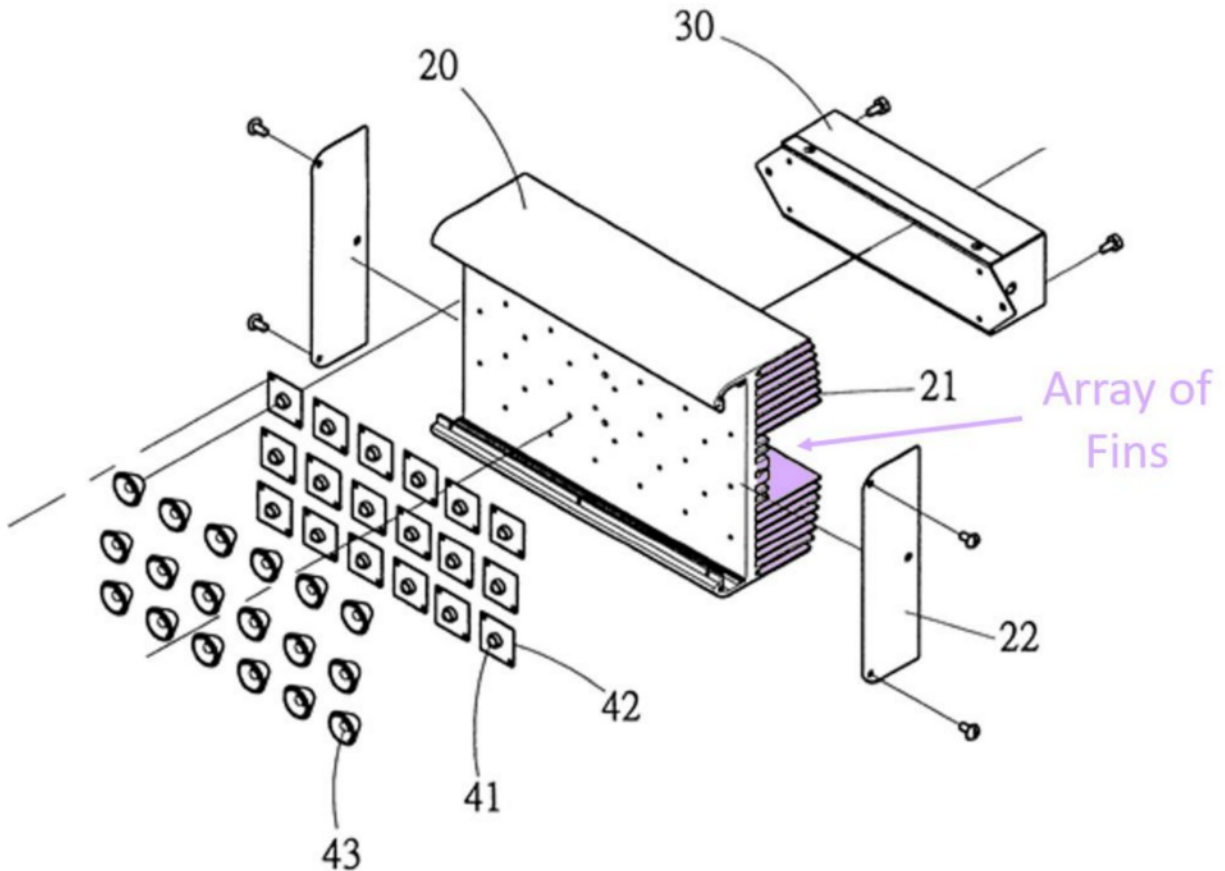


Figure 2

(Lin, Fig. 2 (annotated), 4:18-30; *see also* Figs. 1, 3.) The light transmissive plate is a lens, as it is an element that allows light to pass through into the environment around the LED searchlight. Such lenses, as shown in Lin, are common in LED lighting devices, as they protect the components, including the LEDs and circuits, from the environment. For example, the frontal lens keeps out dust and other debris that could cause damage to or degrade the electrical and optical components. Lin explains that “light emitted by the LEDs (41) is converged after passing through the cover bodies, and the converged light passes through the through holes (45) on the cover plate (44) and the light-transmissive plate (23) at the front end of the heat dissipation unit (20) before being released outward.” (*Id.*, 5:11-19.) That is, the

“light-transmissive plate (43)” is the final lens the light passes through before being emitted from the light fixture.



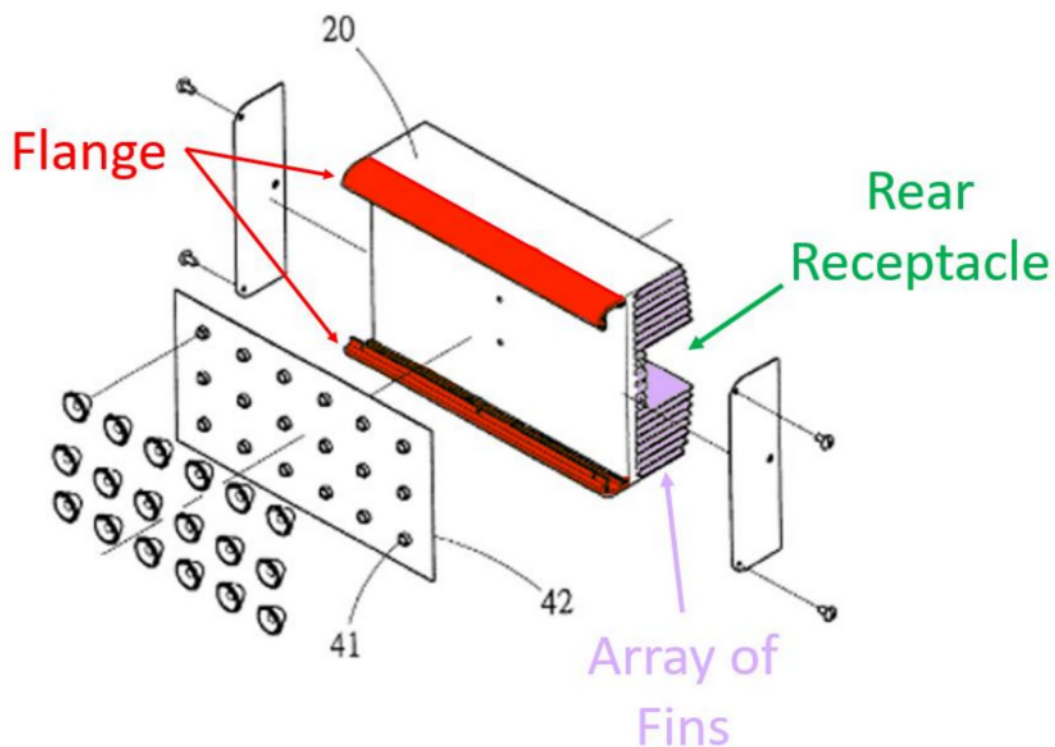


(*Id.*, Figs. 1-2 (annotated), 4:4:-10, 4:18-32, 6:1-5; *see also* Fig. 3.) As previously explained, the heat dissipation fins help “increase the heat energy released during the operation of the searchlight.” (*Id.*, 4:14-16.) The fins act as a heatsink, absorbing heat generated from the electrical components and transferring it into the surrounding air. Heatsinks with a fin structure are common, as fins provide a greater surface area in contact with the ambient air for a given weight or volume of material. The larger surface area allows the heatsink to more efficiently dissipate heat into the surrounding air.

45. Accordingly, Lin discloses a housing including a flange, an internal receiver, a frontal lens, and an array of fins.

21[A.ii]: ...*[the array of fins] extending rearward from the flange to define a rear receptacle that extends forward towards the flange,*

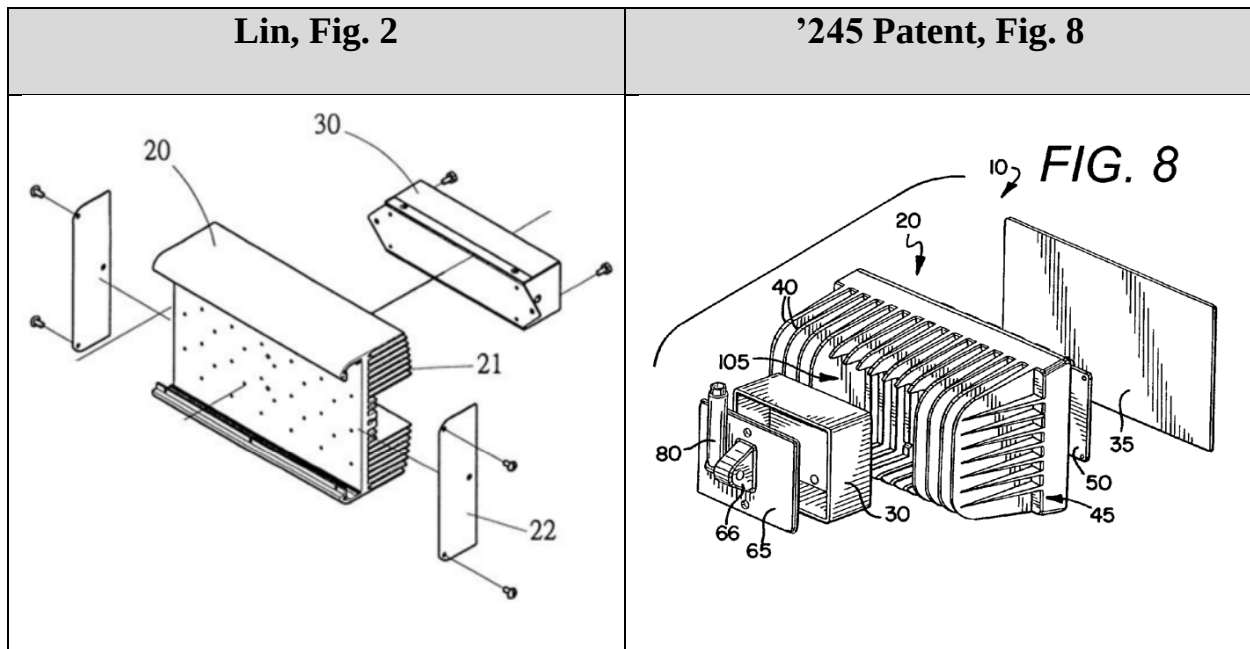
46. Lin discloses Claim 21[A.ii]. Again, Lin discloses that “the back of the heat dissipation unit is provided with a plurality of heat dissipation fins.” (Lin, 4:4-10, 4:18-32, 6:1-5, Figs. 1-3.) These fins extend rearward from the flange portion at the front of heat dissipation unit 20, and define a rear receptacle, or recessed space, that extends from the back of the unit toward the flange portion:



(*Id.*, Fig. 3 (annotated); see also Fig. 2.) As can be seen, the fins start from an area behind the flange, and extend rearward. Moreover, the array of fins is shown to

have fins of varying length, which causes there to be a “receptacle” in the middle of the fins where only shorter fins are present. (*Id.*) There is an upper and lower set of longer fins, and a set of shorter fins in the middle, and these define a rear receptacle such that “power supply unit (30) is arranged at the back end of the heat dissipation unit (20).” (*Id.*, 4:31-32, Figs. 2-3.) Figures 2 and 3 further show how the power supply unit (30) fits within the rear receptacle defined by the rearwardly extending array of fins, as it is indicated by the lines in the figure as being inserted into the space between the longer sets of top and bottom fins. (*Id.*, Figs. 2-3.)

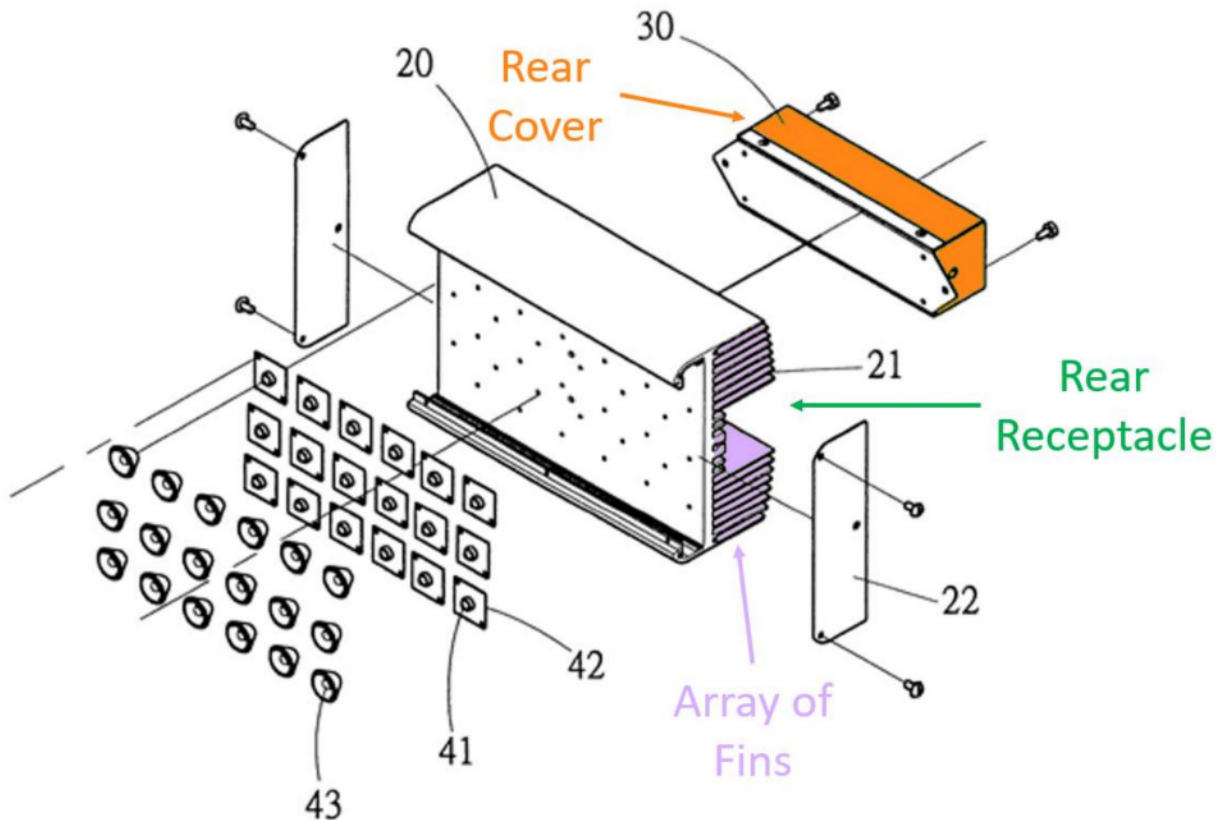
47. Notably, Lin’s “rear receptacle” is nearly identical to the “rear receptacle” of the ’245 Patent, as both are defined by fins of different lengths creating a recess, or cavity, on the back of the lighting unit:



(Compare Lin, Fig. 2, with '245 Patent, Fig. 8.)

21[A.iii]: the housing further including a rear cover that encloses the rear receptacle;

48. Lin discloses Claim 21[A.iii]. Lin discloses that its housing includes “power supply unit (30)” which is “arranged at the back end of the heat dissipation unit (20).” (Lin, 4:4-10, 4:18-5:10, Figs. 2-3.) In particular, power supply unit 30 fits into the “rear receptacle” formed by the fins at the back of heat dissipation unit 20. The power supply unit 30 is illustrated as having a rear cover portion that encloses the rear receptacle:



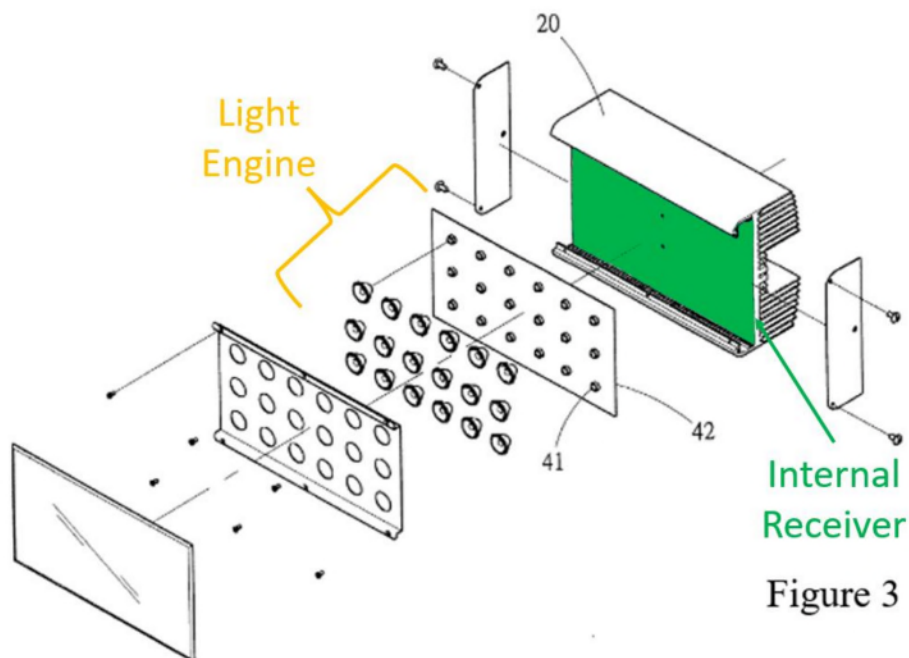
(*Id.*, Fig. 2 (annotated), Fig. 3, 4:4-10, 4:18-5:10; *see also infra* Ground 1, Claim 21[C].) The rear cover of power supply unit 30 encloses the power supply and the rear receptacle, securing the power supply in place and providing protection.

49. In summary, Lin discloses a housing (combination of “heat dissipation unit (20),” “baffle plates (22),” “light-transmissive plate (23),” and “power supply unit (30)”) including a flange (protruding front portion of “heat dissipation unit (20)”; alternatively, “cover plate 44”), an internal receiver (flat front surface of “heat dissipation unit (20)”), a frontal lens (“light-transmissive plate (23)”), an array of fins (“heat dissipation fins (21)”) extending rearward from the flange to define a rear receptacle (space created by “fins” into which “power supply unit 30”

is placed) that extends forward towards the flange, and a rear cover (back portion or rear surface of “power supply unit (30)”) that encloses the rear receptacle.

21[B]: a light engine assembly mounted to the receiver, the light engine having a plurality of light modules, wherein each module includes both a LED mounted to a printed circuit board and an optical lens extending from the printed circuit board;

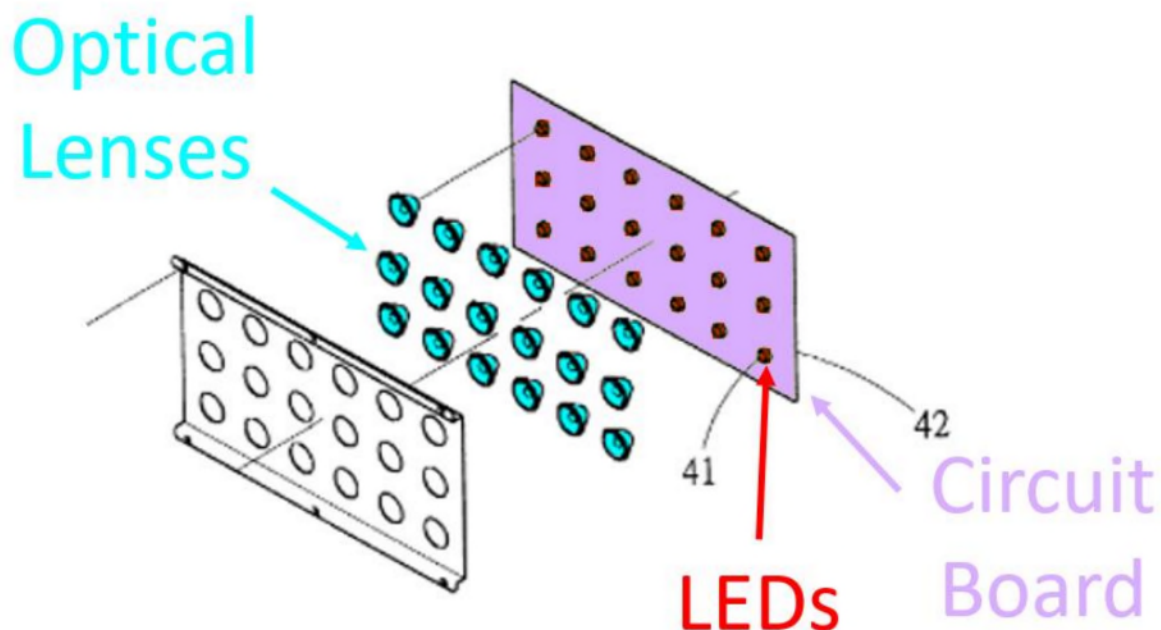
50. Lin discloses Claim 21[B]. Lin discloses that its lighting device includes “light-emitting unit (40)” (*i.e.*, a light engine assembly). Lin discloses that light-emitting unit 40 “is composed of a plurality of LEDs (41)” and is arranged in the housing space at the front end of heat dissipation unit 20 [(*i.e.*, the receiver)]:



(Lin, Fig. 3 (annotated), 4:26-5:1, 6:21-26; *see also* Fig. 2.) Lin discloses that the light emitting unit is mounted to the receiver, as it states, for example, that “the

LEDs (41) are fixed on the heat dissipation unit (20) through the circuit boards (42)” and that a “cover plate (44)” for the light emitting unit is also “fixed on the heat dissipation unit (20).” (*Id.*, 4:33-5:10, 6:21-26, Figs. 2-3.) That is, as shown in Figures 2-3, the light engine is mounted within the receiving space defined by the flange portion of the body, and is secured to a mounting surface in the receiving space by a series of fasteners.

51. Moreover, as shown in Figures 2-3 of Lin, the “light-emitting unit” includes a plurality of light modules, with each module including an “LED (41),” a “circuit board (42),” and a “cover body (43)” (*i.e.*, an optical lens) that extends from the circuit board:



(*Id.*, Fig. 3 (annotated), 4:33-5:19, 6:21-26; *see also* Fig. 2.). For example, Lin discloses that “a circuit board (42) is arranged behind each LED (41), and the

LEDs (41) are fixed on the heat dissipation unit (20) through the circuit boards (42) ... At the same time, an outer side of each LED (41) may be further covered with a cover body (43); and a front end of each cover body (43) can be further provided with a cover plate (44), the cover plate (44) is fixed on the heat dissipation unit (20), and then the cover bodies (43) are fixed on the LEDs (41).” (*Id.*, 4:33-5:10, 6:21-26 (noting the “LEDs can further be fully integrated on the circuit board (42), thereby being fixed on the heat dissipation unit (20) through the circuit board.”), Figs. 2-3.)

52. The cover bodies are lenses because, as explained by Lin, they are shaped and positioned to “converge” light that is emitted by the LEDs, and Lin notes that the light “passes through the cover bodies” before being emitted from the lighting unit (Lin, 5:1-16.) By stating that the light “passes through” the cover bodies, and is converged by these cover bodies, it is clear that they are lenses. In a lens, light passes through the material of the lens, and is converged or focused by reflecting or refracting at surfaces of the lens before exiting from an emitting face. In particular, “light emitted by the LEDs (41) is converged after passing through the cover bodies (43), and the converged light passes through the through holes (45) on the cover plate (44) and the light-transmissive plate (23) at the front end of the heat dissipation unit (20) before being released outward, thereby achieving the lighting effect.” (Lin, 5:11-19.) Lin’s optical lenses converge, or focus, the light to

better the performance of the LED searchlight device. Converging the light emitted by the LEDs through the optical lens concentrates more light into a target area, increasing the brightness. By converging the light into a narrower beam, the device can also illuminate areas at further distances more effectively.

21[C]: a power supply residing within the rear receptacle and enclosed by the cover; and,

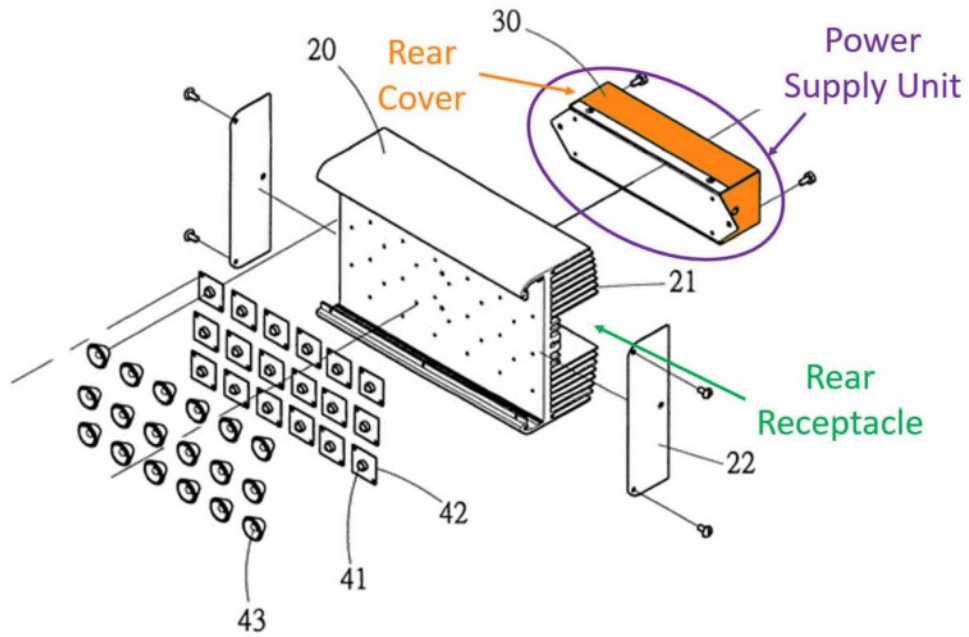
53. As viewed by a POSITA, Lin discloses Claim 21[C].

54. Lin discloses that “a power supply unit (30) is arranged at the back end of the heat dissipation unit (20) to provide power.” (Lin, 4:31-32, 4:4-10, 4:33-5:19, 6:14-26, Figs. 2-3.) In particular, power provided by the power supply unit (30) is passed to the circuit boards so that it “drives each LED” to emit light. (*Id.*, 5:11-19, 6:14-26.) Driving an LED normally refers to providing the appropriate amount of voltage and current to the LED, such that it emits the level or intensity of light desired without failing. Lin indicates that its power supply unit can “use a battery to provide power,” or it can “be connected with a general power line to be directly plugged into a general plug [sic: socket], thereby achieving the purpose of providing power. However, when the power supply unit is connected to the power line, the power supply unit needs to be further provided with a transformer inside, so as to convert a current of 110 Volts into a current acceptable to the LEDs (41) to avoid burning of the LEDs (41) due to overly large currents.” (*Id.*, 6:14-20.) When the battery is used, the battery itself is the power source.

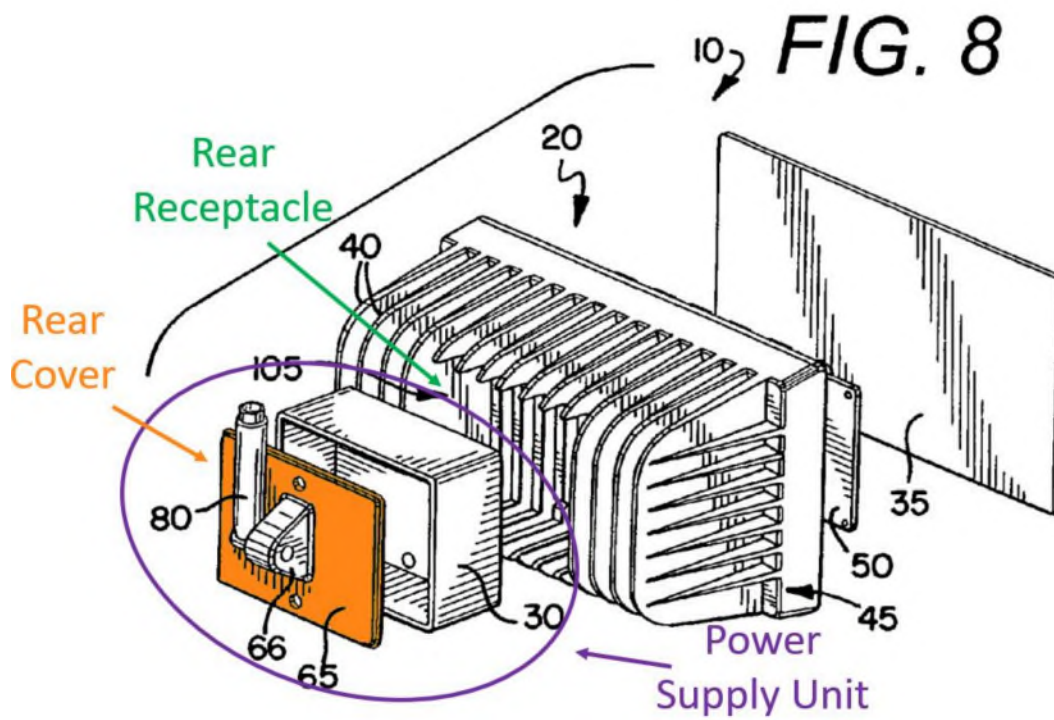
When a transformer is used as the power supply, for example when connected to an external AC voltage source like a wall plug or fixture mount, the transformer converts the 110 Volt AC source to a low voltage DC source appropriate for the LEDs. This low voltage DC source supplies power to the LEDs, again so that they emit light at the desired intensity without failing.

55. Further, Lin discloses that the power supply (whether a battery or transformer and other circuitry) resides in the rear receptacle defined by the fins. Like the '245 Patent, Lin's rear cover encloses the power supply that resides in the rear receptacle:

Lin, Fig. 3



'245 Patent, Fig. 8



(Compare Lin, Fig. 3 (annotated) with '245 Patent, Fig. 8 (annotated); see also '245 Patent, Abstract, 2:1-2; 3:1-7; 3:57-61.) Again, Lin discloses that “power supply unit (30) is arranged at the back end of the heat dissipation unit (20) to provide power,” and clearly illustrates this as inserting the power supply into the recess, or “receptacle,” defined by the open area between the shorter and longer fins. (*Id.*, Figs. 1-3, 4:4-10, 4:31-5:19, 6:14-26 4:10-32.) Further, as shown in annotated Figure 3 above, the power supply unit has a rear cover that encloses the power supply contained within it. (Lin, Fig. 3; see also Figs. 1-2.) See also *supra* Ground 1, Claim 21[A.iii].

21[D]: wherein during operation, heat generated by the LEDs passes through the circuit board and then said heat is dissipated by the array of fins without the use of a fan.

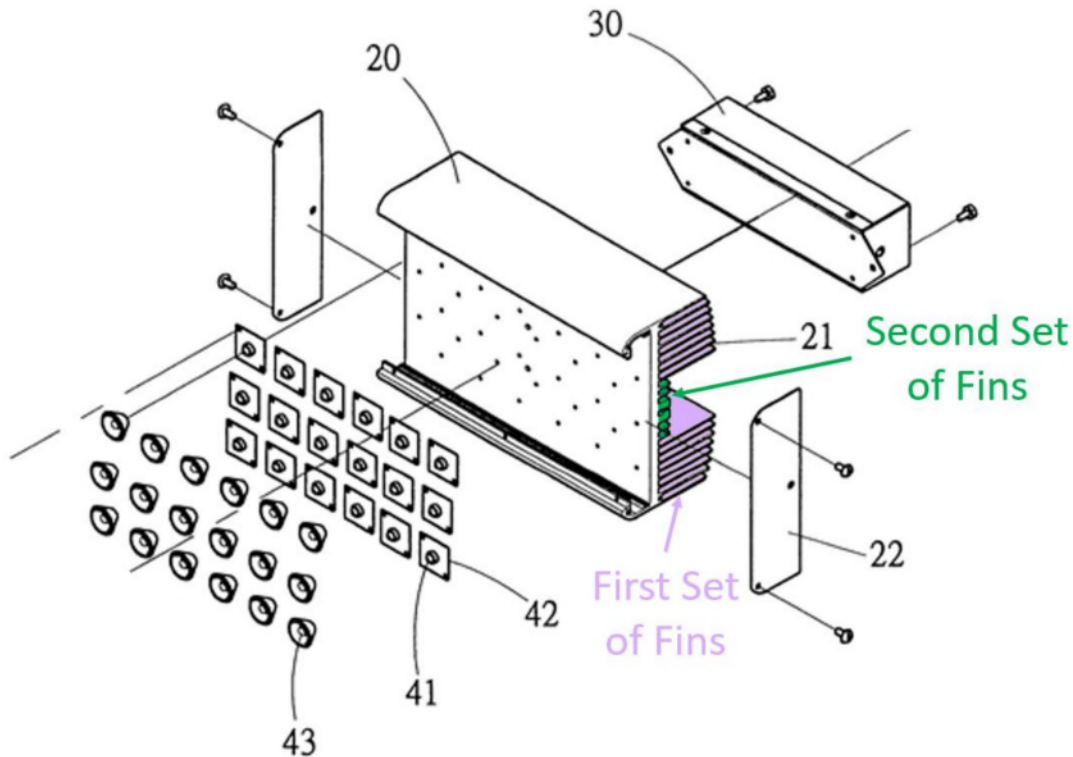
56. Lin discloses Claim 21[D]. Lin discloses that during operation of the light, “the heat energy produced when the LEDs (41) are driven is transmitted to the heat dissipation unit (20), and undergoes heat exchanges with air through the heat dissipation fins (21) at the back end of the heat dissipation unit (20), thereby effectively achieving the heat dissipation effect, and prolonging the service life of the LEDs (41).” (Lin, 5:11-19, 4:4-10, 4:14-16, 4:26-30, 6:1-5, 6:21-7:2.) As noted above, Lin’s LEDs are “fixed on the heat dissipation unit (20) through the circuit boards (42),” and thus heat generated by the LEDs passes through the circuit board so that it is transmitted to the heat dissipation unit and dissipated into

the air by the fins. (*Id.*, 5:1-4, 6:21-26.) By being “fixed” on the unit through the circuit boards, it is clear that heat from the LEDs would pass through the circuit board, which is mounted on the heat dissipating unit, before being dissipated into air from the fins. As Lin notes, this prolongs “the service life of the LEDs.” (*Id.*, 4:14-16, 5:11-19.) Further, Lin makes no mention of a fan, nor does Lin illustrate a fan in any of the figures showing its lighting device. Further, a POSITA would have understood that no fan is used in Lin, as Lin clearly states that the dissipation of the heat from the LEDs is achieved by this heat being “transmitted” to the heat dissipation unit and undergoing “heat exchanges” with the ambient air through the heat dissipation fins. *See also supra* Ground 1, Cls. 21[A.i]-[A.iii].

2. Dependent Claim 22

The LED light fixture of claim 21, wherein the array of fins includes a first set of fins with a first fin length and a second set of fins with a second fin length, wherein the first fin length exceeds the second fin length.

57. Lin anticipates and renders obvious Claim 22. Lin discloses that its array of “heat dissipation fins (21)” has fins of different lengths. (Lin, 4:4-10, 4:18-32, 6:1-5, Figs. 1-3.) *See supra* Ground 1, Cls. 21[A.i]-[A.iii], [D]. As shown in Figure 2 of Lin, the heat dissipation fins include fins of at least two different lengths:

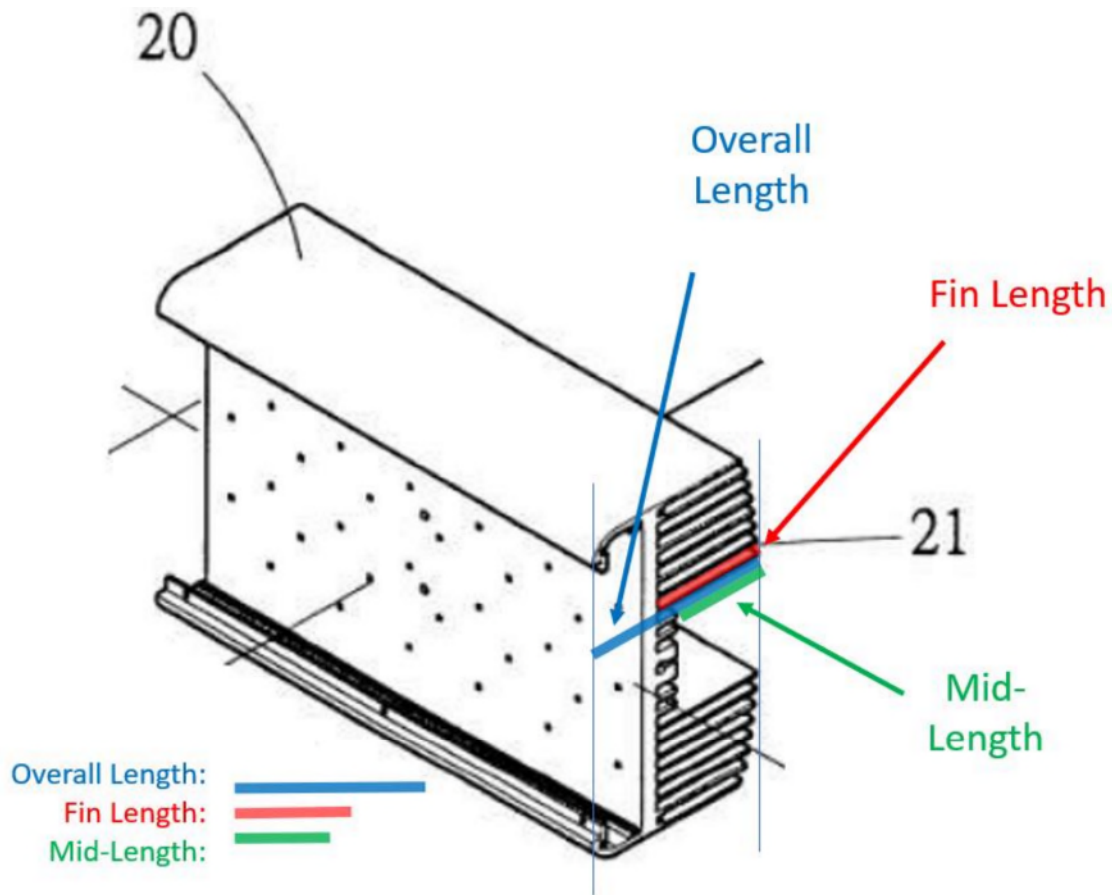


(Lin, Fig. 2 (annotated); *see also* Fig. 3 (showing same).) As shown above, the first set of fins are longer and have a fin length that exceeds the fin length of the second set of fins, which are shorter and located in the middle of back of the housing. The longer, first set of fins primarily define the top and bottom of the rear receptacle that holds the power supply. For example, the set of two fins immediately adjacent to the shorter fins (that is, those above and below the shorter fins shown above) have a length that exceeds that of the shorter fins. These fins have the same size, and are much longer than the shorter fins in the middle.

3. Dependent Claim 23

The LED light fixture of claim 21, wherein the housing has an overall length and a mid-length, and wherein the array of fins has a length that exceeds said mid-length.

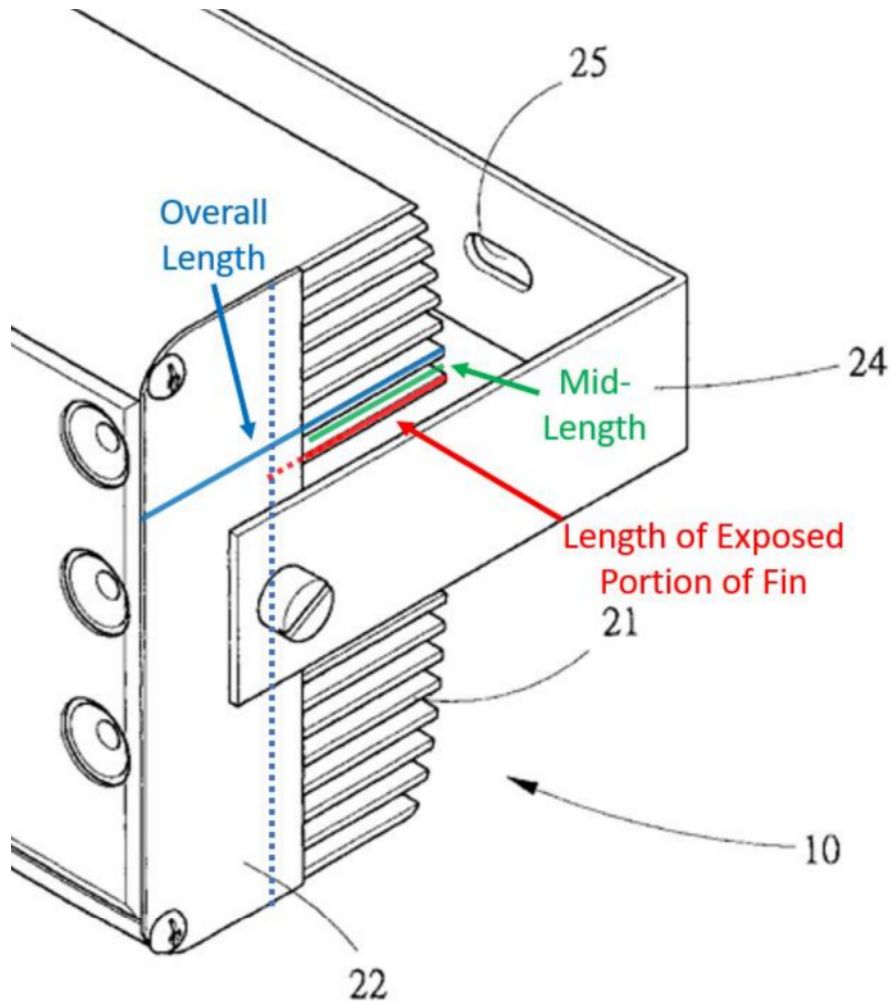
58. Lin anticipates and renders obvious Claim 23. As previously explained, Lin discloses a housing including an array of fins. *See supra* Ground 1, Cls. 21[A.i]-21[A.iii], 21[D], 22. As shown in Figure 2, Lin discloses a housing with an overall length spanning from the front end of the heat dissipation unit 20 where the light-transmissive plate is attached to the rear edge of the fins. (Lin, 4:4-16, 4:26-5:11, 6:1-5, Figs. 2-3.) A POSITA would understand that the housing's mid-length is half of the overall length, or a length from the end to the middle of the housing. Figure 2 shows that the array of fins has a length that exceeds the housing's mid-length:



(Lin, Fig. 2 (annotated).)

59. As shown above, the blue line shows the overall length, going from the front of the unit to the back of the longest fins in the array protruding from the back. The green line on the figure is half of the length of the blue line, representing half of the overall length, or the mid-length. And, the red line shows the length of the longest fins. As can be seen, the red line illustrating the fin length is clearly greater than the green line showing the mid length of the overall housing. Further, when fully assembled, baffle plates 22 cover a portion of the fin array. (*See id.*, Fig. 1.)

60. Even when the baffle plates 22 are covering a portion of the array of fins, the length of the exposed portion of the fin alone is close to (if not greater than) the mid-length of the housing as shown in Fig. 1:



(Lin, Fig. 1 (annotated).) As shown in the annotated figure above, the red line shows the length of the array of fins (ending at the front edge of the screw hole for the mounting bracket, which is marked by the vertical dotted line), with the dashed portion of the red line showing the portion of the fin length covered by the baffle

plate 22. When the portion of the fin covered by the baffle plate covering is considered, the length of the fin is greater than the mid-length.

61. Moreover, given Lin's figures and descriptions of the fins as serving the purpose of dissipating heat generated by the LEDs, a POSITA would have found it obvious for such array of fins to have a length that exceeds a mid-length of the overall housing. For example, Lin clearly shows the fins being the longest component (and in fact shows them with a length exceeding the mid-length as discussed above). In addition, as the fins are described as dissipating the heat, a POSITA would have found it obvious for them to have a length exceeding the mid-length so that the surface area of the fins is increased to provide better dissipation of heat into the ambient air around the light.

4. Dependent Claim 25

The LED light fixture of claim 21, further comprising a mounting bracket having opposed side segments that are secured to opposed sides of the housing rearward of the flange.

62. Lin anticipates and renders obvious Claim 25. Lin discloses "a grab handle (24)" (*i.e.*, a mounting bracket), with two ends that "are fixed on two corresponding sides of the heat dissipation unit (20)":

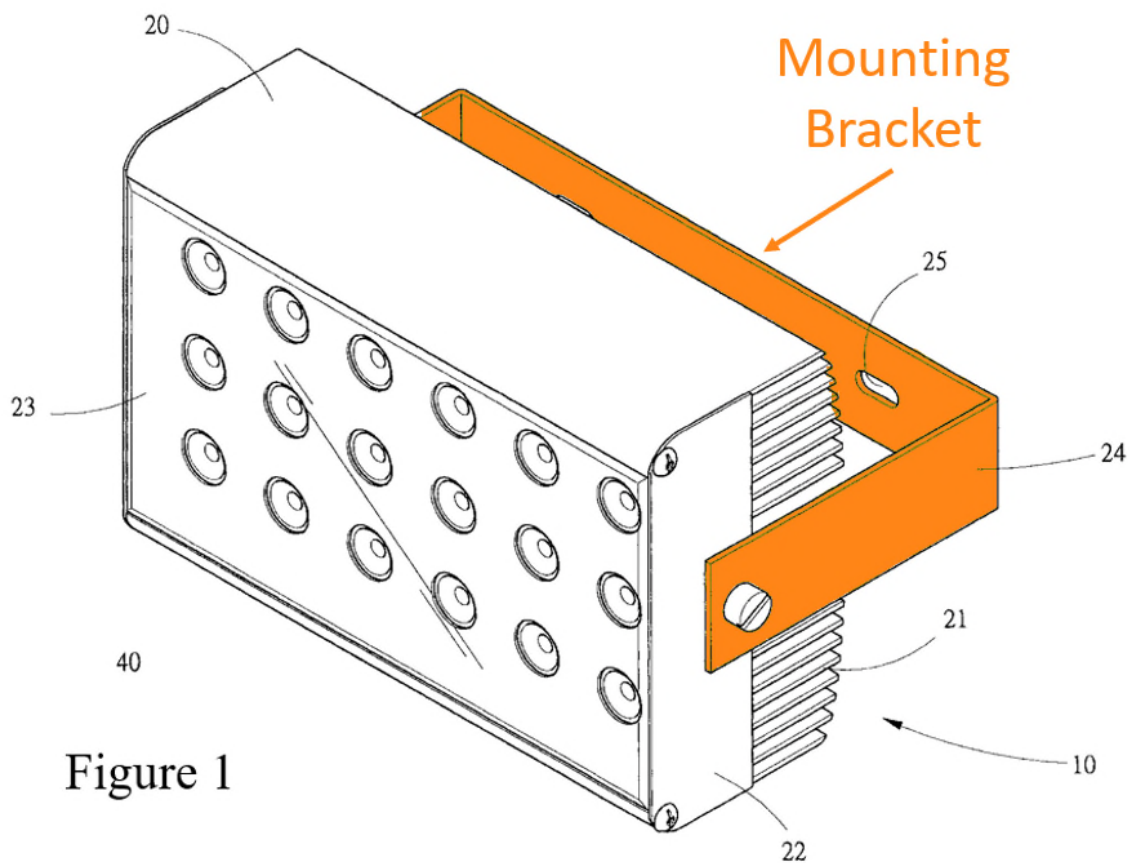
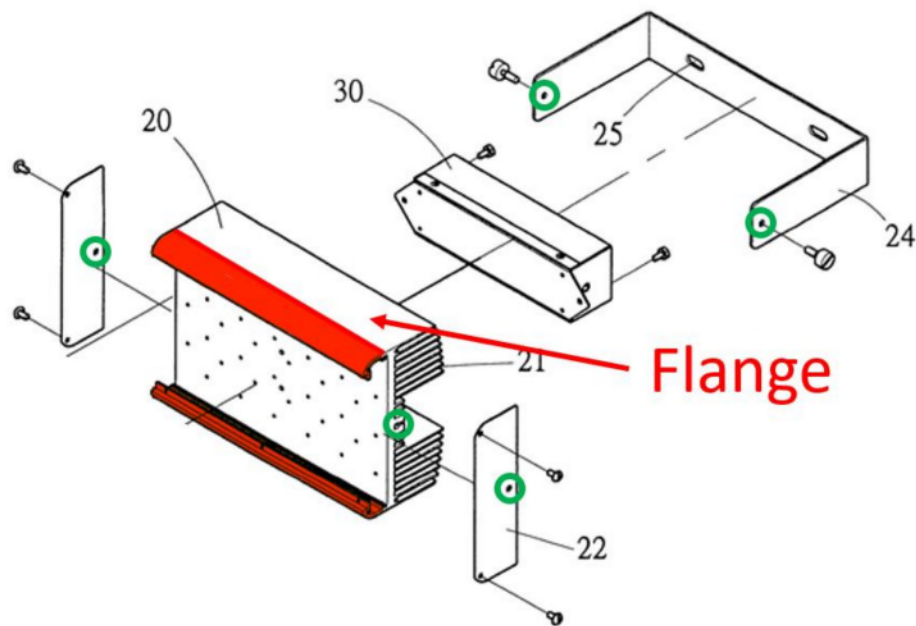


Figure 1

(Lin, Fig. 1 (annotated), 6:6-8.) As seen in Figs. 1-3, the mounting bracket is secured to the heat dissipation unit housing by two screws that connect rearward of the flange. (Lin, Figs. 1-3.) Looking at Figs. 2 and 3, for example, it can be seen that there is a hole in the side baffle plates (22) positioned rearward of the flange through which the screws securing the grab handle to the unit are inserted:



(Lin, Fig. 2 (annotated), Figs. 1, 3.) Lin further explains that “the grab handle (24) may further be provided with a slotted hole (25), so that the LED searchlight (10) can be fixed to the wall surface through the slotted hole (25).” (*Id.*, 6:6-11.) A mounting brackets is a very common feature of a light fixture. Mounting brackets are used, for example, to provide a means for locating the light fixture and to increase the stability of the light fixture to have a more consistent light distribution. Mounting brackets also can increase lighting effectiveness by allowing the light fixture to be mounted at a location or at an angle that it would be otherwise difficult to position the light fixture.

5. Dependent Claim 26

The LED light fixture of claim 21, wherein the frontal lens is secured to the flange by a plurality of fasteners arranged at the periphery of both the frontal lens and the flange.

63. Lin anticipates and renders obvious Claim 26. Lin discloses that light-transmissive plate 23 (*i.e.*, frontal lens) is secured to the flange portion at the front end of heat dissipation unit 20. (Lin, 4:26-30; *see also* 5:11-19, Figs. 1-3.) Lin discloses “baffle plates (22) arranged on both sides,” and these baffle plates have holes for screws to be inserted at the periphery of the flange and light-transmissive plate so that the light-transmissive plate is secured to the flange and housing. (*Id.*, Figs. 1-3, 4:26-30; *see also* cls. 2, 9.) That is, Lin’s frontal lens is secured to the flange by a plurality of fasteners at the periphery of the frontal lens and flange that pass through the baffle plates into the flange:

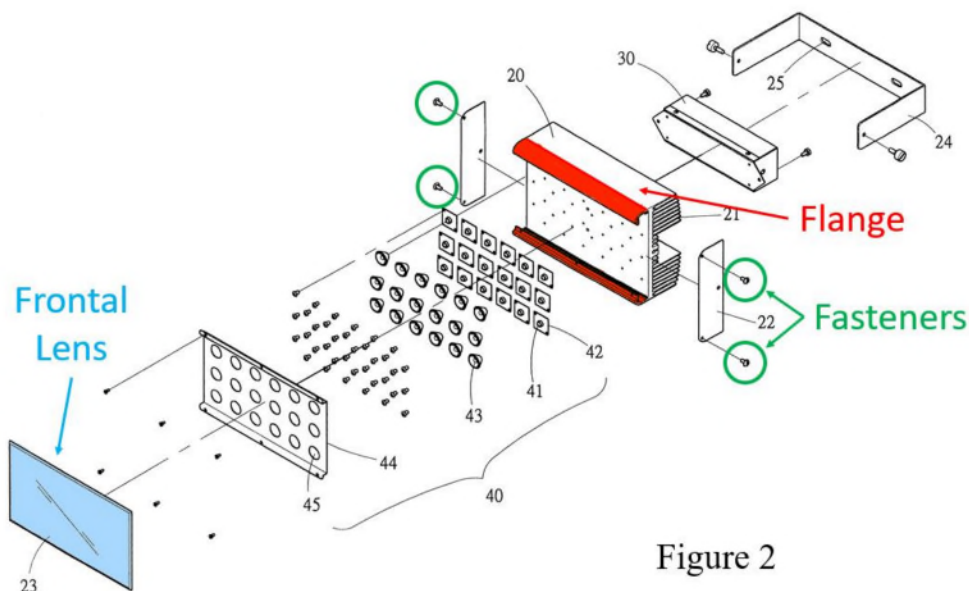
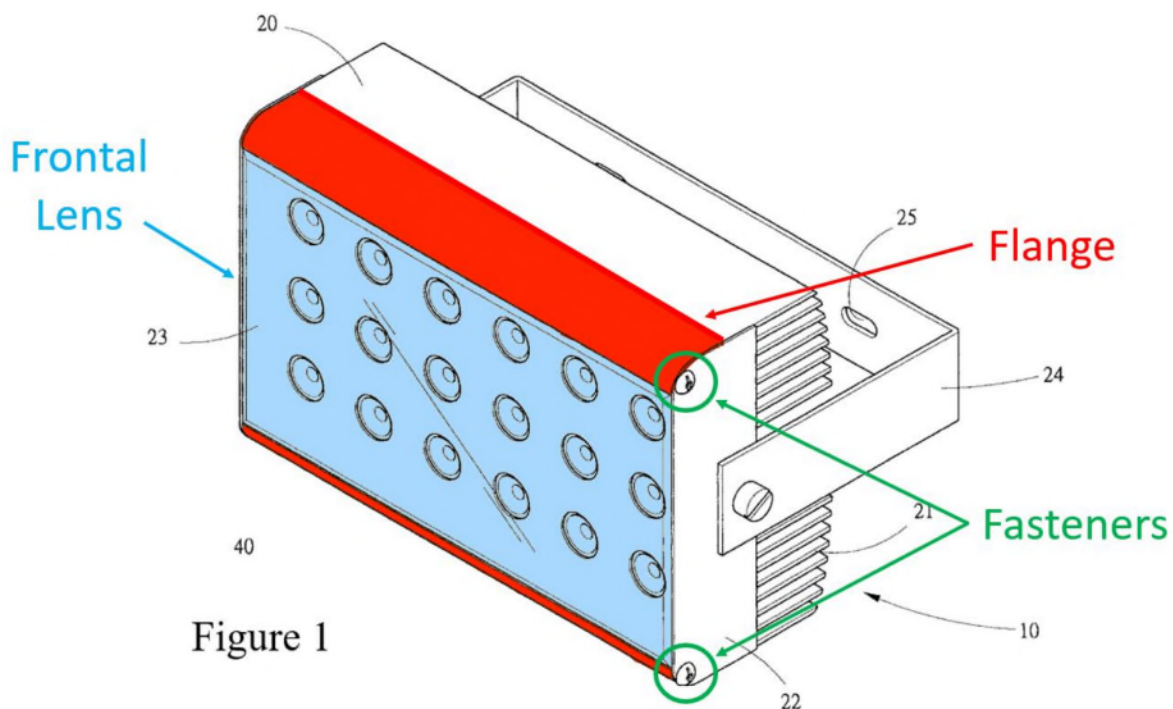


Figure 2

(Lin, Fig. 2 (annotated), Fig. 3.) In particular, the frontal lens is secured in place by at least four fasteners that pass through the baffle plates 22 at approximately each of the four corners of the flange and frontal lens. The frontal lens is secured to a lip or protrusion of the flange, with the fasteners and baffle plates preventing the frontal lens from moving side-to-side. Figure 1 shows the frontal lens secured in place by the fasteners which pass through the baffle plates and into the flange portion of the heat dissipation plate at the periphery of the frontal lens and flange, thereby securing the frontal lens in the flange:



(Lin, Fig. 1 (annotated).) Because of the fasteners, the frontal lens is secured firmly in place between the flange portion and the baffle plates. The fasteners are clearly located at the periphery of both the frontal lens and the flange.

B. Ground 2 – Lin in view of Zeng and Lodhie Renders Obvious Claim 24

64. Zeng (EX1009) is US20060146553. Zeng was filed October 7, 2005 and published July 6, 2006. I understand Zeng is prior art under at least pre-AIA § 102(a), (e). Lodhie (EX1008) is US5,577,832. Lodhie issued November 26, 1996, and is prior art under at least pre-AIA § 102(b).

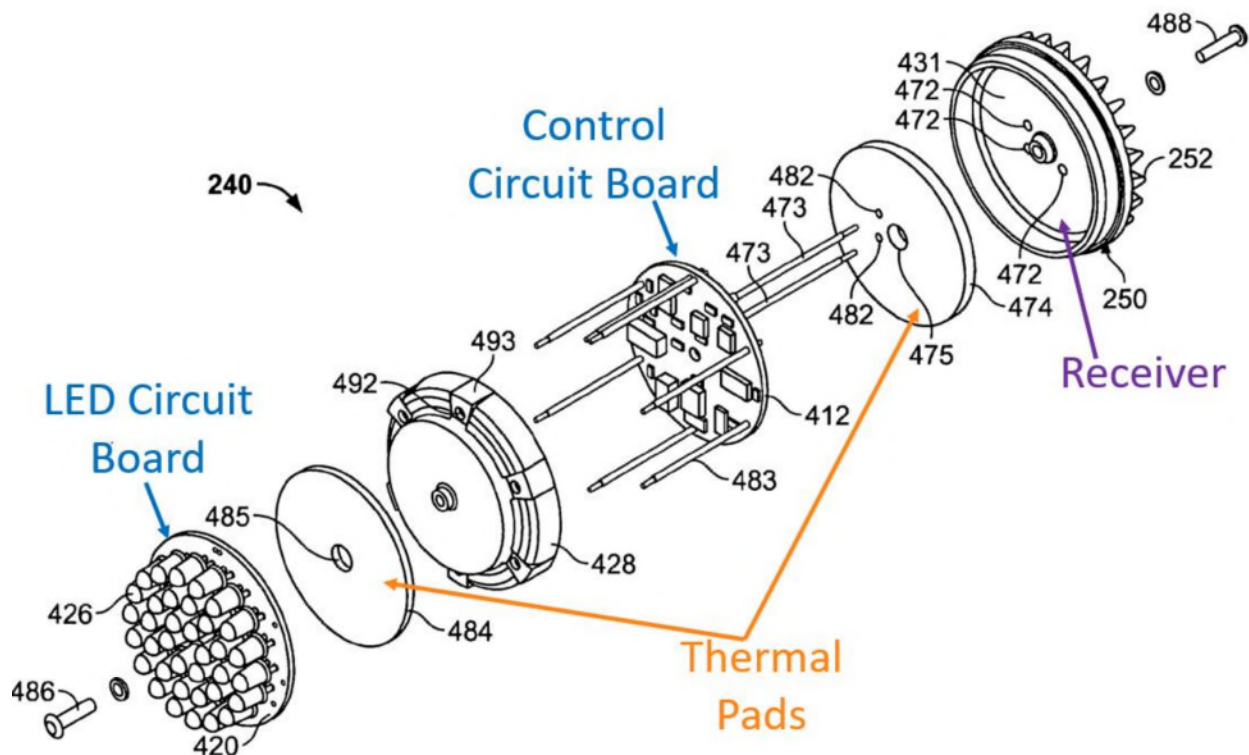
1. Dependent Claim 24

The LED light fixture of claim 21, further comprising a thermal pad residing between the receiver and the printed circuit board, wherein both the thermal pad and the printed circuit board have at least one opening that receives a lead extending between the power supply and the printed circuit board.

65. Lin in view of Zeng and Lodhie renders obvious Claim 24. Lin discloses a lighting fixture with a heat dissipation unit to “increase the heat energy released during the operation of the searchlight . . . thereby prolonging the service life of the LEDs.” (Lin, 4:4-10, 4:14-16.) *See supra* Ground 1, Cl. 21.

66. Zeng, in the same field as Lin, discloses an LED light assembly that includes “a plurality of LEDs” and a “heat sink with a plurality of fins . . . at its distal end that dissipate heat generated by the plurality of LEDs.” (Zeng, [0019], [0021], Figs. 2-4, Abstract.) Zeng discloses that its LEDs, like those of Lin, are “mounted on a board 420 (e.g., a PCB),” and that “circuit board 412” having power and control components thereon may also be included and linked to the LED circuit board via wires. (*Id.*, [0021]-[0024], Figs. 4-5.) Zeng further discloses

that a “front thermal pad 484 is interposed between the front portion 428 [of the heat sink] and the [LED] board 420,” and that a “rear thermal pad 474 that may be similar or different from front thermal pad 484 is interposed between the circuit board 412 and rear portion 431 of heat sink 250”:

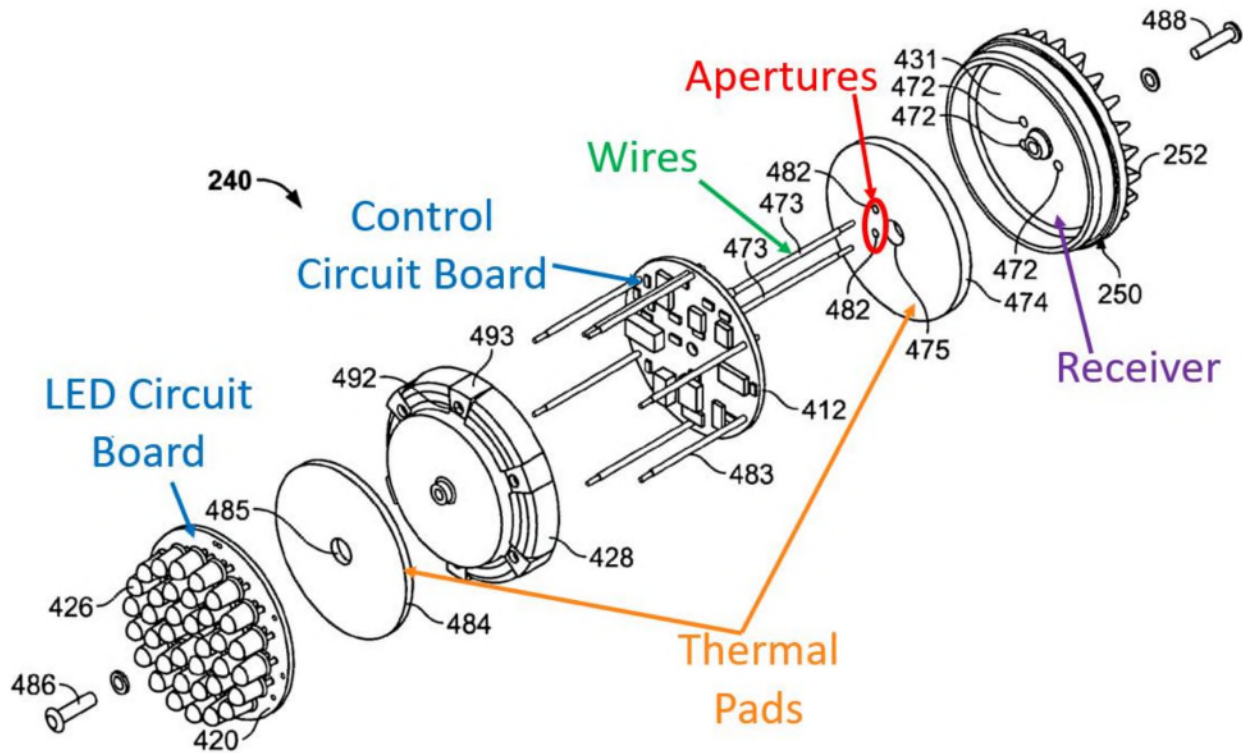


(Zeng, Fig. 4 (annotated), [0021]-[0022].)

67. Zeng explains that when the “LED board 420” and “circuit board 412” are mounted to the front and rear thermal pads, respectively, “[h]eat generated by the plurality of LEDs 426 on board 420 is transferred via conduction to the front portion 428 of heat sink 250. Heat flows radially outward to the outer circumference 493 of the front portion 428 and then rearward to the plurality of fins 252 for dissipation, thereby preventing overheating of both the LEDs 426 and

circuit board 412.” (*Id.*, [0023]; *see also* [0021]-[0022], Figs. 2-4.) That is, the thermal pad provides a contact surface for the LED circuit board, on which the LED circuit board can be mounted. The thermal pad can then be mounted to the body of the heatsink. Using a thermal pad, as taught by Zeng, was a well-known and common way to provide an effective channel or path for heat transfer from the LEDs into the heat sink. These thermal pads may be made of a compressible material, such as silicone, that is thermally conductive or includes thermally conductive particles. When placed between an LED circuit board and the receiving surface of a heat dissipating unit (as shown in Zeng), the thermal pad can help to fill gaps or imperfections in the receiving surface. This helps to improve thermal conductivity from the LEDs, through the pad, and into the heatsink. Thus, thermal pads such as those taught in Zeng are known to help dissipate more efficiently, and prevent overheating. As such, as POSITA would have found it obvious to include a thermal pad between Lin’s LED circuit board and the receiving surface of its heat dissipating unit.

68. Further, Zeng discloses that the thermal pads may include a “plurality of apertures” (*e.g.*, holes) for “receiving the wires” going to a circuit board:



(Zeng, Fig. 4 (annotated), [0021]-[0022].) Zeng notes that such wires may include wires to receive “power” for the circuit board, and further discloses that the “apertures 482” in the thermal pad may line up with corresponding apertures in the heat sink such that the wires can extend externally through the heat sink to a power input source. (*Id.*, Figs. 1, 4, [0014]-[0015], [0021], [0022] (stating that “[a]pertures 482 are aligned with apertures 472 of the rear portion 431 of heat sink 250 so that wires 473 may extend externally.”).) While Zeng expressly discloses such apertures in the rear thermal pad connected to the control circuit board 412, a POSITA would have readily understood that such apertures could also be included in the front thermal pad on which the LED circuit board 420 is mounted to achieve the same purpose. That is, depending on space and placement of wires, a POSITA

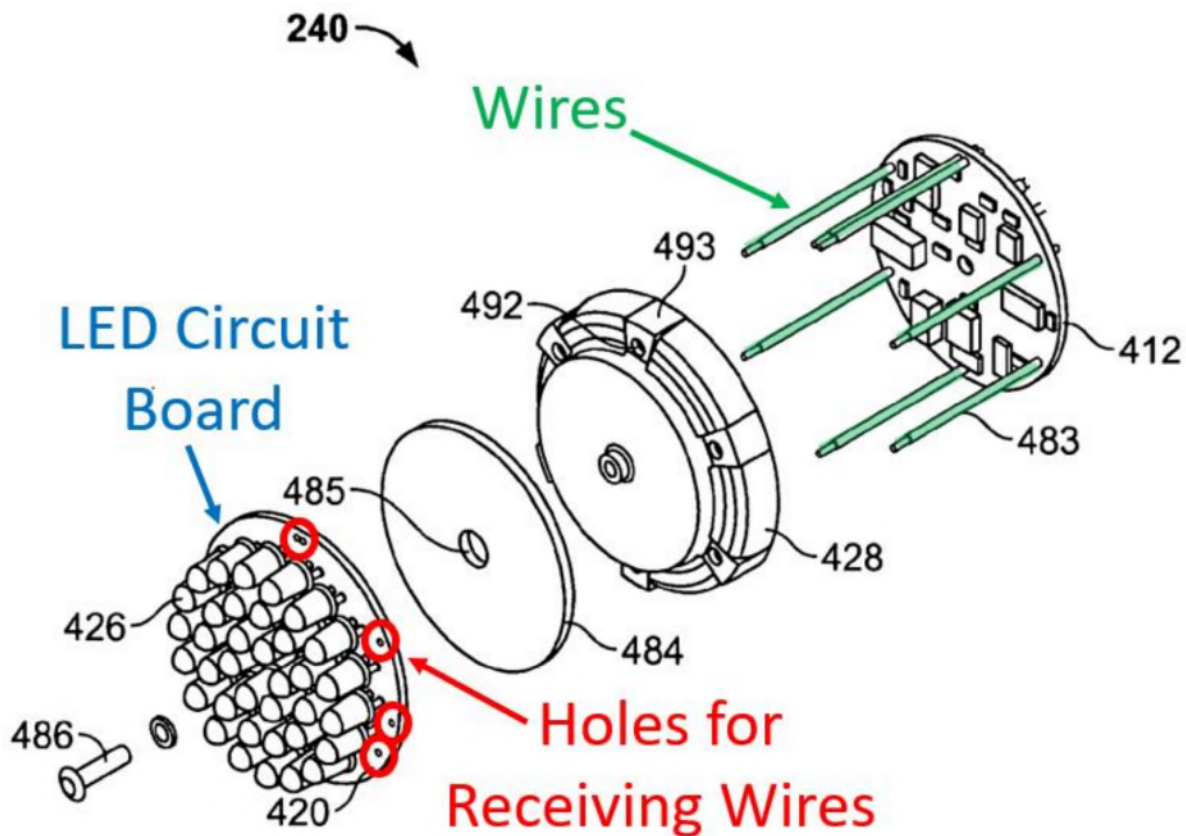
would understand that any thermal could have holes like those shown in Zeng for the wires to pass directly through.

69. It would have been obvious to modify Lin to include a thermal pad having holes for wires between Lin's LED circuit board and its heat dissipation unit housing, as taught by Zeng. Lin and Zeng are analogous art; both disclose lighting devices with heat dissipating elements to prevent overheating of the LEDs. (Lin, 4:4-10, 4:14-16; Zeng, [0021]-[0023].) Zeng discloses that the thermal pads assist in heat being "transferred via conduction" to a heat sink, such as Lin's heat dissipating unit's body, where it can then be dissipated by fins at the rear of the heat sink. (Zeng, [0023], That is, both a thermal pad and a housing with fins can be used in combination to dissipate heat from LED circuit boards. As I explained above, this can help to increase the efficiency of heat dissipation, and prevent overheating. For example, a POSITA would have been motivated to include holes in the thermal pad used in Lin, as also taught by Zeng, in order to have a pathway for wire connections coming from the power supply to reach the LED power and power the LEDs. (*Id.*) Thus, it would have been obvious to a POSITA to use Zeng's thermal pad, having holes for receiving wires, in Lin between the LED circuit board and heat dissipating unit surface to which it is fixed, to further dissipate heat generated by the operation of Lin's LEDs thereby achieving Lin's goal of prolonging service life of the device. (Lin, 4:14-16.)

70. A POSITA have had a reasonable expectation of success, as using a thermal pad between Lin's LED circuit board and heat sink housing body would have simply been the application of a known component to improve a similar device in the same way. Moreover, Lin's lighting unit was ready for such an improvement, as it has a similar receiver space in front of a heat sink having a plurality of fins as Zeng, and holes or apertures in the heat sink for attachment to a power source as also taught by Zeng. (Lin, Fig. 3 (showing two holes in the receiver face of the heat dissipating unit for receiving wires from the power supply), Fig. 2 (same).) The two holes, such as shown in Figure 3 of Lin, would be understood as connections to the power supply. They generally align with the placement of the power supply on the rear of Lin's unit, and lead directly to the LED circuit board, which Lin expressly discloses as being powered by the power supply. As such, it would have been understood that these holes are for leads or wires to extend from the power supply to the LED circuit board. Being mounted to such a thermal pad, Lin's LEDs would continue to function in the same way when powered by the power supply, but with a thermal pad to assist in conducting heat from the LEDs through the housing to the fins where it can be dissipated, while providing apertures, or holes, for running wires to make a direct connection between the power source and the LEDs. A POSITA would have understood that this would provide the benefit of not having to run the wires around the unit from

the power supply, where they could potentially get tangled, damaged, or crimped, including by the baffle plates secured to the sides. (*Id.*)

71. It would have further been obvious to a POSITA to include holes in the LED circuit board corresponding to lead wires connecting to the circuit board in Lin. For example, Zeng discloses power leads, or wires, which connect to the LED circuit board, and illustrates these being received by holes in the LED circuit board:



(Zeng, Fig. 4 (annotated), [0021]-[0023]; see also [0014], [0015], [0024]-[0027], Fig. 5.) A POSITA would have been motivated to include such receiving holes in the LED board in order to have a direct, straight path connection for the wires. A

POSITA would have found this at least obvious to try, as it is one of a limited ways of connecting the wires to the circuit board, and a POSITA would have had a reasonable expectation of success as it would have simply been the use of a known method of connecting power lead wires to an LED circuit board such that the LEDs can be activated. (*Id.*)

72. In addition, Lodhie discloses an LED lighting unit like those of Lin and Zeng, with a power supply that provides power to LEDs through wires running from the power supply to the LEDs on a circuit board. (Lodhie, Abstract, 1:46-63, 2:16-67, 3:23-62, 4:1-7, Figs. 2-3, 5.) Lodhie discloses that, for example, “wires 43 and 45 are electrically conductive wires, one of which passes through base 13 and is in electrical contact with one of contacts 15a and 15b at one end and a lead of an LED, preferably on printed circuit board 11a' at the other end. The other of wires 43 and 45 passes through base 13 and is in electrical contact with the other of contacts 15a and 15b, the other end of which is in electrical contact with a lead of an LED, preferably on printed circuit board 11c.” (*Id.*, 3:31-48.) Lodhie further discloses that, to connect the wires to the LED contacts, the wires may pass through “holes” in the circuit boards:

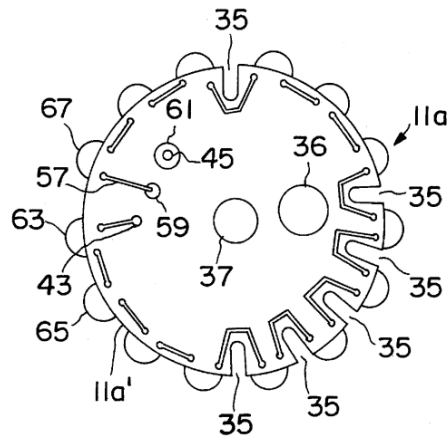


FIG. 5

(*Id.*, Fig. 5, 3:49-67, 2:39-47, Fig. 2.)

73. In particular, Lodhie discloses that “wire 43 is shown connected to one lead of LED 63 in LED layer 11a. ... One lead of LED 67 is connected to a wire 57 which passes through hole 59 to the second LED layer and is connected to one lead of an LED on the second layer. Wire 45 passes through hole 61 and through a corresponding hole in printed circuit board 11b' and is coupled to one lead of an LED on the third layer. In this manner a complete circuit is formed so that the LEDs in each layer are connected in a series relationship and are electrically connected to contacts 15a and 15b so that when appropriate power is applied to contacts 15a and 15b, all the LEDs in each layer become lit.” (*Id.*, 3:49-67.) That is, Lodhie discloses that lead wires may be passed through holes in LED circuit boards in order to power LEDs, and Lodhie further discloses that the use of

holes for passing the wires allows for the wires to be “kept as short as possible” to avoid problems during installation and to avoid crimping. (*Id.*, 4:1-7.)

74. A POSITA been motivated to include holes in the LED PCBs of Lin (and Zeng) as taught by Lodhie for providing a pathway to receive wires from the power supply in order to power the LEDs. (Lodhie, 1:46-63, 2:16-67, 3:23-62, 4:1-7, Figs. 2-3, 5.) A POSITA would have understood that providing a hole for the power supply wires to connect to the LED contacts on the circuit boards would have been simply use of a well-known technology, forming a hole in the PCB for wires to pass, to provide a pathway for physical wires to make the required connections to power the LEDs. A POSITA would have had a reasonable expectation of success because using a PCB hole, or opening, as taught by Lodhie, would allow the wires to pass through to their connections even when there is not space within a housing for the wires to go from an opening and then around a circuit board. This would have also allowed the wires to be kept as short as possible, avoiding problems with tangling or crimping during installation as taught by Lodhie. (*Id.*, 4:1-7.) If the wires were too long, or had to snake around too many other components to reach the contact points on the circuit board, there is a greater chance of them becoming tangled, crimped, or damaged during installation. Moreover, trying to pull wires through tight spaces can be difficult, and can again result in the wires becoming damaged if they get caught during the installation

process. By providing the wires through holes in the circuit board, as taught by Lodhie, the installation process can be made easier as the wires can be more directly connected from the power source to the circuit board contacts.

75. At the very least, a POSITA would have found it obvious to try a hole, or opening, in the PCBs of Lin for the power supply wires to pass through and connect to the traces and other electronic components on the PCBs requiring power, as this would be one of a limited known ways of making such connections. For example, a POSITA found it obvious to try creating a hole in the LED PCB for the wires to pass through where space is more constrained or a direct connection from the thermal pad opening is desired such that the wires do not need to bend or be potentially pinched. In Lin, where the power supply is directly behind the LED circuit board, a POSITA would have found it obvious to have corresponding holes in the heat dissipating unit (as shown in Figures 2-3 of Lin), thermal pad, and PCB so that the wires could extend directly through to the power supply without potentially being pinched or damages during installation or connection of the side baffles.

C. Ground 3 – Lin in view of Moriyama Renders Obvious Claim 27

76. Moriyama (EX1010) is U.S. Patent Pub. No. 2005/0239342. Moriyama was filed on October 24, 2003, and published October 27, 2005. I understand Moriyama is prior art under at least pre-AIA § 102(b).

1. Dependent Claim 27

The LED light fixture of claim 21, wherein each module of the light engine includes a zener diode in a one to one parallel relationship with the LED.

77. Lin in view of Moriyama renders obvious Claim 27. Lin discloses a plurality of LEDs 41 and a circuit board 42 arranged behind each LED. (Lin, 4:33-5:4, Fig. 3.) Lin explains “the LEDs (41) can further be fully integrated on the circuit board (42).” (*Id.*, 6:21-24.)

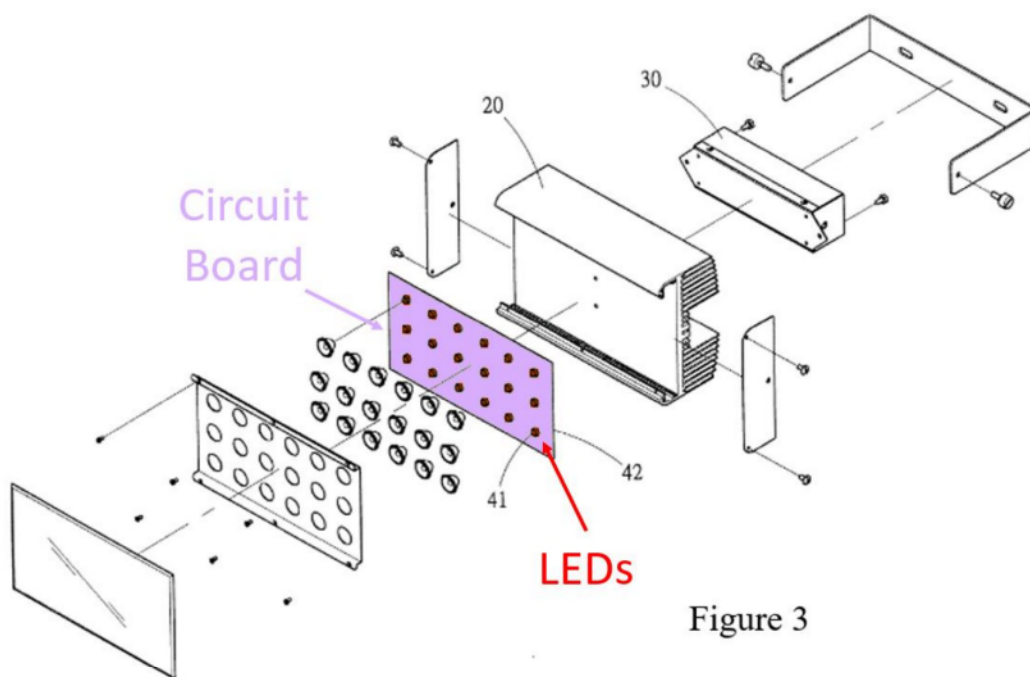
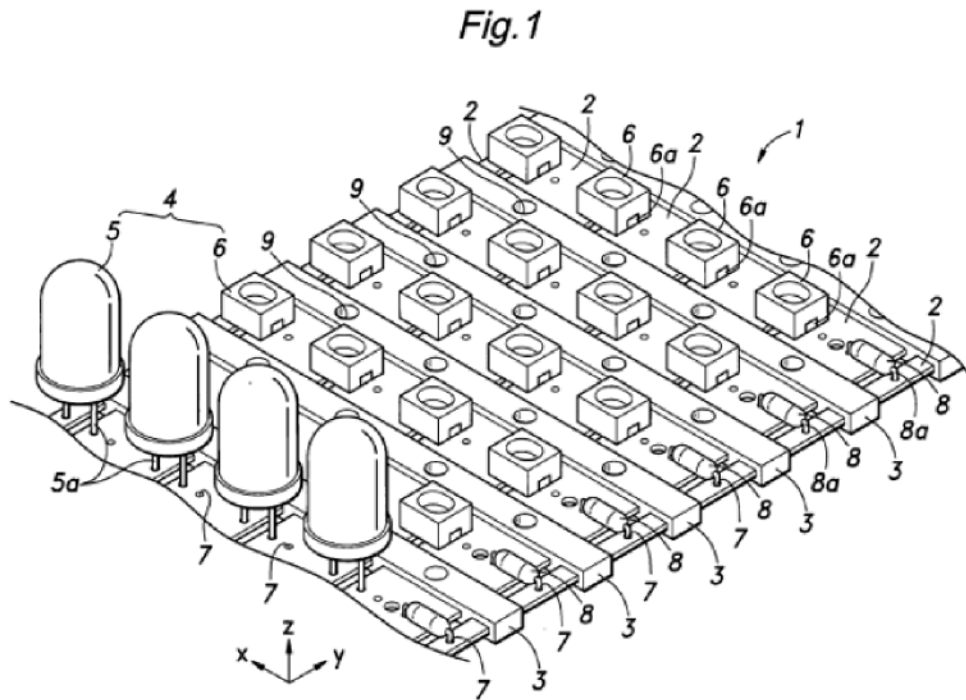


Figure 3

(*Id.*, Fig. 3 (annotated).)

78. Moriyama, in the same field of LED lighting fixtures as Lin, similarly discloses “a light emitting module comprising one more light sources.” (Moriyama, [0002], [0007].) Like Lin, Moriyama’s light emitting module has “an improved heat dissipation property.” (*Id.*) Moriyama discloses a light emitting

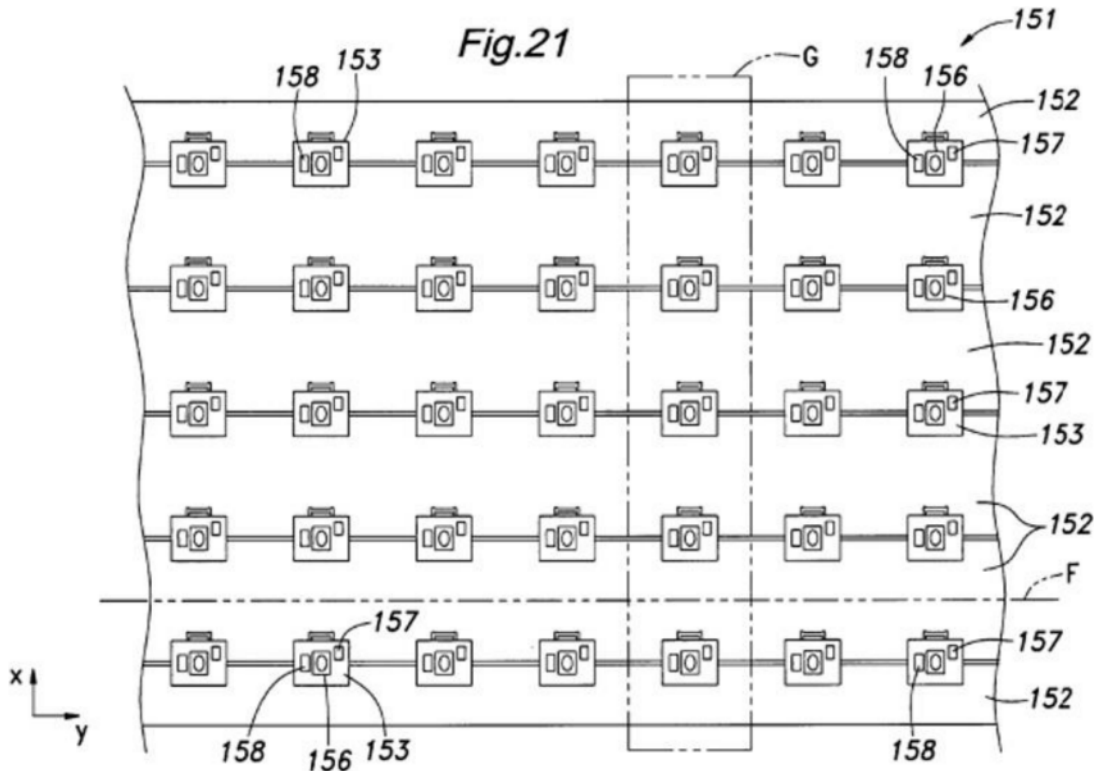
module with “a plurality of plate-shaped conductors 2 spaced apart from each other” and “a plurality of LEDs 4 mounted between adjoining conductors 2 to serve as light sources.” (*Id.*, [0079]-[0080].)



(Moriyama, Fig. 1)

79. Moriyama discloses “insulating joint members 3 expose both sides of various portions of the conductors 2 inclusive of the portions where the LEDs 4 are mounted, and the thickness of the joint members 3 serves to ensure that a space is created between the conductors 2 and the support member (not shown) when the light emitting module 1 is secured to the support member, whereby achieving favorable heat dissipation characteristics.” (*Id.*, [0084].)

80. Moriyama further discloses that “a resistor 157 and a Zener diode 158” may be “provided for each LED 156.” (*Id.*, [0120].)



(Moriyama, Fig. 21.) Moriyama explains that “zener diode 158 connected in parallel with LED 156 functions to prevent an overvoltage from being applied to LED 156.” (*Id.*, [0121].) A Zener diode is a special diode that acts like a normal diode when it is forward biased, however, it is intentionally biased in its breakdown region such that it starts to conduct electricity when the reverse voltage reaches its “breakdown” voltage, often referred to as a Zener voltage or knee voltage. They are meant to “breakdown” and purposely allow current to flow through them in reverse bias when there is a large voltage in that direction. Zener

diodes are commonly used to prevent an overvoltage. Zener diodes in parallel with LEDs are often included within the LED package. When the breakdown voltage is reached, the Zener diode will maintain a stable voltage across its terminals. Thus, using a Zener diode with a Zener voltage less than a harmful voltage level effectively prevents an overvoltage. High voltages can occur due to high voltage electrostatic discharges, voltage spikes, high voltage fluctuations due to component failures, or shorts, for example.

81. It would have been obvious to a POSITA to modify Lin's LEDs and circuit boards to include a Zener diode for each LED, connected in parallel with the LED, as taught by Moriyama. Lin already uses an array of LEDs like the lighting module disclosed by Moriyama. Lin was also concerned with protecting his LEDs "to avoid burning of the LEDs (41) due to overly large current." (Lin, 6:14-20.) An overly large current may result from a short with the AC supply power that causes excessive voltage and current. A short may occur, for example, when there is damage to a component, loose connections, or a wire touching a component of a housing. When there is a short, the electricity takes a path it is was not intended to, and can create an overload voltage. Large voltage spikes can occur due to electrostatic discharges from people, equipment, and sources of friction. It would have been obvious for a POSITA to use the Zener diodes as disclosed in Moriyama to also protect from overly large voltage in Lin. Zener diodes were well-

known components often used to protect circuits from overvoltage issues. Further, Zener diodes were known to protect against an entire string of LEDs failing if one LED in the array were to fail by becoming open. Including a Zener diode for each of Lin's LED would have been the simple use of a known electrical component to improve a similar device in the same way, that is, to prevent an overvoltage from being applied to one of the LEDs. A POSITA would have been motivated to include Zener diodes with the LEDs in Lin's array in order to protect the LEDs and extend their service life, something that Lin notes is one of its goals. (Lin, 4:14-16.)

D. Ground 4 – Lin in View of Nishimoto and Cunningham Renders Obvious Claim 28

82. Nishimoto (EX1011) is WO2005/029185. Nishimoto was filed September 7, 2004 and published March 31, 2005. Nishimoto is prior art under at least pre-AIA § 102(b). Cunningham (EX1012) is U.S. Patent Pub. No. 2004/0021859. Cunningham was filed on August 1, 2002, and published February 5, 2004. Cunningham is prior art under at least pre-AIA § 102(b).

1. Dependent Claim 28

The LED light fixture of claim 21, wherein during steady state operation of the fixture in 25 C ambient environment, the LED junction temperature at the printed circuit board is approximately 55 C and the housing body temperature is approximately 45 C.

83. Claim 18 simply recites temperatures that could be measured when the light of claim 21 (which is disclosed by Lin) is in steady-state operation in

25°C ambient conditions (typical room temperature). This is merely reciting the results of using the light in an environment with a standard reference temperature for measurements. (Nishimoto, 11:15-26.)

84. Lin in view of Nishimoto and Cunningham renders obvious Claim 28. Lin discloses an LED searchlight with a heat dissipating housing including heat dissipation fins to “increase the heat energy released during operation.” (Lin, 4:14-16.) *See supra* Ground 1, Cls. 21-23. The temperature at the LED junction, where the heat is generated, would be higher than that of the heat-dissipating body, including the fins, which draw away heat from the LED circuit board and dissipate it into the environment around the lighting fixture. The heat from the source (the LED) flows from regions of higher temperature (the LED junction) to regions of lower temperature (ambient environment). At equilibrium with a constant, lower ambient temperature, the heat generated by the LED will flow from the LED junction through components, such as housings or heat sinks where some of the heat will dissipate to the ambient environment, resulting in components that are warmer than ambient, but not as hot as the source. If the heat were not to flow, or have a large resistance to flow, the junction temperature would increase to very high temperature values that drastically reduce the lifetime of the LED. Using heat conducting housings and/or heat sinks offers a lower thermal resistance to conduction of heat (lower than just air for example), such that heat may flow more

easily to other components with larger surface areas where it can dissipate. Using thermally conducting housings and/or heat sinks are common methods for lowering the junction temperature of LEDs. In particular, the heat sink is designed to dissipate heat away from the LEDs on the PCB, thereby preventing the LEDs from getting too hot, which could lead to thermal deterioration, reduced efficiency, or potentially failure of the LEDs. (Lin, 4:14-16, 5:11-19 (noting that heat dissipation prolongs “service life” of the LEDs); Nishimoto, 2:11-311, 6:4-14.)

85. Nishimoto, in the same field as Lin, discloses “an LED lighting apparatus . . . for improving thermal dissipation properties.” (Nishimoto, Abstract, 1:5-7, 3:8-12, 11:15-28, 15:26-16:24, 28:19-30:21, Figs. 1, 10A-11B.) Nishimoto discloses there is a relationship between properties of the heatsink, LEDs, and circuit board components, and that junction temperature and the temperature of any attached heat sink body are dependent upon (and vary with respect to), for example, the thermal resistance of heatsink, volume of the heatsink, surface area of the heatsink, and the amount of current driving the LEDs. (*Id.*, 21:11-23:20, 24:1-25:1 (including Table 1), 30:22-33:24, Figs. 13-15 (showing the relationship between junction temperature and heat sink volume, surface area, and weight, respectively, for different driving currents).) Increasing the heat sink volume or surface area reduces the thermal resistance, while normally increasing the mass or weight. Also, the specific material used for the heat sink, such as aluminum,

copper, or thermally conductive polymer affects the thermal resistance of the heatsink. For example, Nishimoto notes that LED chip temperature, or junction temperature, “changes due to factors such as heatsink thermal resistance, enveloping volume, area, and weight.” (Nishimoto, 33:20-24.) Further, as recited in claim 28, Nishimoto discloses that it was known to assess junction temperature at an ambient temperature of 25°C. (Nishimoto, 11:15-26, 24:1-28 (Table 1).)

86. In particular, Nishimoto includes a table, Table 1, showing “the relationships between the enveloping volume of the heatsink and the heatsink thermal resistance” with respect to “junction temperature” at driving currents of 20mA, 30mA, 40mA, and 50mA. (*Id.*, 24:1-26:1.) As shown in Table 1, it was known in the art that, at an ambient temperature of 25°C and a particular junction to heat sink thermal resistance, various combinations of driving current and heat sink thermal resistance could result in a steady-state junction temperature around 55°C as recited in Claim 28:

TABLE 1

Relationship Between Heatsink and Junction Temperature

(Ambient Temperature: $T_a=25^{\circ}\text{C}$)

Heatsink No.	Thermal Resistance (10 W)	Enveloping Volume	Junction Temperature ($^{\circ}\text{C}$)			
	$^{\circ}\text{C}/\text{W}$	cm^3	20 mA	30 mA	40 mA	50 mA
1	0.38	4464	34.8	38.7	41.7	44.5
2	0.56	2322	35.2	39.0	43.3	46.8
3	0.65	1108.8	35.8	41.8	46.7	50.3
4	1.0	816	36.5	42.8	48.3	52.8
5	1.24	571.2	38.5	44.4	51.5	55.0
6	1.7	400	39.5	46.1	52.3	57.7
7	1.9	280	41.2	48.7	56.5	62.3
8	2.2	208	43.2	52.9	61.4	69.7
9	2.6	145.6	46.1	57.6	66.8	74.2
10	2.9	144.06	44.1	56.0	65.6	73.8
11	3.3	104	47.2	56.8	64.5	74.8
12	3.4	108.78	46.8	59.3	69.0	78.0
13	3.9	100	47.6	60.3	69.5	79.5
14	4.3	73.5	47.2	64.4	70.8	81.3
15	4.5	59.5	53.2	57.5	69.8	82.5
16	5.2	52.5	51.3	69.0	78.5	86.4
17	5.6	42.5	52.6	68.6	92.0	

(Nishimoto, Table 1 (annotated).)

87. Thus, based on these teachings from Nishimoto, a POSITA would have understood Lin's lighting fixture, comprised of a similar combination of LEDs, LED circuit boards, and a housing with a heat sink, would have had an LED junction temperature of around 55°C at an ambient temperature of 25°C , at least when the LEDs are driven with certain currents. For example, a POSITA would have understood to vary the driving current (thereby supplying more or less power to the LEDs), thermal resistance of the heat sink housing and fins (such as by different materials), and volume and layout of the heat sink and fins in order to

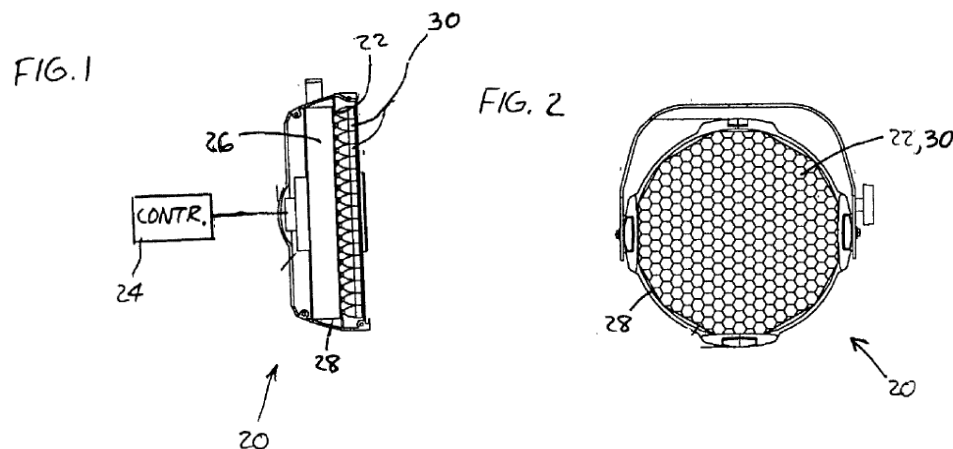
achieve a junction temperature of around 55°C. (*Id.*) This would have been well within routine experimentation a POSITA could perform, as junction temperature is simply a result of the relationship between several known variables as disclosed in Nishimoto. Moreover, a POSITA would have been motivated to achieve such an LED junction temperature in order to ensure that the LEDs do not become too hot, such that their performance would degrade or they could fail. This is a stated goal of both Lin and Nishimoto.

88. A POSITA would have understood and expected that, when the LED junction temperature is around 55°C, the temperature of the heat dissipating body including the heat sink would be around 45°C in at least certain circumstances. Both Lin and Nishimoto disclose that the heatsinks dissipate heat, and as such they pull heat away from the LEDs. (Lin, 4:14-16, 5:11-19 (noting that heat dissipation prolongs “service life” of the LEDs); Nishimoto, 2:11-311, 6:4-14.) In pulling heat away, the heatsink temperature will not be as hot as the LED junction temperature, but would be somewhat less. A POSITA would have therefore understood that Lin’s LED lighting module could be made to have a junction temperature of 55°C and a housing temperature of 45°C when measured in 25°C ambient temperature, as this would merely involve the routine changing materials, heatsink thermal resistance (which could be easily changed by adjusting the volume or surface area of the heatsink), and the current or power at which the LEDs are driven.

(Nishimoto, 21:11-23:20, 24:1-25:1 (including Table 1), 30:22-33:24, Figs. 13-15, Figs. 17A-17C, 35:15-36:18.)

89. That the housing (or heat sink) temperature in Lin could be 45°C when the junction temperature is 55°C (at 25°C ambient conditions) can also be confirmed based on the teachings of Cunningham, which discloses the relationship between heatsink temperature and junction temperature. Cunningham describes several equations relating LED junction temperature to heat sink temperature, based on similar variables as discussed in Nishimoto.

90. Cunningham, in the same field as Lin, discloses a method for controlling a lighting fixture. (Cunningham, Abstract, [0010].) Cunningham discloses the lighting fixture may comprise an array of LEDs:



(Cunningham, Figs. 1-2; *see also* Abstract, [0010], [0020]-[0021].) Cunningham teaches that when the heat sink has reached steady state, isothermal condition, the

junction temperature and the heat sink temperature have the following relationship (which I will refer to as Eq. 1):

$$T_{JX} = (P_X)(\theta_{JC} + \theta_{CS}) + T_S$$

where:

T_{JX} = junction temperature of a group X LEDs (°C)

P_X = power dissipated by each LED in group X (watts)

θ_{JC} = thermal resistance between junction and case of each LED ($\frac{^{\circ}\text{C}}{\text{watt}}$)

θ_{CS} = thermal resistance between case of each LED and heat sink ($\frac{^{\circ}\text{C}}{\text{watt}}$)

T_S = heat sink temperature (°C)

(Cunningham, [0056]-[0069].)

91. To determine T_S , this equation can be rearranged by subtracting $(P_X)(\theta_{JC} + \theta_{CS})$ from both sides, resulting in the equation below (which I will refer to as Eq. 2):

$$T_S = T_{JX} - (P_X)(\theta_{JC} + \theta_{CS})$$

92. By applying the relationship between junction temperature and heatsink temperature disclosed by Cunningham to the data disclosed by Nishimoto's Table 1, a POSITA would have understood that an ambient temperature of approximately 25 °C, a heat sink temperature of approximately 45 °C, and a junction temperature of approximately 55 °C could be achieved by

selecting various heatsinks and driving currents. For example, when Nishimoto's Heatsink No. 6 from Table 1 is used with LEDs driven at 50 mA (total power at 11 Watts)⁴ in an ambient temperature of 25 °C, the junction temperature is 57.7 °C (Nishimoto at 31:2-5, Table 1). The thermal resistance in Nishimoto between the junction and the heat sink is referred to as the thermal substrate resistance, which is the sum of the thermal resistance from the junction to the heat sink. This substrate thermal resistance is the total thermal resistance from the LED bare chip to the back surface of the metal layer 10A of the package which is in close thermal contact with the heat dissipating means (heatsink). (Nishimoto, 4:6-8, 15:18-22, 17:4-7, 12-16, 26:22-24, 30:10-12, Fig. 4). This substrate thermal resistance is the thermal resistance represented by $\theta_{JC} + \theta_{CS}$ in Cunningham. Nishimoto discloses that this substrate thermal resistance should not be greater than 3 °C/W and

⁴ When the thermal resistance used in Eq. 2 is the thermal resistance between all LEDs and the heatsink (which is referred to as the substrate thermal resistance by Nishimoto), the total power by all of the LEDs is used for P_x . (Nashimoto, 15:22-25). Alternatively, one may use the power from each individual LED and the thermal resistance from each individual LED to the heatsink, which is the total substrate thermal resistance described by Nishimoto multiplied by the number of LEDs for the configuration. (EX1013, Luxeon Application Brief AB05, 3, 10-11.)

demonstrates that the substrate thermal resistance may be 1.2 °C/W and may be adjusted. (*Id.* 16:3-11, 18:11-20, 19:1-5, 22:7-10, 19-23, 26:8-13, Figs. 8, 9).

Using this substrate thermal resistance and the data for Heatsink 6 from Table 1, the heatsink temperature from Eq. 2 is:

$$T_S = 57.7^{\circ}\text{C} - (11\text{W}) \left(1.2 \frac{^{\circ}\text{C}}{\text{W}}\right) = 44.5^{\circ}\text{C}.$$

93. Similarly, Nishimoto's Heatsink No. 7 used with LEDs driven at 40 mA (9 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 56.5 °C and a heatsink temperature of approximately 45.7 °C. That is, using Eq. 2 above:

$$T_S = 56.5^{\circ}\text{C} - (9\text{W}) \left(1.2 \frac{^{\circ}\text{C}}{\text{W}}\right) = 45.7^{\circ}\text{C}.$$

94. Likewise, Nishimoto's Heatsink No. 15 used with LEDs driven at 20 mA (5 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 53.2 °C and, using Eq. 2, a heatsink temperature of approximately 47.2 °C. Nishimoto also discloses examples where the substrate thermal resistance (the junction to heat sink thermal resistance represented by $\theta_{JC} + \theta_{CS}$ in Cunningham) may be 2 °C/W. (*Id.* 26:8-13, Fig. 9). Using this substrate thermal resistance and Nishimoto's Heatsink No. 10 used with LEDs driven at 30 mA (6 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 56 °C and a heatsink temperature of approximately 44 °C. Thus, as I discussed above, a POSITA would have understood that the heat sink housing in Lin could

have temperature of around 45 °C during steady state operation of the LEDs at 55 °C junction temperature in an ambient temperature of 25 °C, as this would have merely been the routine result of using different materials, volumes, and power supplied to the LEDs. The equations and calculations discussed above demonstrate this, using typical variables for the heat sink volume, LED driving current, LED junction temperature at 25 °C ambient temperature, and thermal resistances.

95. Again, at the very least, it would have been obvious to a POSITA to have a heatsink temperature of approximately 45 °C, and a junction temperature of approximately 55 °C in an ambient temperature of approximately 25 °C because for a specific ambient temperature, heatsink temperature and junction temperature are a function of the thermal resistance from the junction to the heatsink, the heatsink thermal resistance, and the power (current) driving the LEDs. A POSITA would have expected to arrive at the claimed temperatures at least as part of routine experimentation, including varying the thermal resistance of the heatsink and the amount of current driving the LEDs.

E. Ground 5 – Chen Anticipates and Renders Obvious Claims 21-23 and 26

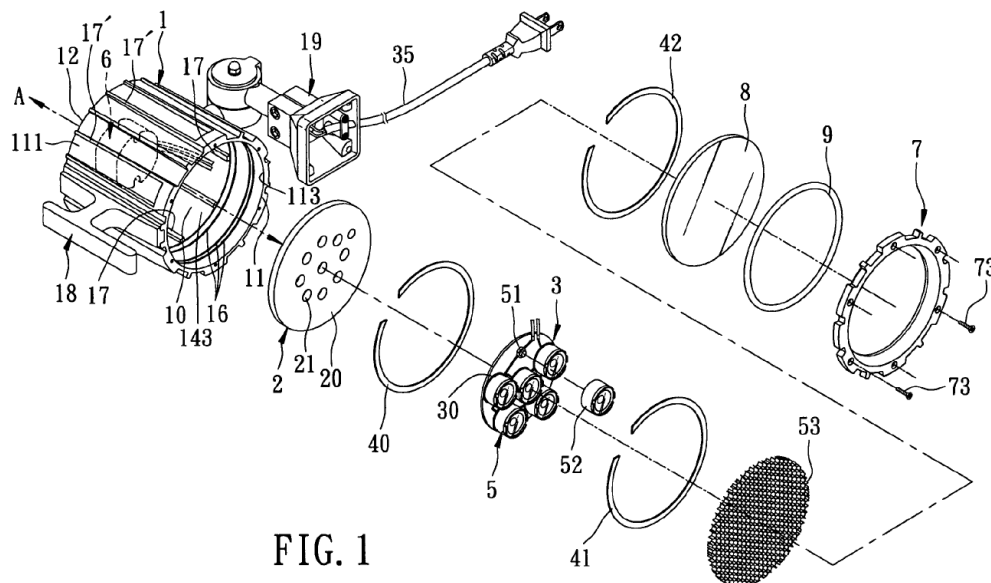
96. Chen (EX1007) is US7,465,066. Chen was filed on February 21, 2006, and issued December 16, 2008. I understand Chen is prior art under at least pre-AIA § 102(e).

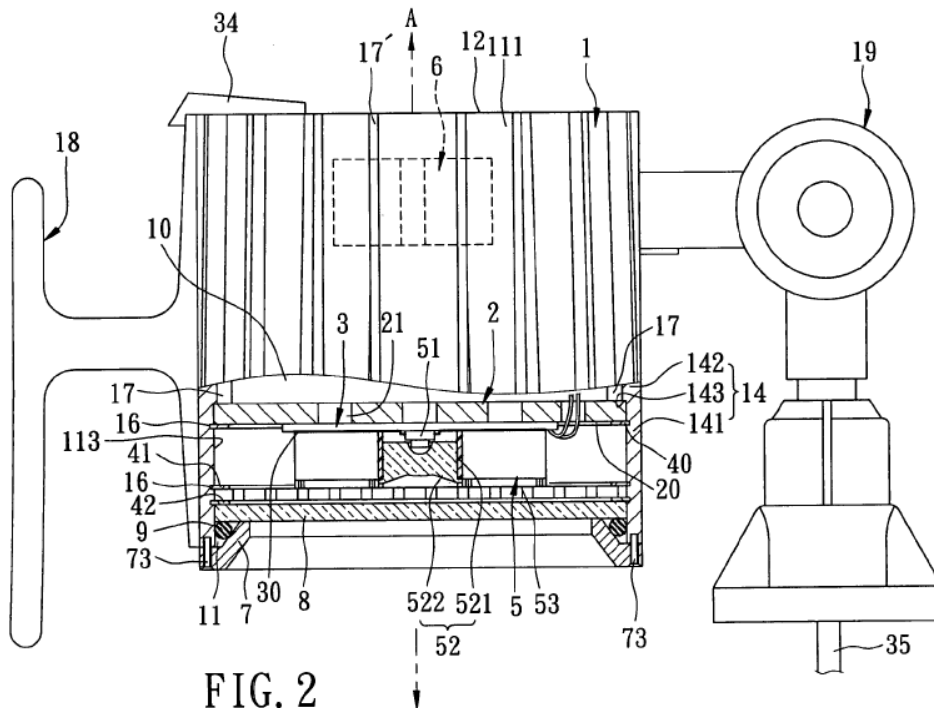
1. Independent Claim 21

97. As viewed by a POSITA, Chen anticipates and renders obvious Claim 21.

21[Pre]: A LED light fixture comprising:

98. To the extent limiting, Chen discloses Claim 21[Pre]. Chen discloses an “illumination apparatus” or “lighting device” that “has a superior heat dissipating capability and longer service life.”(Chen, Abstract, 1:18-21.) Chen’s lighting device includes “a heat dissipating plate,” “lighting units, each having a light emitting diode mounted on a circuit board,” and a “transparent plate in front of the lighting units”:



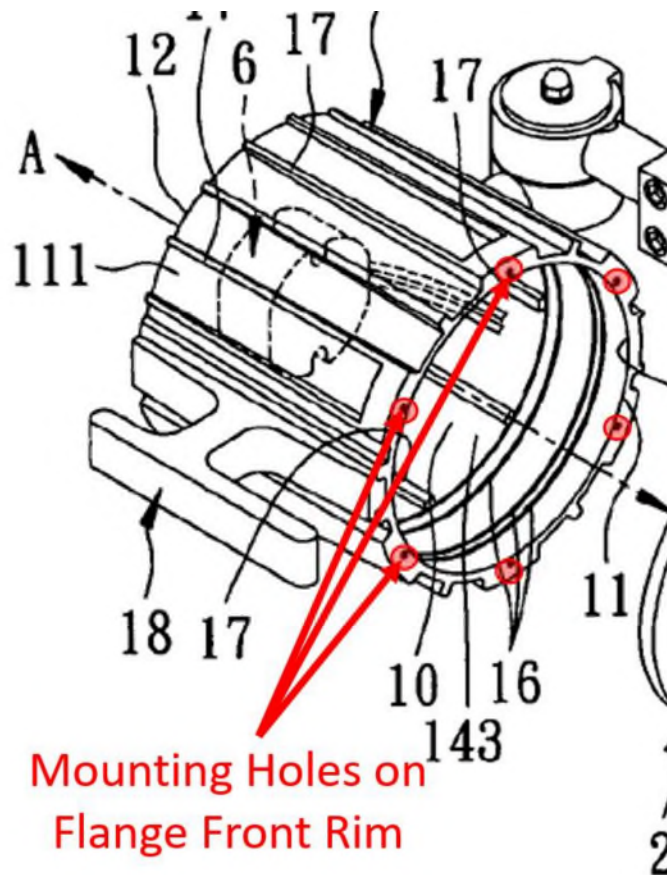


(Chen, Figs. 1-2, Abstract, 1:18-21.) Moreover, as shown above, there is an “adjustable supporting frame 19” that supports the housing of the light. (*Id.*, 2:22-23.) A “power cord 35” is shown which goes through the “supporting frame 19” and allows connection of the lighting device to an external power source. (*Id.*, Figs. 1-2, 2:51-60.) Chen further discloses its lighting device has a “plurality of heat-dissipating ribs” such that the device “has a superior heat dissipating capability and longer service life.” (*Id.*, Abstract, 1:18-21, 2:18-22, 3:10-12.)

99. Chen discloses Claim 21[A.i]. Chen discloses “a tubular housing made of heat conductive material” that includes 1) a flange, 2) an internal receiver, 3) a frontal lens, and 4) an array of fins:

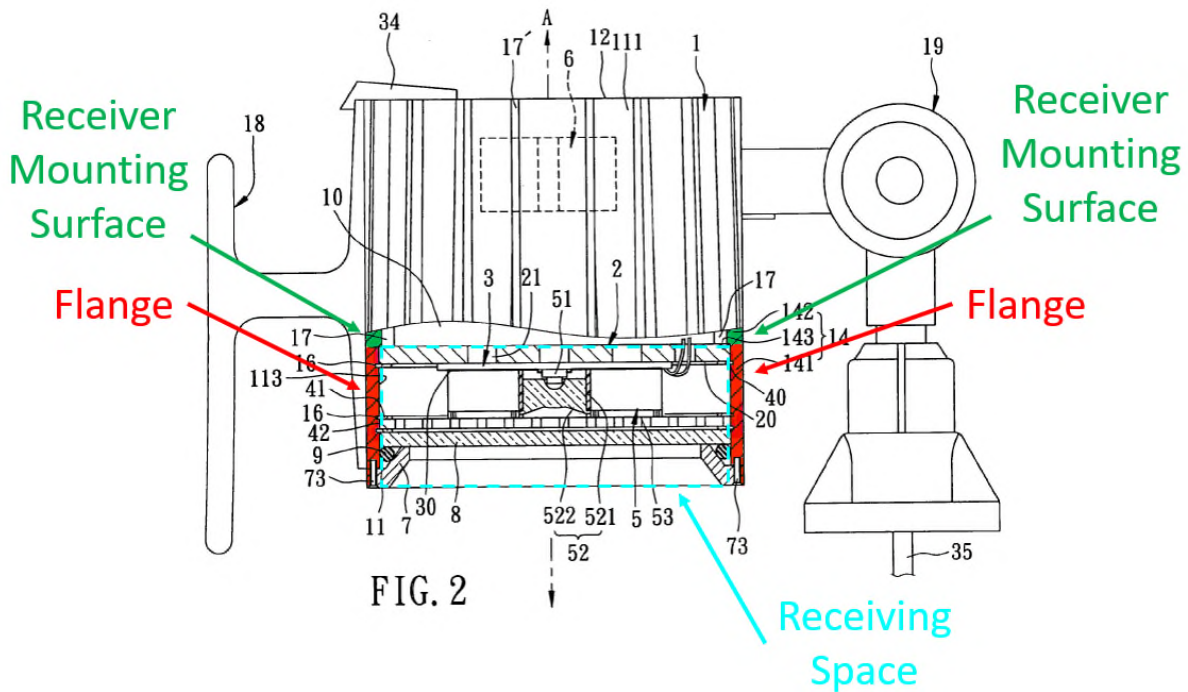


100. **First**, Chen’s housing includes a flange. Chen discloses the tubular body 12 with “a rear end portion 142 having an inner diameter smaller than that of the front end portion 141, and an intermediate shoulder portion 143” where the front and rear end portions meet. (Chen, 2:8-12.) The front end portion 141 forms a flange which extends to the front edge of the housing:



(*Id.*, Fig. 1 (annotated).)

101. **Second**, Chen discloses an internal receiver. Chen discloses that the housing 1 . . . is configured with receiving space 10" including an open space towards the front of the light:

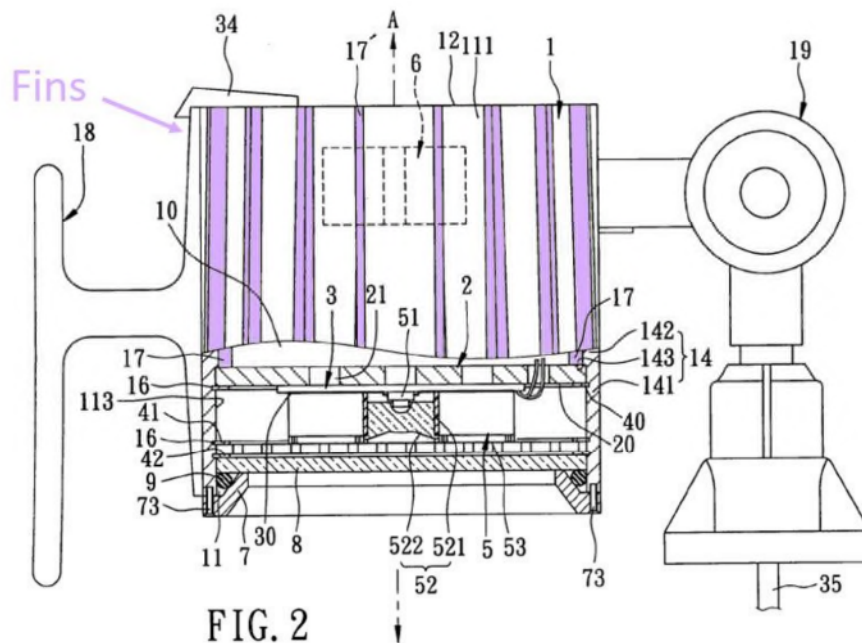


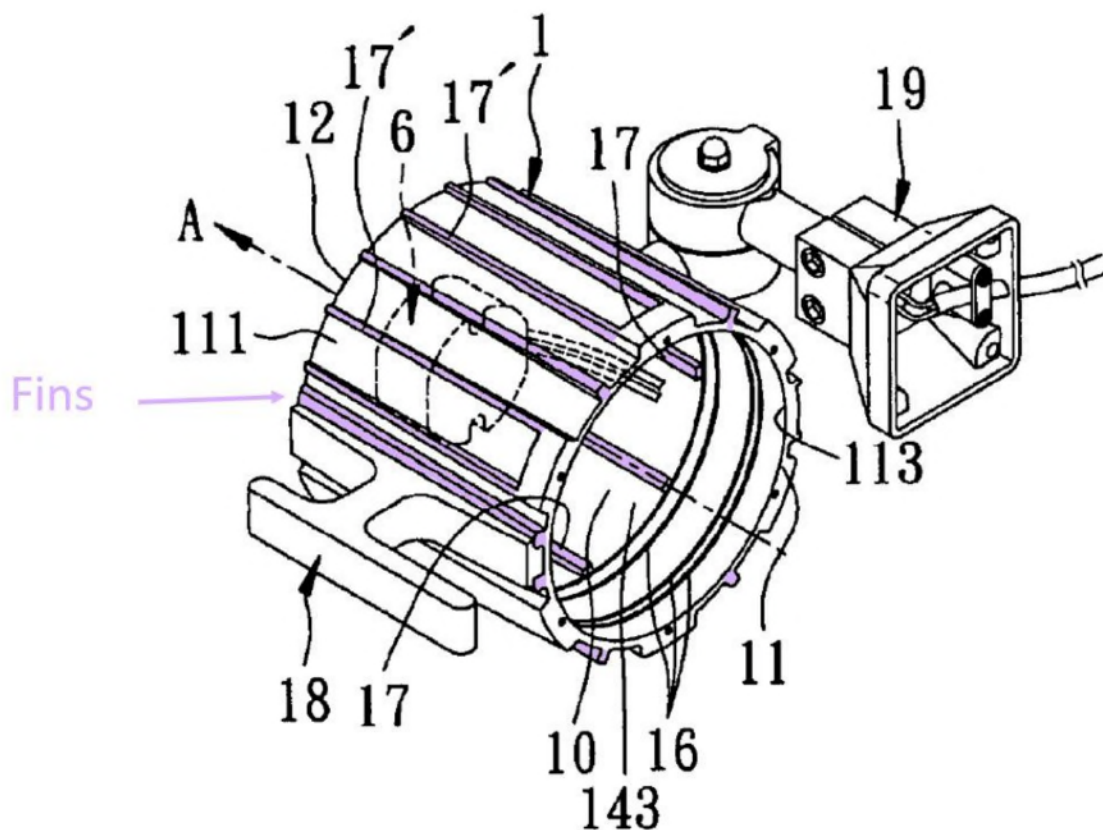
(Chen, Fig. 2 (annotated), 2:3-6; see also Fig. 1, Cl. 1, 1:24-31, 1:45-46, 2:65-67.)

In particular, Chen discloses that a “lighting device is disposed in the receiving space 10 . . . and includes a heat dissipating plate 2, a circuit board 3, a plurality of lighting units 5, and a driving unit 6.” (*Id.*, 2:24-27.) As can be seen above, there is an area within the flange that receives, among other components, the circuit board 3 and lighting units 5. Components are placed in the receiving space and secured to the lighting device at the intermediate shoulder receiver surface. The circuit board and LEDs are mounted to a “mounting surface 20” of the heat dissipating plate, which itself “abuts against the intermediate shoulder portion 143” of the flange of the tubular body. (*Id.*, 2:24-39.) That is, as shown in Figure 1, during installation, the circuit board 3 and lighting units 5 are attached to the heat dissipating plate 2,

through into the environment around the lighting device. Chen's lens is further secured between an "annular cap 7" and a "seal washer 9." (*Id.*, 1:66-2:2, 3:1-7.) By having it sealed in place with the washer and cap, the lens is able to protect the interior of the lighting device from the environment, while allowing light from the LEDs to pass through.

103. **Fourth**, Chen's housing further includes an array of fins. *See also infra* Ground 5, Claim 21[A.ii]. Chen discloses tubular body 14 of heat conductive housing 1 is formed "with a plurality of heat-dissipating ribs" 17 and 17' (*i.e.*, an array of fins):





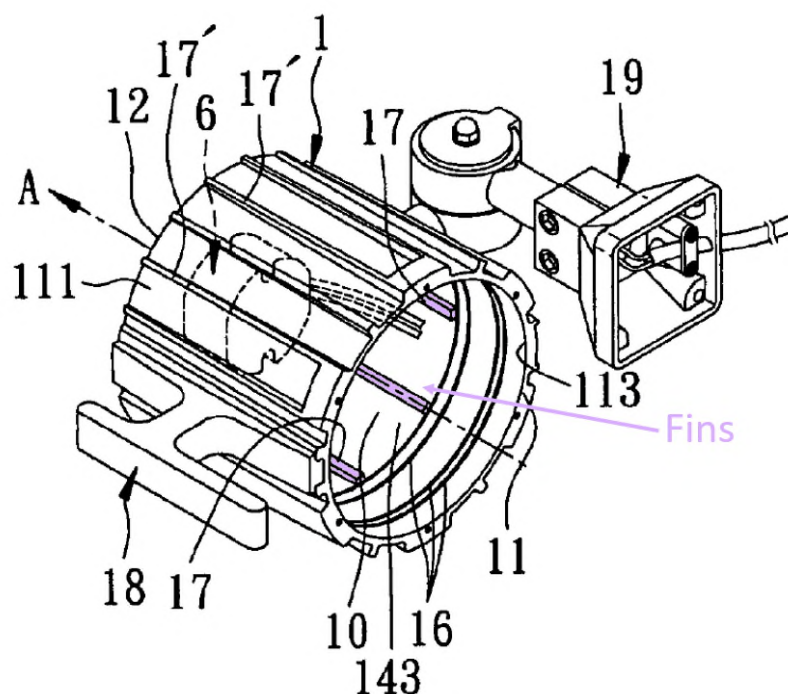
(Chen, Figs. 1-2 (annotated), 2:18-24.) In particular, Chen discloses that the “rear end portion 142 of the tubular body 14 has an inner surface formed with a plurality of heat-dissipating ribs 17 extending in the axial direction (A). Also, the tubular body 14 of the housing 1 has an outer surface 111 formed with a grip 18, and a plurality of heat-dissipating ribs 17’ extending in the axial direction (A).” (*Id.*, 2:8-24, 3:10-12.)

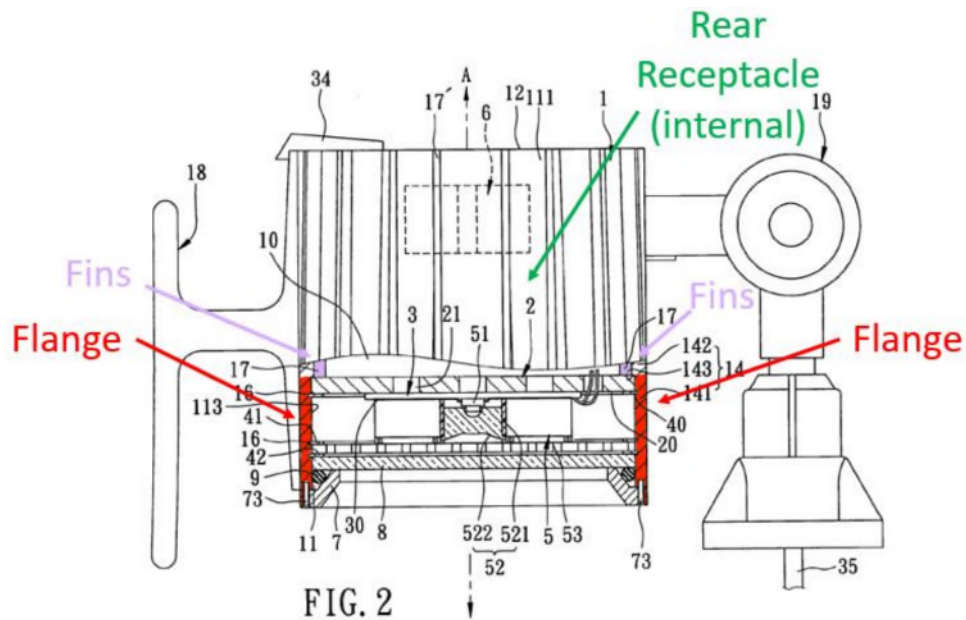
104. The “ribs” in Chen are shown as thin protrusions that extend in “the axial direction” from both the outer and inner surfaces of the light housing 1. (*Id.*) Chen further explains that “due to the presence of the heat dissipating plate 2 and the heat conductive housing 1, heat generated by the light emitting diodes 51 can

be dissipated.” (Chen, 3:10-12.) Chen’s ribs, or fins, increase the surface area of the heat conducting housing, allowing for more surface to be in contact with the ambient air. Heat generated by the LEDs is conducted through the circuit board and into Chen’s heat-dissipating plate 2, housing, and ribs, and then dissipated into the surrounding air. (*Id.*, 2:3-39.)

21[A.ii]: ...[the array of fins] extending rearward from the flange to define a rear receptacle that extends forward towards the flange,

105. Chen discloses Claim 21[A.ii]. Chen discloses that the fins, including “heat-dissipating ribs 17” formed on the inner surface of the housing, extend rearward from the shoulder portion 143 of the flange, and ribs 17' on the outer surface of the housing that extend rearward from the front rim and top portion 141 of the flange:

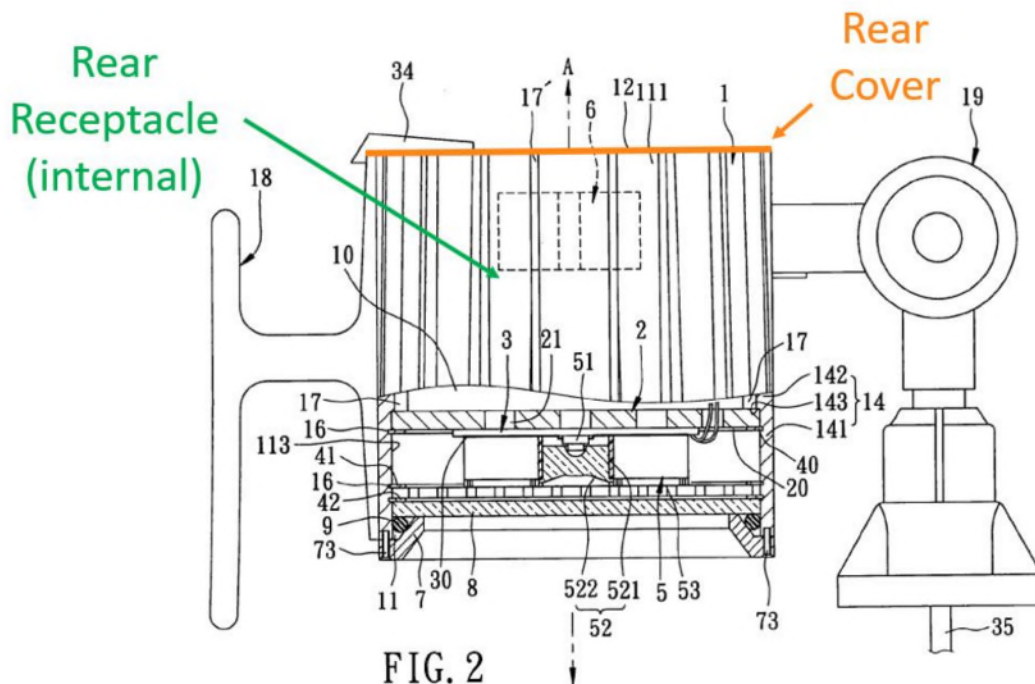




(Chen, Figs. 1-2, (annotated), 2:18-23; *see also* Fig. 3.) These ribs extend rearward from the front rim and shoulder 143 of the flange and define an interior recess space within the housing, as, for example, the interior ribs 17 surround and define the interior “receiving space 10” inside of the housing 1 that extends from the closed rear end 12 forward toward the shoulder 143 of the flange. (*Id.*, Figs. 1-3, 2:3-6, 18-27.) *See also infra* Ground 5, Claim 21[C]. The space between these ribs is open, and is capable of receiving other components to be mounted within the interior of the lighting device. For example, driving unit 6, is disposed in this space, and is connected to the circuit board 3 by wires passing through one of the through holes in the heat dissipating plate 2. (*Id.*, 2:51-60.)

21[A.iii]: the housing further including a rear cover that encloses the rear receptacle;

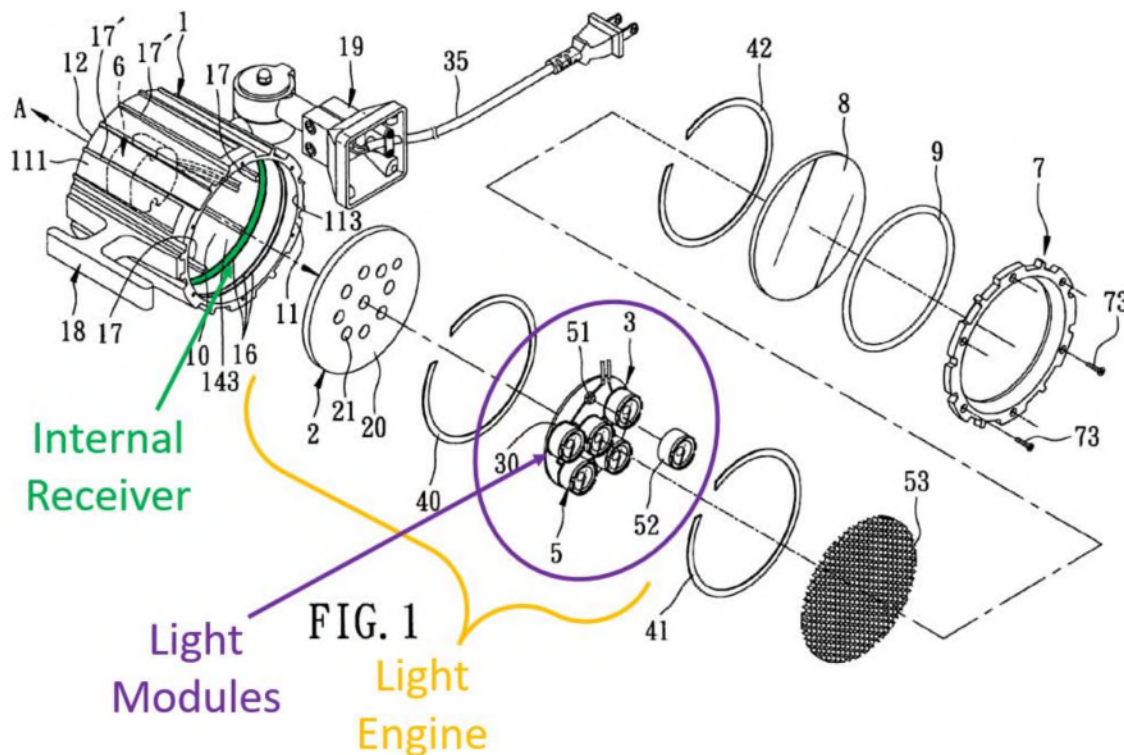
106. Chen discloses Claim 21[A.iii]. Chen discloses that the housing includes “a rear wall connected to a rear end of the tubular body 14”:



(*Id.*, Fig. 2 (annotated), 2:3-8 (stating the housing has a “closed rear end 12”); *see also* Fig. 3, Cl. 1, 1:24-27.) This rear wall encloses the interior receiving space 10 between the interior fins 17. (*Id.*) By enclosing the rear receptacle, or open interior receiving space 10, the rear wall helps to create a closed lighting unit. In doing so, it helps to protect the electrical components within the housing and support safety of users.

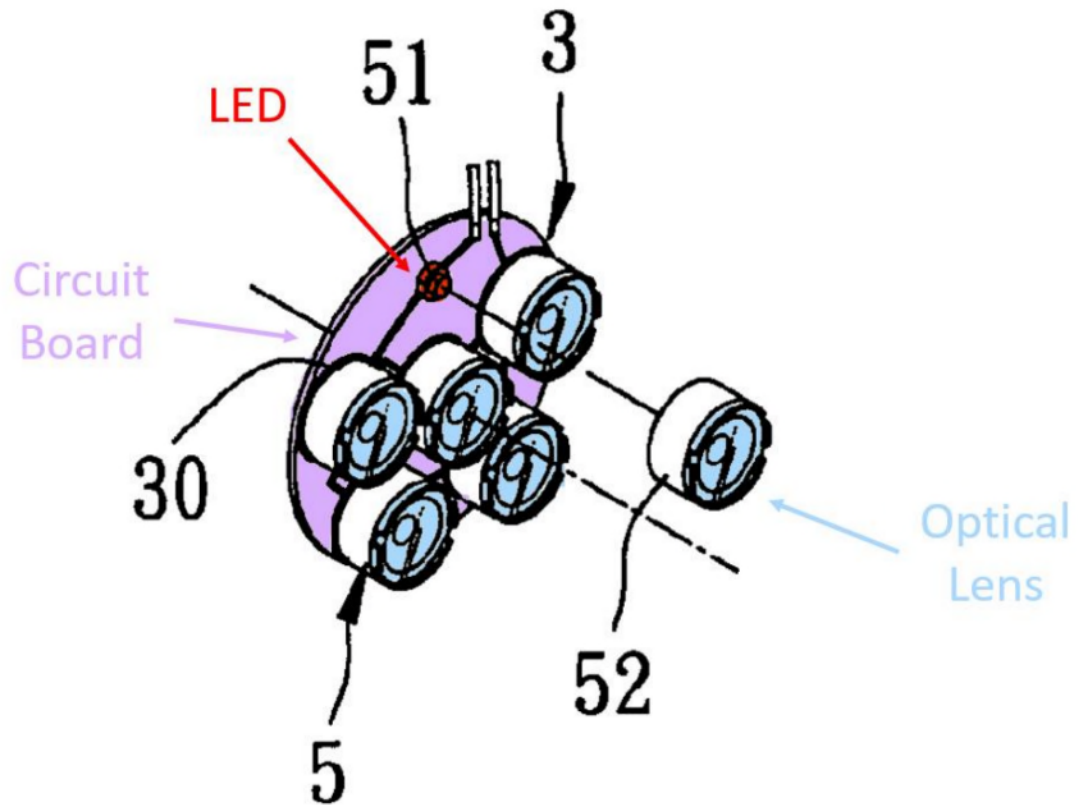
21[B]: a light engine assembly mounted to the receiver, the light engine having a plurality of light modules, wherein each module includes both a LED mounted to a printed circuit board and an optical lens extending from the printed circuit board;

107. Chen discloses Claim 21[B]. Chen discloses a “light engine assembly,” which is a term commonly used to refer to an assembly of one or more LEDs or LED modules, along with other optical, electrical, and mechanical components. In particular, Chen discloses “a lighting device” comprising a plurality of “lighting units” attached to a heat dissipating plate 2 (together, a light engine assembly) mounted in “the receiving space in the housing” (i.e., the receiver):

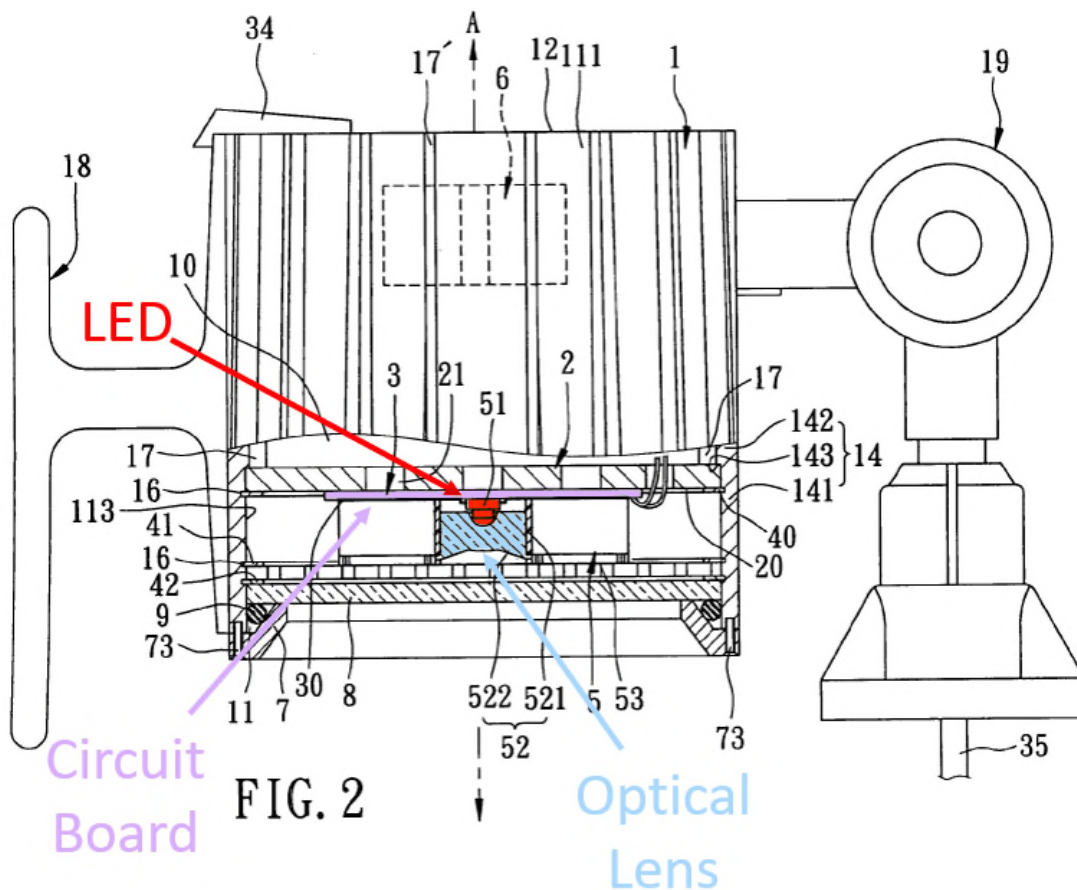


(Chen, Fig.1 (annotated), 1:28-39, Fig. 2.) For example, Chen discloses that the lighting units are mounted to a “mounting surface 20” of the heat dissipating plate, which is positioned within the receiving space defined by the flange and “abuts against the intermediate shoulder portion 143” of the tubular body. (*Id.*, 2:24-39.) Thus, the “lighting units” (or modules) attached to the heat dissipating plate make up the light engine assembly in Chen and are mounted to a receiver, the intermediate shoulder portion 143, in the housing. As I discussed above, during installation, the heat dissipating plate with the circuit board and lighting units attached thereto, is mounted to the intermediate shoulder portion when it is positioned in the lighting device and “abuts” the shoulder portion. See Ground 5, Claim 21[A.i.].

108. Chen further discloses that its light engine assembly comprises “a plurality of lighting units,” or modules, each having “a light emitting diode 51 . . . mounted on the circuit board 3, and a condensing member 52 mounted on the circuit board 3 and disposed around the light emitting diode 51”:



(Chen, Fig. 1 (annotated), 2:40-44; *see also* 1:35-38.) Chen’s condensing members are “lenses,” and extend from the circuit board. (*Id.*, Fig. 2 (annotated), 2:40-51.) In particular, Chen discloses that condensing members are in fact “mounted on” the circuit board with each LED having “a condensing lens 522”:



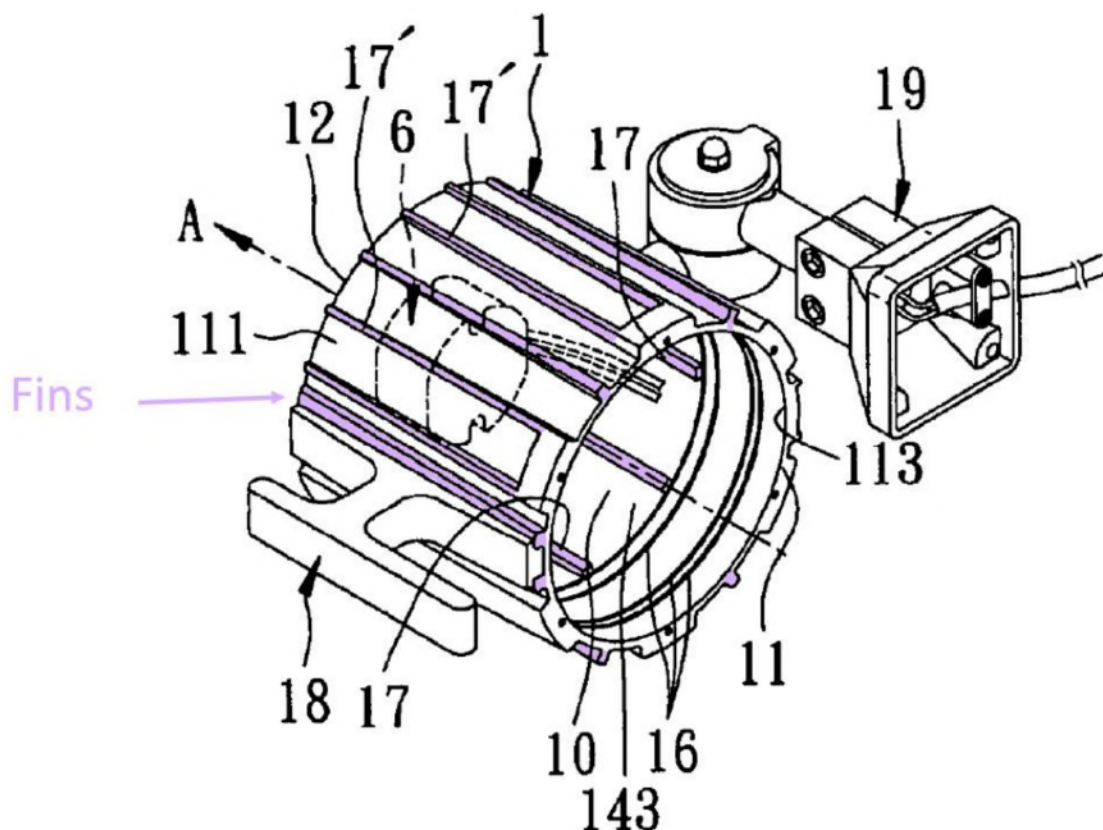
(*Id.*, Fig. 2 (annotated), 2:40-51.) Each condensing lens 522 optically condenses light generated by an LED 51 so that “the illumination apparatus can achieve high-brightness illumination.” (*Id.*, 2:40-51, 3:17-19.) Stated differently, the condensing lens concentrates the light emitted from the LED so that it is more concentrated in a forward direction, rather than being spread out. As previously explained, this increases the brightness in a target area, allows the device to illuminate areas at further distances more effectively, and reduces the amount of light that would otherwise be wasted illuminating unnecessary areas.

electrically to an external power source . . . for activating the light emitting diodes 52.” (*Id.*, 2:51-57; *see also* Cl. 1, 1:39-42, 2:24-27, 4:11-15.) That is, the driving unit 6 is a power supply, as it provides power to the LEDs so that they can be “activated.”

110. Further, a switch 24 is mounted on the rear wall and is connected to the driving unit to control the electrical power thereto. (*Id.*, 2:51-60) The driving unit “activates” the LEDs by supplying electrical power at an appropriate current and voltage. Usually, in doing this, a driving unit converts AC power from the external power source to which it is connected into DC power for the LEDs. This driving unit applies the appropriate voltage and current to the LEDs so that they emit light at a desired intensity. For example, driving at a higher current (*i.e.*, supplying more power) causes the LEDs to emit more light flux.

21[D]: wherein during operation, heat generated by the LEDs passes through the circuit board and then said heat is dissipated by the array of fins without the use of a fan.

111. Chen anticipates and renders obvious Claim 21[D]. As previously discussed, Chen discloses a housing including heat dissipating ribs 17 and “heat dissipating ribs 17’ (*i.e.*, fins) that extend from the inner and outer surfaces of the housing:



(Chen, Fig. 1 (annotated), 2:18-24.) *See also supra* Ground 5, Claim 21[A.i]-[A.ii].

Chen further discloses that during operation of the light when the LEDs are activated, “[d]ue to the presence of the heat dissipating plate 2 and the heat conductive housing 1, heat generated by the light emitting diodes 51 can be dissipated.” (Chen, 3:10-12, 1:17-20, 2:3-51.) That is, the heat-dissipating fins, which are extensions of the housing, dissipate heat from the LEDs that conducts through the circuit board to the heat dissipating plate and into the housing.

Converting electricity to light using light emitting diode is not a 100% efficient conversion and the result is that LEDs generate undesired heat during operation.

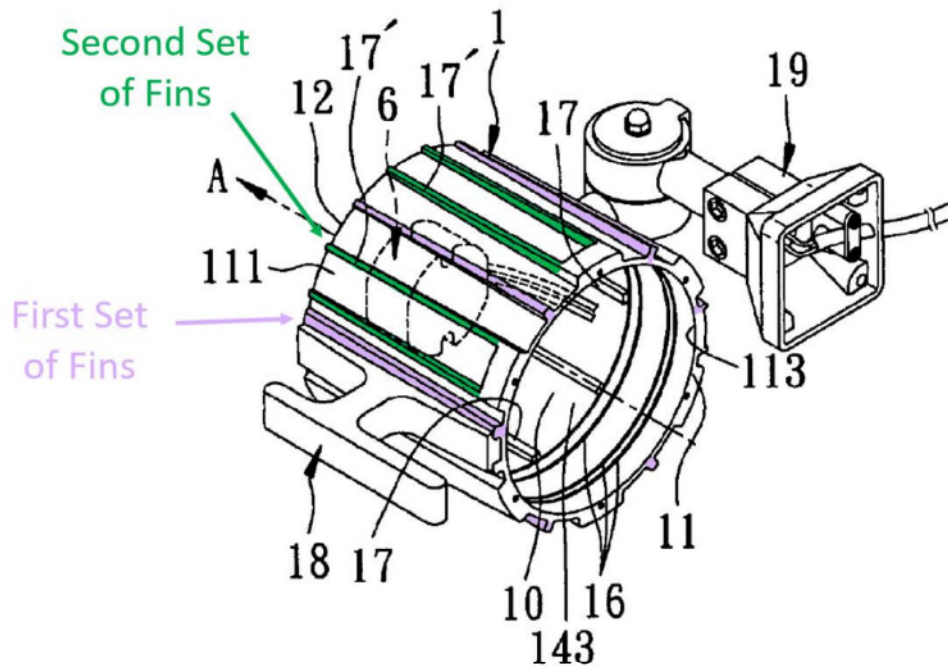
As the LEDs are mounted to the circuit board, the heat generated by the LED is

conducted through this circuit board and into the heat-dissipating plate 2 (and housing 1) to which the circuit board is mounted. From there, the heat is conducted into the housing and its ribs, where it is then dissipated into the cooler air of the surrounding environment. Chen does not disclose or discuss a fan, nor does Chen illustrate a fan in any of its figures.

2. Dependent Claim 22

The LED light fixture of claim 21, wherein the array of fins includes a first set of fins with a first fin length and a second set of fins with a second fin length, wherein the first fin length exceeds the second fin length.

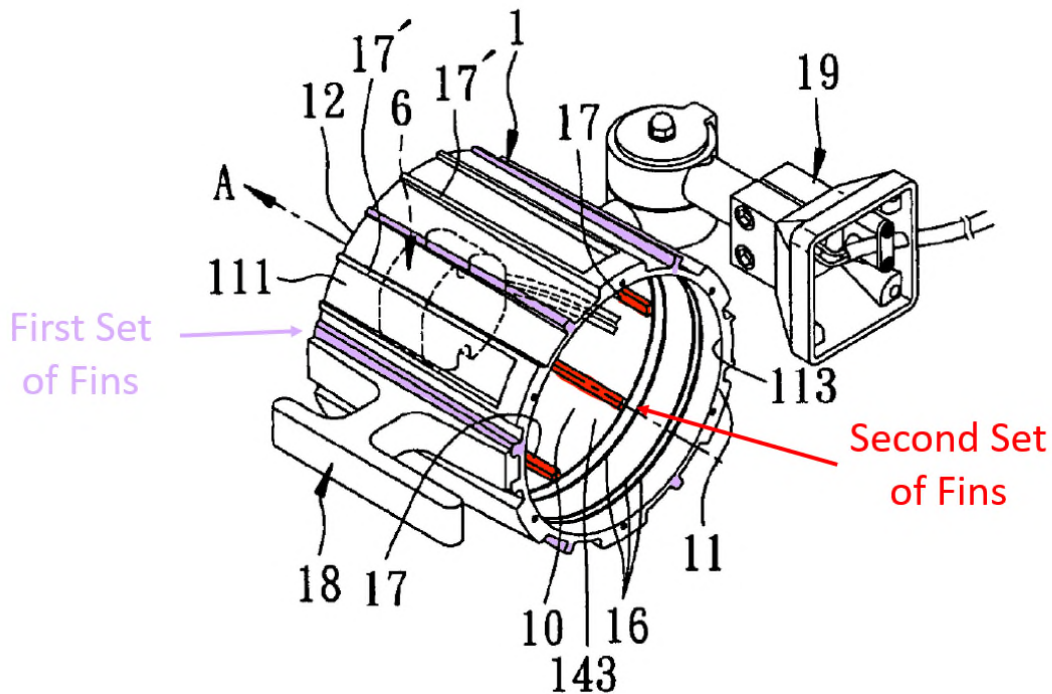
112. Chen anticipates and renders obvious Claim 22. Chen discloses “a plurality of heat-dissipating ribs” 17 and 17’ (*i.e.*, an array of fins). *See supra* Ground 5, Cls. 21[A.iii], [D]. As shown in Figure 2, Chen’s outer heat-dissipating ribs 17’ consist of a set of fins with a first fin length (annotated in purple) and a set of fins with a second fin length (annotated in green) that is less than the first fin length:



(Chen, Fig. 1 (annotated).) The first set of fins annotated above in purple span the entire length of Chen’s tubular housing, whereas the second set of fins annotated in green span from the rear end of the tubular housing to a rectangular, protruding portion of the housing which provides a hole for fasteners to be anchored.

113. Moreover, Chen discloses inner heat-dissipating ribs 17 that span from the rear-most annular engaging groove 16 to the rear end of the tubular body.

(Chen, 2:13-23, Fig. 2.) Inner heat-dissipating ribs 17 have a fin length less than the fin length of a set of outer fins as can be seen in annotated Figure 1 below:



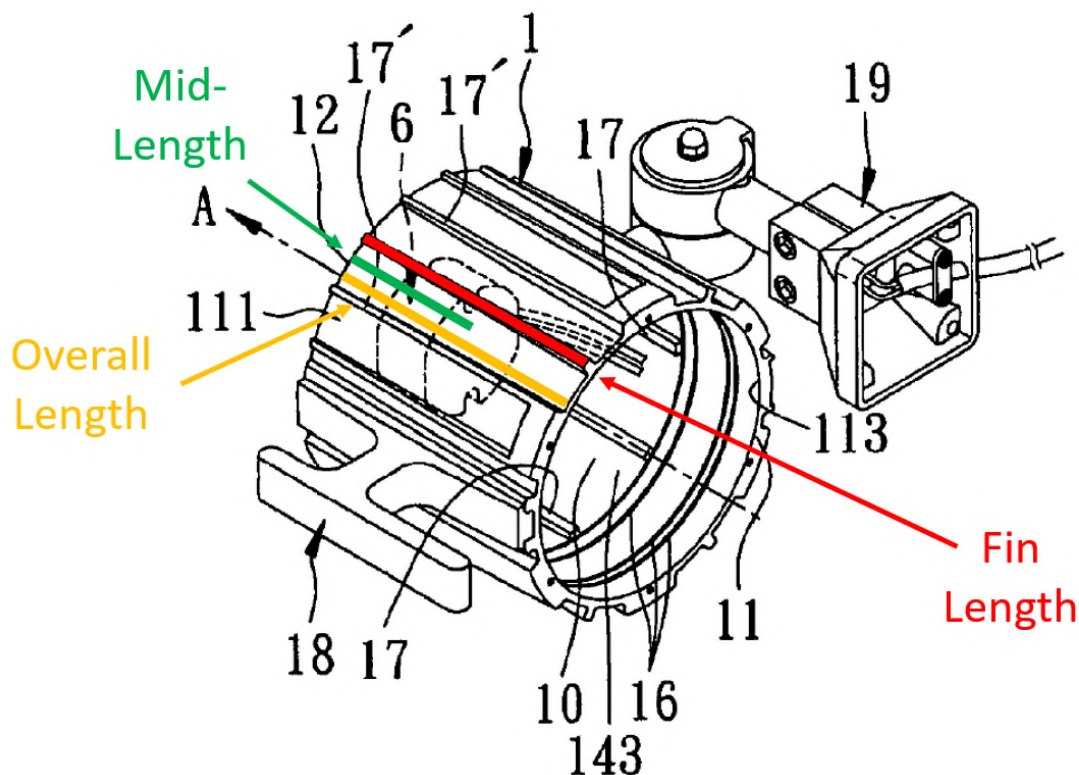
(Chen, Fig. 1 (annotated).) For example, while the outer ribs can extend all the way from the back of the lighting device to the front rim of the flange, the inner ribs (e.g., second set of fins) only extend from the back of the lighting device up to the heat-dissipating plate and intermediate shoulder portion 143 of the flange. (*Id.*, Figs. 1-2, 2:3-35.) The outer ribs are clearly longer than the inner ribs, and thus, these inner fins are also a second set of fins having a second fin length that is shorter than the fin length of the outer fins.

3. Dependent Claim 23

The LED light fixture of claim 21, wherein the housing has an overall length and a mid-length, and wherein the array of fins has a length that exceeds said mid-length.

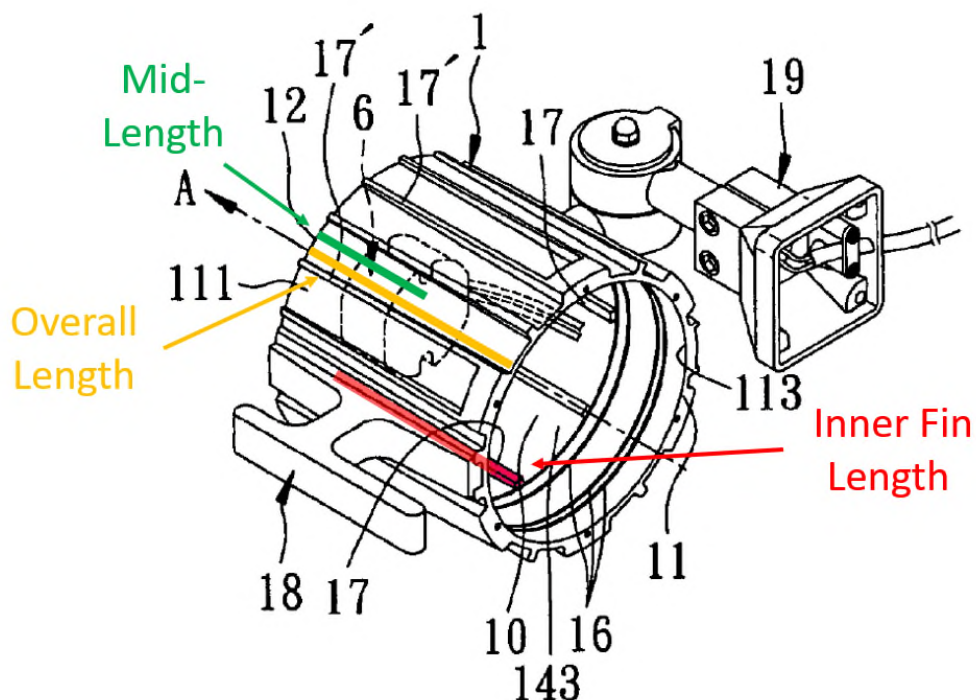
114. Chen anticipates and renders obvious Claim 23. As previously explained, Chen discloses a housing including a plurality of heat-dissipating ribs

(i.e., an array of fins). *See supra* Ground 5, Cls. 21[A.i]-21[A.iii], 21[D], 22. A POSITA would understand that the housing's mid-length is half of the overall length, or a length from the end to the middle of the housing. As shown in Figure 2, Chen discloses a housing with an overall length spanning from rear end 12 to front end 11 represented by the yellow line annotated below. (Chen, 2:3-6.) The mid-length, the distance between the end and middle of the housing in the length direction is shown annotated in green. Accordingly, Chen's housing has a mid-length half this distance. Figure 2 of Chen shows that the array of fins also spans from the rear end to the front end of the housing. Thus, the length of the array of fins has a length that greatly exceeds said mid-length:



(Chen, Fig. 1 (annotated).)

115. Further, Chen discloses that the “tubular body 14 has a front end portion 141, and a rear end portion 142” and “the rear end portion 142 of the tubular body 14 has an inner surface formed with a plurality of heat-dissipating ribs 17.” (Chen, 2:9-10, 17-19.) Chen shows the inner heat-dissipating ribs 17 (*i.e.*, inner fins) span the rear end portion of the body to the rearmost engaging groove 16 at the intermediate shoulder portion 143 of the body:



(Chen, Fig. 2 (annotated).) Accordingly, the length of Chen’s inner fins have a length that exceeds the mid-length.

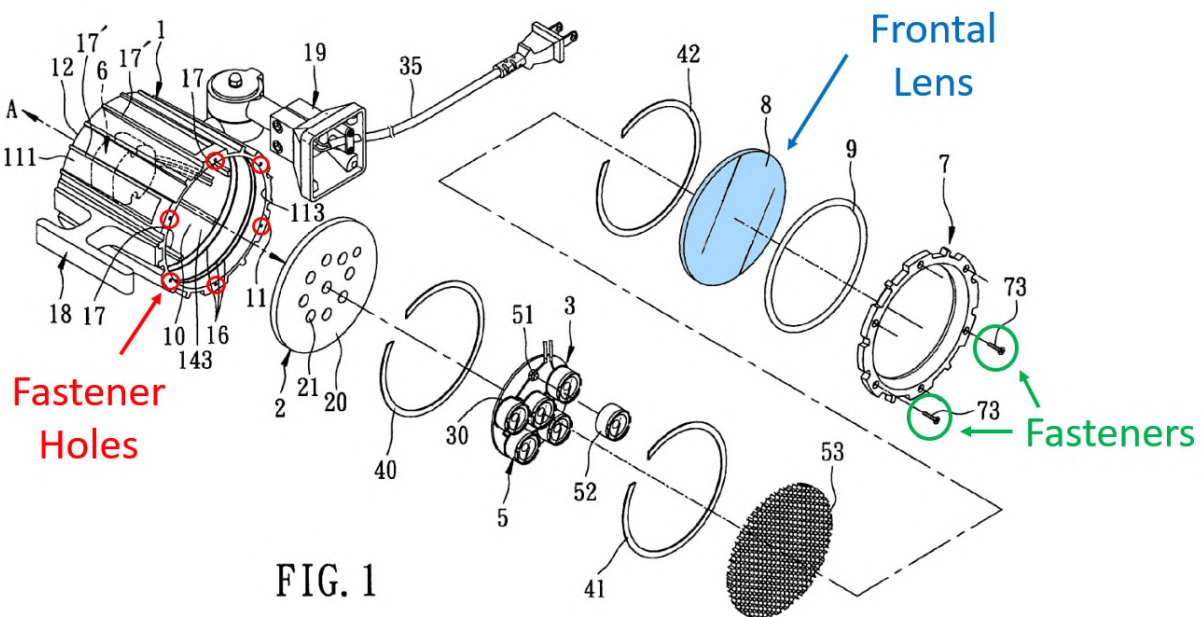
116. Moreover, even when the additional components, such as the transparent plate, washer 9, and annular cap are attached, these add very little

additional length to the overall lighting device. (*Id.*, Figs. 1-2.) As such, it is clear that the ribs, which extend axially along most of the length of the housing 1, still have a length that is well over half of the overall length of the entire device.

4. Dependent Claim 26

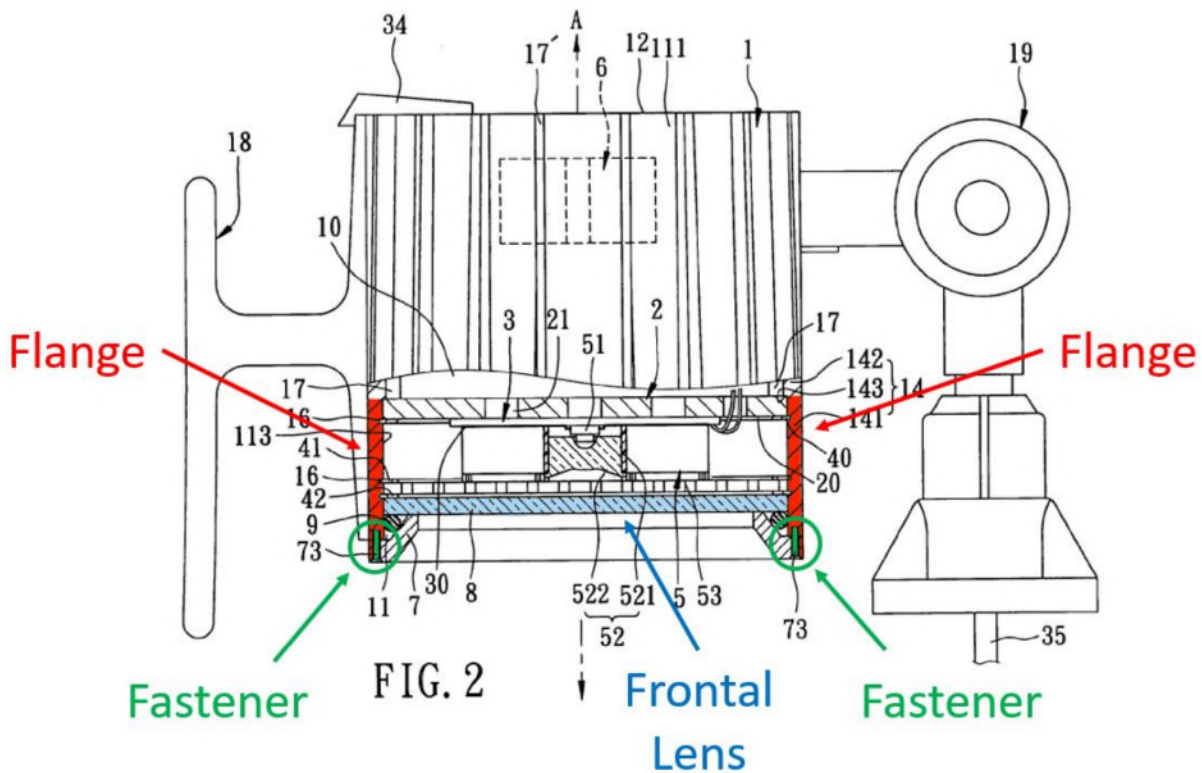
The LED light fixture of claim 21, wherein the frontal lens is secured to the flange by a plurality of fasteners arranged at the periphery of both the frontal lens and the flange.

117. Chen anticipates and renders obvious Claim 26. Chen discloses transparent plate 8 [(i.e., the frontal lens)] is disposed in the housing 1” and is secured in place to the flange by “annular cap 7 . . . by means of a plurality of screw fasteners 73” arranged around the edges, or periphery, of the flange and lens:



(Chen, Fig. 1 (annotated), 2:61-67.) As shown in Fig. 1 above, screw fasteners 73 are arranged at the periphery of the frontal lens and flange, and secure the

transparent plate (*i.e.*, lens) to the flange. (Chen, Figs 1-2, 2:61-67.) In particular, six fasteners are evenly spaced along the periphery of the frontal lens and flange. (*Id.*, Figs. 1-2.) As illustrated, the frontal lens (transparent plate 8) is positioned just inside where the screws pass through the annular cap, with the screws surrounding the periphery of the lens. The screw fasteners 73 are anchored into rectangular protruding portions of the front rim of the flange of the tubular body, which have holes for receiving the screws. For example, screw fasteners 73 extend through holes in the annular cap 7 and into corresponding holes the flange portion of the housing:



(Chen, Fig. 2 (annotated), Figs. 1, 3, 2:61-3:7.) Thus, screw fasteners 73, along with annular cap 7 secure the frontal lens in place. (*Id.*)

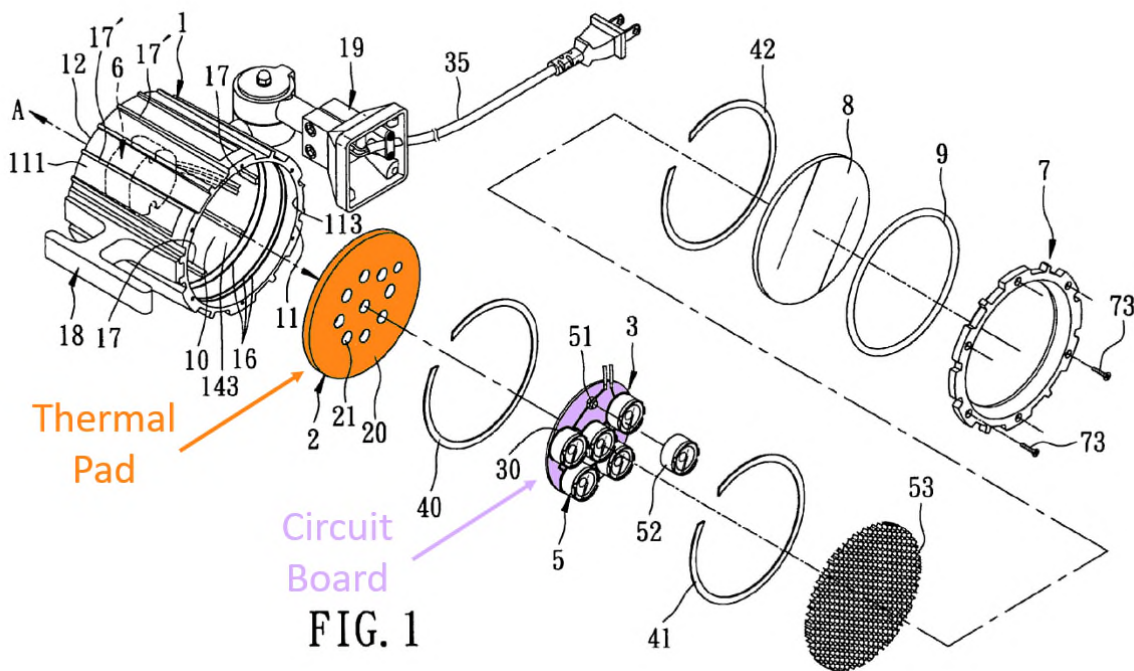
F. Ground 6 – Chen in view of Lodhie Renders Obvious Claim 24

1. Dependent Claim 24

The LED light fixture of claim 21, further comprising a thermal pad residing between the receiver and the printed circuit board, wherein both the thermal pad and the printed circuit board have at least one opening that receives a lead extending between the power supply and the printed circuit board.

118. Chen in view of Lodhie renders obvious Claim 24.

119. Chen discloses its lighting device includes heat dissipating plate 2 (*i.e.*, thermal pad) and circuit board 3. (Chen, 2:28-39; *see also* Fig. 1.) Chen's heat dissipating plate can be made from, for example, aluminum – a material with a high thermal conductivity. (*Id.*, 2:28-29.)



(Chen, Fig. 1 (annotated), 2:28-39.) Chen explains “circuit board 3 is attached to the mounting surface 20 of the heat dissipating plate 2 . . . so as to be in thermal contact therewith.” (*Id.*, 2:36-39.) The heat dissipating plate 2 is a thermal pad because it acts as a thermal interface between the circuit board which is generating heat and the heat-conductive body. The heat dissipating plate 2 provides a path for heat to be efficiently conducted from the electrical components to the housing and its fins which then transfer the heat into the surrounding air. The heat dissipating plate is, itself, attached to a mounting surface in a receiver of the housing, as it “abuts against the intermediate shoulder portion 143” in an open receiving space of the body housing (*Id.*, 2:38-58, Figs. 1-2.) Chen discloses that “[d]ue to the presence of the heat dissipating plate 2 . . . heat generated by the light emitting diodes 51 can be dissipated.” (*Id.*, 3:10-13.)

120. Chen further discloses heat dissipating plate 2 includes plurality of through holes 21 allowing driving unit 6 (*i.e.*, the power supply) to be “connected electronically to the circuit board 3 via wires passing through one of the through holes 21.” (*Id.*, 2:52-58.) For example, Chen shows an arrangement of holes in heat-dissipating plate 2 in Figures 1 and 2. There is one hole off the upper right of the rest in Figure 1, and this hole is illustrated as the hole through which wires (leads) coming from the power supply 6 pass through before they connect onto circuit board 3:

through base 13 and is in electrical contact with one of contacts 15a and 15b at one end and a lead of an LED, preferably on printed circuit board 11a' at the other end. The other of wires 43 and 45 passes through base 13 and is in electrical contact with the other of contacts 15a and 15b, the other end of which is in electrical contact with a lead of an LED, preferably on printed circuit board 11c.” (*Id.*, 3:31-48.) Lodhie further discloses that, to connect the wires to the LED contacts, the wires may pass through “holes” in the circuit boards. (*Id.*, 3:49-67, 2:39-47, Figs. 2, 5.) In particular, Lodhie discloses that “wire 43 is shown connected to one lead of LED 63 in LED layer 11a. ... One lead of LED 67 is connected to a wire 57 which passes through hole 59 to the second LED layer and is connected to one lead of an LED on the second layer. Wire 45 passes through hole 61 and through a corresponding hole in printed circuit board 11b' and is coupled to one lead of an LED on the third layer. In this manner a complete circuit is formed so that the LEDs in each layer are connected in a series relationship and are electrically connected to contacts 15a and 15b so that when appropriate power is applied to contacts 15a and 15b, all the LEDs in each layer become lit.” (*Id.*, 3:49-67.) That is, Lodhie discloses that lead wires may be passed through holes in LED circuit boards in order to power LEDs, and Lodhie further discloses that the use of holes for passing the wires allows for the wires to be “kept as short as possible” to avoid problems during installation and to avoid crimping. (*Id.*, 4:1-7.)

122. A POSITA been motivated to include holes in the LED PCB of Chen as taught by Lodhie for providing a pathway to receive wires from the power supply in order to power the LEDs. (Lodhie, 1:46-63, 2:16-67, 3:23-62, 4:1-7, Figs. 2-3, 5.) A POSITA would have understood that providing a hole for the power supply wires to connect to the LED contacts on the circuit boards would have been simply use of a well-known technology, forming a hole in the PCB for wires to pass, to provide a pathway for physical wires to make the required connections to power the LEDs. A POSITA would have had a reasonable expectation of success, as using a PCB hole, or opening, as taught by Lodhie, would allow the wires to pass through to their connections even when there is not space within a housing for the wires to go from an opening and then around a circuit board (as is shown in Chen). (*Id.*)

123. This would have also allowed the wires to be kept as short as possible, avoiding problems with tangling or crimping during installation as taught by Lodhie. (*Id.*, 4:1-7.) If the wires were too long, or had to snake around too many other components to reach the contact points on the circuit board, there is a greater chance of them becoming tangled, crimped, or damaged during installation. Moreover, trying to pull wires through tight spaces can be difficult, and can again result in the wires becoming damaged if they get caught during the installation process. By providing the wires through holes in the circuit board, as taught by

Lodhie, the installation process can be made easier as the wires can be more directly connected from the power source to the circuit board contacts. At the very least, a POSITA would have found it obvious to try a hole, or opening, in the PCBs of Chen for the power supply wires to pass through and connect to the traces and other electronic components on the PCBs requiring power, as this would be one of a limited known ways of making such connections.

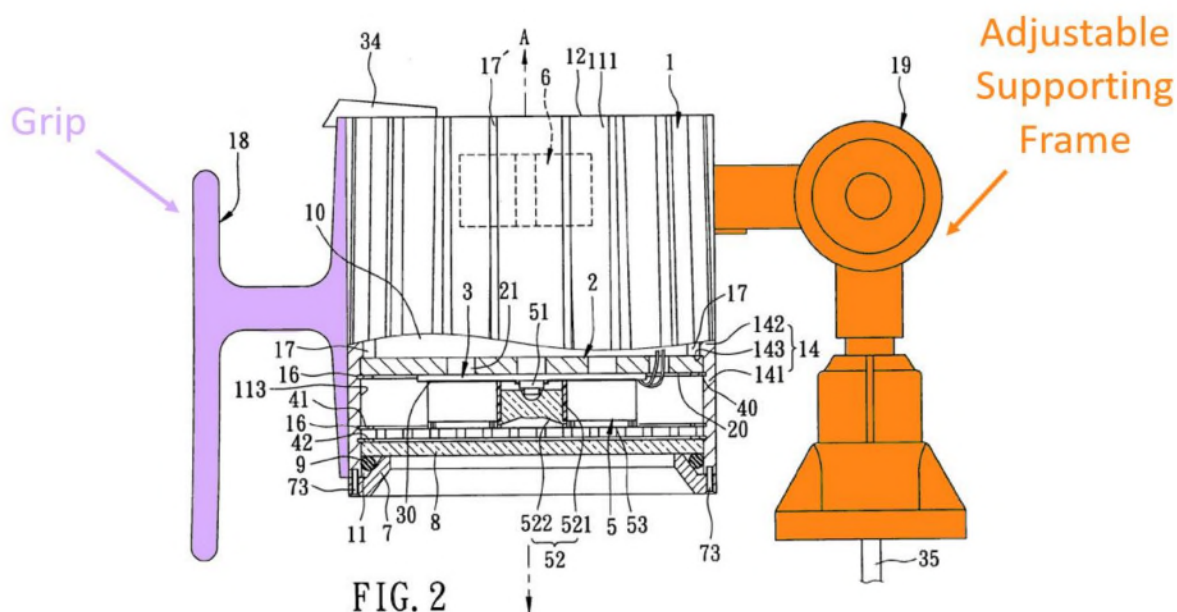
124. For example, a POSITA would have recognized there are only a few ways such wires could be connected, including: 1) passing wires around a circuit board, as taught in Chen, or 2) creating a hole in the LED PCB for the wires to pass through as taught by Lodhie. And, a POSITA would have found it obvious to try these different approaches under different circumstances. A POSITA would have found it at least obvious to try passing wires through a circuit board where space is more constrained or a direct connection from the thermal pad opening is desired such that the wires do not need to bend or be potentially pinched, damaged, or caught during installation. (*Id.*)

G. Ground 7 – Chen in view of Lin Renders Obvious Claim 25

1. Independent Claim 25

The LED light fixture of claim 21, further comprising a mounting bracket having opposed side segments that are secured to opposed sides of the housing rearward of the flange.

125. Chen in view of Lin renders obvious Claim 25. Chen discloses its device may include a grip 18 and an adjustable supporting frame 19:



(Chen, Fig. 2 (annotated), 2:19-23.) A POSITA would have understood Chen’s grip and adjustable supporting frame are used to hold the lighting device’s position, and the adjustable supporting frame could be fastened to a surface to mount Chen’s lighting device in position.

Further, Lin, in the same field as Chen, discloses “a grab handle (24), the two ends of the grab handle (24) [(i.e., a mounting bracket)] are fixed on two corresponding sides of the heat dissipation unit (2)” and “can be fixed to the wall

surface through the slotted hole (25).”

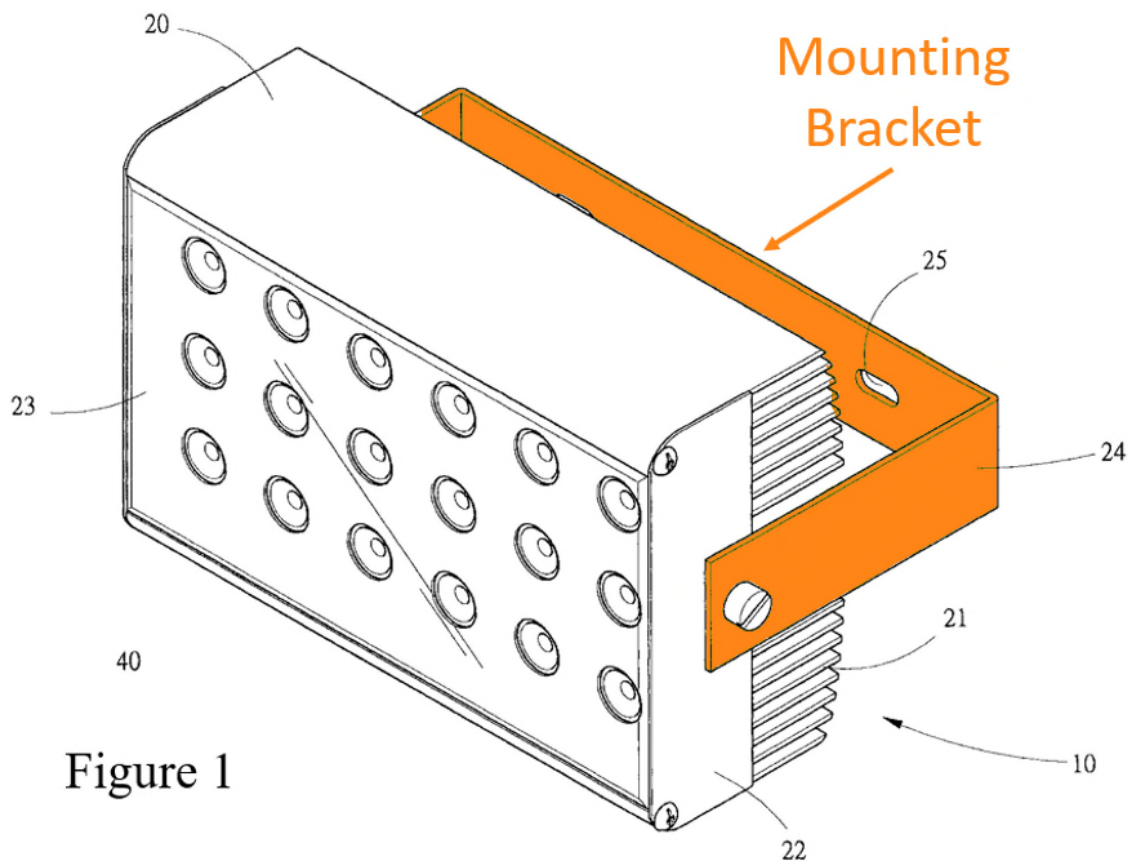


Figure 1

(Lin, Fig. 1 (annotated), 6:6-11.) *See supra* Ground 1, Claim 25.

126. A POSITA would have been motivated to modify Chen to include Lin’s grab handle in place of or in addition to Chen’s grip and adjustable supporting frame. Lin and Chen both disclose lighting devices with LEDs and heat-dissipating elements, and both disclose components to hold or mount the light. (*Compare* Lin, 4:4-10, 4:14-16 *with* Chen, 1:18-21.) Using Lin’s grab handle would have been a simple substitution of a known element for another to obtain predictable results, and would have provided a simple mechanism for the light to

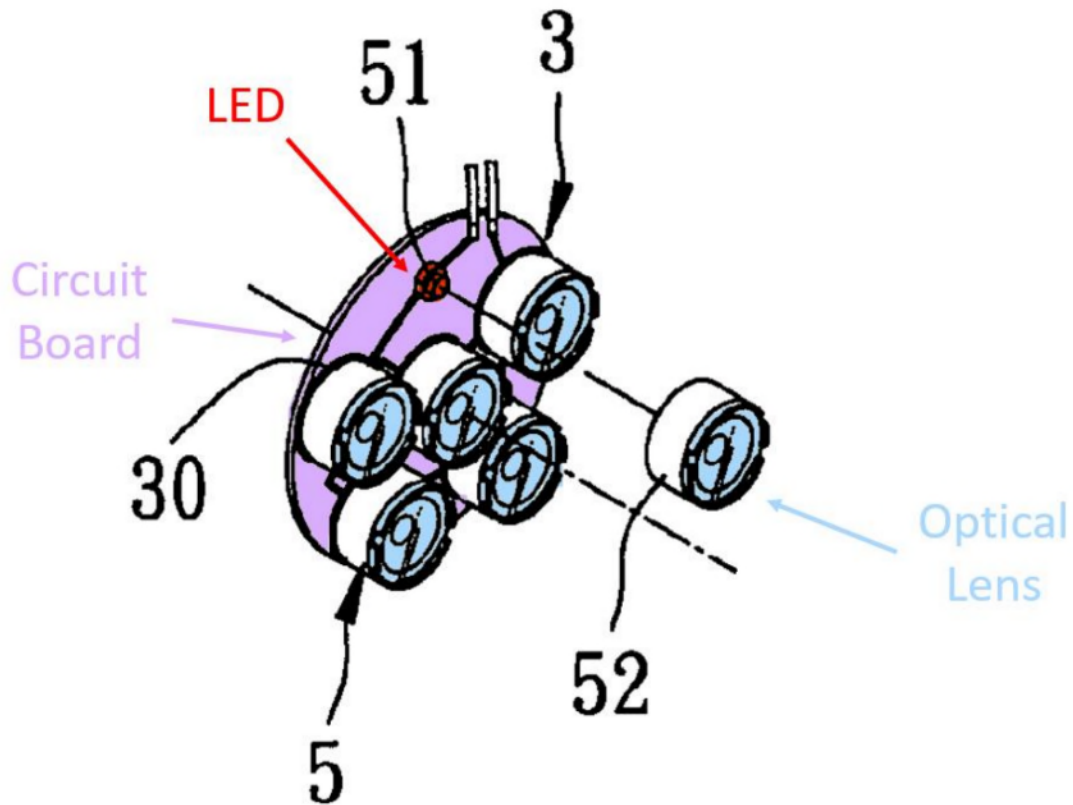
either be held or mounted to a wall using slotted holes in the grab handle. Chen already teaches elements to stabilize the lighting device like Chen's grip and adjustable supporting frame, and a POSITA would have understood to use a grab handle like that in Lin to be known alternative way to have a handle for a light that also allows for fixably mounting the light to a surface like a wall. A POSITA would have found it obvious to try a mounting bracket like that in Lin, and would have had a reasonable expectation of success using it with the lighting device in Chen, as using Lin's grab handle would have been a simple alternative means to stabilize and support Chen's lighting device, and Lin's bracket could easily be attached at the same locations on the light as Chen's grip and adjustable support to continue to perform its same function. A POSITA would have also understood that Lin's grab handle could be used in addition to Chen's grip and adjustable supporting frame.

H. Ground 8 – Chen in view of Moriyama Renders Obvious Claim 27

1. Dependent Claim 27

The LED light fixture of claim 21, wherein each module of the light engine includes a zener diode in a one to one parallel relationship with the LED.

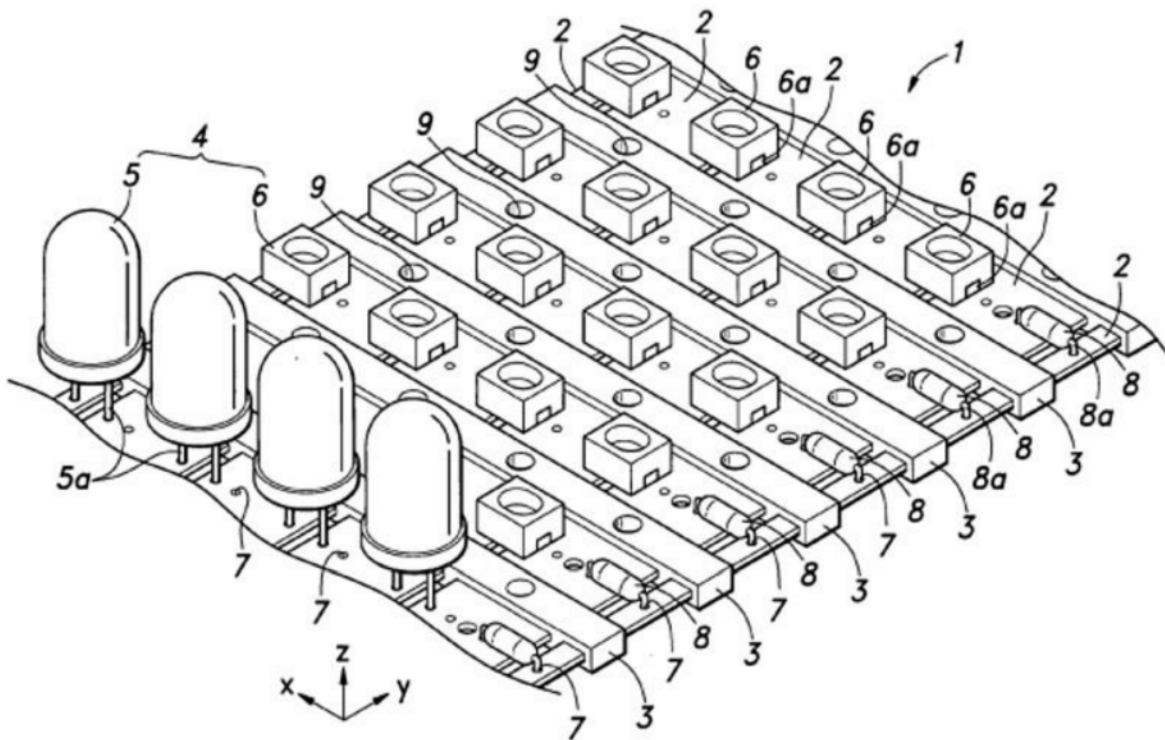
127. Chen in view of Moriyama renders obvious Claim 27. As explained above, Chen discloses “a plurality of lighting units” that each have “a light emitting diode 51 . . . mounted on the circuit board 3, and a condensing member 52 mounted on the circuit board 3 and disposed around the light emitting diode 51”:



(Chen, Fig. 1 (annotated), 2:40-44; *see also* 1:35-38.)

128. Moriyama discloses “a light emitting module comprising one more light sources.” (Moriyama, [0002].) Moriyama teaches “a light emitting module which has an improved heat dissipation property.” (*Id.*, [0007].) Moriyama discloses a light emitting module with “a plurality of plate-shaped conductors 2 spaced apart from each other” and “a plurality of LEDs 4 mounted between adjoining conductors 2 to serve as light sources.” (*Id.*, [0079].) Moriyama further explains the LEDs may comprise “bullet-type LEDs (or lamp-type LEDs) 5” and “chip-type LEDs 6.” (*Id.*, [0080].) The LEDs used in the module may also “comprise LEDs of only one type.” (*Id.*)

Fig. 1



(Moriyama, Fig. 1) Moriyama discloses “insulating joint members 3 expose both sides of various portions of the conductors 2 inclusive of the portions where the LEDs 4 are mounted, and the thickness of the joint members 3 serves to ensure that a space is created between the conductors 2 and the Support member (not shown) when the light emitting module 1 is secured to the support member, whereby achieving favorable heat dissipation characteristics.” (*Id.*, [0084].)

129. Moriyama additionally discloses that “a resistor 157 and a Zener diode 158” may be “provided for each LED 156.” (*Id.*, [0120].)

voltage in that direction. Zener diodes are commonly used to prevent an overvoltage. Zener diodes in parallel with the LEDs are often included within the LED package. When the breakdown voltage is reached, the Zener diode will maintain a stable voltage across its terminals. Thus, using a Zener diode with a Zener voltage less than a harmful voltage level effectively prevents an overvoltage. High voltages can occur due to high voltage electrostatic discharges (such as from people, equipment, and sources of friction), voltage spikes, or high voltage fluctuations due to component failures, or shorts, for example. Further, Zener diodes were known to protect against an entire string of LEDs failing if one LED in the array were to fail by becoming open.

131. It would have been obvious to a POSITA to modify Chen's lighting units to include a Zener diode for each LED as taught by Moriyama. Chen already uses an array of LEDs like the LED module taught by Moriyama. Including a Zener diode for each of Chen's LED would be using a known technique and electrical component to improve a similar device in the same way, that is, to prevent an overvoltage from being applied to one of the LEDs. A POSITA would have been motivated to include Zener diodes with the LEDs in Chen's array in order to protect the LEDs and extend their service life, something that Chen notes is one of its goals.

I. Ground 9 – Chen in View of Nishimoto and Cunningham Renders Obvious Claim 28

1. Dependent Claim 28

The LED light fixture of claim 21, wherein during steady state operation of the fixture in 25 C ambient environment, the LED junction temperature at the printed circuit board is approximately 55 C and the housing body temperature is approximately 45 C.

132. Chen in view of Nishimoto and Cunningham renders obvious Claim 28. Again, Chen discloses an LED Lighting device with a “a housing made of heat conductive material” that has a “plurality of heat-dissipating rubs.” (Chen, Abstract, 1:18-27, 2:17-39, 3:10-16.) *See supra* Ground 5, Claims 21-23. The temperature at the LED junction, where the heat is generated, would be higher than that of the heat-dissipating body, including the fins, which draw away heat from the LED circuit board and dissipate it into the environment around the lighting fixture. The heat from the source (the LED) flows from regions of higher temperature (the LED junction) to regions of lower temperature (ambient environment). At equilibrium with a constant, lower ambient temperature, the heat generated by the LED will flow from the LED junction through components, such as housings or heat sinks where some of the heat will dissipate to the ambient environment, resulting in components that are warmer than ambient, but not as hot as the source. If the heat were not to flow, or have a large resistance to flow, the junction temperature would increase to very high temperature values that

drastically reduce the lifetime of the LED. Using heat conducting housings and/or heat sinks offers a lower thermal resistance to conduction of heat (lower than just air for example), such that heat may flow more easily to other components with larger surface areas where it can dissipate. Using thermally conducting housings and/or heat sinks are common methods for lowering the junction temperature of LEDs. In particular, the heat-dissipating plate, housing 1, and ribs 17, 17' in Chen are designed to dissipate heat away from the LEDs on the PCB, thereby preventing the LEDs from getting too hot, which could lead to thermal deterioration, reduced efficiency, or potentially failure of the LEDs. (Chen, 1:18-27, 2:17-39, 3:10-16; Nishimoto, 2:11-311, 6:4-14.) *See also supra* Ground 4, Claim 28.

133. Nishimoto, in the same field as Chen, discloses “an LED lighting apparatus . . . for improving thermal dissipation properties.” (Nishimoto, Abstract, 1:5-7, 3:8-12, 11:15-28, 15:26-16:24, 28:19-30:21, Figs. 1, 10A-11B.) Nishimoto discloses there is a relationship between properties of the heatsink, LEDs, and circuit board components, and that junction temperature and the temperature of any attached heat sink body are dependent upon (and vary with respect to), for example, the thermal resistance of heatsink, volume of the heatsink, surface area of the heatsink, and the amount of current driving the LEDs. (*Id.*, 21:11-23:20, 24:1-25:1 (including Table 1), 30:22-33:24, Figs. 13-15 (showing the relationship between junction temperature and heat sink volume, surface area, and weight,

respectively, for different driving currents).) Again, increasing the heat sink volume or surface area reduces the thermal resistance, while normally increasing the mass or weight. Also, the specific material used for the heat sink, such as aluminum, copper, or thermally conductive polymer affects the thermal resistance of the heatsink. For example, Nishimoto notes that LED chip temperature, or junction temperature, “changes due to factors such as heatsink thermal resistance, enveloping volume, area, and weight.” (Nishimoto, 33:20-24.) Further, as recited in claim 28, Nishimoto discloses that it was known to assess junction temperature at an ambient temperature of 25°C, which is slightly above normal room temperature. (Nishimoto, 11:15-26, 24:1-28 (Table 1).)

134. In particular, Nishimoto includes a table, Table 1, showing “the relationships between the enveloping volume of the heatsink and the heatsink thermal resistance” with respect to “junction temperature” at driving currents of 20mA, 30mA, 40mA, and 50mA. (*Id.*, 24:1-26:1.) As shown in Table 1, it was known in the art that, at an ambient temperature of 25°C, various combinations of driving currents and heat sink thermal resistances for a given junction to heat sink thermal resistance could result in a steady-state junction temperature around 55°C as recited in Claim 28:

TABLE 1

Relationship Between Heatsink and Junction Temperature

(Ambient Temperature: $T_a=25^{\circ}\text{C}$)

Heatsink No.	Thermal Resistance (10 W)	Enveloping Volume	Junction Temperature ($^{\circ}\text{C}$)			
	$^{\circ}\text{C}/\text{W}$	cm^3	20 mA	30 mA	40 mA	50 mA
1	0.38	4464	34.8	38.7	41.7	44.5
2	0.56	2322	35.2	39.0	43.3	46.8
3	0.65	1108.8	35.8	41.8	46.7	50.3
4	1.0	816	36.5	42.8	48.3	52.8
5	1.24	571.2	38.5	44.4	51.5	55.0
6	1.7	400	39.5	46.1	52.3	57.7
7	1.9	280	41.2	48.7	56.5	62.3
8	2.2	208	43.2	52.9	61.4	69.7
9	2.6	145.6	46.1	57.6	66.8	74.2
10	2.9	144.06	44.1	56.0	65.6	73.8
11	3.3	104	47.2	56.8	64.5	74.8
12	3.4	108.78	46.8	59.3	69.0	78.0
13	3.9	100	47.6	60.3	69.5	79.5
14	4.3	73.5	47.2	64.4	70.8	81.3
15	4.5	59.5	53.2	57.5	69.8	82.5
16	5.2	52.5	51.3	69.0	78.5	86.4
17	5.6	42.5	52.6	68.6	92.0	

(Nishimoto, Table 1 (annotated).)

135. Thus, based on these teachings from Nishimoto, a POSITA would have understood Chen's lighting fixture, comprised of a similar combination of LEDs, LED circuit boards, and a housing with a heat sink, would have had an LED junction temperature of around 55°C at an ambient temperature of 25°C , at least when the LEDs are driven with certain currents. For example, a POSITA would

have understood to vary the driving current, thermal resistance of the heat sink housing and fins (such as by different materials), and volume and layout of the heat sink and fins in order to achieve a junction temperature of around 55°C. This would have been well within routine experimentation a POSITA could perform, as junction temperature is simply a result of the relationship between several known variables as disclosed in Nishimoto. A POSITA would have been motivated to achieve such an LED junction temperature in order to ensure that the LEDs do not become too hot, such that their performance would degrade or they could fail. This is a stated goal of both Chen and Nishimoto.

136. Moreover, a POSITA would have understood and expected that, when the LED junction temperature is around 55°C, the temperature of the heat dissipating body including the heat sink would be around 45°C in at least certain circumstances. Both Chen and Nishimoto discloses that the heatsinks dissipate heat, and as such they pull heat away from the LEDs. (Chen, 1:18-27, 2:17-39, 3:10-16; Nishimoto, 2:11-311, 6:4-14.) In pulling heat away, the heatsink temperature will not be as hot as the LED junction temperature, but would be somewhat less. A POSITA would have therefore understood that Chen's LED lighting module could be made to have a junction temperature of 55°C and a housing temperature of 45°C when measured in 25°C ambient temperature, as this would merely involve the routine changing materials, heatsink thermal resistance

(which could easily be changed by adjusting the volume or surface area of the heatsink), and the current or power at which the LEDs are driven. (Nishimoto, 21:11-23:20, 24:1-25:1 (including Table 1), 30:22-33:24, Figs. 13-15, Figs. 17A-17C, 35:15-36:18.)

137. That the housing (or heat sink) temperature in Chen could be 45°C when the junction temperature is 55°C (at 25°C ambient conditions) can also be confirmed based on the teachings of Cunningham, which discloses the relationship between heatsink temperature and junction temperature.

138. Cunningham, in the same field as Chen, discloses a method for controlling a lighting fixture. (Cunningham, Abstract, [0010].) Cunningham discloses the lighting fixture may comprise an array of LEDs:

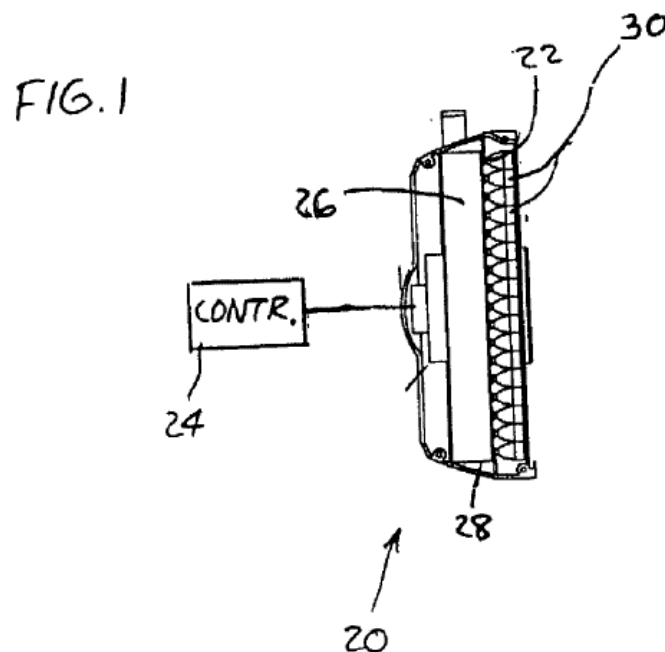
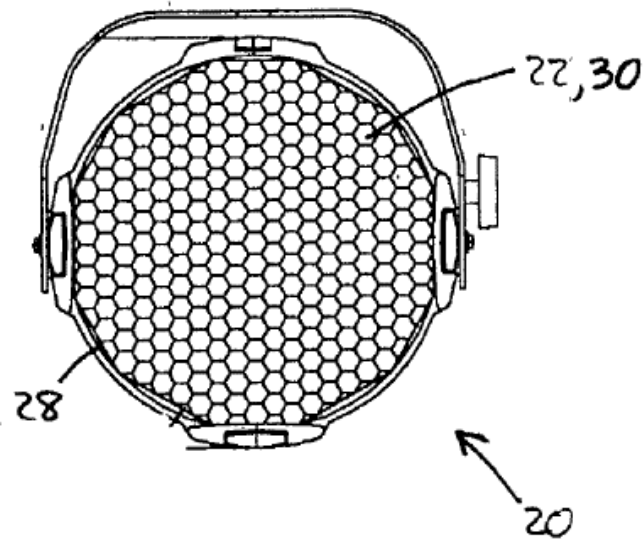


FIG. 2



(Cunningham, Figs. 1-2; *see also* Abstract, [0010], [0020]-[0021].) Cunningham teaches that when the heat sink has reached steady state, isothermal condition, the junction temperature and the heat sink temperature have the following relationship (which I will refer to as Eq. 1):

$$T_{JX} = (P_X)(\theta_{JC} + \theta_{CS}) + T_S$$

where:

T_{JX} = junction temperature of a group X LEDs (°C)

P_X = power dissipated by each LED in group X (watts)

θ_{JC} = thermal resistance between junction and case of each LED ($\frac{^{\circ}\text{C}}{\text{watt}}$)

θ_{CS} = thermal resistance between case of each LED and heat sink ($\frac{^{\circ}\text{C}}{\text{watt}}$)

T_S = heat sink temperature ($^{\circ}\text{C}$)

(Cunningham, [0056]-[0069].)

139. As I discussed above with respect Ground 4, this equation can be rearranged to determine the heat sink temperature (which I will refer to as Eq. 2):

$$T_S = T_{JX} - (P_X)(\theta_{JC} + \theta_{CS})$$

140. By applying the relationship between junction temperature and heatsink temperature disclosed by Cunningham to the data disclosed by Nishimoto's Table 1, a POSITA would have understood that an ambient temperature of approximately 25 $^{\circ}\text{C}$, a heat sink temperature of approximately 45 $^{\circ}\text{C}$, and a junction temperature of approximately 55 $^{\circ}\text{C}$ could be achieved by selecting various heatsinks and driving currents. For example, when Nishimoto's Heatsink No. 6 is used with LEDs driven at 50 mA (total power at 11 Watts)⁵ in an

⁵ When the thermal resistance used in equation Eq. 2 is the thermal resistance between all LEDs and the heatsink (which is referred to as the substrate thermal resistance by Nishimoto), the total power by all of the LEDs is used for P_X . (Nashimoto, 15:22-25). Alternatively, one may use the power from each individual LED and the thermal resistance from each individual LED to the heatsink, which is

ambient temperature of 25 °C, junction temperature is 57.7 °C (Nishimoto, 31:2-5, Table 1). The thermal resistance in Nishimoto between the junction and the heat sink is referred to as the thermal substrate resistance, which is the sum of the thermal resistance from the junction to the heat sink. This substrate thermal resistance is the total thermal resistance from the LED bare chip to the back surface of the metal layer 10A of the package which is in close thermal contact with the heat dissipating means (heat sink). (Nishimoto, 4:6-8, 15:18-22, 17:4-7, 12-16, 26:22-24, 30:10-12, Fig. 4). This substrate thermal resistance is the thermal resistance represented by $\theta_{JC} + \theta_{CS}$ in Cunningham. Nishimoto discloses that this substrate thermal resistance should not be greater than 3 °C/W and demonstrates that the substrate thermal resistance may be 1.2 °C/W and may be adjusted. (*Id.*, 16:3-11, 18:11-20, 19:1-5, 22:7-10, 19-23, 26:8-13, Figs. 8, 9). Using this substrate thermal resistance and the data for Heatsink 6 from Table 1, the heatsink temperature from Eq. 2 is:

$$T_S = 57.7^{\circ}\text{C} - (11\text{W}) \left(1.2 \frac{^{\circ}\text{C}}{\text{W}} \right) = 44.5^{\circ}\text{C}.$$

(Nishimoto, 24, Table 1.)

the total substrate thermal resistance described by Nishimoto multiplied by the number of LEDs for the configuration. (EX1012, Luxeon Application Brief AB05, 3, 10-11.)

141. Similarly, Nishimoto's Heatsink No. 7 used with LEDs driven at 40 mA (9 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 56.5 °C and a heatsink temperature of approximately 45.7 °C. (*Id.*) Likewise, Nishimoto's Heatsink No. 15 used with LEDs driven at 20 mA (5 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 53.2 °C and a heatsink temperature of approximately 47.2 °C. (*Id.*) Nishimoto also discloses examples where the substrate thermal resistance (the junction to heat sink thermal resistance represented by $\theta_{JC} + \theta_{CS}$ in Cunningham) may be 2 °C/W. (*Id.* 26:8-13, Fig. 9). Using this substrate thermal resistance and Nishimoto's Heatsink No. 10 used with LEDs driven at 30 mA (6 Watts) in an ambient temperature of 25 °C would result in a junction temperature of 56 °C and a heatsink temperature of approximately 44 °C. Thus, as I discussed above, a POSITA would have understood that the heat sink housing in Chen could have a temperature of around 45 °C during steady state operation of the LEDs at 55 °C junction temperature in an ambient temperature of 25 °C, as this would have merely been the routine result of using different materials, volumes, and power supplied to the LEDs. The equations and calculations discussed above demonstrate this, using typical variables for the heat sink volume, LED driving current, LED junction temperature at 25 °C ambient temperature, and thermal resistances.

142. Again, at the very least, it would have been obvious to a POSITA to have a heatsink temperature of approximately 45 °C, and a junction temperature of approximately 55 °C in an ambient temperature of approximately 25 °C because for a specific ambient temperature, heatsink temperature and junction temperature are a function of the thermal resistance from the junction to the heatsink, the heatsink thermal resistance, and the power (current) driving the LEDs. A POSITA would have expected to arrive at the claimed temperatures at least as part of routine experimentation, including varying the thermal resistance of the heatsink and the amount of current driving the LEDs.

VI. CERTIFICATION

I 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 are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the U.S. Code.

A handwritten signature in cursive script, appearing to read "Zane Coleman", is written over a horizontal line.

Dr. Zane Coleman

Dated: May 5, 2025

APPENDIX A

Materials Considered

Exhibit No.	Description
1001	U.S. Patent No. 7,651,245 (“ ’245 Patent ”)
1002	File History for the ’245 Patent
1004	Curriculum Vitae of Dr. Zane Coleman
1005	TW94204571U (“ Lin ”)
1006	TW94204571U (“ Lin ”) – English Translation with Certification
1007	U.S. Patent No. 7,465,006 (“ Chen ”)
1008	U.S. Patent No. 5,577,832 (“ Lodhie ”)
1009	U.S. Patent Pub. No. 2006/0146553 (“ Zeng ”)
1010	U.S. Patent Pub. No. 2005/0239342 (“ Moriyama ”)
1011	WO2005/029185 (“ Nishimoto ”)
1012	U.S. Patent Pub. No. 2004/0021859 (“ Cunningham ”)
1013	Luxeon Application Brief AB05, 3, 10-11