

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.

Brightplus Ventures LLC
Patent Owner

Patent No. 7,690,812
Filing Date: March 16, 2007
Issue Date: April 6, 2010
Title: APPARATUS AND METHODS FOR CONFORMABLE DIFFUSE
REFLECTORS FOR SOLID STATE LIGHTING DEVICES

Ex. 1003 – Declaration of P. Morgan Pattison, Ph.D.

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I, P. Morgan Pattison, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Review of U.S. Patent No. 7,690,812 (“the ’812 Patent”).

3. I provide this Declaration at the request of and have been retained by Kilpatrick Townsend & Stockton, LLP, which represents Hisense USA Corporation (“Hisense”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Hisense contends that claims 1-7, 10-12, 14-21, and 231 of the ’812 Patent are invalid.

4. I am being compensated at an hourly rate of \$550 per hour. My compensation is not dependent on the outcome of or any issue in relation to the above-captioned *Inter Partes* Review, and I have no interest in either party.

5. In forming my opinions, I relied on my knowledge, education, experience, and training in the field and on documents and information referenced in this Declaration.

II. Qualifications

6. My curriculum vitae (“CV”) is attached hereto as Exhibit 1004 and provides an accurate identification of my background and experience.

7. I have over (25) years of experience in the areas of light emitting diodes (LEDs), organic light emitting diodes (OLEDs), lighting, solid state lighting (SSL), displays, lasers, and optoelectronic materials and devices

8. I am the Founder and President of Solid State Lighting Services, Inc. In that capacity, I am responsible for, among other things, providing technical, strategic, and market expertise in the areas of LEDs, OLEDs, lighting, SSL, displays, and optoelectronic materials and devices. I am also involved in connecting optical device technical performance with application requirements for displays, general illumination, color discrimination applications (medical, retail), and various novel lighting applications enabled by SSL technology.

9. From January 2006 through November 2007, I worked as a Project Manager at the U.S. Department of Energy (DOE). In that capacity, I was responsible for managing DOE funded research and development projects in SSL, including LED and OLED lighting technologies. My duties included managing the solicitation and selection of R&D projects with the objective of saving energy. As part of the solicitation and selection process, I evaluated and identified priority

areas of research necessary for advancement of SSL in terms of efficiency, lighting performance, and cost.

10. From September 2000 through January 2006, I was a Graduate Student Researcher at University of California Santa Barbara (UCSB). I performed my Doctoral thesis research under Professor Shuji Nakamura (Nobel Prize in Physics 2014) on gallium-nitride (GaN) based micro-cavity light emitting diodes. The research included: epitaxial structure design and growth by MOCVD, semiconductor process development, materials characterization, and electro-optical device characterization. While at UCSB, I participated in additional areas of research, including research and development of UV LEDs, vertical cavity surface emitting lasers (VCSEL), and edge emitting laser diodes.

11. From November 1996 through May 2000, I worked as a Laser Test Engineer at Cymer Laser. I was responsible for testing and developing test methodology for production and prototype KrF and ArF excimer lasers used in deep UV photolithography for manufacturing of advanced semiconductor products. Testing included optical characterization and full system troubleshooting. I also developed new electrical and optical test methodologies to improve test cycle times, automated test procedures, and developed test documentation.

12. I earned a Ph.D. in Materials Science, Electronic and Photonic Materials from the USCBA in 2006. As stated above, my graduate work focused on

development of Fabrication and Characterization of Gallium Nitride Based Micro-Cavity LEDs. I obtained a Master's Degree in Electrical Engineering, Electronics and Photonics from UCSB in 2003, and I obtained a Bachelor's Degree in Electrical Engineering, Electronic Devices and Materials from UC San Diego in 1996.

13. I am listed as an inventor on at least 11 issued patents, including multiple patents in the field of LED materials and device design, LED lighting product design, and home automation and controls for lighting.

14. I have authored numerous peer reviewed journal articles and publications on the topics of LED materials and device design.

15. Since 2008, I have also authored the approximately annually updated R&D and technology and manufacturing roadmaps used by the DOE to guide federal lighting R&D efforts. I frequently give presentations and talks on the topic of LED technology, SSL status and R&D opportunities, and application advancements enabled by LED technology.

III. Summary of Legal Issues

16. I am not a lawyer. Thus, in expressing my opinions and considering the subject matter of the claims of the '812 Patent, I am relying upon certain legal principles that counsel has explained to me.

A. Obviousness

17. First, I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious from what was known before the invention was made.

18. I understand the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art” and generally includes patents and printed publications (e.g., books, articles, product manuals, company publications, etc.).

19. I understand that in this proceeding the Petitioner, Hisense, has the burden of proving that the claims of the patents-at-issue are obvious in view of the prior art by a preponderance of the evidence. I understand that “a preponderance of the evidence” is evidence sufficient to show that a fact is more likely true than it is not true.

20. I understand that in this proceeding, the information that may be evaluated is limited to patents and printed publications. My analysis below compares the claims to patents and printed publications that I understand are prior art to the patents-at-issue.

21. I have been informed and understand that a claim is obvious in light of the prior art if the difference or differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been

obvious, at the time the invention was made, to a person having ordinary skill in the art. I have been informed and understand that the Supreme Court provided an outline for analyzing obviousness in which it rejected an earlier test in favor of an “expansive and flexible approach” using “common sense.” I have also been informed and understand that the Supreme Court explained that under the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed. I have also been informed and understand that the Supreme Court explained that “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” I further have been informed and understand that the Court pointed to other factors that may show obviousness. These factors included the following principles:

- a. combination that unites old elements with no change in their respective functions is unpatentable. As a result, the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results,
- b. a predictable variation of a work in the same or a different field of endeavor is likely obvious if a person of ordinary skill would be able to implement the variation,

- c. an invention is obvious if it is the use of a known technique to improve a similar device in the same way, unless the actual application of the technique would have been beyond the skill of the person of ordinary skill in the art. In this case, a key inquiry is whether the improvement is more than the predictable use of prior art elements according to their established functions,
- d. an invention is obvious if there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims,
- e. inventions that were “obvious to try” — chosen from a finite number of identified, predictable solutions, with a reasonable expectation of success — are likely obvious,
- f. known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art, and
- g. an explicit teaching, suggestion, or motivation in the art to combine references, while not a requirement for a finding of obviousness, remains “a helpful insight” in determining upon which a finding of obviousness may be based.

B. Claim Construction

22. I have been informed and understand that in an *inter partes* review claim terms are construed according to their ordinary and customary meaning as understood by one of ordinary skill in the art in view of the specification and the prosecution history of the patent.

C. Level of Skill in the Art

23. I am informed and understand that a person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the alleged invention. I am informed and understand that factors that may be considered in determining the level of ordinary skill in the art may include: (A) the type of problems encountered in the art; (B) prior art solutions to those problems; (C) the rapidity with which innovations are made; (D) the sophistication of the technology; and (E) the educational level of active workers in the field

IV. The '812 Patent

24. The '812 Patent is entitled "Apparatus and methods for conformable diffuse reflectors for solid state lighting devices" and was filed on March 16, 2007. I am informed that the earliest claimed priority date of the '812 Patent is March 16, 2007. I am informed that each of the prior art references I address herein was available prior to that date, thus I have not analyzed whether each claim of the '812 Patent is entitled to an earlier priority date.

A. Person of Ordinary Skill in the Art of the '812 Patent

25. The field of the '812 Patent relates to “Solid state lighting, and more particularly to tiles and/or panels including Solid State lighting components.” '812 Patent, 1:6-8.

26. I am informed and understand that in a corresponding litigation, the Petitioner, Hisense, has argued that as of March 16, 2007, a person of ordinary skill in the art “would have had at least a graduate degree in mechanical engineering, physics, materials science, electrical engineering, or a related discipline, coupled with at least four years’ experience in designing backlighting systems for displays; the level of ordinary skill in the art is approximate and additional education could make up for a lack of experience or vice-versa.”

27. I am informed and understand that in a corresponding litigation, the Patent Owner, Brightplus has argued that as of March 16, 2007, a person of ordinary skill in the art “would possess the following qualifications: (a) A Bachelor of Science degree in a technical field and at least four years of experience in the field of design and/or manufacture of display systems; (b) a Master of Science degree in a technical field and at least two years of experience in the field of design and/or manufacture of display systems; or (c) a PhD in a technical field relating to the design and/or manufacture of display systems.”

28. In my opinion, a person with any of these levels of skill in the art would find the claims of the '812 Patent to be obvious in view of the prior art discussed here. Further, as I explain above, I have the relevant educational background and I have worked in the technical area of the '812 Patent for many years. As of March 16, 2007, which I understand to be the time of the alleged invention, I was a person of ordinary skill in the art under either level.

B. Construction of Claim Terms of the '812 Patent

29. As explained in further detail below, under any reasonable construction, the claims are obvious in view of the prior art I address herein. Thus, I do not separately offer an opinion with respect to the proper construction of the terms of the claims of the '812 Patent.

V. Materials Considered

30. In forming my opinions, in addition to my knowledge and experience, I have considered the following documents and things that I have obtained, or that have been provided to me:

Exhibit	Description
1001	U.S. Patent No. 7,690,812("the '812 Patent")
1002	Prosecution History of U.S. Patent No. 7,690,812
1005	US 7,497,592 to Chou ("Chou")
1006	US 2006/0262310A1 to Starry ("Starry")
1007	US 2007/0103908 to Tabito <i>et al.</i> ("Tabito")

31. In addition to the documents above, in forming the opinions expressed below, I have also considered my own knowledge and experience based upon my education and work in the field of LED and display technology, as described above and in my *curriculum vitae* (Ex. 1004).

VI. State of the Art as of March 16, 2007.

A. General Display Technology Background

32. By 2008 liquid crystal display (LCD) technology and the supporting backlighting technology were well understood. Liquid crystal displays require a light to illuminate color filters within liquid crystal shutters that create an image. In this timeframe the backlight light source technology had transitioned from mostly cold cathode fluorescent to light emitting diode (LED) technology. Edge emitting arrangements and direct backlighting arrangements of the light source technologies were both described in publicly available references, exemplified by the references described below. The different lighting arrangements engendered different performance, cost, efficiency, and display panel thickness trade-offs. Each had similar general challenges that differed in the details of the solution, but the optical concepts and techniques to solve the challenges were similar.

B. Chou

33. I am informed that Chou is prior art to the '812 Patent. Chou describes a lighting assembly comprising “a circuit board, a plurality of spot light sources disposed on the circuit board, and a reflector sheet disposed on the circuit board

having a plurality of first holes” corresponding to one of the plurality of spot light sources. Chou, Abstract. Chou expressly discloses that Light Emitting Diodes (LEDs) could be used as the spot light sources. Chou, 1:6-8 (“The invention relates to a light source assembly, and in particular relates to a light source assembly using light emitting diodes (LEDs) as the light source.”).

34. Chou explains that “the reflector sheet 1700 adjacent to the hole 1750 is deformed to form an angle θ between about 0 degree and about 90 degree with the circuit board 1500.” Chou, 4:26-28. Chou makes clear that in this “embodiment, the reflector sheet 1700 can be a deformable material, such as a resin film having reflecting function, and the slits can be omitted.” Chou, 4:29-31. Figures 3A and 8 show the use of a deformable reflector sheet 700 in comparison to LED 600, lead 650, and solder 800.

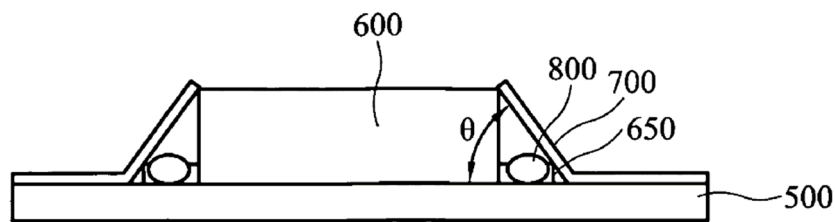


FIG. 3A

Chou, Fig. 3A.

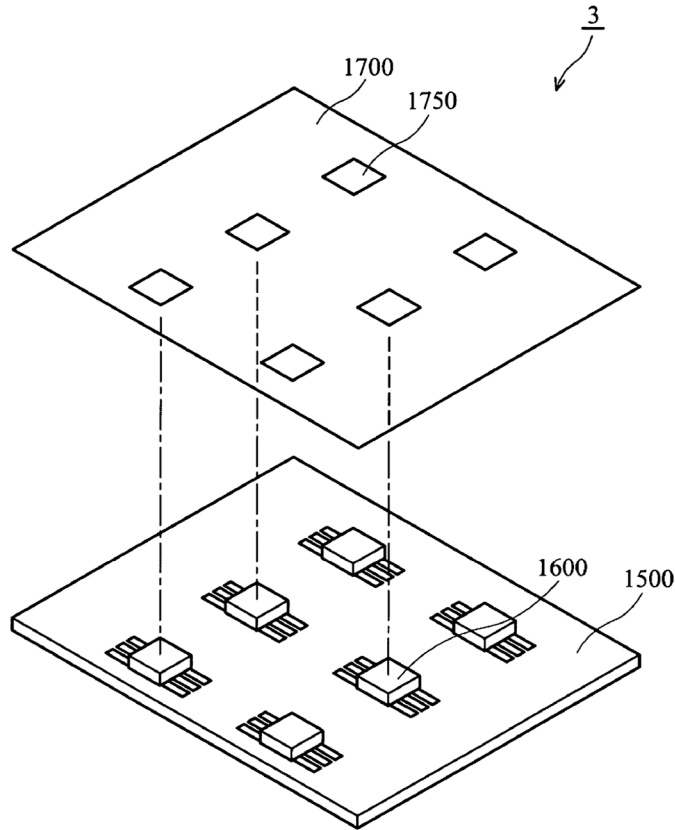


FIG. 8

Chou, Fig. 8.

35. As seen in these figures and their accompanying description, Chou discloses a deformable reflector sheet that conforms to the underlying protruding feature.

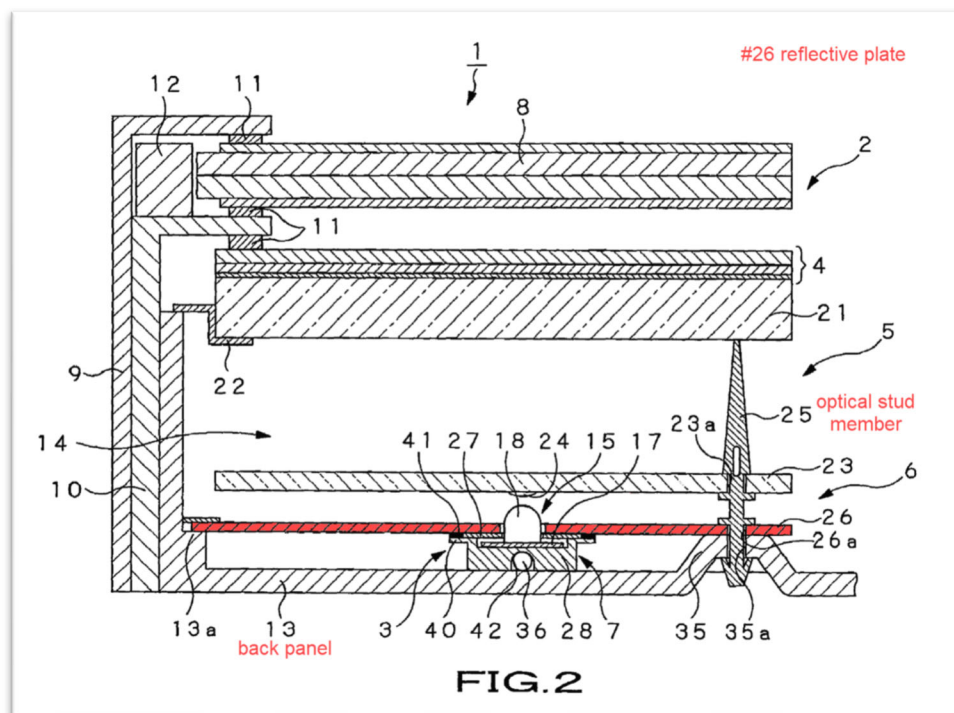
C. Starry

36. I am informed that Starry is prior art to the '812 Patent. Starry discloses an optical display that includes a light source, a display panel, and a diffuse reflector positioned within an optical cavity to reflect light toward an object. *See* Starry, Abstract (“A diffuse reflective article is provided including a

diffuse reflector of light positioned within a structure defining an optical cavity.”). Further Starry discloses a backlight reflector that “is relatively thin, i.e., less than 250 μm and often less than 150 μm , to minimize the thickness of the completed display.” Starry, [0006].

D. Tabito

37. I am informed that Tabito is prior art to the '812 Patent. Tabito discloses a light transmitting LCD with a reflecting plate 26, diffusing plate 23, light diffusing conducting plate 21, and back panel 13 supported by optical stud members 25, through the underlying back panel 13 at mounting member 35. See Tabito, [0081]-[0083]; Fig. 2.



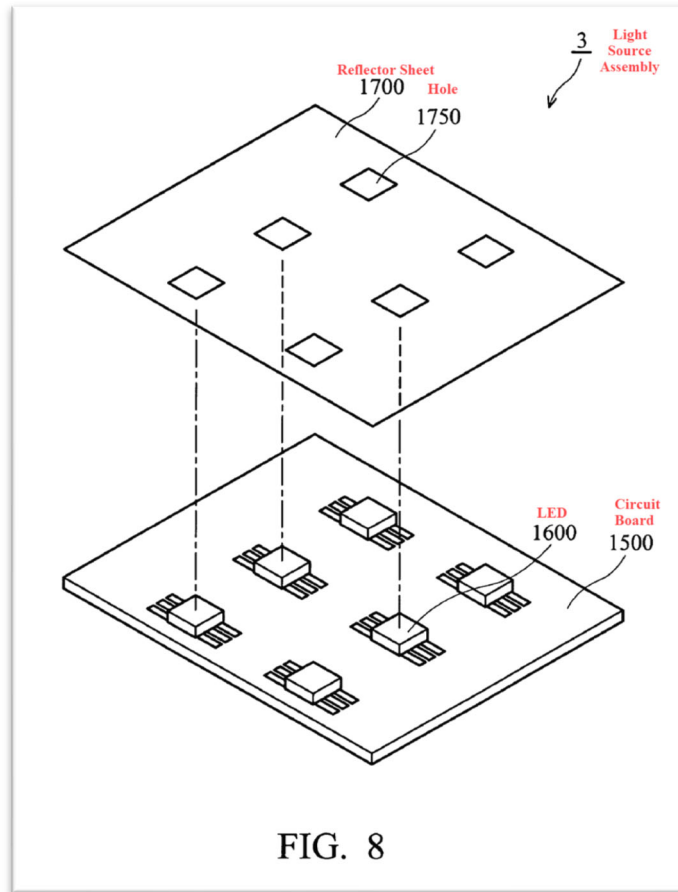
Tabito, Fig. 2 (annotated).

VII. The Prior Art Renders Every Element of Claims 1-7, 10-12, 14-21, and 23 of the '812 Patent Obvious.

38. In the analysis below I break down the elements of claims 1-7, 10-12, 14-21, and 23 of the '812 Patent and demonstrate that each of these elements were known in the art before the March 16, 2007, priority date of the '812 Patent.

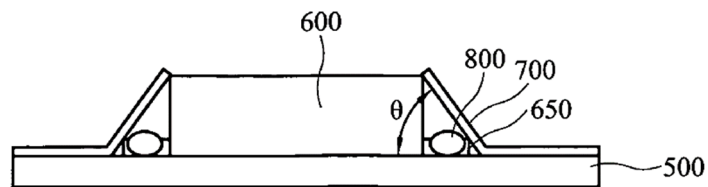
A. Solid State Lighting Tiles Including Substrates with Mounted LEDs Were Known in the Art (Claims 1A, 1B, 15A, 15B, 20A, 20B)

39. Solid state lighting devices using LED's were well known in the art and are expressly disclosed in Chou. *See* Chou, 1:6-8 (“a light source assembly using light emitting diodes (LEDs) as the light Source.”). Chou further describes with regard to Figure 8 that “light source assembly having a plurality of spot light sources, the light source assembly 3 compris[ing] a circuit board 1500, [and] a plurality of spot light sources 1600 disposed on the circuit board 1500....” Chou, 4:19-22. The circuit board 1500 underlying spot light sources 1600 is a substrate for a lighting tile.



Chou, Fig. 8 (annotated).

40. The LEDs are mounted to the circuit board (i.e., the substrate). In particular, Chou discloses lead 650 from the LED 600 is mounted to the circuit board 500, via solder 800. Chou, 3:42-51.



Chou, Fig. 3A.

B. Reflector Sheets Mounted to the Surface of a Substrate and Confirming to the Shape of a Protruding Feature or Lead on the Tile Were Known in the Art (Claim 1C, 15C, 19, 20C)

41. Reflector sheets used together with LEDs in backlighting panels were also well known in the art. As one example, Figure 3A of Chou discloses a reflector sheet 700 positioned to conform to the protruding features the LED 600, including the lead 650 and solder 800. Chou, 3:42-51 (“The reflector sheet 700 is disposed on the circuit board 500 and the reflector sheet 700 adjacent to the hole 750 forms an angle θ between about 0 degree to about 90 degree with the circuit board 500. The angle θ will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800.”).

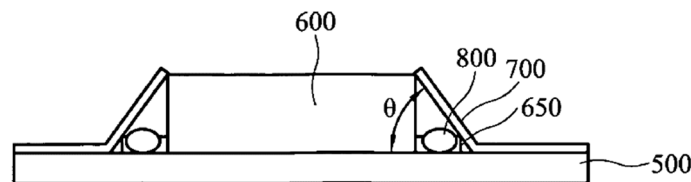


FIG. 3A

Chou, Fig. 3A.

42. Chou further discloses that the reflector sheet conforms to the protruding features. In particular, Chou describes that the angle of the reflector sheet “will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800.”

Chou, col. 3:45-47. Chou further discloses that “the reflector sheet 1700 can be a *deformable material*, such as a resin film having reflecting function.” Chou, col. 4:30-32 (emphasis added).

43. In my opinion, a person of ordinary skill in the art would recognize that the “deformable material” used as the reflector sheet 700 would conform to the shape of the protruding features, e.g., the LED 600, lead 650, and solder 800. This is also shown to a person of ordinary skill in the art because another embodiment in Chou teaches the use of slits to create relief areas for the reflector sheet relative to a protruding feature. *See* Chou, 3:7-8 (“The hole 750 has at least one slit 760 extended from the periphery of the hole 750.”). As an alternative to using slits, Chou teaches the use of a deformable material such that the reflector sheet can have the same shape, outline, or contour of the underlying protruding feature. *See* Chou, 4:29-32 (“In this embodiment, the reflector sheet 1700 can be a *deformable material*. Such as a resin film having reflecting function, and *the slits can be omitted*.” (emphasis added)).

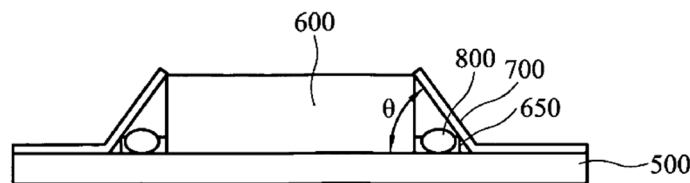


FIG. 3A

Chou, Fig. 3A.

44. As shown in Figure 3A above, the reflector sheet 700 confirms to at least the shape of the LED 600, lead 650 and solder 800. Further, as explained by Chou, the angle θ between the reflector sheet 600 and the circuit board 500 can vary “between about 0 degree and about 90 degree.” Chou, col. 3:42-44. This “angle θ will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800.” This variance in the angle θ demonstrates to a person of ordinary skill in the art that the reflector sheet is conforming to the protrusions that the reflector sheet overlays, e.g., the LED 600, “the length of the lead 650,” and “the amount of solder 800.” Chou, col. 3:42-44.

45. Further, Tabito expressly discloses that its reflector may be a thermoformable material, e.g., PET. *See* Tabito, [0068] (“the reflecting plate 26 ... may be formed by expandable PET containing e.g. a phosphorescent material. The expandable PET is lightweight, exhibits high reflectance on the order of 95%, and presents a color tint different from metal luster color such that grazing on the reflecting surface is not outstanding. For this reason, the expandable PET is used in conventional liquid crystal devices as well.”). A person of ordinary skill in the art would recognize that PET is a thermoformable material, and that PET could have been used as the reflector described in Chou.

C. Reflector Sheets Including an Aperture Proximate to an LED, but Not Contacting the LED Were Known in the Art (Claims 12, 18)

46. Chou discloses a reflector sheet wherein the holes/apertures are positioned over the LED. This is shown, e.g., in Chou Figure 3A.

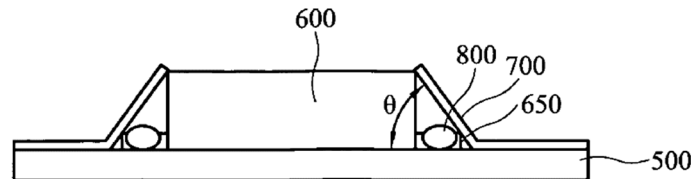


FIG. 3A

Chou, Fig. 3A.

47. In my opinion a person of ordinary skill in the art would have been motivated to modify the reflector sheet shown in Figure 3A (pasted above) to slightly increase the angle θ such that the reflector sheet does not contact the solid state lighting element 600. The motivation to make this modification is to avoid mechanical friction between the reflector 700 and the solid state lighting element 600, which could lead to damage to either the reflector 700 or the solid state lighting element 600. Such mechanical friction is a particular concern in an application in which the backlight is used for a portable display, e.g., in a tablet or laptop computer, or in a display that is mounted in a moving object, e.g., a display in vehicle such as a boat, airplane, train, or car.

48. Another motivation to slightly increase the angle θ such that the reflector sheet does not contact the solid state lighting element 600 would be to

ensure that the reflector sheet does not block any of the LED light output resulting in consistent optical emissions from each LED within the LED array.

49. LED chips are typically packaged with a clear protective encapsulant. Thus, to the extent there is contact between the reflector sheet and the LED in the design shown in Chou, that contact is not with the semiconductor itself. Rather the contact would be between the encapsulant and the reflector sheet.

50. Further, to the extent there is no such lens or casing on the LED, this would further motivate a POSITA to increase the angle θ such that the reflector sheet does not contact the solid state lighting element 600. Such a modification would reduce the risk of a short circuit based on contact between a reflector sheet made of a conductive material (e.g., aluminum or another conductive metal) and the lead 650 or solder 800. Such an embodiment in which the reflector does not contact the lighting element is expressly disclosed in Chou as “prior art.” In particular, with respect to Figure 1A, Chou describes a lighting system using a plurality of LEDs 200, a reflector sheet 300, which does not contact the solid state lighting elements, i.e., the LEDs 200, as shown below.

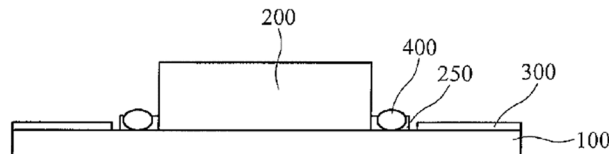


FIG. 1A (PRIOR ART)

Chou, Fig. 1A. With respect to this embodiment Chou further describes that “[t]he hole 350 of the reflector sheet 300 must be enlarged to avoid the welding position and this also will result in reducing the covering area of the reflector sheet 300.” Chou, 1:54-57. As shown in Figure 1B below, the hole 350 in reflector sheet 300 ensures that the reflector sheet 300 does not contact the solid state lighting element 250.

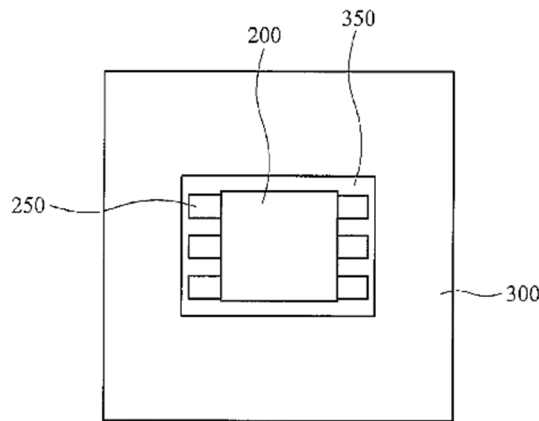


FIG. 1B (PRIOR ART)

Chou, Fig. 1B. Chou’s description of such a design as “prior art” as of the date Chou was filed, which is prior art to the ’812 Patent, further confirms that such a design was well-known.

51. That this would have been known is also demonstrated by Tabito, [0074], which describes placing an insulator between an aluminum reflecting plate and terminals of the LED. *See* Tabito, [0074] (“[I]n the reflecting section 6, electrical insulation is maintained between the portion of the aluminum substrate of

the reflecting plate 26 by the reflective sheet piece 27 and the terminal 18 c of the LED unit 18.”).

52. In my opinion, such a modification is nothing more than an obvious variation, i.e., applying a slightly larger angle θ such that the reflector sheet. This is nothing more than a design choice of already installed components since it is simply adjusting the angle of one of those components (the reflector sheet) by a few degrees.

D. Reflector Sheets Comprising Diffuse Reflectors Were Known in the Art (Claims 2, 3, 21)

53. Chou describes a reflector with holes for solid state lighting elements. Chou does not explicitly disclose that its reflector sheet is a diffuse reflector, neither does Chou disclose that the reflector is specular. A person of skill in the art would consider both options, since both diffuse and specular reflectors are well known optical components, and performance of either would be predictable. In a similar field, Starry discloses an improvement in light reflectivity with a diffuse reflector. *See* Starry Abstract (“A diffuse reflective article is provided including a diffuse reflector of light positioned within a structure defining an optical cavity.”). Starry discloses a reflector sheet comprises a polymer-based porous material. *See* Starry, [0055] (“A preferred embodiment of nonwoven sheet diffuse reflector comprises a consolidated sheet of flash-spun plexifilamentary film-fibrils, wherein

the fibrils comprise polymer containing pores. The polymer preferably comprises polyolefin, especially polyethylene.”).

54. As discussed above, Starry describes a similar backlighting system as Chou, and a person of ordinary skill in the art would have been motivated to apply Starry’s diffuse reflector to the backlighting system of Chou as such diffuse reflectors were known to improve the quality of light in backlighting systems.

E. Reflector Sheets with a Thickness of Less than 0.25 mm Were Known in the Art (Claims 4, 5, 6)

55. Chou describes a reflector sheet but does not expressly describe the thickness of that reflector sheet. In a similar field, Starry discloses a reflector sheet of a preferable thickness between 0.25 and 0.15 mm. Starry, [0006] (“For certain markets it is critical that the backlight reflector is relatively thin, i.e., less than 250 μm and often less than 150 μm , to minimize the thickness of the completed display.”). As discussed further below, person of ordinary skill in the art would have been motivated to apply a thin reflector, as described by Starry, to the backlighting system.

F. Including a Plurality of Tiles and Using a Single Reflector Sheet Configured to Cover the Plurality of Tiles Was Known in the Art (Claim 14, 23)

56. Chou Figure 9 shows three circuit boards 1500’ and multiple spot light sources (e.g., LEDs) 1600’ back-welded between two of the circuit boards

1500'. Each of the LEDs is covered by a single reflector sheet 1700', which includes holes 1750' for each of the spot light sources 1600'.

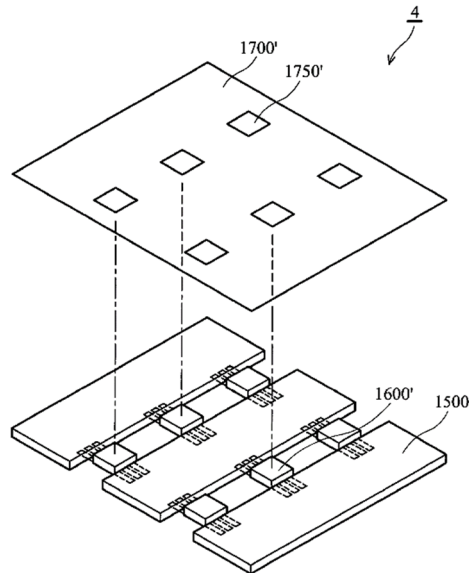


FIG. 9

Chou, Fig. 9; *see also* Chou, col. 4:39-45 (“the light source assembly 4 comprises at least two circuit boards 1500', a plurality of spot light sources 1600' back welded between the at least two circuit boards 1500', and a reflector sheet 1700' disposed on the at least two circuit boards 1500' having a plurality of holes 1750'. Each hole 1750' corresponds to one spotlight source 1600'.”). Tabito further discloses a reflective sheet piece 27 that includes “guide through-holes 34 in register with the 25 LED units 18 provided on a single straight line on each light emitting unit 15. These guide through-holes 34 are formed side-by-side along the length-wise direction on the same co-axial line in the reflective sheet piece 27 and are each a circular opening the inner diameter of which is substantially equal to that of the light emitting part 18 a

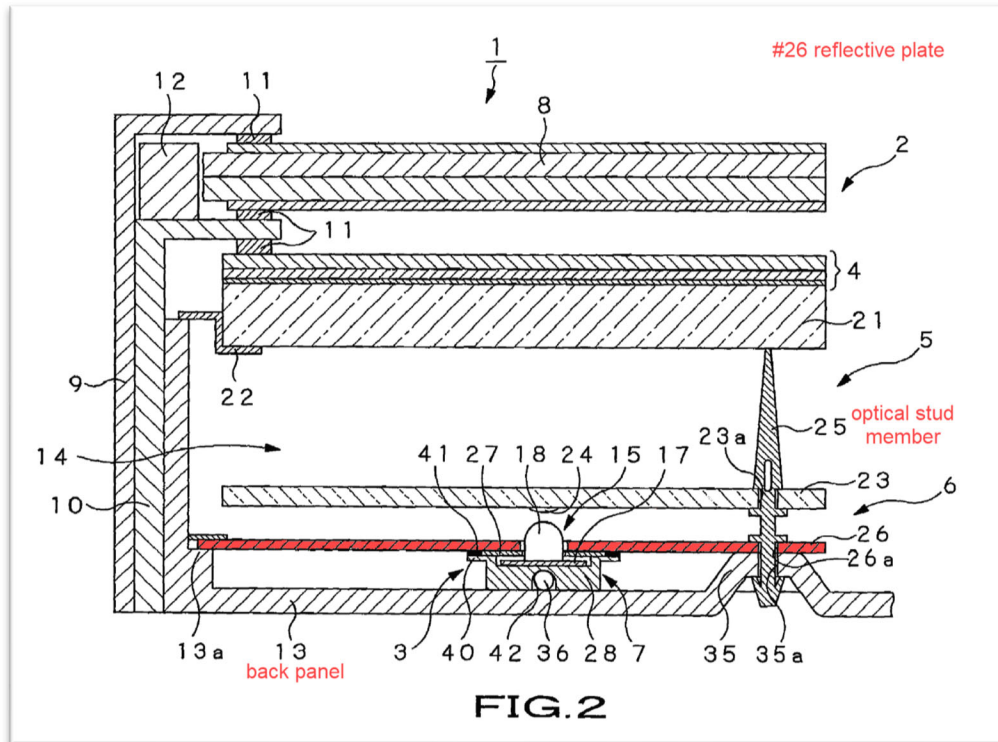
of the LED unit 18.” Tabito, [0071]. From this disclosure, a POSITA would recognize that Tabito’s reflective sheet piece covers multiple LEDs and their corresponding tile(s).

57. A person of ordinary skill in the art would recognize that the plurality of circuit boards 1500' and spot light sources 1600' form a plurality of solid state lighting tiles covered by a single reflector sheet 1700'. Further, Chou describes that “[t]he reflector sheet. 1700' adjacent to each hole 1750 forms an angle θ between about 0 degree to about 90 degree with the circuit board 1500'.” Chou, col. 4:45-47.

58. Thus, a person of ordinary skill in the art would recognize that Chou discloses “a single reflector sheet ... configured to cover the plurality of tiles of the solid state light bar.”

G. Mechanically or Chemically Fastening the Reflector Sheet to the Surface of the Substrate Was Known in the Art (Claims 7, 10, 11, 16, 17, 20D)

59. Chou describes a lighting panel comprising a plurality of LEDs mounted to substrate and a reflective sheet. In a similar field, Tabito discloses a light transmitting LCD with a reflecting plate 26 and diffusing plate 23, being mechanically attached to substrate back panel 13. *See* Tabito, [0081]-[0083]; Figs. 2, 3, 6.



60. Tabito, Fig. 2 (annotated). Tabito also discloses a reflector mechanically fastened to the surface of the substrate. *See e.g.* Tabito, [0088] (“The reflecting plate 26 is assembled on the mounting member 35 of the back panel 13 ... the fitting part 25 b of each optical stud member 25 is pushed into the mounting through-hole 35 a formed in the mounting member 35 through the fitting hole 26 a of the reflecting plate 26.”). Tabito describes an “optical stud member 25,” that is “mounted to the back panel 13.” Tabito, [0081], [0088]. The optical stud member is a mounting post mounted to the substrate. As described, “each optical stud member 25 is pushed into the mounting through-hole 35 a formed in the mounting member 35 through the fitting hole 26 a of the reflecting plate 26.” Tabito, [0088]. “The result is that the reflecting plate 26 is retained as it is positioned with respect

to the back panel 13 for highly accurately positioning and retaining each reflective sheet piece 27.” Tabito, [0089].

61. With respect to a chemical bonding, the ’812 Patent makes clear that a chemical bonding component includes “glue and/or a pressure sensitive adhesive compound.” *See* ’812 Patent, col. 1:54-56 (“The chemical bonding component can include glue and/or a pressure sensitive adhesive compound.”). Such compounds are expressly disclosed by Tabito for this same purpose. Tabito, [0110] (“In the above embodiment, the reflecting plate 26 is bonded in position by double-sided adhesive tapes 41, 41 bonded in turn to the reflecting plate supports 40, 40 of each heat dissipating plates 28. Alternatively, the reflective plate may be secured in position by an adhesive coated on the reflecting plate supports 40, 40.”).

H. Including in the Reflector Sheet a Plurality of Alignment Holes Configured to Receive at Least a Portion of a Mounting Post When the Reflector Sheet is Attached to the Surface of the Substrate Was Known in the Art (Claim 20E)

62. Tabito describes that its “reflecting plate 26 [is] provided with a large number of fitting holes ... 26a ... for combination with the optical stud members 25.” Tabito, [0082]. These holes are clearly shown as element 26a in the annotated version of Tabito, Figure 2, shown below.

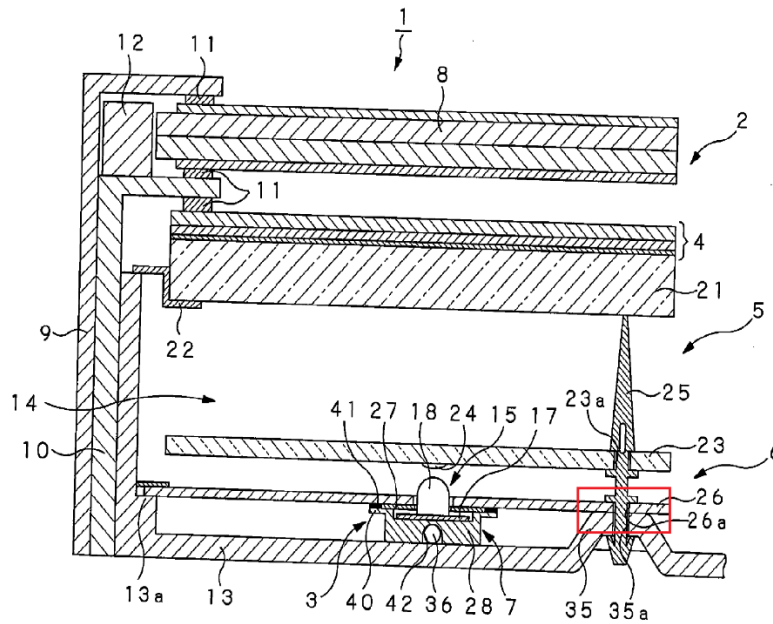


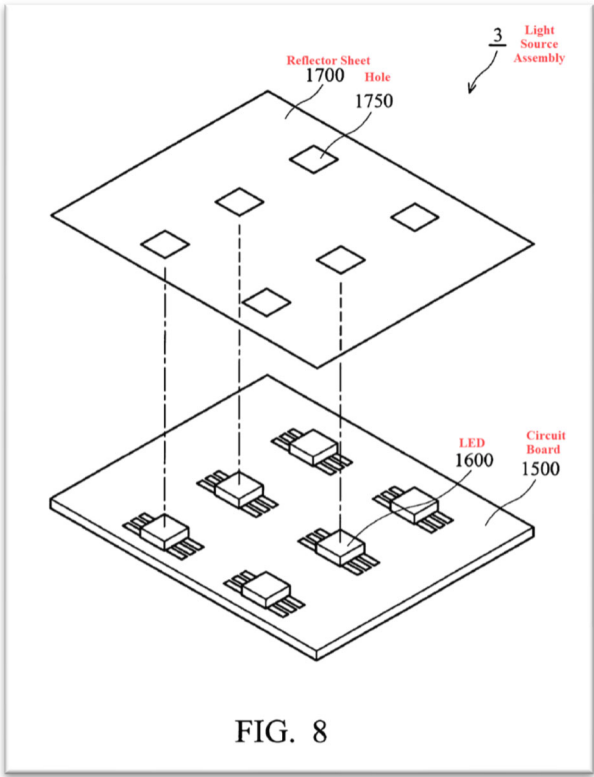
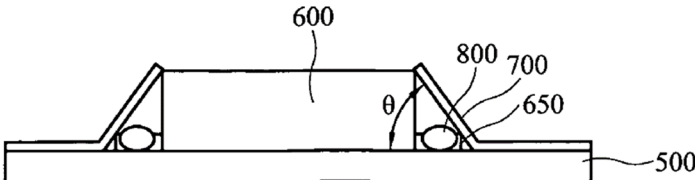
FIG.2

Tabito, Fig. 2 (annotated).

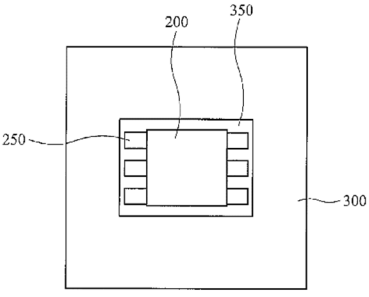
VIII. Chou In View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1, 12, 15, and 18 of the '812 Patent.

63. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1, 12, 15, and 18 was obvious in view of Chou. This is further demonstrated by the claim chart below.

'812 Patent	Chou in View of the Knowledge of a Person of Ordinary Skill in the Art
[1 Preamble] A solid state lighting tile, comprising:	Chou describes “a light source assembly using light emitting diodes (LEDs) as the light Source.” Chou, 1:6-8.
[1A] a substrate;	Chou describes “light source assembly having a plurality of spot light sources, the light source assembly 3 compris[ing] a circuit board 1500, [and] a plurality of spot light sources 1600 disposed on the circuit board 1500....” Chou, 4:19-22.

'812 Patent	Chou in View of the Knowledge of a Person of Ordinary Skill in the Art
	 FIG. 8
[1C] a solid state lighting element mounted on a surface of the substrate; and	Chou, 3:42-51 (“The reflector sheet 700 is disposed on the circuit board 500 and the reflector sheet 700 adjacent to the hole 750 forms an angle Θ between about 0 degree to about 90 degree with the circuit board 500. The angle Θ will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800. As shown in the figure, only the emission surface of the spotlight source (LED 600) is exposed. In practice, the reflector sheet 700 should only shield the lead 650 and the solder 800 but is not limited to this.”).  FIG. 3A

'812 Patent	Chou in View of the Knowledge of a Person of Ordinary Skill in the Art
[1D] a reflector sheet on the surface of the substrate, the reflector sheet configured to conform to a shape of a protruding feature on the tile.	Chou, 3:42-51 (“The reflector sheet 700 is disposed on the circuit board 500 and the reflector sheet 700 adjacent to the hole 750 forms an angle θ between about 0 degree to about 90 degree with the circuit board 500. The angle θ will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800.”). Chou, 3:45-47 (the reflector sheet “will change with the height of the spotlight source (LED 600), the length of lead 650 of the spot light source (LED 600), and the amount of the solder 800.”). Chou, 4:29-32 (“In this embodiment, the reflector sheet 1700 can be a <i>deformable material</i>. Such as a resin film having reflecting function, and <i>the slits can be omitted</i>.”) Chou, 3:7-8 (“The hole 750 has at least one slit 760 extended from the periphery of the hole 750.”). Chou, Fig. 3A.
12. The tile of claim 1, wherein the reflector sheet comprises an aperture configured to be positioned proximate to the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element.	Chou, 1:54-57 (“The hole 350 of the reflector sheet 300 must be enlarged to avoid the welding position and this also will result in reducing the covering area of the reflector sheet 300.”) FIG. 1A (PRIOR ART) Chou, Fig. 1A

'812 Patent	Chou in View of the Knowledge of a Person of Ordinary Skill in the Art
	 FIG. 1B (PRIOR ART) Chou, Fig. 1B
[15 Preamble] A method of forming a solid state lighting device comprising:	<i>See supra</i> Claim 1 Preamble.
[15A] providing a substrate of a solid state lighting tile;	<i>See supra</i> Claim 1[A].
[15B] mounting a solid state lighting element on a surface of the substrate; and	<i>See supra</i> Claim 1[B].
[15C] positioning a reflector sheet on the surface of the substrate, the reflector sheet configured to conform to a shape of a protruding feature on the solid state lighting tile.	<i>See supra</i> Claim 1[C].
18. The method of claim 15, wherein the reflector sheet comprises an aperture	<i>See supra</i> Claim 12.

'812 Patent	Chou in View of the Knowledge of a Person of Ordinary Skill in the Art
configured to be positioned over the solid state lighting element, wherein the reflector sheet does not contact the solid state lighting element	

IX. Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 2-6 and 21 of the '812 Patent.

64. As discussed above, Chou describes a backlighting system comprising an array of LED tiles mounted on a substrate and including a reflector sheet. Chou does not expressly disclose a diffuse reflector sheet or provide the specific thickness of the reflector sheet. However Starry discloses a diffuse reflector and specific thicknesses for the reflector.

65. In my opinion, a person of ordinary skill in the art would have been motivated to combine Chou and Starry. Both disclose optical elements for backlit LCD assemblies. In a similar field, Starry discloses “a diffuse reflective article having a nonwoven sheet diffuse reflector containing pores of high light scattering efficiency and having a high photopic reflectance of visible light.” Starry, [0002].

66. In my opinion, a person of ordinary skill in the art would have been motivated to apply Starry’s diffuse reflector to Chou’s system. Starry provides an express motivation to combine, explaining “[d]iffuse reflectivity of visible light is critical in many applications. Direct view displays used in electronic equipment

(e.g., instrument panels, portable computer screens, liquid crystal displays (LCDs)), whether relying on supplemental lights (e.g., backlight) or ambient light, require diffuse reflectant back surfaces to maximize image quality and intensity.” Starry, [0005]. An LCD display, which is an example given by Starry, is exactly the type of display device described in Chou. *See* Chou, 1:19-22 (“The performance of an LCD is affected by all of the internal devices of which it is composed and the backlight module is primarily responsible for screen brightness, uniformity, contrast, and viewing angle.”). Including the refractive diffuser disclosed by Starry with the backlight described by Chou would “maximize image quality and intensity.” Starry, [0005]. This provides an additional motivation to make the combination.

67. A person of ordinary skill in the art would recognize that Chou focuses on improving performance. *See e.g.*, Chou, col. 1:19-22 (“The performance of an LCD is affected by all of the internal devices of which it is composed and the backlight module is primarily responsible for screen brightness, uniformity, contrast, and viewing angle.”); col. 1:58-60. (“Hence, a method of improving the covering area of the reflector sheet 300 so as to improve the lighting efficiency of the backlight module is desirable.”). A person of ordinary skill in the art would have been motivated to add Starry’s diffuse reflector to the Chou system

in order to “maximize image quality and intensity” of these backlights. Chou, [0005]. Providing an additional motivation to make the combination.

68. Further, while Chou describes a reflector sheet, it does not describe the specific thickness of that reflector sheet. Starry expressly discloses the claimed thicknesses, explaining that “[f]or certain markets it is critical that the backlight reflector is relatively thin, i.e., less than 250 μm and often less than 150 μm , to minimize the thickness of the completed display.” Starry, [0006]. A person of ordinary skill in the art would have been motivated to use the “relatively thin” reflector sheet disclosed by Starry to “minimize the thickness of the completed display.” Starry, [0006]. As Starry explains, this minimal thickness is critical in “[p]ortable computer LCDs,” which “require[e] high levels of diffuse reflection of visible light from very thin materials.” Starry, [0006].

69. A person of ordinary skill in the art would have been motivated to use Starry’s thinner materials to minimize the thickness of the backlight assembly and thereby minimize the thickness of the overall LCD display. Additionally, thin reflector sheets are more deformable and thus using Starry’s thin reflector sheet aligns with the Chou’s teachings of the benefits of using deformable reflector sheets over protruding features.

70. Chou and Starry are in the same field of backlight assembly units for display devices. A person of ordinary skill in the art would recognize that this

combination is nothing more than the use of a known solution described by Starry in a similar system described by Chou. This combination would have been within the skillset of a person of ordinary skill in the art at the time.

71. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 2-6 and 21 was obvious in view of the combination of Chou and Starry. This is further demonstrated by the claim chart below.

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
2. The tile of claim 1, wherein the reflector sheet comprises a diffuse reflector.	Starry Abstract (“A diffuse reflective article is provided including a diffuse reflector of light positioned within a structure defining an optical cavity.”).
3. The tile of claim 1, wherein the reflector sheet comprises a polymer-based porous material.	Starry, [0055] (“A preferred embodiment of nonwoven sheet diffuse reflector comprises a consolidated sheet of flash-spun plexifilamentary film-fibrils, wherein the fibrils comprise polymer containing pores. The polymer preferably comprises polyolefin, especially polyethylene.”).
4. The tile of claim 1, wherein the reflector sheet comprises a thickness of less than approximately 1.0 millimeter.	Starry, [0006] (“For certain markets it is critical that the backlight reflector is relatively thin, i.e., less than 250 μm and often less than 150 μm , to minimize the thickness of the completed display.”).
5. The tile of claim 1, wherein the reflector sheet has a thickness of less than	<i>See claim 4.</i> <i>See claim 4.</i>

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
approximately 0.50 millimeters.	
6. The tile of claim 1, wherein the reflector sheet has a thickness of less than approximately 0.25 millimeters.	<i>See claim 4.</i>
21. The method of claim 15, wherein the reflector sheet comprises a diffuse reflector.	<i>See claim 2.</i>

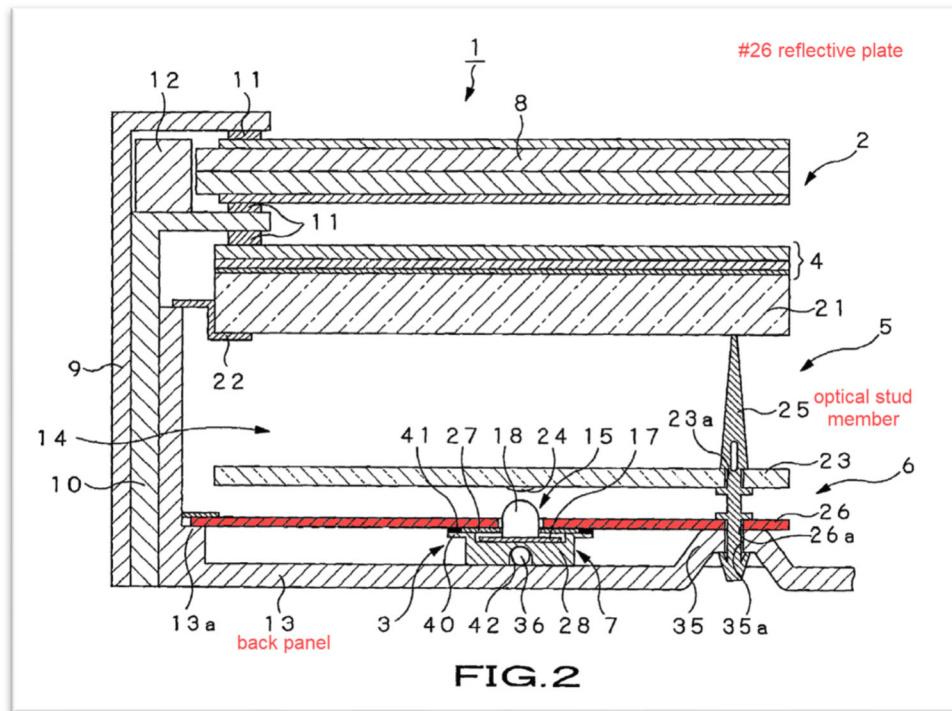
X. Chou and Tabito in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 7, 10-11, 14, 16-17, 19-20, and 23 of the '812 Patent.

72. Chou describes a backlighting system comprising an array of LED tiles mounted on a substrate and including a reflector sheet. Chou does not expressly disclose a mechanical fastening device configured to attach the reflector sheet to the surface of the substrate. In a similar field, Tabito describes a mechanical fastener to hold a reflective plate to a surface of a substrate.

73. In my opinion a person of ordinary skill in the art would have been motivated to combine Chou and Tabito. Chou describes LED backlight assemblies as a light source for an LCD display. Chou, 1:6-8. Chou describes a reflective sheet but does not expressly describe the mounting mechanism for that reflective sheet.

Tabito describes “a liquid crystal display apparatus, having a light transmitting liquid crystal display (LCD) device, and to a backlight device used for this liquid crystal display apparatus.” Tabito, [0001]. Tabito similarly describes a “reflecting plate 26 ... formed by a plate 29 of, for example, aluminum, and a layer of expandable PET 30, containing phosphorescent agents.” Tabito, [0068]. Tabito describes that its “reflecting plate 26 [is] provided with a large number of fitting holes ... 26a ... for combination with the optical stud members 25.” Tabito, [0082].

74. As described by Tabito, “each optical stud member 25 is pushed into the mounting through-hole 35 a formed in the mounting member 35 through the fitting hole 26 a of the reflecting plate 26.” Tabito, [0088]. “The result is that the reflecting plate 26 is retained as it is positioned with respect to the back panel 13 for highly accurately positioning and retaining each reflective sheet piece 27.” Tabito, [0089]. Thus, as described by Tabito, the reflecting plate 26 is held in place by the optical stud member.



Tabito, Fig. 2 (annotated).

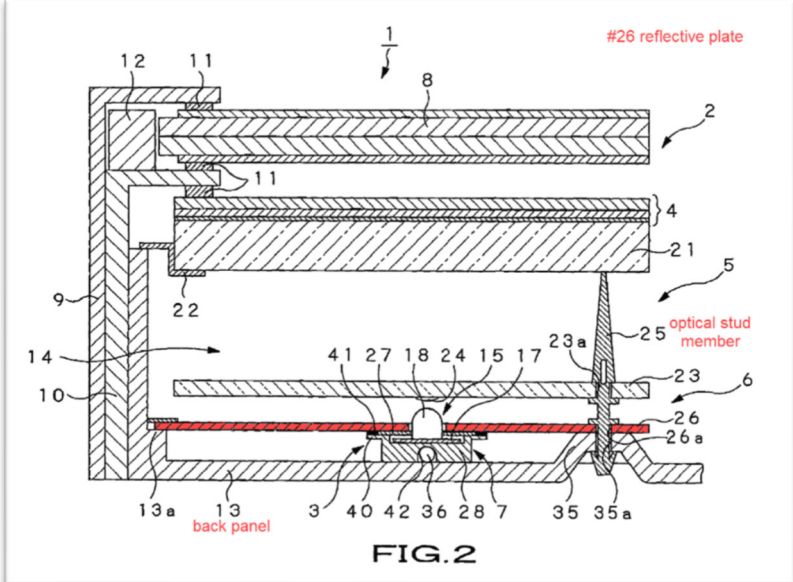
75. A person of ordinary skill in the art would have recognized that Tabito's method of supporting reflective plates would also be suitable for use in supporting Chou's reflective sheet. A person of ordinary skill in the art would have been motivated to apply Tabito's supports and mounting methods to Chou to provide mounting and support for the backlighting elements described in Chou to provide a more rigid structure and reduce the risk that Chou's reflective sheet separates from the circuit board comprising the LEDs. Moreover, Chou's disclosure is focused on the lighting assembly, whereas Tabito's disclosure is focused on the both the lighting assembly and upper layers of a lighting system. Thus, it would have been obvious to use Tabito's teaching on how to best support

upper layers of the lighting system with Chou's teachings regarding optimal light source assembly.

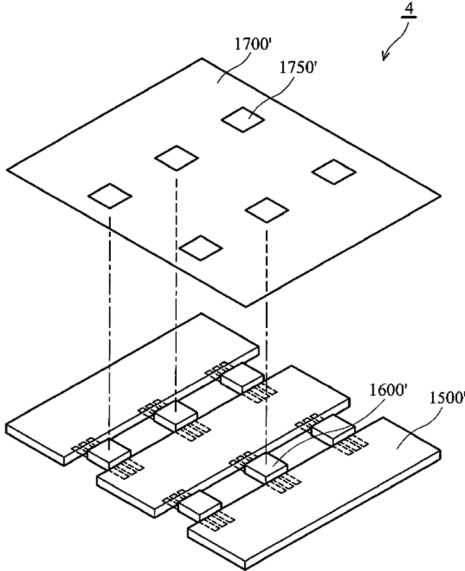
76. Further, a person of ordinary skill in the art would recognize that Chou and Tabito are in the same field of backlight assembly units for display devices. Thus, this combination is nothing more than the use of a known solution described by Tabito in a similar system described by Chou. This combination would be within the skillset of a person of ordinary skill in the art at the time.

77. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 7, 10-11, 14, 16-17, 19-20, and 23 was obvious in view of the combination of Chou and Tabito. This is further demonstrated by the claim chart below.

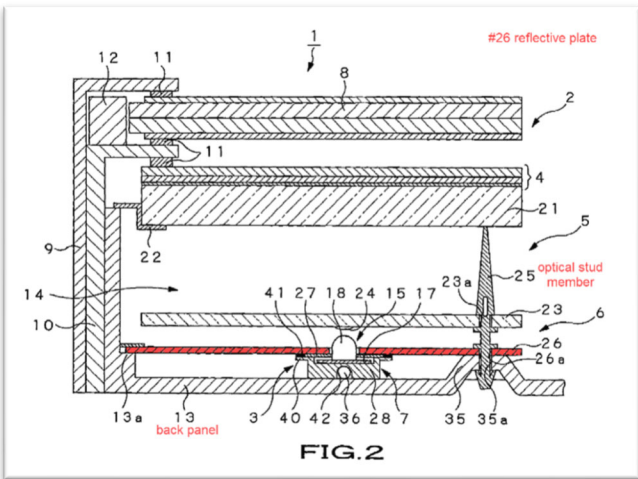
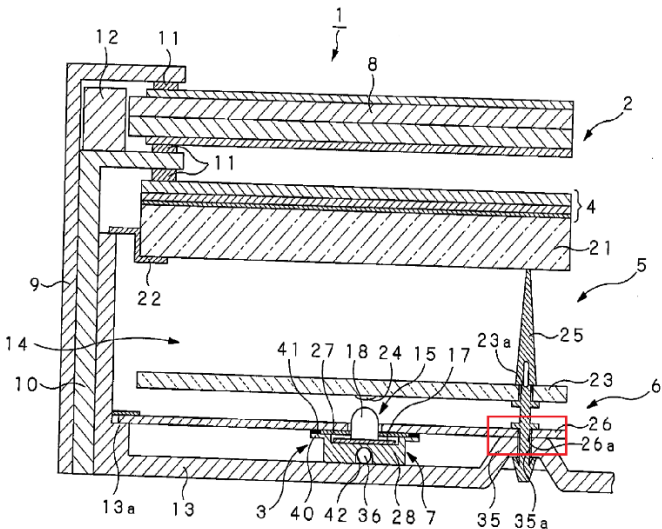
'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
7. The tile of claim 1, further comprising a mechanical fastening device configured to attach the reflector sheet to the surface of the substrate.	Tabito, [0081] ("The liquid crystal display apparatus 1 of the present embodiment is constructed Such that many optical stud members 25 are mounted to the back panel 13, the functional optical sheets forming the aforementioned optical converting section 4, the light diffusing conducting plate 21 and the holding bracket member 22, forming the light guide section 5, and the reflecting plate 26, forming the reflecting section 6, are positioned relative to one another and Such that parallelism between facing major surfaces in their entirety will be maintained to high accuracy.") Tabito, [0082] ("The light diffusing plate 23 and the reflecting plate 26 are provided with a large number of fitting holes 23a, 26a, respectively, for combination with the optical stud members 25. These fitting holes 23a, 26a

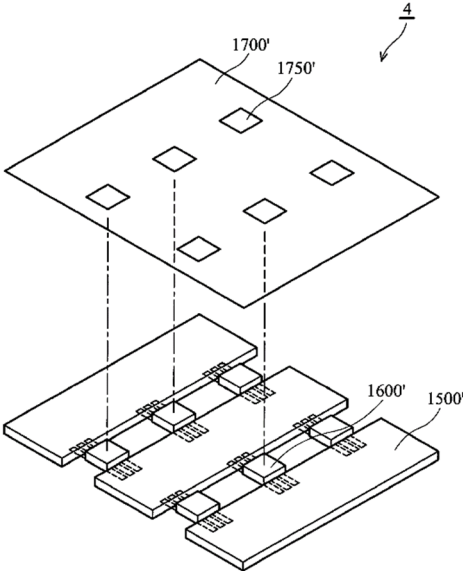
'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
	are positioned between neighboring rows of the light emitting arrays 16 and are formed in axial alignment to one another.”) Tabito, [0088] (“The reflecting plate 26 is assembled on the mounting member 35 of the back panel 13 ... the fitting part 25 b of each optical stud member 25 is pushed into the mounting through-hole 35 a formed in the mounting member 35 through the fitting hole 26 a of the reflecting plate 26.”). Tabito, [0089] (“The result is that the reflecting plate 26 is retained as it is positioned with respect to the back panel 13 for highly accurately positioning and retaining each reflective sheet piece 27.”)  FIG. 2 Fig. 2.
10. The tile of claim 1, further comprising a chemical bonding component configured to attach	Tabito, [0110] (“In the above embodiment, the reflecting plate 26 is bonded in position by double-sided adhesive tapes 41, 41 bonded in turn to the reflecting plate supports 40, 40 of each heat dissipating plates 28. Alternatively, the reflective plate may be secured in

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
the reflector sheet to the surface of the substrate.	position by an adhesive coated on the reflecting plate supports 40, 40.”). The '812 Patent makes clear that a chemical bonding component includes “glue and/or a pressure sensitive adhesive compound.” '812 Patent, col. 1:54-56 (“The chemical bonding component can include glue and/or a pressure sensitive adhesive compound.”).
11. The tile of claim 10, wherein the chemical bonding component comprises glue and/or a pressure sensitive adhesive compound.	See Claim 10 above. Glue includes adhesives.
14. A solid state light bar comprising a plurality of tiles according to claim 1, wherein a single reflector sheet is configured to cover the plurality of tiles of the solid state light bar.	Chou, col. 4:39-45 (“the light source assembly 4 comprises at least two circuit boards 1500', a plurality of spot light sources 1600' back welded between the at least two circuit boards 1500', and a reflector sheet 1700' disposed on the at least two circuit boards 1500' having a plurality of holes 1750'. Each hole 1750' corresponds to one spotlight source 1600'.”). Chou, col. 4:45-47 “[t]he reflector sheet. 1700' adjacent to each hole 1750 forms an angle θ between about 0 degree to about 90 degree with the circuit board 1500'.”)

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
	 FIG. 9 Chou, Fig. 9. Tabito, [0071] (“The reflective sheet piece 27 is provided with 25 guide through-holes 34 in register with the 25 LED units 18 provided on a single straight line on each light emitting unit 15. These guide through-holes 34 are formed side-by-side along the length-wise direction on the same co-axial line in the reflective sheet piece 27 and are each a circular opening the inner diameter of which is substantially equal to that of the light emitting part 18 a of the LED unit 18.”)
16. The method of claim 15, wherein positioning the reflector sheet comprises chemically bonding the reflector sheet to the surface of the substrate.	See Claim 10 above.

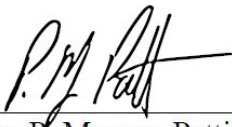
'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
17. The method of claim 15, wherein positioning the reflector sheet comprises mechanically attaching the reflector sheet to the surface of the substrate.	<i>See Claim 7 above.</i>
19. The method of claim 15, wherein the reflector sheet is thermoformable and configured to conform to a shape of a protruding feature on the surface of the substrate.	Tabito, [0068] (“the reflecting plate 26 ... may be formed by expandable PET containing e.g. a phosphorescent material. The expandable PET is lightweight, exhibits high reflectance on the order of 95%, and presents a color tint different from metal luster color such that grazing on the reflecting surface is not outstanding. For this reason, the expandable PET is used in conventional liquid crystal devices as well.”).
[20 Preamble] A method of forming a solid state lighting device comprising:	<i>See Claim 15 Preamble.</i>
[20A] providing a substrate of a solid state lighting tile;	<i>See Claim 15[A].</i>
[20B] mounting a solid state lighting element on a surface of the substrate;	<i>See Claim 15[B].</i>
[20C] positioning a reflector sheet on the surface of the substrate;	<i>See Claim 15[C].</i>

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
[20D] forming a plurality of mounting posts in the substrate; and	See Claim 7; Tabito describes an “optical stud member 25,” that is “mounted to the back panel 13.” Tabito, [0081], [0088]. 
[20E] forming a plurality of alignment holes in the reflector sheet, wherein at least a portion of the alignment holes are configured to receive at least a portion of the mounting posts when the reflector sheet is attached to the surface of the substrate.	Tabito, [0082] (“reflecting plate 26 [is] provided with a large number of fitting holes ... 26a ... for combination with the optical stud members 25.”) 
[23A] The method of claim 16, further comprising: providing a plurality	See Claim 14 above.

'812 Patent	Chou and Starry in View of the Knowledge of a Person of Ordinary Skill in the Art
of solid state lighting tiles;	
[23B] mounting a plurality of solid state lighting elements on the plurality of solid state lighting tiles; and	<i>See Claim 14 above.</i> As shown in Figure 9 of Chou, multiple spot light sources (e.g., LEDs) 1600' are back-welded between two of the circuit boards 1500'.  FIG. 9 Chou, Fig. 9.
[23C] attaching the reflector sheet to the plurality of solid state lighting tiles.	<i>See Claim 14 above.</i>

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may revise my opinions accordingly as necessary. I declare under penalty of perjury that the foregoing Declaration is true and correct.

September 5, 2023



Dr. P. Morgan Pattison