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. 8,294,075
Filing Date: August 5, 2010
Issue Date: October 23, 2012
Title: SOLID-STATE LUMINAIRES FOR GENERAL ILLUMINATION

Inter Partes Review No. IPR2023-01410

Ex. 1036 – Declaration of P. Morgan Pattison, Ph.D. in Response to Patent Owner's Revised Contingent Motion to Amend

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 1 of 48

Table of Contents

Page

I. Introduction.....5

II. Materials Considered.....6

III. Patent Owner's Substitute Claims. 7

IV. Grounds 1 and 2 in Combination with Lys, Chang, and Grootes Render Every Element of Substitute Claims 34-38 Obvious.....9

A. "A lighting panel, comprising: a first substrate on a surface of a first tile, the first substrate and the first tile together comprising a first metal core printed circuit board (MCPCB), the first substrate having a first side parallel to a principal plne of the lighting panel" (Substitute Claim 34[a]). 10

B. "a first plurality of solid state lighting devices arranged on the first side of the first substrate configured to emit light; wherein the first plurality of solid state lighting devices are arranged on the first side of the first substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the first plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the first substrate" (Substitute Claim 34[b]).....15

C. "a second substrate on a surface of a second tile, the second substrate and the second tile together comprising a second MCPCB, the second substrate having a first side parallel to the principal plane of the lighting pane" (Substitute Claim 34[c]). 18

D. "a second plurality of solid state lighting devices arranged on the first side of the second substrate and configured to emit light; wherein the second plurality of solid state lighting devices are arranged on the first side of the second substrate as a lurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the second plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the second substrate" (Substitute Claim 34[d]). 20

E. "wherein the first tile and the second tile are arranged horizontally across the lighting panel" (Substitute Claim 34[e]). 21

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 2 of 48

F. "a first reflector sheet mounted on the first side of the first substrate and not in contact with the first plurality of solid state lighting devices" (Substitute Claim 34[f]).....23

G. "a second reflector sheet mounted on the first side of the second substrate and not in contact with the second plurality of solid state lighting devices" (Substitute Claim 34[g]). 26

H. "a brightness enhancement film on the reflector sheets, wherein the first and second reflector sheets are arranged between the first and second substrates, respectively, and the brightness enhancement film and the brightness enhancement film is configured to preferentially emit light having a first orientation from the lighting panel and to preferentially reflect light having a second orientation, different from the first orientation, back into the lighting panel" (Substitute Claim 34[h]). 27

I. "a diffuser sheet between the first and second reflector sheets and the brightness enhancement film, wherein the first and second reflector sheets, the diffuser sheet and brightness enhancement film extend and are arranged parallel to the principal plane of the lighting panel" (Substitute Claim 34[i]).....29

J. "an optical reflective cavity in contact with the substrate and formed around the solid state lighting elements, the optical reflective cavity having planar angled sidewalls; wherein the optical reflective cavity is not in contact with solid state lighting elements" (Substitute Claim 35) 30

K. "the diffuser sheet is in direct contact with the uppermost surface of the optical reflective cavity" (Substitute Claim 36).....34

L. "further comprising a plurality of current supply circuits that are operable to control a pulse width of a current supplied to each one of the plurality of strings of solid state lighting devices" (Substitute Claim 37).....37

M. "wherein the first and second plurality of strings arranged on each of the first and second substrate, respectively, are controlled by at least two current supply circuits" (Substitute Claim 38).....39

V. Motivations to Combine. 40

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 3 of 48

A. It Would Have Been Obvious to Incorporate the Teachings of Lys and Chang with the Prior Art of Ground I. 40

B. It Would Have Been Obvious to Incorporate the Teachings of Lys and Chang with the Prior Art of Ground II. 43

C. It Would Have Been Obvious to Incorporate the Teachings of Grootes with the Mok-Holman-Lamb-Lys-Chang Combination. 45

D. It Would Have Been Obvious to Incorporate the Teachings of Grootes with the Epstein-Holman-Lamb-Lys-Chang Combination. 46

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 4 of 48

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. 8,294,075 ("the '075 Patent") and the Contingent Revised Motion to Amend (the "Motion") Filed by Patent Owner in that *Inter Partes* Review Proceeding.

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 substitute claims 34-38 submitted by the Patent Owner in the Motion 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.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 5 of 48

6. My qualifications are summarized in Ex. 1003, which is my prior declaration in this proceeding and my CV, which was submitted as Ex. 1004. *See* Ex. 1003, ¶¶6-15. I am not a lawyer, however, my understanding of the legal issues, in particular with respect to obviousness are summarized in my prior declaration. *See* Ex. 1003, ¶¶16-23. My prior declaration also provides my opinion on the appropriate level of experience for a person to be a person of ordinary skill in the art. *See* Ex. 1003, ¶¶25-28.

II. Materials Considered

7. In addition to the materials identified in my prior declarations (*see* Ex. 1003, ¶30; Ex. 1016, ¶7) 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
1037	US 2005/0231943 to Sloan *et al.* ("Sloan")
1038	WO 2005/089293 to Lys *et al.* ("Lys")
1039	US 2003/0189829 to Shimizu *et al.* ("Shimizu")
1040	US 2007/0046485 to Grootes *et al.* ("Grootes")
1041	US 2005/0047134 to Mueller *et al*. ("Mueller")
1042	Japanese Patent Pub. No. 2004-139871 A to Shimizu et al. ("Shimizu '871")
1043	Certified Translation of Ex. 1042, Japanese Patent Pub. No. 2004-139871 A to Shimizu et al. ("Shimizu '871")

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 6 of 48

8. 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, research and work in the fields of optics, LEDs, and display technology, as described above and in my *curriculum vitae* (Ex. 1004).

III. Patent Owner's Substitute Claims.

9. I am informed and understand that Patent Owner has proposed to substitute original claims 1-5 of the '075 Patent with the following substitute claims (the "Substitute Claims"):

34. (proposed substitute for Claim 1) A lighting panel, comprising:

~~at least one~~ first substrate on a surface of a first tile, the first substrate and the first tile together comprising a first metal core printed circuit board (MCPCB), the first substrate having a first side parallel to a principal plane of the lighting panel;

a first plurality of solid state lighting devices arranged on the first side of the first ~~at least one~~ substrate and configured to emit light;

wherein the first plurality of solid state lighting devices are arranged on the first side of the first substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the first plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the first substrate;

a second substrate on a surface of a second tile, the second substrate and the second tile together comprising a second MCPCB, the second substrate having a first side parallel to the principal plane of the lighting panel;

a second plurality of solid state lighting devices arranged on the first side of the second substrate and configured to emit light;

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 7 of 48

wherein the second plurality of solid state lighting devices are arranged on the first side of the second substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the second plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the second substrate;

wherein the first tile and the second tile are arranged horizontally across the lighting panel;

a first reflector sheet mounted on the first side of the ~~at least one~~ first substrate and not in contact with the first plurality of solid state lighting devices;

a second reflector sheet mounted on the first side of the second substrate and not in contact with the second plurality of solid state lighting devices;

a brightness enhancement film on the reflector sheets, wherein the first and second reflector sheets ~~is~~ are arranged between the first and second ~~at least one~~ substrates, respectively, and the brightness enhancement film and the brightness enhancement film is configured to preferentially emit light having a first orientation from the lighting panel and to preferentially reflect light having a second orientation, different from the first orientation, back into the lighting panel; and

a diffuser sheet between the first and second reflector sheets and the brightness enhancement film, wherein the first and second reflector sheets, the diffuser sheet and brightness enhancement film extend and are arranged parallel to the principal plane of the lighting panel.

35. (proposed substitute for Claim 2) The lighting panel of claim ~~1~~ 34, ~~wherein the reflector sheet is configured to reflect and disperse light incident thereon.~~ further comprising an optical reflective cavity in contact with the substrate and formed around the solid state lighting elements, the optical reflective cavity having planar angled sidewalls; wherein the optical reflective cavity is not in contact with solid state lighting elements.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 8 of 48

36. (proposed substitute for Claim 3) The lighting panel of claim ~~1~~ 35, ~~wherein the reflector sheet includes a plurality of apertures therethrough, wherein respective ones of the plurality of apertures aligned with corresponding ones of the plurality of solid state lighting devices~~ wherein the diffuser sheet is in direct contact with the uppermost surface of the optical reflective cavity.

37. (proposed substitute for Claim 4) The lighting panel of claim ~~1~~ 34, ~~wherein the reflector sheet comprises a plastic foam~~ further comprising a plurality of current supply circuits that are operable to control a pulse width of a current supplied to each one of the plurality of strings of solid state lighting devices.

38. (proposed substitute for Claim 5) The lighting panel of claim ~~1~~ 34 ~~wherein the brightness enhancement film comprises a plurality of three dimensional light extraction features configured to bend at least some light rays passing through the brightness enhancement film toward the direction normal to the principal plane of the lighting panel~~ wherein the first and second plurality of strings arranged on each of the first and second substrate, respectively, are controlled by at least two current supply circuits.

IV. Grounds 1 and 2 in Combination with Lys, Chang, and Grootes Render Every Element of Substitute Claims 34-38 Obvious.

10. In my prior declaration I broke down the elements of claims 1-7 and 9-12 and demonstrated that each of the elements of those claims were known in the art before the April 21, 2006, priority date of the '075 Patent. *See* Ex. 1003, ¶¶39-108. In the analysis below I address the new elements of Substitute Claims 34-38 and demonstrate that each of these elements was also known in the art before the April 21, 2006, priority date of the '075 Patent.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 9 of 48

A. "A lighting panel, comprising: a first substrate on a surface of a first tile, the first substrate and the first tile together comprising a first metal core printed circuit board (MCPCB), the first substrate having a first side parallel to a principal plane of the lighting panel" (Substitute Claim 34[a]).

11. Substitute claim 34[a] covers elements well known in the art before April 2006. This is demonstrated, for example, by Mok, which states that "one embodiment of a light emitting panel 10 may comprise a base panel 12 suitable for receiving the various light emitting elements 14 in the manner described herein. The base panel 12 may comprise a generally rectangular shaped, plate-like member having a length 38 and a width 40 that are commensurate with the intended size of the panel 10." Mok, [0019]. Mok goes on to state that "[b]ecause each of the light emitting elements needs to be electrically connected to a source of electrical power, it will be convenient in most applications for the base panel 12 to comprise a printed circuit board." *Id.* Thus, Mok teaches a base panel 12 that comprises a substrate.

12. The structure described in Mok was well known in the art, as shown for example, by Shimizu, which teaches a "heat dissipating substrate 1" upon which LEDs are mounted that includes "a metal plate as a base." Ex. 1039, [0022-0023], [0087], [0120-0121]. The metal plate is a "metal back plate 50," which is on the back of the substrate to "increase the heat conduction." Id. The substrate 1 and

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 10 of 48

metal back plate 50 in Shimizu comprise a tile and a substrate, which together form a multilayer circuit board 51. *Id*., [0168-0169].

13. A POSITA would understand that PCB, as used in Mok, is a generalized term for printed circuit boards, of which there are a number of types such as metal core, FR4, and Teflon printed circuit boards. *See* https://www.mainpcba.com/pcb-substrates/. In particular, metal core printed circuit boards are commonly used in LED systems, as demonstrated by Sloan, which states "Different types of metal core boards can be used such as an aluminum core board. By being metal core, heat from the light elements conducts into the PCB such that the PCB 18 helps draw away heat from the light elements 22, 24." Sloan, [0039]. Indeed, such Metal Core Printed Circuit Boards (MCPCB) were well known in the art as of the priority date of the '075 Patent and still are commonly used. A person of ordinary skill in the art would recognize that there are multiple advantages of MCPCBs, including: (1) Heat dissipation: MCPCBs can transfer heat much faster than regular PCBs, this is due to the use of metal, which is a natural heat conductor, which functions to dissipate heat away from the components, which helps keep them cool and prevents damage to the circuit. (2) Increased performance and life: Keeping the heat generating components cool increases their performance and life. For example, the MCPCB design can help extend the lifespan of an LED. (3) Reduced vibration: The core of the board

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 11 of 48

reduces vibration, so components don't fall off in environments where the larger device is in motion, e.g., in airplane seatback displays. (4) Durability and strength: The metal substrates used in MCPCBs are long-lasting and strong. (5) Non-toxic and recyclable: Metals are non-toxic and can be recycled. *See, e.g.*, https://www.mainpcba.com/pcb-substrates/.

14. In view of these advantages, and that MCPCBs were well known in the art, a POSITA would have been motivated to use a MCPCB in Mok's design (to the extent Mok does not already expressly disclose such a PCB as noted above). Indeed, such a MCPCB would be desirable for use in Mok, for example, because of its excellent heat dissipation properties, as well as the fact that they allow for the necessary electrical connections, as shown by Mok which states "light emitting elements needs to be electrically connected to a source of electrical power." Mok, [0019].

15. With respect to the first substrate having a first side parallel to a principal plane of the lighting panel, this is also disclosed by Mok. Figure 5A of the '075 Patent shows the principal plane 76 of lighting panel as a horizontal plane parallel to the substrate 10. *See, e.g.*, Ex. 1001, 10:63-11:9, Fig. 5A. A similar horizontal principal plane of the lighting panel and a corresponding side of the base panel 12 parallel to the horizontal principal plane of the lighting panel is shown in Mok, for example in Figure 1. Mok, Figure 1:

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 12 of 48

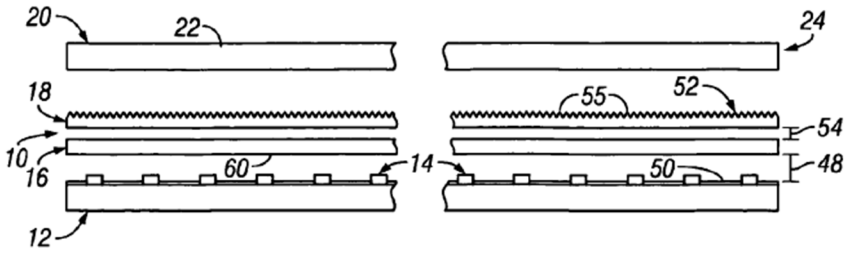


FIG. 1

16. Substitute claim 34[a] is also disclosed by Epstein, which states that "The display panel 302 of the lighting unit 300 comprises a number of tiles 304, and each tile 304 comprises a number of light emitting elements 306. The layers of the tile 306 comprise a substrate 308, a guiding layer 310 and an optional contrast/projection filter 312." Epstein, [0039]. The substrate 308 may also have a metallic layer on its lower surface "for extracting heat generated by the LEDs". *Id.* at [0054]. This metallic layer on the lower surface of the substrate is a tile as in substitute claim 34[a], while the substrate is a substrate on the surface of a tile as in substitute claim 34[a]. Alternatively, a POSITA would understand that Epstein's multi-component tile has a metallic layer and substrate layer that is the claimed "tile," while Epstein's substrate, as a component of its tile, is on the surface of the claimed "tile." Further, the substrate in Epstein "may be formed from a metal." *Id*., [0046]. Epstein also states that the substrate can include conductors, and the "conductors may take the form of metallic traces." *Id*., [0051]. The tile and substrate including metallic traces would be understood by a POSITA to be a

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 13 of 48

MCPCB, which was a very commonly used substrate in lighting panel design. This is because, as set forth above, MCPCB are very useful for efficient heat dissipation and electrical connections, which are required in LED lighting panels.

17. To the extent not disclosed by Mok (Ground 1) or Epstein (Ground 2), substitute claim 34[a] is also disclosed by Lys, which states "light sources 300 may be disposed on a support structure, such as a board 204. The board 204 may be a circuit board or similar facility suitable for holding light sources 300 as well as electrical components." Lys, 31. The light sources in Lys are arranged in arrays 2208 which are disposed on the boards 204. *Id*., 146-148.

18. Lys further states that "The board may be a printed circuit board or similar circuit board 204. The board may be positioned on top of a heat-conducting plate 7004, such as a metal plate, that acts as a thermal facility 2500 for conducting heat away from the light sources 300." *Id*., 144. Additionally, Lys's "thermal facility may include" "a potting facility for receiving heat from a circuit board associated with one or more of the plurality of LEDs, and/or a metal plate" and "a metal core board for accepting heat from one or more of the plurality of LEDs" where "The metal core board may be a printed circuit board." *Id*., 5, 31, 56. A POSITA would thus understand that Lys discloses a MCPCB, which is comprised of the board 204 and heat conducting metal plate 7004. Lys shows this board 204

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 14 of 48

as having a first side parallel to principal plane of the lighting panel, for example in Figures 22b, 70, 74, 75.

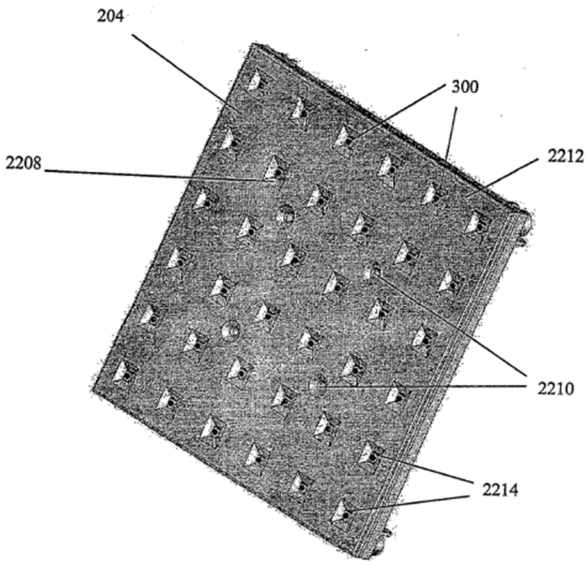


Fig. 22b

B. "a first plurality of solid state lighting devices arranged on the first side of the first substrate configured to emit light; wherein the first plurality of solid state lighting devices are arranged on the first side of the first substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the first plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the first substrate" (Substitute Claim 34[b]).

19. Substitute claim 34[b], aimed at series of strings of LEDs connected by metallic traces, was also well known in the art before April 2006.

20. For example, Mok states that "The base panel 12 provides a convenient mounting location for the various light emitting elements 14, allowing them to be arranged in a two dimensional array or pattern over both the length 38

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 15 of 48

and width 40 of the base panel 12." Mok, [0019]. Mok further recognizes that "each of the light emitting elements needs to be electrically connected to a source of electrical power" so "the light emitting elements 14 may be electrically connected (e.g., by soldering) to pads (not shown) provided on the base panel 12. The pads of the base panel 12 may then be connected to drive circuitry (not shown) suitable for providing the required electric current to the light emitting elements 14." *Id.* A POSITA would know that a common way of arranging LEDs in an array with electrical connections would be to arrange the LEDs in series of strings connected by metallic traces. *See, e.g.*, Mueller at [0308] (teaching "multiple strings or channels of LEDs"); https://www.pcbaaa.com/pcb-structure/ ("PCB conductive layers are critical components within a printed circuit board, forming the intricate network of electrical pathways that connect various components and facilitate the flow of electricity. These layers primarily consist of copper foils laminated onto the board's substrate material, creating conductive traces that carry electrical signals across the PCB."); Shimizu at Fig. 6A, [0129] (describing "a simple series-parallel connection… or a ladder connection" between the LEDs disposed on the substrate"). Such a configuration was well-known in the art as a way of creating more efficient lighting, as the series of strings of LEDs would allow for easier delivery of currents to each LED.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 16 of 48

21. Epstein also discloses substitute claim 34[b], stating "Conductors may be provided on different layers for carrying electrical current to and from the LEDs 420" which are disposed on a metal substrate. Epstein, [0051]. "The conductors may take the form of metallic traces" and "are positioned on the substrate 408 to carry current to and/or from the LEDs 420." *Id.*

22. These metallic traces 421/425 are "provided on the substrate 408" and connect the LEDs 420 in series, as shown in Figure 4A of Epstein. *Id.*, [0051-0052], Fig. 4A:

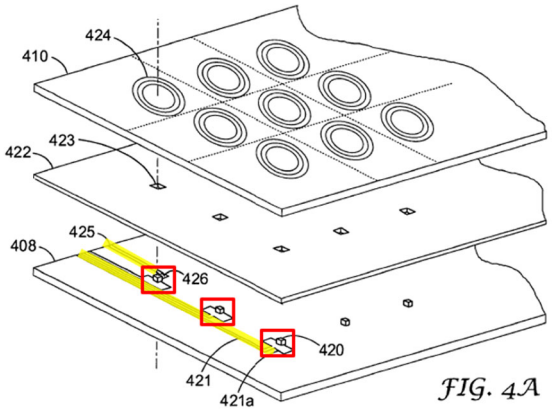


FIG. 4A

23. Connecting strings of LEDs via metallic traces, such as the conductors in Epstein, was well known in the art. *See, e.g.,* Mueller at [0308]; https://www.pcbaaa.com/pcb-structure/. Thus, to the extent that PO argues Epstein's series of LEDs are not in strings, such a configuration would be an obvious way of arranging Epstein's LEDs for further efficiency.

24. To the extent not taught by Mok (Ground 1) or Epstein (Ground 2), Lys and Grootes also teach substitute claim 34[b]. Lys, for example, states that its

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 17 of 48

"printed circuit board or similar circuit board 204… may be positioned on top of a heat-conducting plate 7004, such as a metal plate, that acts as a thermal facility 2500 for conducting heat away from the light sources 300." Lys, 144. The lighting units in Lys may further be "series of lighting units 102" which are "configured in long strings" by circuitry and connected to a housing 800 on the board 204 which may be made of metal. *Id*., 49, 56-57, 60, 62, 95. A POSITA would thus understand Lys's series of strings of lighting units, connected by circuitry on metal housings, to be connected by metallic traces, as this was common in the art.

25. Similarly, Grootes teaches substitute claim 34[b], as it describes "strings of LEDs" where "the LEDs are mounted on a PCB and connected in series." Grootes, [0004]; [0010]; [0050]; [0066], *see also* Abstract, [0015] (describing "the series string of LEDs"). It would be understood to a POSITA that series of strings on a PCB as in Grootes would be connected by metallic conductors or traces. *See, e.g.,* https://www.pcbaaa.com/pcb-structure/.

C. "a second substrate on a surface of a second tile, the second substrate and the second tile together comprising a second MCPCB, the second substrate having a first side parallel to the principal plane of the lighting pane" (Substitute Claim 34[c]).

26. Substitute claim 34[c] is also taught by the prior art. For example, as explained above, Mok teaches a base panel 12 that is a substrate on a tile, comprising a MCPCB, where the substrate has a first side parallel to the principal plane of the lighting panel. Although Mok does not explicitly teach a second base

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 18 of 48

panel with these features, Mok states that its "light emitting panel 10 is not size-limited and is capable of providing high illuminations over large areas." Mok, [0017]. In order to provide a larger light emitting panel 10, a POSITA would understand that multiple base panels 12 may be used this overall lighting panel. Further, in light of the other prior art, such as Lys, it would have been obvious to modify Mok to comprise multiple base panels.

27. Epstein also discloses substitute claim 34[c], as it states "the lighting unit 300 comprises a ***number of tiles*** 304" where each tile has the same features described with respect to substitute claim 34[a], such as layers including "a substrate 308, a guiding layer 310 and an optional contrast/projection filter 312." Epstein, [0039] (emphasis added). Epstein further shows, for example, in Figures 3A and 3B a number of tiles 304/306.

28. Epstein also recognizes that the use multiple tiles may be "eliminated if the manufacturing processes permit the manufacture of sufficiently large substrate, lens films and screen layers." Epstein, [0045]. Thus, the tile structure in Epstein does not use one large substrate—rather it uses a number of tiles, each including a number of layers including separate substrates.

29. To the extent that substitute claim 34[c] is not taught by Mok (Ground 1) or Epstein (Ground 2), it is also taught by Lys, which describes "two or more boards 204 with arrays 2208" with the same features as the board 204 described

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 19 of 48

with respect to substitute claim 34[a]. Lys, 115. Lys further states that the "boards 204 [are] to be used as elements, such as tiles, to make up larger structures." *Id*., 65. Using Lys's boards, or tiles, in a two dimensional lighting array would be obvious to a POSITA, as such an arrangement was well-known in the art, and had the advantage of creating more light. Further, a POSITA would understand that Lys's boards would be made of components such as a substrates, reflectors, lens, diffusers, and other optical components, all of which were common components in LED systems. It would thus be obvious to a POSITA to use these commonly used components in a two-dimensional array.

D. "a second plurality of solid state lighting devices arranged on the first side of the second substrate and configured to emit light; wherein the second plurality of solid state lighting devices are arranged on the first side of the second substrate as a plurality of strings of solid state lighting devices and each one of said plurality of strings comprises ones of the second plurality of lighting devices connected in series with one another by a plurality of metal traces formed on the first side of the second substrate" (Substitute Claim 34[d]).

30. Substitute claim 34[d] is also aimed at well-known components, and is disclosed by the prior art. As I explained with respect to substitute claim 34[c], Mok, Epstein, and Lys all teach a plurality of substrates, all of which have the same characteristics. And as I explained with respect to substitute claim 34[b], Mok, Epstein, Lys, and Grootes each disclose a plurality of series of strings of

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 20 of 48

LEDs which are on a first side of a substrate that are connected by metal traces on the first side of the substrate.

E. "wherein the first tile and the second tile are arranged horizontally across the lighting panel" (Substitute Claim 34[e]).

31. Substitute claim 34[e] is disclosed by the prior art. Mok, for example, describes a light emitting panel 10 that "may comprise a base panel 12 having a plurality of light emitting elements 14 thereon." Mok, [0015]. Mok further states that "the light emitting panel 10 may be positioned adjacent a display device 20, such as a liquid crystal display panel 22, to form a backlit display system 24." *Id.*

32. A POSITA would understand that multiple of Mok's base panels could be utilized to create the light emitting panel Mok describes, where the base panels would be arranged horizontally across the light emitting panel. As explained with respect to substitute claim 34[c], such an arrangement would be done, for example, where a larger light emitting panel is needed, so multiple base panels would be needed to increase the size of the overall light emitting panel.

33. Epstein also discloses substitute claim 34[e], stating the "display panel 302 of the lighting unit 300 comprises a number of tiles 304." Epstein, [0039]. As shown, for example in Figure 3A, the tiles 304 are arranged horizontally across the light emitting panel (display panel 302). *See id*., Fig. 3A:

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 21 of 48

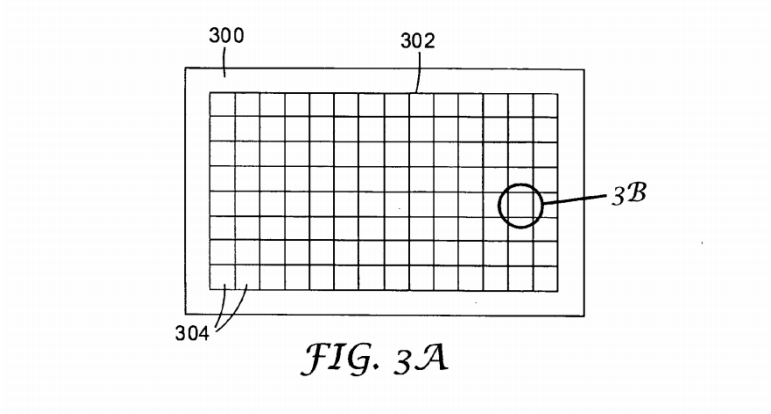
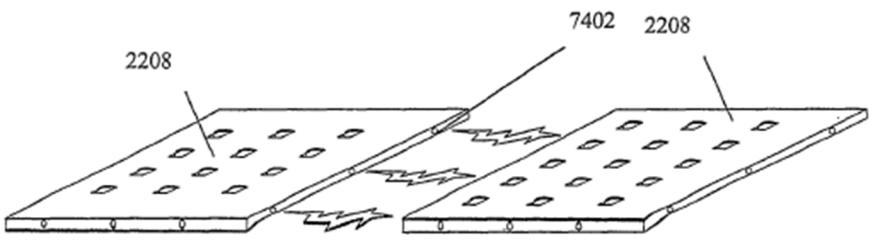


FIG. 3A

34. To the extent substitute claim 34[e] is not disclosed by Mok (Ground 1) or Epstein (Ground 2), it is disclosed by Lys. Lys describes a plurality of boards upon which are "an array 2208 of light sources 300," and states "the boards 204 that hold the arrays 2208 may be fitted with magnetic facilities 7402 along the sides for fastening one board 204 to another." Lys, 145. The plurality of boards fastened together are a part of a lighting system which "may include a dipline style mounting panel that allows units to be placed anywhere on a surface." *Id*., 70. As shown in Fig. 74 of Lys, for example, the panels fastened together would be arranged horizontally across the lighting panel (e.g., the dipline style mounting panel). *Id*., Fig. 74:



Petitioner Hisense USA Corporation
Exhibit 1036 - Page 22 of 48

F. "a first reflector sheet mounted on the first side of the first substrate and not in contact with the first plurality of solid state lighting devices" (Substitute Claim 34[f]).

35. Substitute claim 34[f] is also aimed at well-known components, and is disclosed by the prior art. With respect to Mok, a reflector sheet 50 is mounted on a first side of a substrate, as shown in Figure 1. Mok, Fig. 1. This reflector sheet 50 would not be in direct contact with the LEDs. This is because LEDs generate heat, and if the reflector sheet was in contact with the LEDs it would have greater exposure to this heat, which would have adverse effects on the reflector sheet, such as causing the reflector sheet to expand.

36. This is taught, for example, by Shimizu '871, which states "warping or bending of the reflective plate may occur when the lighting device reaches a high temperature due to continuous operation of the light source," and "uneven brightness occurs on the display screen of the liquid crystal display device, leading to a decrease in image quality." Shimizu '871, Abstract, [0007].

37. Such a configuration, where a reflector sheet is not in direct contact with the LEDs, was well known in the art. For example, Shimizu teaches and "optical reflector 3 [that] includes the same number of openings (or holes) 3b as that of the LED bare chips 2 that are arranged on the heat-dissipating Substrate 1. Thus, the light that has been emitted from the LED bare chips 2 goes out through the openings 3b of the optical reflector 3" wherein "the openings (or holes) of the

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 23 of 48

optical reflector preferably have varying diameters such that the light outgoing portion thereof… has a greater diameter than that of their portion closer to the heat-dissipating substrate." Shimizu, [0120].

38. Further, Mok states that "The reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12," and the reflective surface may be made of aluminum. Mok, [0021]. When manufacturing a separate reflective sheet, made of a material such as aluminum, to avoid friction with the LEDs and to make it easier to incorporate the separate sheet in the lighting system, sufficient space would need to be left in the sheet for the LEDs, such that the LEDs and reflective sheet would not be in contact when the sheet is used in the lighting panel.

39. Epstein also teaches substitute claim 34[f], disclosing a reflective intermediate layer 422/522 that is, as shown in Figure 5A-5E for example, mounted on the substrate 508. Epstein, [0054], [0058-0061]. This reflective intermediate layer is formed as a sheet and is not in contact with the LEDs 520. *See, e.g., id*., [0062] (the aperture in the intermediate layer 522 may be sized larger than the LED 520 so as to reduce the constraints on registration between the LEDs 520 and the intermediate layer 522 when assembling the lighting unit), Fig. 5D:

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 24 of 48

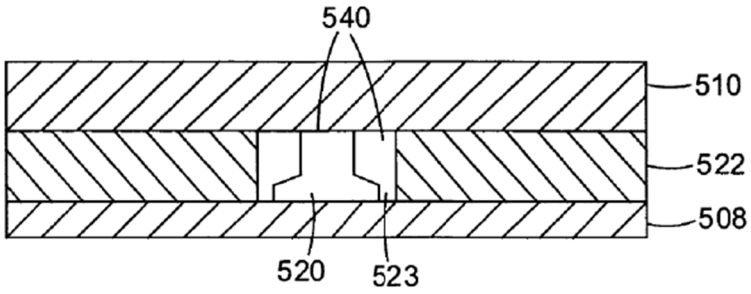


FIG. 5D

40. To the extent not taught by Mok or Epstein, Chang discloses a reflector sheet mounted to the first side of substrate that is not in contact with the LEDs. Chang states that accumulation of heat in LED display panels "will not only affect the normal operation of the display panel, but also cause a reduction in display quality (for example a decrease in brightness), and can easily and significantly reduce the service life of surrounding components." Chang, 6-7. Chang further teaches the important of keeping LEDs separate from the reflector for increase a "heat dissipation area," and is focused on improved heat dissipation in LED display panels. *Id*., 9, Fig. 6. Chang further states that "reduc[ing] the contact area between the reflector and the base plate, reduc[es] the heat dissipation effect." *Id*., 6-7. To avoid these adverse effects and have better heat dissipation, Chang further teaches a reflector and base plate in direct contact.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 25 of 48

G. "a second reflector sheet mounted on the first side of the second substrate and not in contact with the second plurality of solid state lighting devices" (Substitute Claim 34[g]).

41. Substitute claim 34[g] is also aimed at well-known components, and is disclosed by the prior art. As described above with respect to substitute claim 34[f], Mok discloses a reflector sheet mounted on a first side of a substrate and not in contact with the LEDs. Further, it would be obvious to utilize a second reflector sheet in Mok. Indeed, utilizing a plurality of reflectors was well known in the art. *See, e.g.,* Shimizu '871, [0025] (describing the use of "[a] plurality of [] reflective plate constituent[s] …[that] form the reflective plate)." For example, in larger lighting panels, one would utilize more than one reflector sheet would be helpful as greater surface area could be covered and more light could be reflected and output. And the utilization of multiple reflector plates is helpful for avoiding warping of the lighting panel and related issues due to the heat created from the LEDs, which is a commonly recognized issue in lighting panel design. *Id*., [0078] (stating the use of multiple reflection plates makes it "possible to obtain a backlight device that does not undergo warping or bending of the reflective plate and provides uniform emission without uneven brightness even when the temperature increases.")

42. Epstein also discloses substitute claim 34[g]. As set forth above with respect to substitute claim 34[c], Epstein teaches a plurality of tiles each comprising a separate substrate and reflector upon which LEDs may be mounted.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 26 of 48

Further, as explained with respect to substitute claim 34[f], Epstein discloses a reflector that is mounted on a substrate and not in contact with the LEDs.

43. To the extent that substitute claim 34[g] is not taught by Mok (Ground 1) or Epstein (Ground 2), it is taught by Lys. As explained with respect to substitute claim 34[c], Lys discloses a number of boards 204, upon which the arrays 2208 of light sources 300 are mounted. Each of the boards 204 have the same components. These boards 204 are part of larger LED lighting system described in Lys. As a POSITA would understand, LED lighting systems generally include similar components, such as reflectors and other optical films, as such components are important for increased light collection, output, and uniformity. Thus, it would be obvious to a POSITA to utilize reflector sheets on Lys's boards 204 with light sources 300.

H. "a brightness enhancement film on the reflector sheets, wherein the first and second reflector sheets are arranged between the first and second substrates, respectively, and the brightness enhancement film and the brightness enhancement film is configured to preferentially emit light having a first orientation from the lighting panel and to preferentially reflect light having a second orientation, different from the first orientation, back into the lighting panel" (Substitute Claim 34[h]).

44. Substitute claim 34[h], which describes a well-known configuration of commonly used components in lighting panels, is disclosed by the prior art. Mok, for example, discloses a brightness enhancer 18 which "comprises a brightness enhance film (BEF) available from 3M and sold under the registered trademark

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 27 of 48

Vikuiti." Mok, [0024]. This BEF 18 is on the reflective surface 50, which is arranged between the BEF 18 and base panel 12. *Id*., Fig. 1:

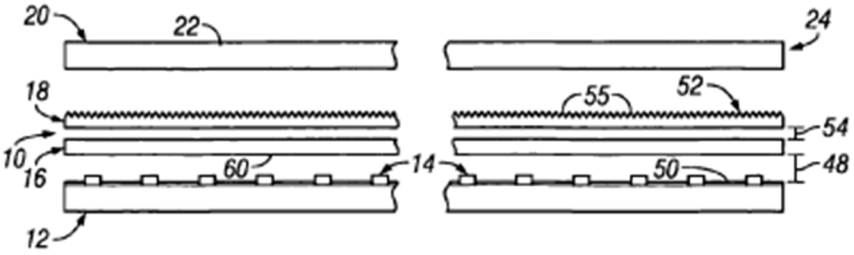


FIG. 1

45. Similarly, Epstein describes using "one or more brightness enhancing films, available from 3M Company, St. Paul, Minn., under the trade name BEF™, may be used" and shows these BEFs 662/664 as on a reflector 422/622, which is between the BEF and substrate 408/608. Epstein, [0074-0075], Fig. 11:

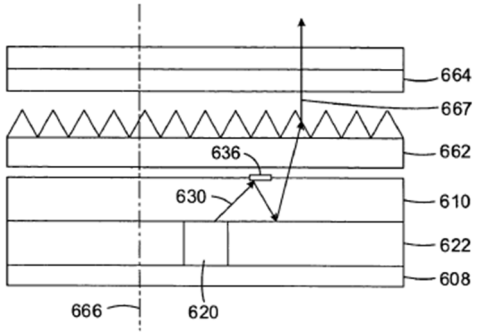


FIG. 11

46. As explained with respect to substitute claim 34[c], Epstein also discloses a plurality of tiles, each with these same elements. Thus, Epstein discloses a first and second reflector sheet that are arranged between the first and second substrates and the brightness enhancement film.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 28 of 48

I. "a diffuser sheet between the first and second reflector sheets and the brightness enhancement film, wherein the first and second reflector sheets, the diffuser sheet and brightness enhancement film extend and are arranged parallel to the principal plane of the lighting panel" (Substitute Claim 34[i]).

47. Substitute claim 34[i] is also aimed at well-known components, and is disclosed by the prior art. Mok, for example, states a "diffuser 16 may be mounted in front of the base panel 12" and "[t]he brightness enhancer 18 is positioned adjacent the diffuser 16 and receives diffused light therefrom." Mok, [0023-0024]. As shown in Figure 1 of Mok, the diffuser sheet 16 is between the reflector sheets 50 and BEF 18, and each of these elements are arranged parallel to the principal plane of the lighting panel. *Id*., Fig. 1:

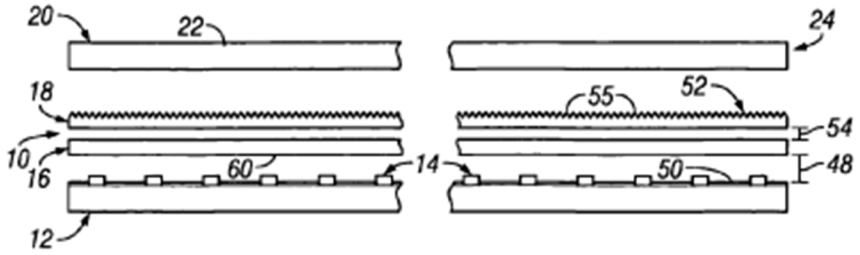


FIG. 1

48. Epstein disclose substitute claim 34[i] as well, describing "spreading the light from the LED 620 within the guiding layer 610" through the use of "[a] diffuser 1902, such as a volume diffuser, [that] is positioned on the far side of the guiding layer 610." Epstein, [0084]. As shown in Figure 11, this diffuser is

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 29 of 48

between the reflector sheet 622 and BEFs 662/664, and all these elements are arranged parallel to the principal plane of the lighting panel. *Id*., Fig. 11:

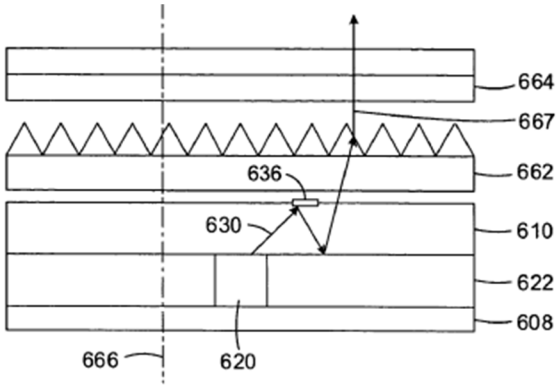


FIG. 11

49. Epstein further discloses a number of tiles with the same elements, as explained with respect to substitute claim 34[c]. Thus, Epstein teaches a diffuser sheet between the first and second reflector sheets and the brightness enhancement film.

J. "an optical reflective cavity in contact with the substrate and formed around the solid state lighting elements, the optical reflective cavity having planar angled sidewalls; wherein the optical reflective cavity is not in contact with solid state lighting elements" (Substitute Claim 35)

50. Substitute claim 35 is disclosed by the prior art, such as Mok for example, which states a "reflector cup 32 may be formed in the base portion 30." Mok, [0028]. Mok further discloses LEDs may be placed in light emitting diode junction 34 which is on "base portion or substrate 30 in which is formed a reflector cup 32." *Id*., 26. This reflector cup 32 is thus in contact with the substrate 30 and forms a reflective optical cavity around the LEDs. As shown in Figure 3, the

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 30 of 48

reflector cup has planar angled sidewalls which are not in contact with the LEDs in diode junction 34. Mok, Fig. 3:

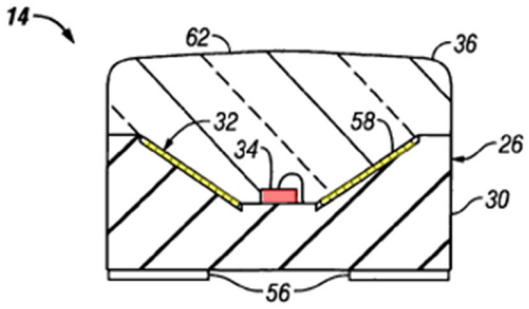
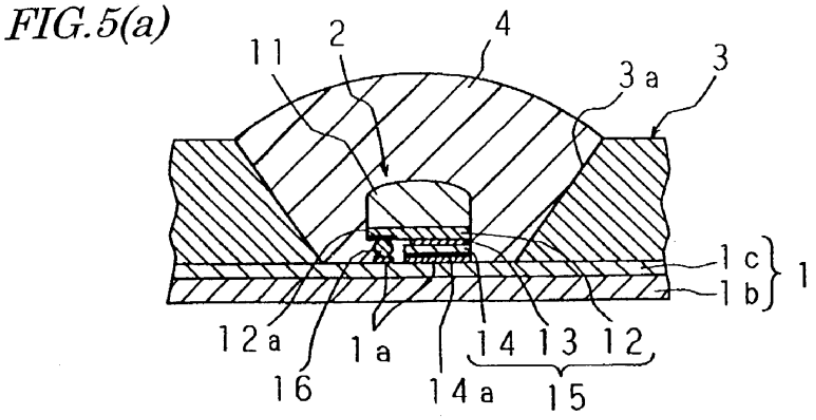


FIG. 3

51. Such reflective optical cavities, like the cavity in Mok, were well known in the prior art. For example, in Shimizu, a reflector 3 with an angled plane 3a is placed on a heat dissipating substrate 1, and forms an optical cavity around the LED chip 2, which is not in contact with the walls of the reflector 3. *See, e.g.*, Shimizu, [0136], [0168], Fig. 5A:



52. Epstein discloses an intermediate layer 522/622, which is a reflective sheet, that is mounted on a substrate 508/608. Epstein, [0058-0061], [0072]. As

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 31 of 48

shown in Figure 5D of Epstein, this reflective sheet forms a reflective optical cavity around, and is not in contact with, the LED 520. *Id*., Fig. 5D:

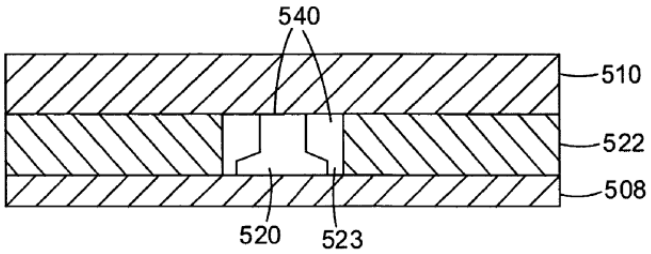
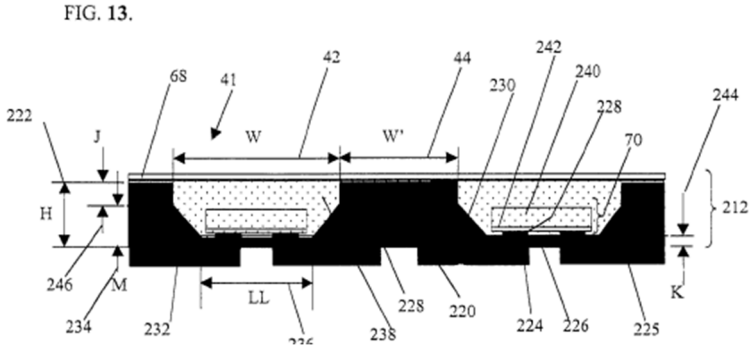


FIG. 5D

53. Holman also teaches substitute claim 35, disclosing sloped sidewalls 230, which can be a diffusely reflecting material" or "can also be made specularly reflecting." Holman, 38. These reflective sloped sidewalls 230 are on a base layer 220. *Id*., 38, Fig. 13:



54. Further, as shown in Figures 13-15, the sloped sidewalls 230 form an optical reflective cavity around the LED chips 70. *Id*., 37-38, Figs. 13-15. To the extent that Holman does not expressly teach multiple tiles with these feature in its claimed lighting panel, it would have been obvious to a POSITA to modify

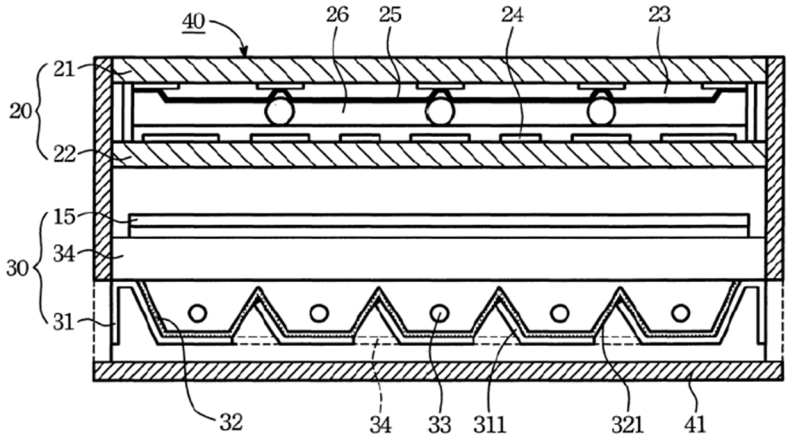
Petitioner Hisense USA Corporation
Exhibit 1036 - Page 32 of 48

Holman such that there were multiple lighting tiles in the LED lighting panel. This is because utilizing multiple smaller lighting tiles would give greater flexibility in the size of the overall lighting panel. For example, if a smaller lighting panel was needed, fewer tiles could be used, but the lighting panel could easily be made larger by utilizing more tiles as well.

55. To the extent substitute claim 35 is not taught by Mok, Holman, or Epstein, it is taught by Chang. Chang discloses a "reflector 32 covers the base plate 31" and a "light-emitting component 33 [that] is provided in a relative concave region 322 at the side of the convex region 321" of the reflector. Chang, 9, Figs. 1-6. Chang further teaches maintaining contract between the reflector and base plane because "reduc[ing] the contact area between the reflector and the base plate, reduc[es] the heat dissipation effect." *Id.*

56. As shown in Figure 6 of Chang for example, the reflector, with convex and concave regions, forms a reflective optical cavity around the light emitting component. *Id*., Fig. 6:

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 33 of 48



57. As also shown in Figure 6 of Chang, the LEDs 33 are not in contact with the reflector 32.

K. "the diffuser sheet is in direct contact with the uppermost surface of the optical reflective cavity" (Substitute Claim 36)

58. Substitute claim 36 is also disclosed by the prior art. For example, Mok states "the diffuser 16 is separated from the base panel 12 by a distance 48 of about 50 millimeters (mm) or less." Mok, [0023]. The reflector sheet 50 is mounted on the base panel 12 between the diffuser and base panel. Id., Fig 1. Thus, as zero mm is less than 50 mm, a distance of zero between the diffuser 16 and reflector sheet 50 on the base panel 12 is disclosed, meaning that there would be direct contact between the diffuser and reflector sheet.

59. To the extent that PO argues that, based on the depiction in Figure 3 of Mok, the lens 36 would come between the diffuser and reflector, the lens would also be understood to be a part of the optical reflective cavity, as it is a part of the space around the LEDs that is created by the reflector and reflective cup.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 34 of 48

60. Further, a POSITA would understand that LEDs may be very thin elements, as utilizing low-profile solid state emitters allow optical components to be placed within the system and reduce panel thickness. The use of low-profile LEDs in Mok would mean that the diffuser contacts the reflector sheet, as the LEDs would be thinner than, and thus below, below the reflector sheet.

61. Epstein also discloses substitute claim 36, describing and showing a diffuser 510 that directly contacts the top of the reflector 522. Epstein, [0058-0061], [0066], [0084], Figs. 5A-5D.

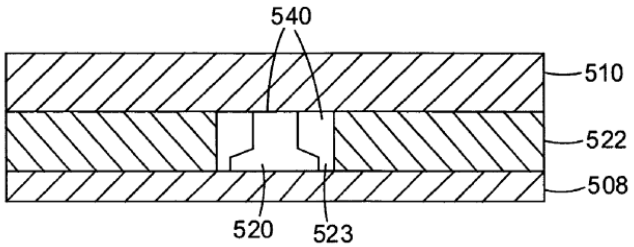
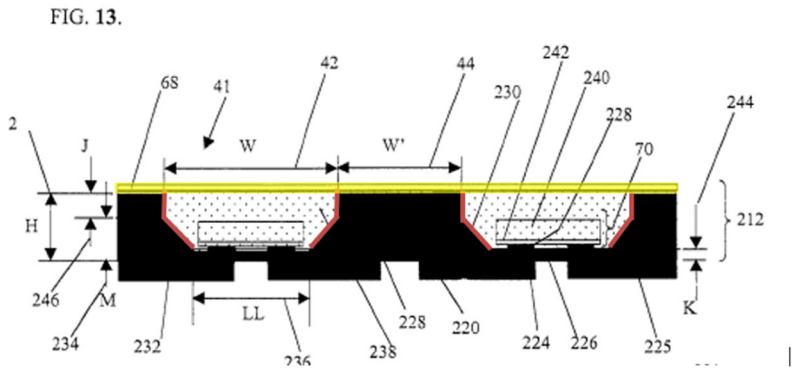


FIG. 5D

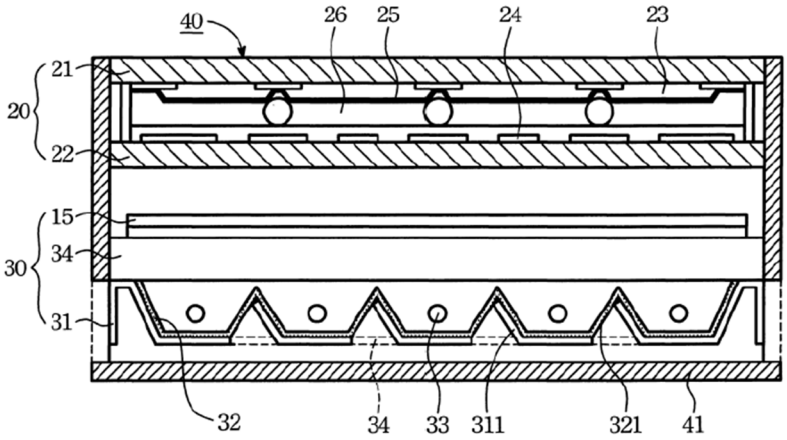
62. As shown in Figure 5D for example, the uppermost surface of the reflective optical cavity is the top of the reflector 522, which comes in direct contact with the diffuser 510. *Id*., Fig. 5D.

63. Holman also discloses substitute claim 36. As shown in Holman, for example in Figure 13, the top of the reflective optical cavity created by reflective sidewalls 230 comes in direct contact with the diffuser 68. Holman, 37-39, Figs. 13, 14, and 15.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 35 of 48



64. To the extent substitute claim 35 is not taught by Mok, Holman, or Epstein, it is taught by Chang. Chang discloses a "direct type backlight module 30 [that] includes a base plate 31, a reflector 32, a light-emitting component 33 and a diffusion sheet 34." Chang, 9. As shown in Figure 6 of Chang, the diffuser sheet 34 is in direct contact with the top of the reflector 32, which is the uppermost portion of the reflective optical cavity. *Id.*, Fig. 6:



L. "further comprising a plurality of current supply circuits that are operable to control a pulse width of a current supplied to each one of the plurality of strings of solid state lighting devices" (Substitute Claim 37)

65. Substitute claim 37, aimed at the well-known concept of pulse width modulation (PWM), is disclosed by the prior art. Mok, for example, describes "light emitting elements 14 may be mounted to the base panel 12 in any of a wide variety of configurations," for example, "the light emitting elements 14 are arranged so that they define a plurality of rows 42 and columns 44." Mok, [0020]. These columns and rows of LEDs 14 are "connected to drive circuitry (not shown) suitable for providing the required electric current to the light emitting elements 14." *Id*., [0019]. Thus, a POSITA would understand Mok to teach current supply circuits for supplying current to the rows and columns of LEDs.

66. Similarly, Epstein discloses "power supply 102, or control circuits within the panel 104, selectively provides current to individual light emitting elements so as to illuminate a desired pattern on the display panel 104." Epstein, [0035].

67. To the extent that substitute claim 37 is not explicitly taught by Mok (ground 1) or Epstein (Ground 2), it is disclosed by Lys and/or Grootes.

68. Lys, for example, describes a lighting unit 102 with includes LED light sources 300 that may be arranged in series of strings. Lys, 83, 95. Lys further discloses power supply circuits for providing current to the plurality of strings of

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 37 of 48

LEDs, stating "[i]n various aspects, examples of power facilities 1800 include, but are not limited to, AC power sources, DC power sources … Additionally, in one aspect, the power facility 1800 may include or be associated with one or more power conversion devices that convert power received by an external power source to a form suitable for operation of the lighting unit 102." *Id*., 60.

69. Lys goes on to describe a "power factor correction facility 1804 and DC to DC converter 1812 [that] are integrated into a single stage power factor correction/DC to DC converter facility 1908 that is integrated with the lighting unit 102." *Id*., 68. A POSITA wounder understand the single stage power factor correction/DC-to-DC converter facilities are current supply circuits, which are operable to control a current supplied to each of the plurality of strings of LEDs.

70. Lys also states that its "Control facilities may include more complex drive facilities 3800" with "various methods of driving 4300, including modulation techniques such as pulse-width-modulation." *Id*, 34. "The PWM technique is considered on of the preferred techniques for driving LEDs," as stated by Lys. *Id*., 77. PWM was also a widely known and used technique for controlling LED strings. A POSITA would thus understand Lys discloses controlling the pulse width of current supplied to its series of strings of LEDs.

71. Next, Grootes discloses PWM controllers 50 for delivering PWM control signals over PWM control lines. Grootes, [0047-0049]. Grootes also

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 38 of 48

discloses "series strings" of LEDs where "[t]he anode of each string is connected to its own voltage regulator 36, 37, 38, and the cathode of each string is connected to its own current source 40, 41, 42." *Id*., [0036-0037]. Thus, Grootes discloses a plurality of current supply circuits for PWM control.

M. "wherein the first and second plurality of strings arranged on each of the first and second substrate, respectively, are controlled by at least two current supply circuits" (Substitute Claim 38)

72. Substitute claim 38 is also aimed at well-known components, and is disclosed by the prior art. For example, as set forth with respect to substitute claim 37, Lys discloses single stage power factor correction/DC-to-DC converter facilities 1908 that control the current supplied to each of the plurality of strings of LEDs. A POSITA would understand that the single stage power factor correction/DC-to-DC converter facilities 1908 are a plurality of current supply circuits, and thus Lys discloses at least two current supply circuits for controlling the plurality of strings of LEDs.

73. Similarly, Grootes discloses series strings of LEDs, where the cathode of each string is connected to its own current source 40, 41, 42" and each string of LEDs is connected to of PWM control lines for delivering PWM control signals. Grootes, [0035-0037],[0048-49].

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 39 of 48

V. Motivations to Combine.

A. It Would Have Been Obvious to Incorporate the Teachings of Lys and Chang with the Prior Art of Ground I.

74. A POSITA would have been motivated to combine multiple substrates, tiles and PCBs, including a Metal Core PCB (MCPCB), a plurality of strings of solid state lighting devices connected using metal traces and in series, and using Pulse Width Modulation ("PWM") controllers to control lighting units, as described in Lys, and to separate the solid state lighting device from the reflector while keeping the reflector sheet in contact with its base to increase the "heat dissipation area," to form convex structures that form concave regions around light sources, as described by Chang with the prior art of Ground 1.

75. First, Mok, Lys, and Chang all relate to solid state lighting systems, which utilize similar components such as LEDs, substrates, and printed circuit boards. *See, e.g.,* Mok, [0015]; Lys, 3, Chang, 3. Mok, Lys, Chang also seek to solve similar problems. For example, Mok, Lys, and Chang aim to solve issues with heat dissipation and efficiency, and produce brighter, more uniform light. *See, e.g*., Mok, [0004-0007]; Lys, 3, 45; Chang, 5-6.

76. Series of strings of LEDs on lighting tiles or boards were well known in the art, and utilizing Ly's series of strings of LEDs with Ground 1 would be useful for more efficient delivery of current to the LEDs, as current could be provided to a plurality of LEDs at once, rather than having to be provided to each

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 40 of 48

LED individually. Lys explicitly recognizes this benefit, stating, for example, that by utilizing series of strings of LEDs, "data can be addressed to lighting units 102 based on their location in a series of lighting units 102, rather than requiring knowledge of the exact physical location of each lighting unit 102." Lys, 94-95. A POSITA would recognize that placing LEDs in series provides a similar current across all LEDs thus improving lighting control over the full string of LEDs to maintain a uniform light output. Indeed, as explained above, Lys itself discusses the benefits of connecting its lighting units in series. *Id*., Fig. 31, pg. 94-95. Series of strings of LEDs, as used in Lys, would also help provide more uniform light and greater control over the lighting system. Furthermore, metallic traces such as the housings in Lys were a well-known and simple way of connecting the strings of LEDs so the current can easily be delivered to each LED string, and a POSITA would know that PCBs commonly use metal traces to create electrical connections.

77. Incorporating Ly's lighting board and heat conducting plate into the references in Ground 1, including Mok's base panel, would also be helpful for better heat dissipation and thermal management. Indeed, Lys discusses in depth the improved thermal management its system provides, and thermal management is a goal of the Ground 1 references as well. *See, e.g*, Lys, 58 ("The board 204 may be a metal core board for accepting heat from the light sources 300 and trapping the heat away from the light sources 300.") Better heat dissipation would also help

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 41 of 48

lengthen the life of the lighting panel, as adverse effects from heat exposure would be reduced.

78. A POSITA would also be motivated to incorporate Lys's PWM modulation technique into ground 1, as it would allow greater control over the lighting provided by the system, and would also improve efficiency of the system. *See, e.g.*, Lys, 78 (LEDs are typically driven well above their most efficient operating current to increase the brightness delivered by the LED while maintaining a reasonable life expectancy. As a result, increased efficacy can be provided when the maximum current value of the PWM signal may be variable. For example, if the desired light output is less than the maximum required output the current maximum and/or the PWM signal width may be reduced.). Lys specifically states that, through use of its lighting system, "optimal efficacy may be obtained at a lower current than the level where maximum brightness occurs." *Id.*, 76. This increased efficiency and control would be sought by a POSITA, and is an explicitly stated goal of Mok. *See, e.g.*, Mok, [0006]. Thus, a POSITA would be motivated to combine Lys with Ground 1.

79. A POSITA would further be motivated to combine Chang's multiple reflector sheets that form reflective optical cavities around LEDs that are not in contact with the reflectors with the reflectors, diffusers, and LEDs described in Ground 1. Chang recognizes that "improving the heat dissipation efficiency of the

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 42 of 48

backlight module has always been one of the goals that research and development personnel have been working on." Chang further states that the LEDs and reflector sheets should not be in contact, because the heat from the LEDs can cause warping and poor performance of the reflector. Chang, 9. Additionally, for better heat dissipation, Chang teaches that the reflector and base plate, as well as the reflector and diffuser, ***should*** be in contact. *Id*. 5-9. Thus, for the increased thermal management abilities described in Chang, a POSITA would be motivated to utilize Chang's arrangement of a reflector, diffuser, and LEDs.

80. A POSITA would also be motivated to utilize Chang's reflective optical cavity, as it would help capture more light from the LEDs, thereby improving brightness and light uniformity. Further, Chang's reflector design allow for a light mixing chamber for increased uniformity of light, while still maintaining a thinner, more compact display device These improvements are explicitly sought by both Chang and Ground 1. *See, e.g.,* Chang, 6; Mok, [0006].

B. It Would Have Been Obvious to Incorporate the Teachings of Lys and Chang with the Prior Art of Ground II.

81. A POSITA would also have been motivated to combine multiple substrates, tiles and PCBs, including a Metal Core PCB (MCPCB), a plurality of strings of solid state lighting devices connected using metal traces and in series, and using Pulse Width Modulation ("PWM") controllers to control lighting units, as described in Lys, and to separate the solid state lighting device from the

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 43 of 48

reflector while keeping the reflector sheet in contact with its base to increase the "heat dissipation area," to form convex structures that form concave regions around light sources, as described by Chang with the prior art of Ground 2.

82. For example, Epstein, Lys, and Chang are all in the same field of endeavor (lighting panels) with similar components (e.g., LEDs, reflectors, diffusers). *See, e.g.,* Epstein, [0005], Lys, 3, Chang, 3. Epstein, Lys, and Chang also all seek to provide brighter, more efficient lighting and better thermal management. *See, e.g.,* Epstein, [0054], [0084]; Lys, 3, 4, Chang, 5-6.

83. As set forth with respect to ground 1, Lys's series strings of LEDs connected by metallic traces on lighting tiles or boards were well known in the art and would provide both better heat dissipation and more efficient lighting. Thus, a POSITA would be motivated to combine Lys with Ground 2 for those benefits. A POSITA would also be motivated to incorporate Lys's PWM system into Ground 2 for greater control and further efficiencies, as also described with respect to Ground 1. These various improvements are explicitly sought by Epstein, and would be desired by a POSITA, who would thus be motivated to combine Lys with Ground 2. *See, e.g.,* Epstein, [0054], [0088].

84. A POSITA would further be motivated to combine Chang's multiple reflector sheets that form reflective optical cavities around LEDs that are not in contact with the reflectors with the reflectors, diffusers, and LEDs described in

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 44 of 48

Ground 2. As set forth with respect to Ground 1, these features in Chang would help efficiency, thermal management, and brightness of the lighting system, which would all be sought by a POSITA, and are also sought by Epstein. *See, e.g.,* Epstein, [0089]. A POSITA would thus be motivated to combine Chang with Ground 2.

C. It Would Have Been Obvious to Incorporate the Teachings of Grootes with the Mok-Holman-Lamb-Lys-Chang Combination.

85. A POSITA would have been motivated to incorporate Grootes' series strings of LEDs and PWM system with the Mok-Holman-Lamb-Lys-Chang combination.

86. Grootes, Mok, Holman, Lamb, Lys, and Chang are all in the same field of endeavor, LED lighting systems, and utilize similar components. *See, e.g.,* Mok, Abstract; Lys, 3; Chang, 3; Grootes Abstract. Grootes and the Mok-Holman-Lamb-Lys-Chang combination also both seek to improve efficiency and performance of lighting panels. *See, e.g,* Mok, [0007]; Lys, 3, 45; Chang, 5-6; Grootes, [0011].

87. Grootes' series of strings of LEDs controlled by a PWM controller would further improve the efficiency of the lighting panel of the Mok-Holman-Lamb-Lys-Chang combination. Utilizing series strings of LEDs was well known in the art for efficient delivery of current. PWM modulation was also a well known way of controlling current and wavelength in lighting devices. Indeed, Grootes

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 45 of 48

states that PWM controllers for LED light strings as used therein lead to more efficient, better controlled lighting systems, stating "color and brightness uniformity is improved" and "maximum efficiency" can be achieved. Grootes, Abstract, [0009-0010], [0050]. Grootes further states that its strings of LEDs and control system "minimize energy dissipation by the current source" and create "uniform light output characteristics." *Id*. A POSITA would thus be motivated to combine Grootes with the Mok-Holman-Lamb-Lys-Chang combination these benefits.

D. It Would Have Been Obvious to Incorporate the Teachings of Grootes with the Epstein-Holman-Lamb-Lys-Chang Combination.

88. A POSITA would also have been motivated to incorporate Grootes' series of strings of LEDs and PWM system with the Epstein-Holman-Lamb-Lys-Chang, for similar reasons as set forth with respect to the Mok-Holman-Lamb-Lys-Chang combination.

89. Grootes, Epstein, Holman, Lamb, Lys, and Chang are all in the same field of endeavor, LED lighting systems, and utilize similar components. *See, e.g.,* Epstein, [0005]; Lys, 3; Chang, 3; Grootes Abstract. Grootes and the Epstein-Holman-Lamb-Lys-Chang combination also both seek to improve efficiency and performance of lighting panels. *See, e.g*, Epstein, [0054], [0084]; Lys, 3, 45; Chang, 5-6; Grootes, [0011].

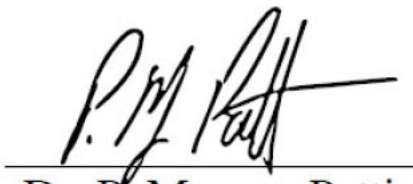
Petitioner Hisense USA Corporation
Exhibit 1036 - Page 46 of 48

90. Grootes series strings of LEDs controlled by a PWM controller, which were well known in the art, would further improve the efficiency of the lighting panel of the Epstein-Holman-Lamb-Lys-Chang combination, similar to respect to the Mok-Holman-Lamb-Lys-Chang combination. As stated above, utilizing series strings of LEDs was well known in the art for efficient delivery of current, and PWM modulation was a well known way of controlling current and wavelength in lighting devices. Indeed, Grootes states that PWM controllers for LED light strings as used therein lead to more efficient, better controlled lighting systems, stating "color and brightness uniformity is improved" and "maximum efficiency" can be achieved. Grootes, Abstract, [0009], [0050]. A POSITA would thus be motivated to combine Grootes with the Epstein-Holman-Lamb-Lys-Chang combination for these benefits.

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.

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 47 of 48

December 17, 2024
Date



Dr. P. Morgan Pattison

Petitioner Hisense USA Corporation
Exhibit 1036 - Page 48 of 48