

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. 9,605,835
Filing Date: February 2, 2015
Issue Date: March 28, 2017
Title: SOLID-STATE LUMINAIRES FOR GENERAL ILLUMINATION

Inter Partes Review No. IPR2023-01168

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

Table of Contents

	<u>Page</u>
I. Introduction.....	4
II. Qualifications.....	5
III. Summary of Legal Issues	7
A. Obviousness.....	8
B. Claim Construction	11
C. Level of Skill in the Art.....	11
IV. The '835 Patent.....	11
A. Person of Ordinary Skill in the Art of the '835 Patent.....	12
B. Construction of Claim Terms of the '835 Patent	13
V. Materials Considered.....	13
VI. State of the Art as of April 21, 2006.	14
A. General Display Technology Background	14
B. Mok.....	17
C. Epstein	17
D. Ko	18
E. Lamb.....	19
F. Kretman	19
VII. The Prior Art Renders Every Element of Claims 1-5 and 7-14 Obvious.....	20
A. Planar Backlighting Panels Including Multiple LEDs were Known in the Art. (Claims 1A and 1B)	20
B. Reflectors Used in Backlighting Panels were Known in the Art, and It Was Known that Reflectors Could Comprise Coatings or Reflector Sheets that Reflect and Scatter Light (Claims 1C, 2, and 3).....	24
C. Reflector Sheets Comprising Plastic Foam were Known in the Art. (Claim 7).....	29
D. It was Known in the Art to Include Apertures in a Reflector to Enable LEDs to Pass-Through the Reflector. (Claim 5).....	30

E.	Brightness Enhancing Films (BEFs) were Known in the Art, and It was Known that BEFs Preferentially Emit Light in a First Orientation and Reflect Light Having a Second Different Orientation (Claims 1D and 1F).....	33
F.	BEFs Comprising 3D Light Extraction Features that Bend Light Rays Toward the Directional Normal to the Principal Plane of the Lighting Panel were Known in the Art. (Claim 9).....	43
G.	BEFs Comprising Random 3D Light Extraction Features were Known in the Art. (Claim 10)	47
H.	BEFs in which Light Extraction Features Comprise Fresnel-Type Lenses were Known in the Art. (Claim 12)	48
I.	BEFs that Would “Limit Direct Emission from the Lighting Panel of Light Emitted by the Plurality of Solid State Light Emitting Devices to thereby Encourage Light Recycling/Diffusion in the Lighting Panel” were Known in the Art. (Claim 11).....	50
J.	BEFs that are “Configured to Substantially Collimate Light Emitted by the Lighting panel” were Known in the Art. (Claim 13)	52
K.	It was Known in the Art to Position a Reflector Between a Substrate of a Lighting Panel and a BEF (Claim 1E)	54
L.	It was Known in the Art to Use Planar Diffuser Sheets Positioned Between a Reflector and a BEF (Claims 1G and 8)	57
M.	It was Known in the Art to Include on BEFs Additional Layer(s) to Diffuse, Polarize, Collimate and/or Reflect Light (Claim 4).....	62
N.	It was Known in the Art to Include on a Backlight a Heatsink Panel Configured to Draw Heat Away from the Panel in a Direction Opposite to the Direction of Light Emission (Claim 14).....	63
VIII.	Combination of Mok, Holman, and Lamb	65
IX.	Combination of Epstein, Holman, and Lamb	77
X.	Combination of Ko, Kretman, and Epstein	88

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* Reviews of U.S. Patent No. 9,605,835 (“the ’835 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 1-5 and 7-14 of the ’835 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 UCSB 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 Bachelor's Degree in Electrical Engineering, Electronic Devices and Materials from UC San Diego in 1996, and I obtained a Master's Degree in Electrical Engineering, Electronics and Photonics from UCSB in 2003.

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 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 '835 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 '835 Patent

24. The '835 Patent is entitled "Solid-state luminaires for general illumination" and claims priority as a continuation of multiple earlier applications. I am informed that the earliest claimed priority date of the '835 Patent is April 21, 2006. Each of the prior art references I address herein was available prior to April 21, 2006, thus I have not analyzed whether each claim of the '835 Patent is entitled to that priority date.

A. Person of Ordinary Skill in the Art of the '835 Patent

25. It is my opinion that the field of the '835 Patent is back-lighting panels and filters for adjusting the light output of solid-state lighting, e.g., Light Emitting Diodes (LEDs). *See* '835 Patent, 1:21-23.

26. I am informed and understand that in a corresponding litigation, the Petitioner, Hisense has argued that as of April 21, 2006, 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 April 21, 2006, 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 '835 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 '835 Patent for many years. As of April 21, 2006, 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 '835 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 '835 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. 9,605,835 (“the '835 Patent”)
1002	Prosecution History of U.S. Patent No. 9,605,835
1005	US 2006/0227545 to Mok <i>et al.</i> (“Mok”)
1006	WO 03/056876 to Holman <i>et al.</i> (“Holman”)
1007	US 2005/0135115 to Lamb <i>et al.</i> (“Lamb”)
1008	US 2005/0265029 to Epstein <i>et al.</i> (“Epstein”)
1009	US 2006/0082698 to Ko <i>et al.</i> (“Ko”)
1010	US 2003/0118805 to Kretman <i>et al.</i> (“Kretman”)

1015	Han-Ping D. Shieh, et al., <i>Micro-Optics for Liquid Cristal Displays Applications</i> , IEEE/OSA Journal of Display Tech., Vol. 1, No. 10, Sep. 2005.
------	---

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

VI. State of the Art as of April 21, 2006.

A. General Display Technology Background

32. By 2006 liquid crystal display (LCD) technology and the supporting backlighting technology was well understood. Liquid crystal displays require a light to illuminate color filters within liquid crystal shutters that create an image. Most LCD developments in this time frame were focused on using an internal light source but some displays used ambient light to illuminate the liquid crystals. In this timeframe the backlight light source technology was transitioning 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 and light source technologies had similar general challenges that differed in the details of the solution, but the optical concepts and techniques to solve the challenges were

similar. For example, both CCFL and LED light sources would require diffusers and reflectors to make their emission into the LCD layers more uniform, removing lines of bright emission from the CCFL sources or spots of high intensity from the LED sources.

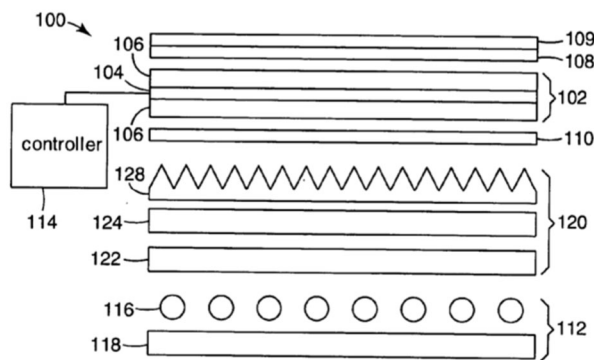


FIG. 1

33. Figure 1 from Ko is shown above. As shown above, 102 is the liquid crystal panel. 112 is the backlight which includes a light source 116 and reflector 118 (CCFLs are shown in the figure but “[o]ther types of light sources may be used ... such as ... light emitting diodes (LEDs).” Ko, [0042]. 120 are the light management layers which include 122 diffuser plate, 124 reflecting polarizer, and 128 brightness enhancing layer. Commercially available components are described for layers 118, 124, and 128 indicating the technical maturity of the application.

34. Within the backlighting module various optical components were combined to condition the light from the light source to light suitable for optimized backlighting of the liquid crystals to achieve desired display performance. As

described in the following references, backlight modules (or units) could have multiple diffusers, collimators (referred to as brightness enhancing films), and reflective elements and components. These various components were often off-the-shelf components and the optical features in these components consisted of well understood techniques to provide the desired performance. Conventional optical understanding was used to determine the relationships between the various components because, within the backlighting module, each optical interface would induce reflection and refraction according to basic principles of optics. Optical elements and components could be combined, similar to combining multiple simple lenses to create a compound lens with performance based on the relationship of the two simple lenses. Standard optical engineering understanding was necessary to integrate the various optical elements to achieve desired performance.

35. Within the backlight module desired performance would be a combination of efficiency, cost, thickness, and display performance aspects which include brightness, color gamut, viewing angle, and uniformity. So, display engineers made various combinations of known optical elements to achieve the balance of these performance aspects.

B. Mok

36. I am informed that Mok is prior art to the '835 Patent. Mok describes a light emitting panel including “a plurality of light emitting elements” and that “[o]ne or more light conditioners ... receive and condition light produced by the light emitting elements.” [Mok, Abstract] to achieve display performance with “substantially uniform intensity that extends over a radiation angle of at least about 60°” [0007]. As described by Mok, “[t]he light conditioners may comprise a diffuser 16 that is positioned adjacent the base panel 12 so that the diffuser 16 receives and diffuses light produced by the various light emitting elements 14 provided on the base panel 12, and a brightness enhancer 18 that is positioned adjacent the diffuser 16.” Mok, [0015].

C. Epstein

37. I am informed that Epstein is prior art to the '835 Patent. Epstein describes “an optical assembly for emitting light comprises an array of light emitting diodes (LEDs) mounted to a substrate. The LEDs emit light in a direction generally perpendicular to the substrate.” Epstein, [0005]. Epstein describes an intermediate layer 422 (and related embodiment 622 of FIG. 6) that may be a reflector for light at the wavelength emitted by the LED 420 (or LED 620). *See* Epstein, [0048] & [0067]. Epstein further discloses that the intermediate layer 422

(and related embodiment layer 622) may be bonded to the substrate 408 (and related embodiment substrate 608).

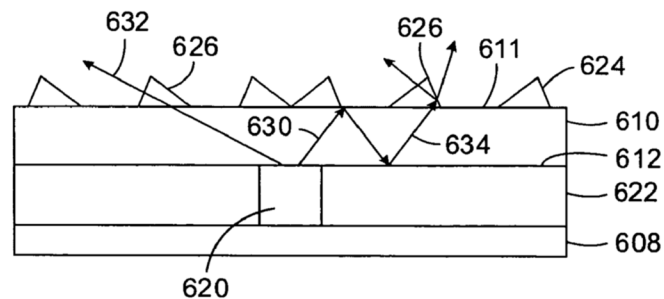


FIG. 6

Epstein, Fig. 6. Epstein also describes the use of a brightness enhancing film (BEF) 662 and 664, stating that “one or more brightness enhancing films, available from 3M Company, St. Paul, Minn., under the trade name BEF, may be used to direct the light more in a direction perpendicular to the substrate 608.” Epstein, [0074].

D. Ko

38. I am informed that Ko is prior art to the '835 Patent. Ko describes that “[i]n a directly-illuminated liquid crystal display (LCD), for example an LCD monitor or an LCD-TV, a number of light management films, including a diffuser layer, lie between the light source and the LCD panel to provide bright, uniform illumination.” Ko, Abstract. Ko further describes a reflector 118, which may be a specular reflector or may be a diffuse reflector for reflecting light. Ko, [0043] (“The backlight 112 may also include a reflector 118 for reflecting light propagating downwards from the light sources 116, in a direction away from the LC panel 102. The reflector 118 may also be useful for recycling light within the

display device 100, as is explained below. The reflector 118 may be a specular reflector or may be a diffuse reflector.”).

E. Lamb

39. I am informed that Lamb is prior art to the '835 Patent. Lamb relates to backlighting systems to be used with liquid crystal displays and provides explicit disclosures related to the refraction and recycling of light by brightness enhancement films. Lamb, [0035] (“The enhancement film 14 refracts light within a certain angle toward the Viewer. Light outside that angle is ‘recycled,’ i.e., reflected back into the backlight 10, where it travels within the System until reaching the proper angle for exiting the system.”).

F. Kretman

40. I am informed that Kretman is prior art to the '835 Patent. Kretman is incorporated by reference into Ko and describes that “diffuse reflective articles are useful in backlight units of liquid crystal displays, lights, copy machines, projection system displays, facsimile apparatus, electronic blackboards, diffuse white Standards, photographic lights and the like.” Kretman, Abstract. Further, Kretman discloses “forming a plurality of surface elements in the diffuse reflective material. These surface elements are positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026].

VII. The Prior Art Renders Every Element of Claims 1-5 and 7-14 Obvious.

41. In the analysis below I break down the elements of claims 1-5 and 7-14 and demonstrate that each of these elements were known in the art before the April 21, 2006, priority date of the '835 Patent.

A. Planar Backlighting Panels Including Multiple LEDs were Known in the Art. (Claims 1A and 1B)

42. The claims of the '835 Patent all relate to backlighting panels for Liquid Crystal (LCD) displays that use multiple solid-state lighting devices (e.g., Light Emitting Diodes (LEDs) to provide light for the backlight. Such backlighting systems for displays were known in the art.

43. As one example, Mok discloses “a light emitting panel.” Mok, Abstract. Mok describes that “Light emitting panels are commonly used as back lights for display systems (e.g. liquid crystal displays).” Mok, [0001].

44. Mok describes a base panel that “provides a convenient mounting location for the various light emitting elements” and one that is a “generally rectangular shaped, plate-like member . . . commensurate with the intended size of the [light emitting] panel.” Mok, [0019]. In Figure 1, the base panel 12 is shown as parallel to principal plane of lighting panel 10.

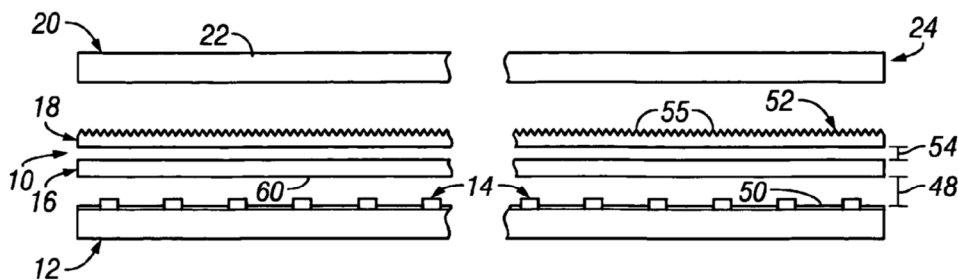


FIG. 1

Mok, Fig. 1. The various lighting emitting elements described in Mok are LEDs, which are “sold state lighting devices.” *See e.g.*, Mok, [0029].

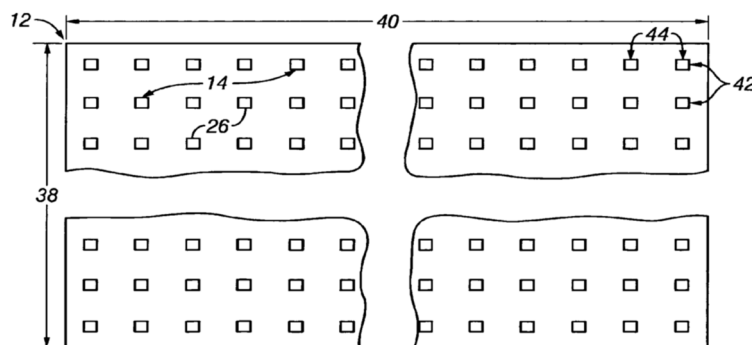
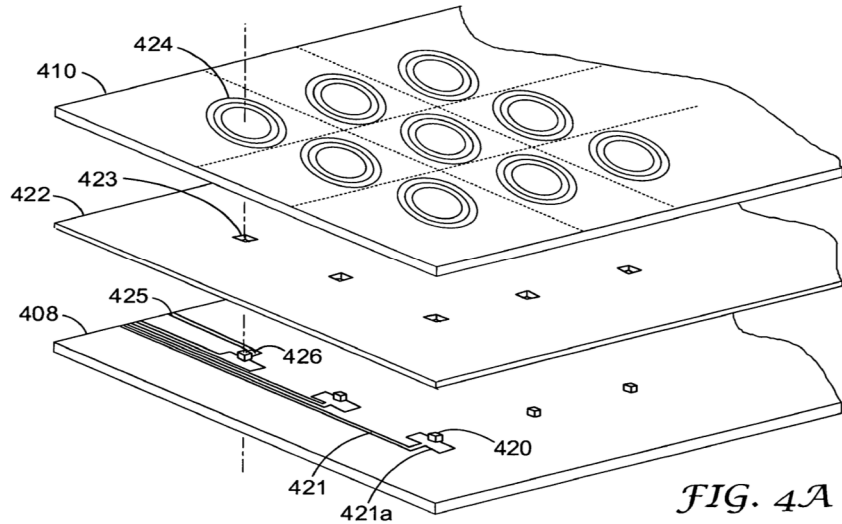


FIG. 2

Mok, Fig. 2.

45. As another example, Epstein discloses “backlighting of liquid crystal displays.” Epstein Abstract. Epstein Figure 4A shows that the “lighting unit 400 comprises a substrate 408 on which are arrayed a number of LEDs 420.” Epstein, [0046]. In my opinion, a person of ordinary skill in the art reviewing Figure 4A would understand that Epstein discloses a substrate that has a first side parallel to the principal plane of the lighting panel.



Epstein, Fig. 4A.

46. Epstein describes a lighting unit 400 that comprises a number of LEDs 420 that emit light and are arrayed on a first side of a substrate 408. Epstein, [0046]. A person of ordinary skill in the art would recognize that LEDs are solid state lighting devices.

47. As another example, Ko discloses that its “invention relates to optical displays, and more particularly to liquid crystal displays (LCDS) that are directly illuminated by light sources from behind, such as may be used in LCD monitors and LCD televisions.” Ko, [0001]. Ko describes various light management layers and substrates, all of which are parallel to the principal plane of the lighting panel. *See, e.g.* Ko, Fig. 1.

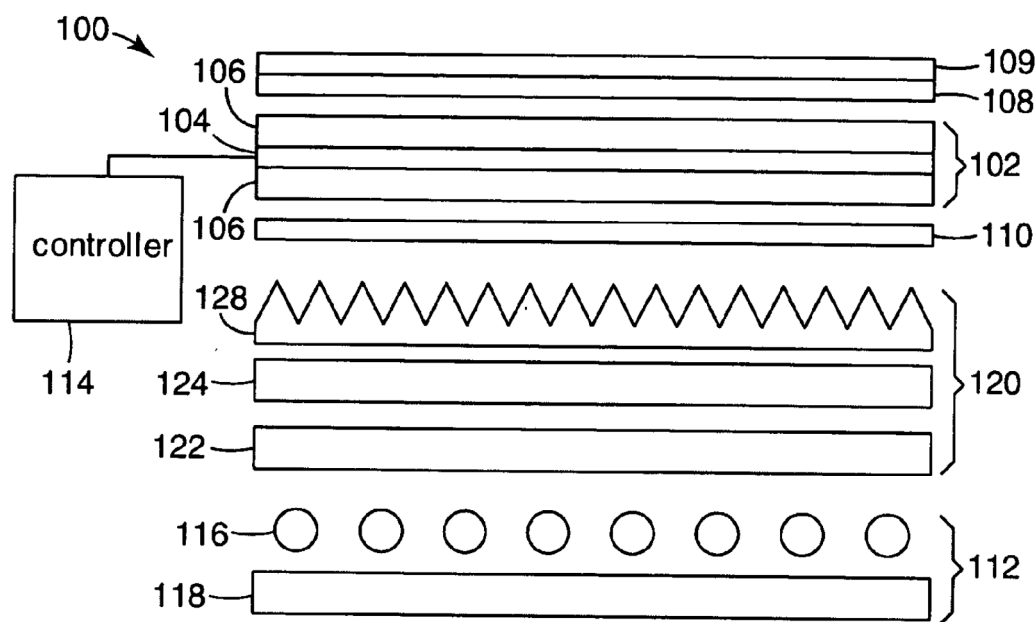


FIG. 1

Ko, Fig. 1.

48. Ko discloses that “[t]he backlight 112 includes a number of light sources 116 that generate the light that illuminates the LC panel 102.” Ko, [0042]. Further, Ko states that the light sources 116 may be LEDs, which a of ordinary skill in the art would know are solid state lighting devices. Ko, [0042]. A person of ordinary skill in the art would understand that LEDs are generally directional which means that they must be supported or placed on a substrate. To the extent that Ko does not disclose the use of LEDs in a planar array on a substrate, as discussed above, Epstein discloses this arrangement. See Epstein, [0046] and 4A. Given Ko’s disclosure of LEDs as an appropriate solid state lighting source, it would have been obvious to incorporate Epstein’s arrangement of LEDs on a

planar array on the first side of a substrate in Ko's light management system and lighting panel.

B. Reflectors Used in Backlighting Panels were Known in the Art, and It Was Known that Reflectors Could Comprise Coatings or Reflector Sheets that Reflect and Scatter Light (Claims 1C, 2, and 3)

49. The claims of the '835 Patent also require a reflector mounted to the panel including the LEDs. Both reflector sheets and reflective coatings used in connection with backlighting panels for LED displays were known in the art. Similarly, it was known that such reflectors could comprise either coatings or reflective sheets. A person of ordinary skill in the art would recognize that such reflector sheets reflect and scatter light.

50. Mok describes a reflective surface 50 used in connection with the backlighting panel, describing that "[t]he reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12." Mok, [0021]. Mok Figure 1 further demonstrates how the reflective surface 50 is on the first side of the base panel or substrate.

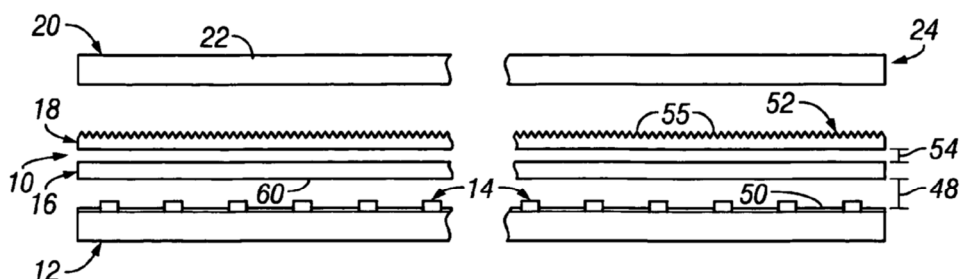


FIG. 1

Mok, Fig. 1.

51. With respect to reflective coatings, Mok describes a coating on the substrate, which is white paint. A person of ordinary skill in the art would recognize that white paint is a diffuse reflector, and Mok discloses that white paint is a diffuse reflector, and person of ordinary skill in the art would recognize that a “diffuse reflector” reflects and scatters light. Mok, [0021] (“The reflective surface 50 may comprise a specular reflective surface (e.g., aluminum), or a diffuse reflective surface (e.g., white paint)... the reflective surface 50 may be deposited directly on the base panel 12 by any of a wide range of processes suitable for depositing the particular type of reflective material that is to be used.”).

52. With respect to a reflector sheet, Mok describes that “[t]he reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12.” Mok, [0021]. Mok also describes reflective surfaces, including one made of aluminum, and another comprising white paint. A person of ordinary skill in the art would understand that a reflective surface, as described in Mok, reflects and scatters light. This is confirming by Mok’s description of white paint as a “diffuse reflector,” as discussed above. Mok, [0021].

53. Similarly, Epstein describes an intermediate layer 422 (and related embodiment 622 of FIG. 6) that may be a reflector for light at the wavelength emitted by the LED 420 (or LED 620). *See* Epstein, [0048] & [0067]. Epstein

further discloses that the intermediate layer 422 (and related embodiment layer 622) may be bonded to the substrate 408 (and related embodiment substrate 608). Epstein, [0048] & [0067].

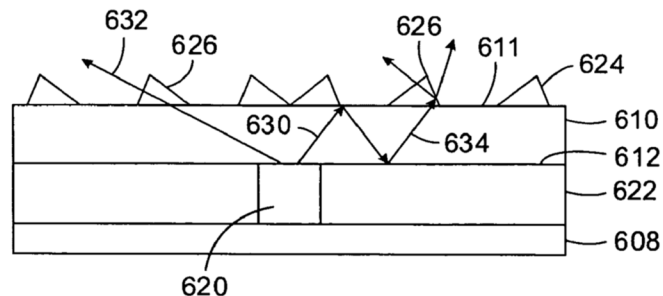


FIG. 6

Epstein, Fig. 6.

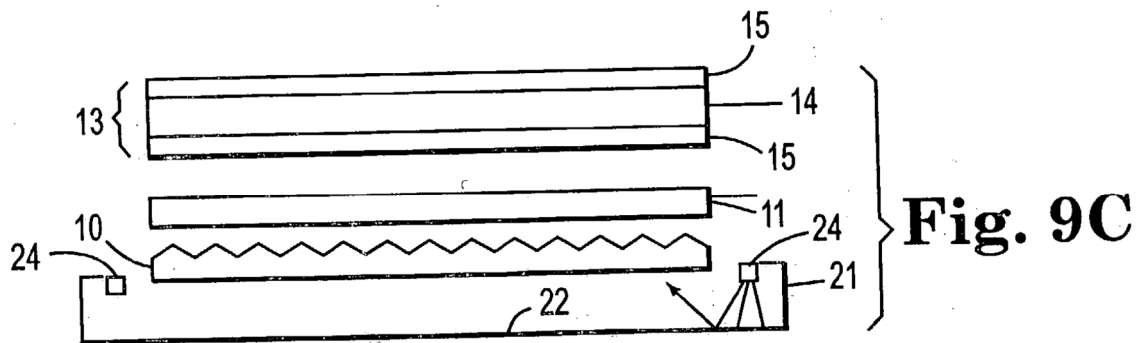
54. Epstein discloses a reflector that may comprise a “multilayer dielectric coating.” Epstein [0048] (“intermediate layer 422 may also include some other type of reflector, such as a metalized layer or multilayer dielectric coating.”). Epstein further describes including white paint, i.e., “white pigmented material” as a “diffusively reflective light extraction material.” See Epstein, [0081] (“Another example is schematically illustrated in FIG. 15B, in which the upper surface of the reflective intermediate layer 622, and/or the lower surface of the guiding layer 610, is provided with patches 695 of diffusely reflective light extraction material, such as a white pigmented material.”). Further, Epstein discloses that “different types of reflector may be used on the lower surface 612. For example, the lower surface 612 may be coated with a reflecting film.” Epstein [0079].

55. Epstein discloses that “[t]he intermediate layer 422 may comprise, for example, a multi-layer polymer reflective film such as Vikuiti ESR film available from 3M Company, St. Paul, Minn. The intermediate layer 422 may also be a white diffuse reflector such as a matrix containing diffusely reflecting particles, for example titanium dioxide particles.” Epstein, [0048]. As discussed above, a person of ordinary skill in the art would know that a “diffuse reflector” such as that disclosed by Epstein reflects and scatter light incident thereon.

56. Ko also describes a reflector 118, which may be a specular reflector or may be a diffuse reflector for reflecting light. Ko, [0043] (“The backlight 112 may also include a reflector 118 for reflecting light propagating downwards from the light sources 116, in a direction away from the LC panel 102. The reflector 118 may also be useful for recycling light within the display device 100, as is explained below. The reflector 118 may be a specular reflector or may be a diffuse reflector.”). A person of ordinary skill in the art would recognize that such a reflector could be a reflector sheet.

57. Further, Kretman, which is incorporated by reference into Ko, discloses “forming a plurality of surface elements in the diffuse reflective material. These surface elements are positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026]. Kretman further discloses that “the optical cavity 21 is lined with

a diffuse reflector 22.” Kretman, [0087]. A person of ordinary skill in the art would understand the arrangement of the reflector 22 on the optical cavity 21 to be a reflector on the first side of a substrate, as described in Kretman [0026]. Kretman further describes that the surface elements may be formed by “by calendering, embossing the structures into it, or coating a material onto the diffuse reflective material to form the structures,” which would suggest to a person of skill in the art that Kretman is describing a reflector sheet.



Kretman, Fig. 9C.

58. With respect to a coating, Kretman discloses surface elements in diffuse reflective material, which “are positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026]. The surface elements may be formed by “coating a material onto the diffuse reflective material to form the structures.”

Kretman, [0026]

C. Reflector Sheets Comprising Plastic Foam were Known in the Art. (Claim 7)

59. Ko discloses that “[p]olymer foams may also be used” to form the substrate. Ko, [0056]. A of ordinary skill in the art would understand that polymer foam is a plastic foam.

60. As another example, Holman discloses a reflector that may be composed of a plastic material. Holman, p. 8. Plastic is a generic term, and plastic foams were well known in the art as optical materials as shown by Ko such that using a plastic foam as the plastic described in Holman in the backlighting panels of either Mok or Epstein would have been an obvious variation to a person of ordinary skill in the art.

61. Ko describes the use of a foam plastic material as a material to achieve optical diffusion. A person of skill in the art would understand that by deploying a foam plastic material on an opaque substrate a similar effect could be achieved but rather than diffusing transmitted light, the reflected light would be diffused. In fact, such an optical material is generally referred to as a diffuse reflector, meaning that the light is reflected at different angles than the incoming light which results in a generally matte white type of finish. The foam plastic material contains random bubbles which will serve to create optical interfaces at random locations with random angles thereby reflecting light at random angles, serving to diffuse the reflected light.

62. A person of ordinary skill in the art would be motivated to consider the total reflectance, diffusion properties, cost, and manufacturability of candidate reflector materials. Plastic foams are lightweight, thin, and inexpensive, and thus a person of ordinary skill in the art would be motivated to consider plastic foam as a reflector sheet. As a transparent diffuser option, the use of plastic foam as a diffuse reflector would have similar and predictable reflective performance. The reflectance and diffusion properties would be a function of the specific plastic foam properties, thickness, and substrate material. A person of ordinary skill in the art would have been motivated to use a plastic foam based on its price, relative thickness, and reflective properties. A person of skill in the art would have further recognized that the selection of a plastic foam to act as the reflector is simply a design-choice that a person of ordinary skill in the art would have made based on the desired thickness and reflectance of the foam optical material.

D. It was Known in the Art to Include Apertures in a Reflector to Enable LEDs to Pass-Through the Reflector. (Claim 5)

63. Claim 5 of the '835 Patent further requires that the reflector sheet includes apertures or vias through which the LEDs pass, in particular, “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.” This configuration was known in the art.

64. As one example, Mok Figures 1 and 2 show a reflective surface 50 with apertures for solid state lighting devices. *See, e.g.,* Mok, [0021] “The reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12.” Mok, [0021]. As Mok explains, the solid state lighting devices are mounted to the substrate or base panel. *See, e.g.,* Mok, [0019] (“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 and width 40 of the base panel 12.

65. As shown in Figures 1 and 2 below, the reflective surface or sheet (50) has apertures that are aligned with and correspond to the plurality of solid state lighting devices. *See* Mok.

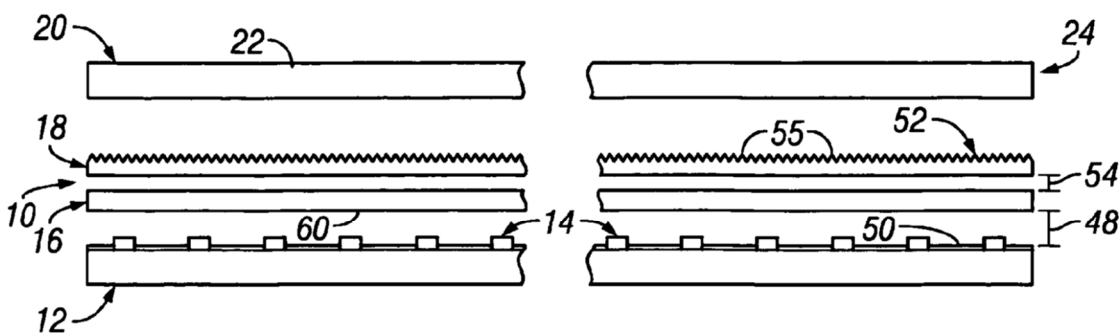


FIG. 1

Mok Figure 1. The reflector sheet 50 of FIG. 1 contains apertures through which LEDs 14 align and correspond with.

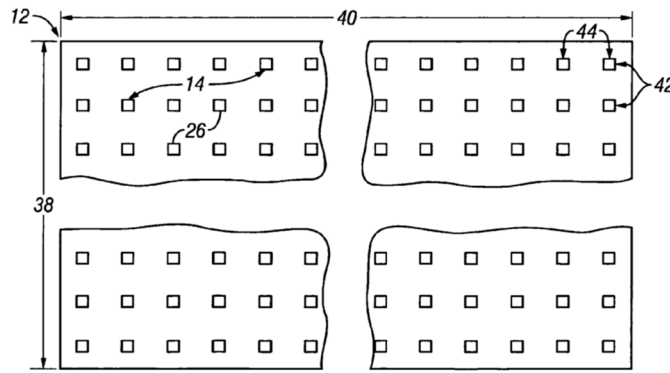
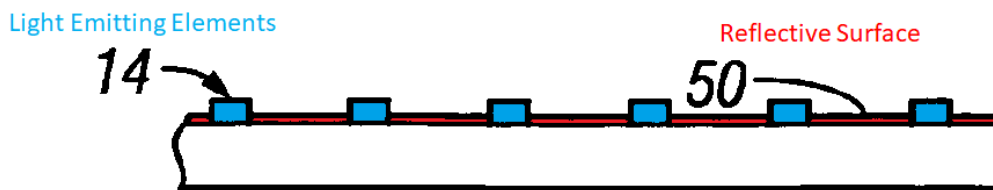


FIG. 2

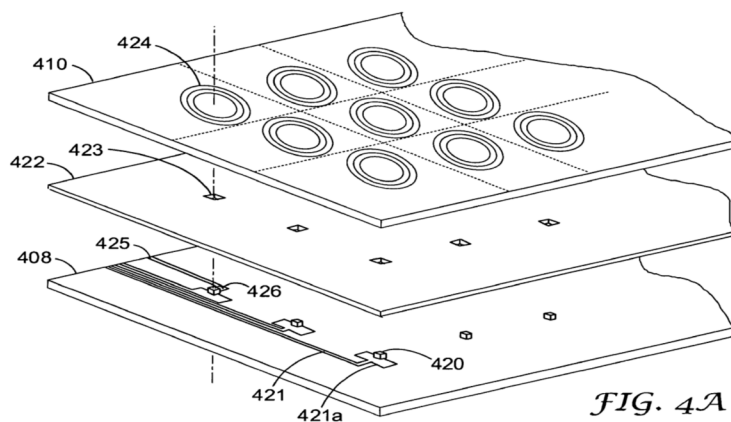
Mok Figure 2.

66. An enlarged and annotated view of the relevant portion Mok Figure 1, as shown below, further demonstrates how Mok discloses a base panel 12 covered with a reflective surface 50.



Mok, Figure 1 (annotated).

67. Similarly, Epstein describes a reflector 422 with a guiding layer 410, stating that “the guiding layer 410 may include an array of light extraction elements 424 associated with each LED 420. The intermediate layer 422 includes apertures 423, also referred to as vias, that are registered to the LEDs 420 disposed on the substrate 408.” Epstein, [0048].



Epstein, Fig. 4A.

E. Brightness Enhancing Films (BEFs) were Known in the Art, and It was Known that BEFs Preferentially Emit Light in a First Orientation and Reflect Light Having a Second Different Orientation (Claims 1D and 1F)

68. The claims of the '835 Patent further require a Brightness Enhancing Film ("BEF"). Such films were known in the art, and the claims recite functionality performed by these BEFs. It was known that BEFs performed functionality like "preferentially emit[ing] 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."

69. As to the positioning of the Brightness enhancing film, the claims of the '835 patent state "a brightness enhancement film on the reflector." As the '835 patent explains, "on" means directly on or with intervening elements in between. *See* '835 Patent, 6:66-7:12 ("It will be understood that when an element such as a layer, region or substrate is referred to as being 'on' or extending 'onto' another

element, it can be directly on or extend directly onto the other element or intervening elements may also be present. In contrast, when an element is referred to as being ‘directly on’ or extending ‘directly onto’ another element, there are no intervening elements present.”). Either interpretation of “on,” i.e., “directly on” or “with intervening elements in between,” was known in the prior art.

70. For example, Mok describes a brightness enhancer 18 that is a brightness enhancement film. Mok, [0024]. (“the brightness enhancer 18 comprises a brightness enhance film (BEF) available from 3M and sold under the registered trademark Vikuiti®. Alternatively, other types of brightness enhancers could be used.”) Mok describes that the brightness enhancer collects light from the diffuser 16 and directs it out the front surface 52 of the brightness enhancer 18, thereby maximizing the on-axis brightness of the panel. Mock, [0024].

71. Mok, discloses that the BEF preferentially emits light having a first orientation and preferentially reflects light having a second orientation, which is different from the first orientation. First, BEFs are designed and configured to work in this manner. Mok reinforces this point when it describes the use of “light conditioners” to, on the one hand, diffuse light to create uniform lighting within the panel and on the other hand to use a “brightness enhancer” to collect diffused light and direct it out of a front surface to “maximize the on-axis brightness of the light emitting panel.” Mok, [0015]. Mok similarly describes the concept of recycling

light, although in relation to light reflected by the diffuser. Mok, [0024]. The same phenomenon occurs with brightness enhancement films, including the specific brightness enhancement film referenced by Mok. *See* Mok, [0024] (referencing 3M's BEF sold under the tradename Vikuiti®).

72. Similarly, Lamb relates to backlighting systems to be used with liquid crystal displays and provides explicit disclosures related to the refraction and recycling of light by brightness enhancement films. Lamb, [0035] (“The enhancement film 14 refracts light within a certain angle toward the viewer. Light outside that angle is ‘recycled,’ i.e., reflected back into the backlight 10, where it travels within the System until reaching the proper angle for exiting the system.”)

73. Lamb discloses the same structures disclosed in Mok, such as LEDs, a reflector, a brightness enhancement film, and a diffuser. Lamb, [0010], [0035], [0039]. Mok and Lamb also both teach that the brightness enhancement film may be Vikuiti Brightness Enhancement Film (BEF), available from 3M Company. *See* Mok, [0024]; Lamb, [0035]. Lamb discloses that an “enhancement film 14 refracts light within a certain angle toward the viewer. Light outside that angle is ‘recycled,’ i.e., reflected back into the backlight 10, where it travels within the system until reaching the proper angle for exiting the system.” Lamb, [0035].

74. Mok further discloses that the BEF is on the reflector. For example, Figure 1 shows that the BEF 18 is on diffuser 16 with an intervening area of air,

while the diffuser 16 is on the reflector 12 with an intervening area of air. Mok shows the diffuser and air gaps as intervening elements such that the BEF is on the reflector. *See* Mok, Fig. 1.

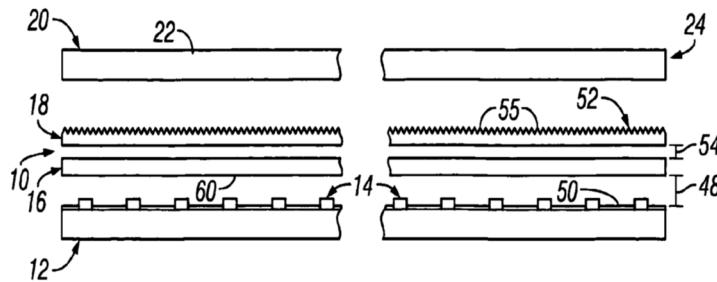
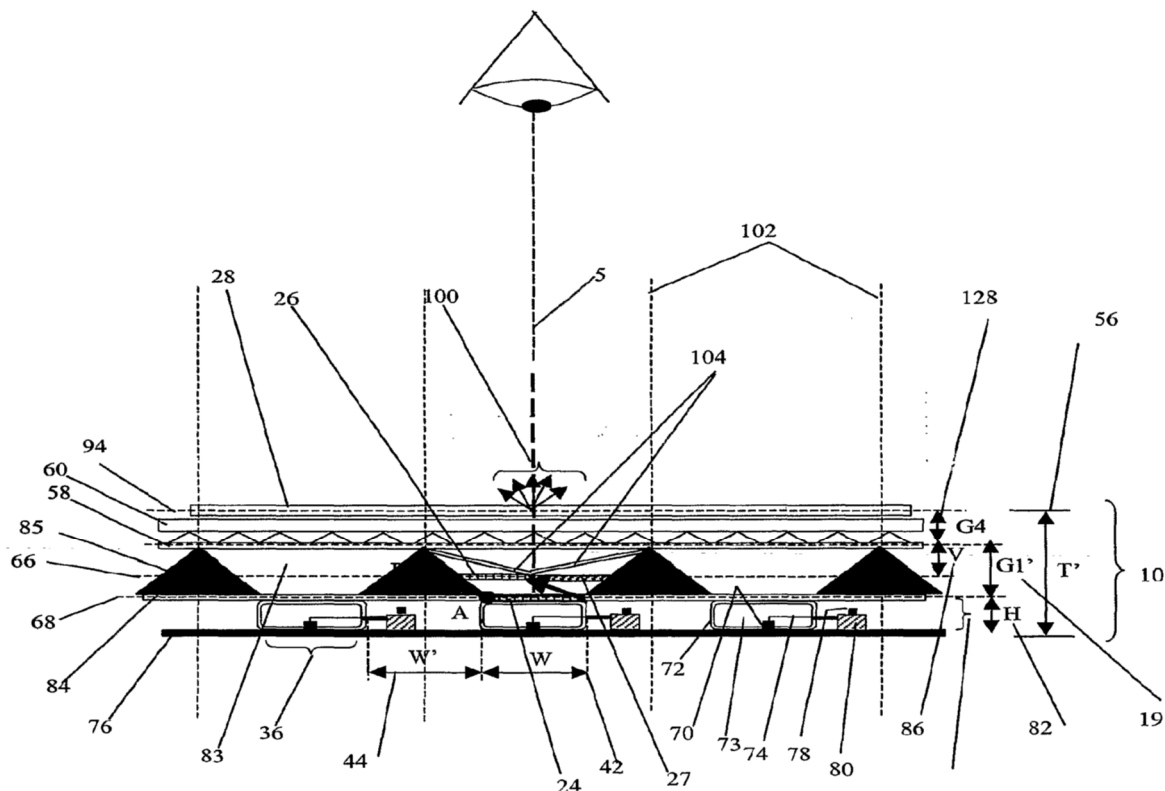


FIG. 1

75. To the extent that an air gap is not an intervening element, various other configurations and arrangements of films, sheets, and surfaces were known. For example, Holman describes and shows a brightness enhancement film on a reflector sheet without an intervening air gap. First, Holman discloses the use of orthogonal, elevated prism sheets 58 and 60. *See, e.g.,* Holman, pp. 9-10, Prism sheets 58 and 60 are brightness enhancement films. Holman, pp. 9-10; *see also*, pp. 7-8 (explicitly disclosing that the prism sheet “may be one of the 90-degree offerings manufactured by the Minnesota Mining & Manufacturing Company (3M) under the trade name BEF, as in brightness enhancement film.”). Holman also explains that the prism sheets perform the same function as 3M’s trademarked BEFs. Holman, p. 121.

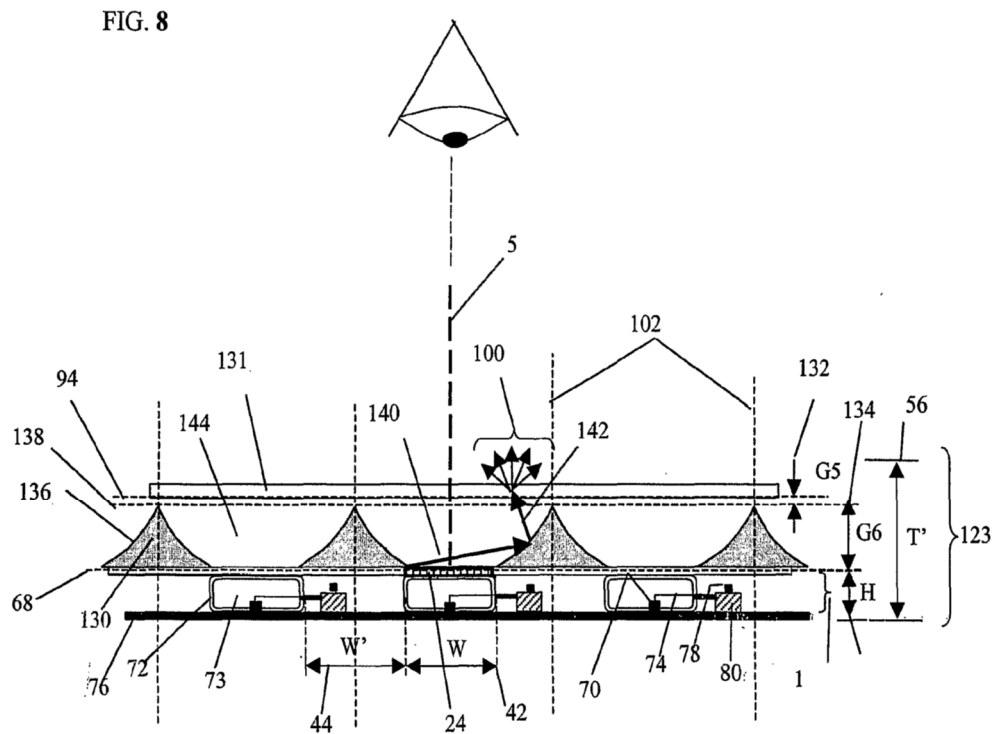
76. As to the physical arrangement of the prism sheets, Holman discloses that prism sheets 58 and 60 are on the reflector (i.e., “reflecting layer 76”) via intervening elements that include “confining structure 72” (see Holman., pp. 36-37), “diffusely scattering layer 68” (Holman, p. 43), “compartmentalized spacer layer 84” and “sidewalls 85” (Holman., p. 15). Holman’s Figures 7 also shows a “stacked” arrangement where the brightness enhancement films (58) is “on” the reflector (76):

FIG. 7



Holman, Figure 7.

77. Holman also describes another stacked arrangement whereby the brightness enhancement film is on the reflector. *See* Holman, Figure 8. For example, Holman discloses a brightness enhancement film 131 that rests on a transparent dielectric material 144. The transparent dielectric material rests on diffusely scattering layer 68, which in turn rests on confining structure 72. Confining structure 72 abuts reflector 76. *See* Holman, FIG. 8:

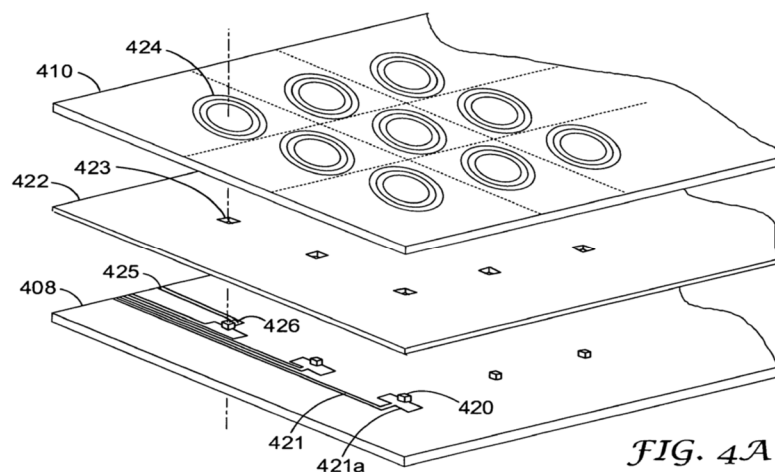


Holman, Figure 8

78. Similarly, Epstein discloses a BEF. With respect to Figure 6, Epstein describes the use of a brightness enhancing film (BEF) 662 and 664, stating that “one or more brightness enhancing films, available from 3M Company, St. Paul,

Minn., under the trade name BEF, may be used to direct the light more in a direction perpendicular to the substrate 608.” Epstein, [0074].

79. Figure 4 of Epstein describes the arrangement of layers by describing an intermediate layer 422, which is a reflector, as bonded to the substrate 408 (and thus similarly to substrate 608 in FIG. 6). As pictured in Figure 4A, the reflector 422 is on one side of the substrate (408), followed by a guiding layer 410 that also includes an array of light extraction elements 424 associated with each LED 420.



Epstein, Fig. 4A

80. Epstein’s Figure 6 shows the physical relationship between these various layers as the reflective layer 622 is on the substrate 608, which the reflector 622 is bonded to, with the guiding layer 610 above the reflective layer 622. *See, e.g.,* Epstein Figures 6, 10A, 12 (*see also* similar disclosures in FIG. 4A). Because the ’835 patent explains that “on” means directly on or with intervening elements

in between (*See* '835 Patent, 6:66-7:12), Epstein's BEF 662 is on the reflector 622 with intervening element 610 in between.

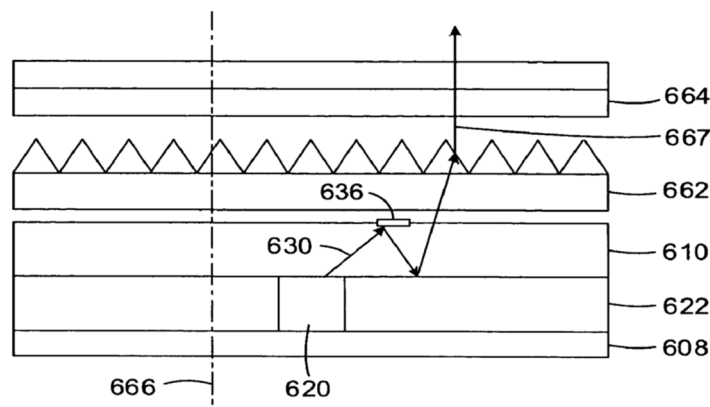


FIG. 11

Epstein, Fig. 11.

81. Epstein, as shown in Figure 11 above, discloses that “a light emitting element that uses a diffractive light extraction element 636 emits light from the guiding layer 610 in a first direction relative to the axis 660. The light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074]. Epstein further discloses that the intermediate layer 622 may be a reflector that causes some depolarization so that the light reflected may be recycled and passed through a reflective polarizer, in addition to stating that “light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074] & [0076].

82. Similarly, Ko discloses light management layers, including a diffuser plate 122, a brightness enhancing layer 128 and a reflective polarizer 124 and a reflector 118. Ko, [0005], [0045], and [0051]. The brightness enhancement layer 128 is on the reflector 118 via intervening layers. Ko Figure 1, which is a “schematic exploded view of an exemplary embodiment,” shows the brightness enhancing layer 128 on the reflector 118. Ko, [0039].

83. Ko describes that the brightness enhancement layer 128 may be attached to the reflective polarizer 124, which in turn is attached to the diffuser plate 122. Ko, [0073]. As illustrated in Ko Figure 1, the reflector 118 is on the brightness enhancement layer 128, with the intervening layers being the light sources 116, the diffuser plate 122, and the reflective polarizer 124. Ko Figure 1. That arrangement of layers may or may not include air gaps. Ko describes that “[t]he brightness enhancing layer 410 may be attached to the reflective polarizer 406, as is schematically illustrated in FIG. 4C, for example using via an adhesive layer 412. In other exemplary embodiments, the brightness enhancing layer 410 may not be attached to the reflective polarizer 406, but may be free-standing relative to the diffuser plate 400, with an air gap between the reflective polarizer 406 and the brightness enhancing layer 410.” Ko, [0073]. Thus, Ko Figure 1 shows brightness enhancement film both directly on the reflector without an intervening air layer, and with an intervening air layer.

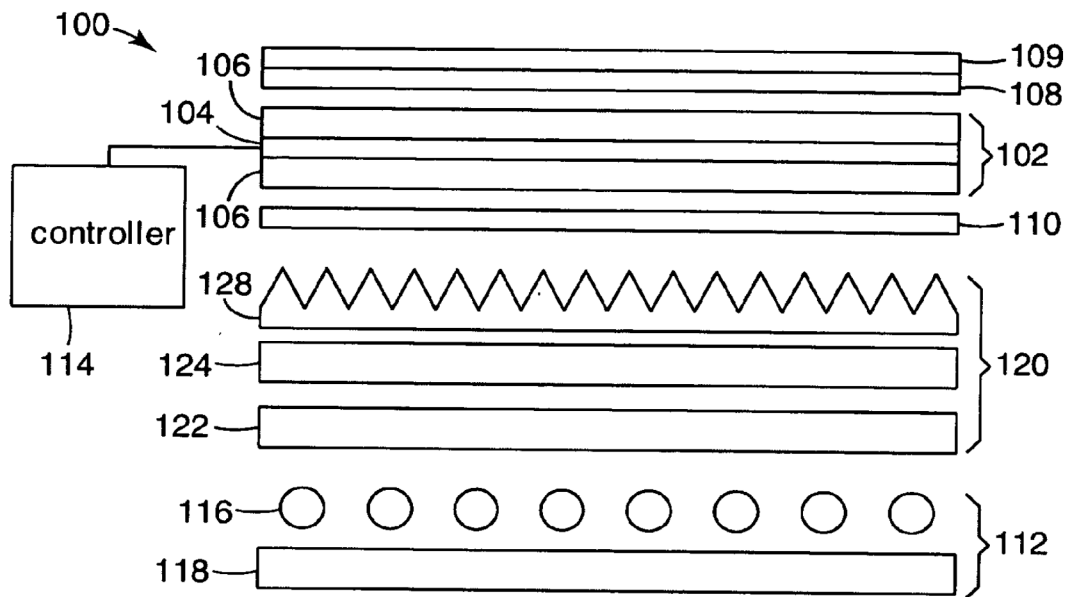


FIG. 1

Ko, Fig. 1.

84. Ko teaches increasing “the amount of light propagating on-axis through the LC layer 104, thus increasing the brightness of the image seen by the viewer. One example is a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051]. Ko also describes light sources that “provide a two dimensional plane or surface that may be used for attaching the diffuser layer and other optical layers.” Ko, [0085].

85. Kretman, discloses that a “reflector can be used to reflect incident light between layer 10 and the diffuse reflective layer 17 to increase display luminance by controlling the angles over which light is emitted. The reflected light

is scattered by the diffuse reflector 17 into all angles. The light within the transmission angles of the brightness enhancing layer 10 is transmitted towards the viewer. Light in the second angular range is reflected for additional scattering.”

Kretman, [0082].

F. BEFs Comprising 3D Light Extraction Features that Bend Light Rays Toward the Directional Normal to the Principal Plane of the Lighting Panel were Known in the Art. (Claim 9)

86. Claim 9 of the '835 Patent states that “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.” Such three-dimensional light extraction features used on a BEF were known in the art.

87. For example, Mok describes that a “brightness enhancer 18 comprises a plurality of optical elements, such as prisms 55 defined by the front surface 52 of the brightness enhancer 18, that collect light from the diffuser 16 and direct it out the front surface 52 of the brightness enhancer 18. The brightness enhancer 18 thereby maximizes the on-axis brightness of the panel 10.” Mok, [0021]. Prisms are three dimensional structures, and a person of skill in the art would understand that maximizing “on-axis brightness” includes bending at least some light rays toward the direction normal to the principal plane of the lighting panel.

88. Similarly, Lamb discloses the use of brightness enhancement film or another suitable prismatic film or structure in combination with a reflective polarizer as part of a recycling enhancement structure 112 and 114. Lamb, [0044]-[0046]. Lamb teaches that the prismatic structures prismatic structures, such as BEF, “redirect and recycle light to increase on-axis output brightness of the backlighting system 200 by refracting toward the viewer light within a certain angle and reflecting back light outside that angle.” Lamb, [0052]. A person of ordinary skill in the art would understand that this disclosure teaches bending at least some light rays toward the direction normal to the principal plane of the lighting panel.

89. Epstein describes a BEF, which “typically comprise a plurality of prismatic refractive elements which, when illuminated from the base side of the prismatic elements, refract the transmitted light in a direction more parallel to the axis.” Epstein, [0074]. Figure 11 shows “a diffractive light extraction element 636 [that] emits light from the guiding layer 610 in a first direction relative to the axis 660. The light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074]. Accordingly, Epstein discloses three dimensional structures, i.e. prismatic elements, as part of the BEF that will bend light in a direction normal to the principal pane of the lighting panel.

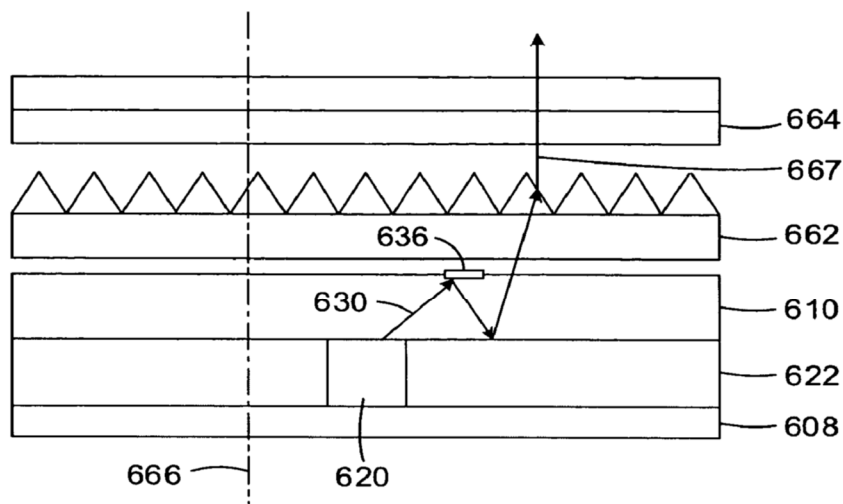


FIG. 11

Epstein, Figure 1

90. Similarly, Ko teaches that the “brightness enhancing layer is one that includes a surface structure that redirects off-axis light in a direction closer to the axis of the display. This increases the amount of light propagating on-axis through the LC layer 104, thus increasing the brightness of the image seen by the viewer. One example is a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051]. The prismatic ridges on the brightness enhancing layer 128 are three dimensional, as illustrated in Ko Figure 1.

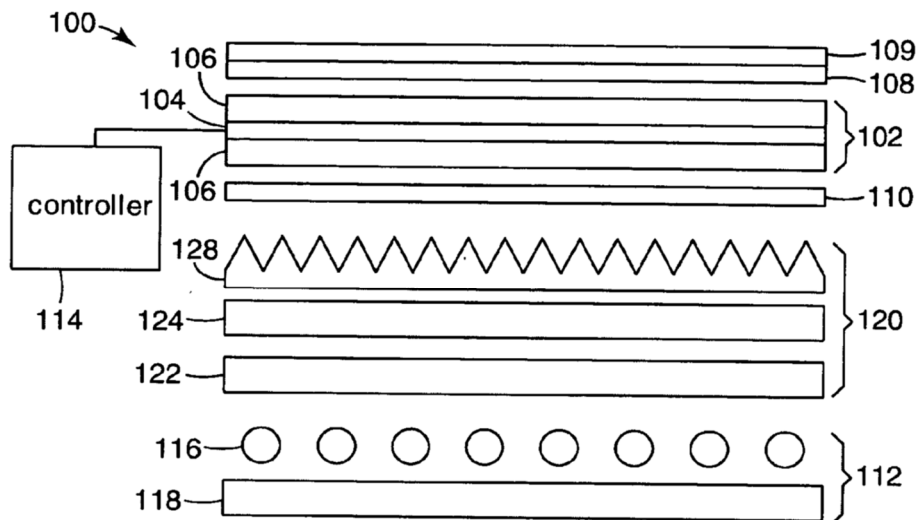


FIG. 1

Ko, Fig. 1.

91. Kretman, further teaches that “the gain obtained on a backlight that is 70% reflective on average is 1.6 if a prismatic brightness enhancing sheet is used that has a refractive index of 1.59 with 90 degree facet angles. Increasing the average reflectance of the backlight to 90% increases the gain to 1.8. The gain increases to 2.0 if there is no absorption loss in the backlight. Thus, a 90% reflectance allows close to the highest possible increase in luminance.” Kretman, [0081]; [0082] (“The light within the transmission angles of the brightness enhancing layer 10 is transmitted towards the viewer. Light in the second angular range is reflected for additional scattering.”).

G. BEFs Comprising Random 3D Light Extraction Features were Known in the Art. (Claim 10)

92. Claim 10 of the '835 Patent further requires that “the light extraction features are random features.” As discussed above, BEFs including surface features were known in the art. A person of ordinary skill in the art would further understand that Random 3D Light Extraction Features were known in the art and would have incorporated them into the disclosures of Mok, Epstein, or Ko.

93. For example, Lamb describes the “randomization” of the polarization and direction of light. Lamb [0042]. This further shows that it would have been obvious to a person of ordinary skill in the art to modify the shown invention to include a plurality of other, random light extraction features.

94. Additional related prior art in peer reviewed academic literature describes the use of a random 3-d grating structure to improve brightness and uniformity of light emitted from a LCD display. The use of randomly patterned optical components was well understood to avoid the creation of moire patterns which are optical interference patterns resulting from regular optical elements acting on the light from a display. *See, e.g.*, Ex. 1015 at 6 (“By optimizing the grating pitches and orientations of RG-LCF [Random Grating Light Control Film], the reflective light distribution can be well controlled and results in high brightness, wide viewing angle, and high uniformity images.”); at 9 (“RG-LCF [Random Grating Light Control Film], as shown in Fig. 18, which can direct light

incident from multiple directions collectively for viewing, can achieve much enhanced brightness of reflective image. The grating pitches and orientations were designed properly to improve the brightness and uniformity. Additionally, the size of each grating is $25 \times 25 \mu\text{m}^2$ and the arrangement in a single pixel is randomized in order to avoid the moiré patterns and dispersion.”). Such patterns would be undesirable for display applications.

95. A person of ordinary skill in the art would further recognize that the LEDs in a backlight are positioned in uniform locations. Thus, including random features on a BEF helps avoid interference effects. This provides a motivation to use randomized patterns on the surface of the BEF. Further, randomized optical patterns also help to minimize optical dispersion which is the separation of colors, such as with a prism, where in a display the objective is to combine colors. This provides an additional motivation for a person of ordinary skill in the art to apply random patterns to the surface of the BEF.

H. BEFs in which Light Extraction Features Comprise Fresnel-Type Lenses were Known in the Art. (Claim 12)

96. The use of fresnel-type lenses as light extraction features in BEFs was known in the art. Epstein discloses that “the lenses are formed on a lens sheet 1852 as prismatic lenses, for example Fresnel lenses.” Epstein, [0110]. Further, Epstein discloses that “the light extraction prisms are arranged on the second side of the optical sheet as one or more Fresnel lenses.” Epstein, Claim 4. Similarly,

Holman discloses that the “lens 356 may be a Fresnel or a pair of Fresnel lens elements.” Holman, pp. 69. A of ordinary skill in the art would understand that lenses are light extraction features and that Fresnel type lens advantageously allow for thinner optical components and help collimate light. Both of these features are features that would have been compatible with and advance Mok’s goals of creating efficient, thin lighting displays.

97. Thus, Fresnel type lenses were known in the art and a person of skill in the art would have been motivated to apply these features to the disclosures of Mok or Ko. By definition, Fresnel lenses have the functionality of a conventional lens but are much thinner since they compress the optical features of the lens into an almost flat element. Figure 6 of Epstein shows the cross section of a Fresnel lens placed over an LED emitter. Epstein describes that the light going through the Fresnel lens “is directed in forwards direction toward the viewer by the prismatic structures” [Epstein 0067]. This is the same desired functionality for any type of brightness enhancing film – to direct more light toward the viewer. The Fresnel lens type of prismatic structure is another option for achieving this result while maintaining a thin form factor to keep the total display as thin as possible.

I. BEFs that Would “Limit Direct Emission from the Lighting Panel of Light Emitted by the Plurality of Solid State Light Emitting Devices to thereby Encourage Light Recycling/Diffusion in the Lighting Panel” were Known in the Art. (Claim 11)

98. Brightness enhancement films are designed to maximize the light directed toward the viewer, in other words increase the amount of light within a solid angle and per area directed toward the viewer. It was well known that BEFs could be configured to encourage light recycling and diffusion of light outside of the desired emission angle. Light not within the desired forward directed angle would be redirected and reflected so that it could have another chance to be within the desired forward angle, and thereby “recycled”. This would increase the efficiency of the display optical system and could serve to diffuse the light as the reflected light would be reflected back at a different angle. A person of skill in the art would recognize that this is the functionality commonly performed by a BEF, i.e., light recycling and diffusion.

99. Lamb expressly discloses recycling enhancement structures 112 and 114, which are brightness enhancement films. Lamb, [0042] and [0044]. As Lamb describes, these “the second recycling enhancement structure 114 includes prismatic structures, e.g., prismatic Structured film, that would aid in redirecting and recycling light to increase on-axis brightness of the backlight 100 by refracting toward the viewer light within a certain angle and reflecting back light outside that

angle.” Lamb, [0045]. Thus, Lamb discloses recycling light and thereby limiting direct emission from the lighting panel.

100. Ko describes “a first side of the brightness enhancing layer is attached to the diffuser plate” and that “the reflective polarizer is attached to a second side of the brightness enhancing layer.” Ko, Claims 11 and 12. Ko further discloses and LCD panel 012, and states that that “light may be recycled by reflection between the reflecting polarizer 124 and the reflector 118.” Ko, [0045], [0083].

101. Kretman further disclose that “[i]f the light is not at the correct range of viewing angles, nor of the correct polarization, it is reflected back towards the light guide 6.” Kretman, [0080]. Further, Kretman describes that a “diffuse reflecting article 17 acts as a light recycler by (1) reflecting the light rejected from the reflective polarizing film 11 and for from the brightness enhancement film 10 and (2) giving that light another opportunity to reach a viewer. This rejecting and recycling can occur numerous times increasing the amount of light directed towards the viewer.” Kretman, [0081].

102. Similarly, Epstein describes the use of “one or more brightness enhancing films, available from 3M Company, St. Paul, Minn., under the trade name BEF.” Epstein, [0074]. A BEF limits direct emission as Epstein explicitly teaches that its brightness enhancement film may reflect light, including when a reflective polarizer is used. *See* Epstein, [74-75].

J. BEFs that are “Configured to Substantially Collimate Light Emitted by the Lighting panel” were Known in the Art. (Claim 13)

103. A person of ordinary skill in the art would recognize that “substantially collimate light” means to substantially align light. This was known in the art.

104. For example, Mok describes that “[t]he brightness enhancer 18 collects diffused light from the diffuser 16 and directs it out of a front surface 52 of the brightness enhancer 18 to maximize the on-axis brightness of the light emitting panel 10.” Mok, [0015].

105. Epstein describes that “light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074]. Epstein Figure 11 further demonstrates that the light 667 is gathered together in parallel by the BEF, which a person of ordinary skill in the art would understand to be aligning light.

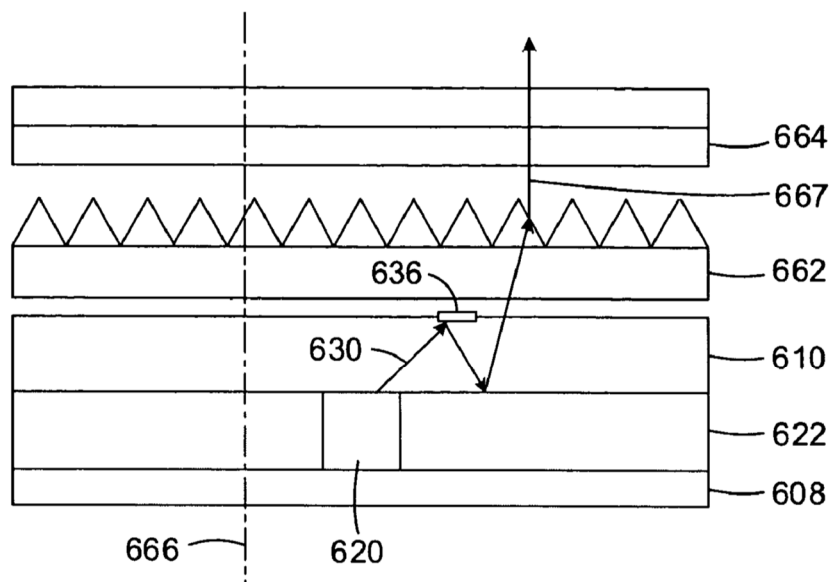


FIG. 11

Epstein, Fig. 11.

106. Similarly, Ko describes “a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051]. Kretman also describes that “the gain obtained on a backlight that is 70% reflective on average is 1.6 if a prismatic brightness enhancing sheet is used that has a refractive index of 1.59 with 90 degree facet angles. Increasing the average reflectance of the backlight to 90% increases the gain to 1.8. The gain increases to 2.0 if there is no absorption loss in the backlight. Thus, a 90% reflectance allows close to the highest possible increase in luminance.” Kretman, [0083].

K. It was Known in the Art to Position a Reflector Between a Substrate of a Lighting Panel and a BEF (Claim 1E)

107. With respect to the positioning and the reflector, the claims of the '835 Patent further require that “the reflector is arranged between the at least one substrate and the brightness enhancement film.” This configuration was obvious and known in the art. At each optical interface within the backlight stack there will be backward reflected light, which can then be redirected forward by a reflective layer on the substrate.

108. In Mok, the reflector is arranged between the substrate and the BEF. For example, Mok describes and shows a reflector (reflective surface 50) as between a substrate, which is the base panel 12, and BEF (brightness enhancer 18). See Mok Figure 1 below.

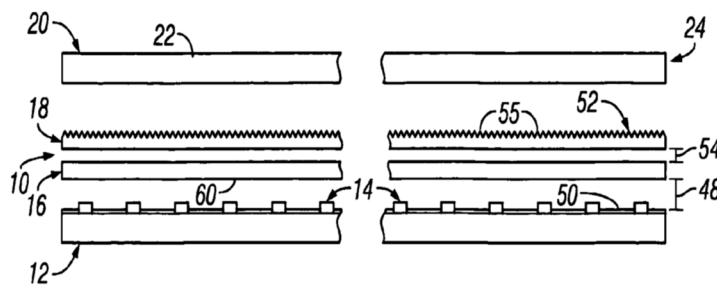


FIG. 1

Mok Figure 1. Figure 5B of the '835 Patent mirrors the arrangement shown in Figure 1 of Mok, confirming that Mok discloses this element of the '835 Patent.

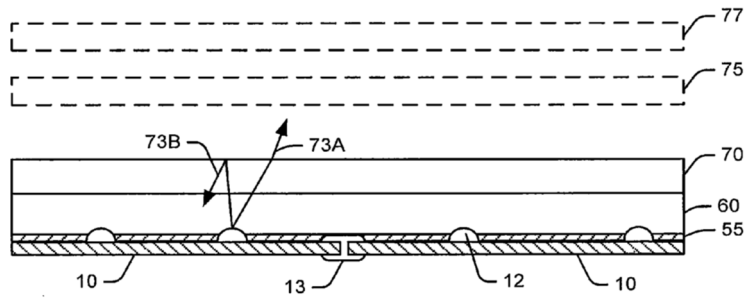


FIGURE 5B

'835 Patent Figure 5B.

109. Holman also shows a reflector arranged between the substrate and brightness enhancement film. *See* Holman, Figure 8.

110. Epstein, as shown in Figure 11, discloses that “a light emitting element that uses a diffractive light extraction element 636 emits light from the guiding layer 610 in a first direction relative to the axis 660. The light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074]. Epstein further discloses that the intermediate layer 622 may be a reflector that causes some depolarization so that the light reflected may be recycled and passed through a reflective polarizer, in addition to stating that “light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074] & [0076].

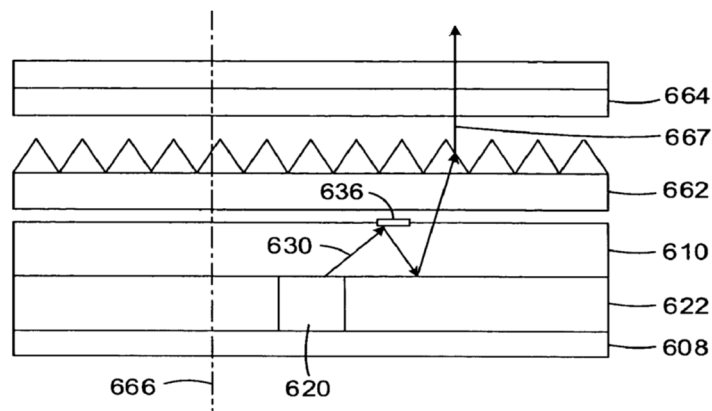


FIG. 11

Epstein, Fig. 11.

111. Similarly, Ko Figure 1 shows an arrangement of the lighting panel. Ko, FIG 1, [0005], [0045], [0051]. Although Ko's FIG. 1 shows a reflector below the lighting elements, a person of ordinary skill in the art would have been motivated to include an arrangement in which the reflector is between the substrate supporting the LEDs and the brightness enhancement layers. For example, Ko describes that the backlight 112 may include a reflector 118 for reflecting light. Ko also explains that backlight 112 may include LEDs. Epstein teaches that LEDs may be mounted on a substrate and teaches how a reflector may be placed on top of the substrate supporting the LEDs. Accordingly, it would have been obvious to use the LED array structure of Epstein in place of Ko's FIG. 1 backlighting as Ko explicitly mentions that the light source may include LEDs.

L. It was Known in the Art to Use Planar Diffuser Sheets Positioned Between a Reflector and a BEF (Claims 1G and 8)

112. The claims of the '835 Patent further require “a generally planar diffuser sheet between the reflector and the brightness enhancement film, wherein the light having the second orientation that is reflected back into the lighting panel is recycled within at least the diffuser sheet.” Such a diffuser sheet was known in the art.

113. In Mok the diffuser sheet 16 resides below the brightness enhancement film 18. Recycled light will thus be reflected back into the diffuser sheet. *See, e.g., Mok, [0022]* (describing a “diffuser 16 is positioned in spaced-apart relation to the base panel 12 so that it receives and diffuses light produced by the light emitting elements 14 as well as light that maybe reflected by the reflective surface 50 provided on base panel 12.”). Mok Figure 1 also shows the diffuser 16 as a planar sheet.

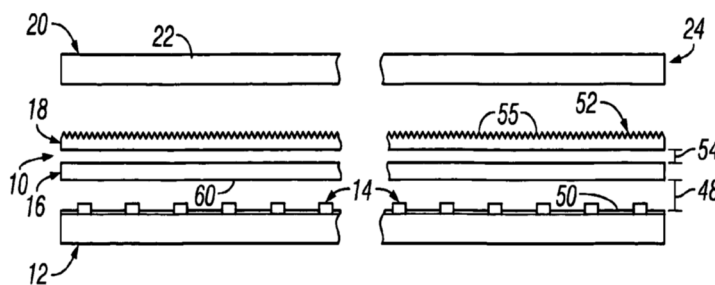


FIG. 1

Mok, Fig. 1.

114. Mok further describes a BEF that receives light and directs it towards the front surface of the brightness enhancer. Mok, [0024]. Because light having a second orientation will be reflected back into the diffuser sheet in Mok, the reflected light will be recycled within the diffuser sheet. Mok, [0024].

115. Lamb discloses a backlighting system 100 that may further include a diffuser sheet 116, a reflector sheet 127, and recycling enhancement structures 112 and 114. Lamb, [0042], [0044], and [0048]. As Lamb describes “‘a recycling enhancement structure’ may be any Structure that is capable of ‘recycling’ light in a manner Similar or equivalent to the enhancement films 12 and 14. Lamb, [0042]. Lamb further describes a specific example of such a film “as a multilayer reflective polarizer Vikuiti™ Dual Brightness Enhancement Film (DBEF), available from 3M Company.” Lamb. These structures “aid in redirecting and recycling light to increase on-axis brightness of the backlight 100 by refracting toward the viewer light within a certain angle and reflecting back light outside that angle.” Lamb, [0045]. Lamb further describes that the diffuser “serves to increase spatial uniformity of the light exiting the second lightguide 140, as well as to aid in randomizing polarization of the light reflected back into the backlight 100.” Lamb, [0048].

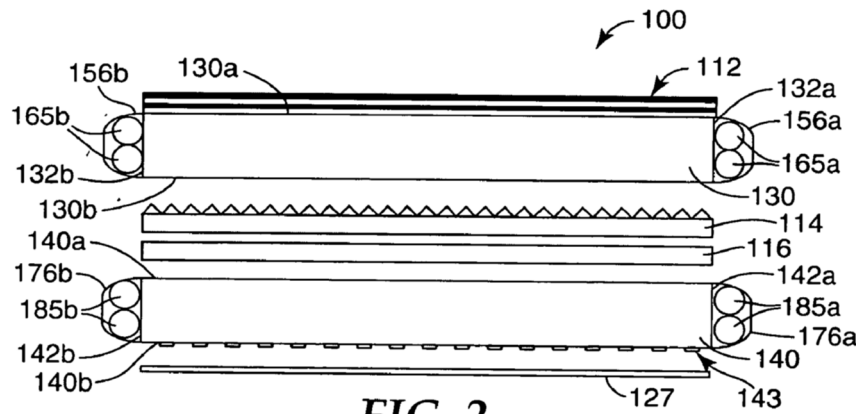


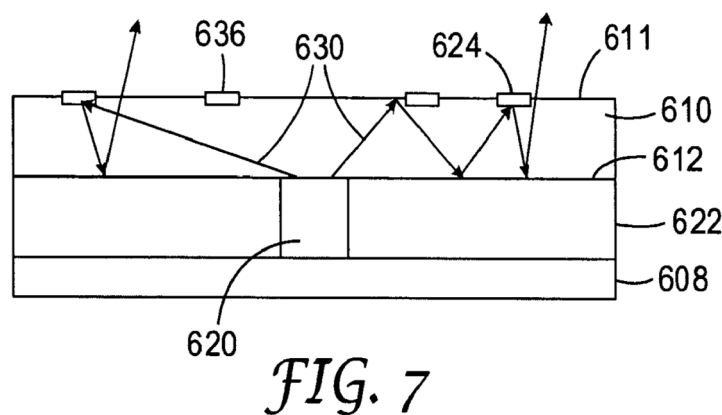
FIG. 2

Lamb, Fig. 2. Thus, Lamb explicitly describes that which is implicitly disclosed in Mok, a brightness enhancement films will reflect some amount of light, which is in turn recycled in the below diffuser sheet layer.

116. Similarly, Epstein discloses that “light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074]. The second direction that the light is refracted in is a second orientation. Epstein further discloses that “a reflective polarizing layer may be provided above the light emitting element, for example a multilayer optical film (MOF) reflective polarizer such as Vikuiti DBEF film” and that “light in the polarization state that is reflected by the reflective polarizer is reflected back towards the substrate 608. One of the layers, for example the intermediate layer 622 may be treated to reflect the light reflected by the reflective polarizer in a manner that causes some depolarization, so that the

light reflected by the reflective polarizer may be recycled and eventually passed through the reflective polarizer.” Epstein, [0075].

117. Epstein discloses both light having a second orientation, and light that is reflected into a lighting panel and recycled. Because light reflecting from the BEF is disclosed as reflecting “back towards substrate 608” a person of skill in the art would understand Epstein discloses that at least some light is recycled within Epstein’s diffuser sheet, i.e. the intermediate layer.



Epstein, Figure 7.

118. Ko further teaches that “the arrangement 120 of light management layers may include a diffuser plate 122” which is “is used to diffuse the light received from the light sources.” Ko, [0044]. The light management layers also include a reflector 118 and a brightness enhancing layer 128. Ko, [0045] & [0051]. As shown in Ko Figure 1, the diffuser plate 122 is between the reflector 118 and the brightness enhancing layer 128.

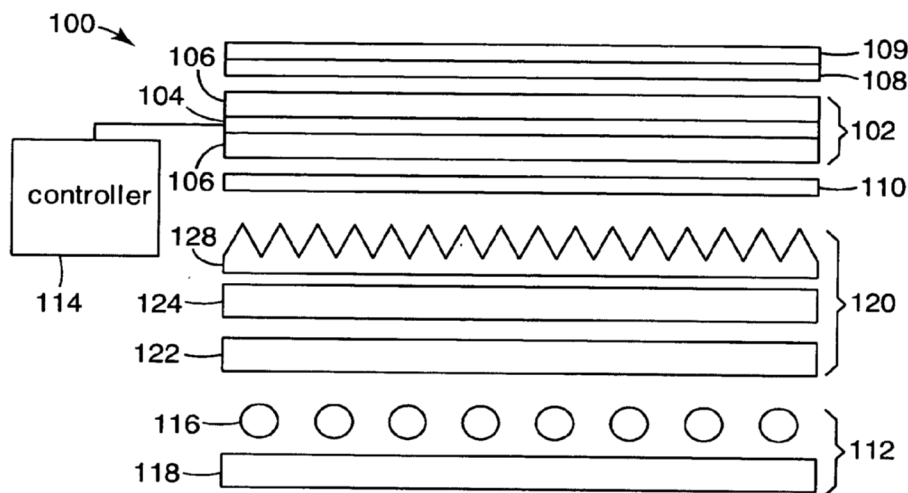


FIG. 1

Ko Figure 1.

119. Ko further teaches recycling light, stating that the reflecting polarizer 124 “may be used to reflect the light that would otherwise be absorbed in the lower absorbing polarizer, and so this light may be recycled by reflection between the reflecting polarizer 124 and the reflector 118. At least some of the light reflected by the reflecting polarizer 124 may be depolarized, and subsequently returned to the reflecting polarizer 124 in a polarization state that is transmitted through the reflecting polarizer 124 and the lower absorbing polarizer 110 to the LC layer 104. In this manner, the reflecting polarizer 124 may be used to increase the fraction of light emitted by the light sources 116 that reaches the LC layer 104, and so the image produced by the display device 100 is brighter.” Ko, [0045].

M. It was Known in the Art to Include on BEFs Additional Layer(s) to Diffuse, Polarize, Collimate and/or Reflect Light (Claim 4)

120. Claim 4 of the '835 Patent further requires “at least one additional layer on the brightness enhancement film configured to diffuse, polarize, collimate and/or reflect light.” Such additional layers were known in the art.

121. For example, Mok discloses a BEF, as discussed above. Lamb discloses a recycling enhancement structure 314 that includes a brightness enhancement film. *See* Lamb [0057]. In Lamb, the recycling enhancement structure 314 is between a first lightguide 330 and a second lightguide 340. Lamb [0057]. Lamb further discloses that “[l]ight extraction from the second lightguide 340 may be accomplished by placing an extractor 343, preferably a diffuse extractor, at a surface of the lightguide 340.” Lamb [0058]. Thus, Lamb explicitly discloses the use of an additional layer in the form of a diffuse extractor on a brightness enhancement film.

122. Similarly, Epstein discloses a second brightness enhancement layer 664 that may be layered with a contrast/projection filter 668. Epstein [0074]-[0075], FIG. 12. A person of skill in the art would recognize and understand that a contrast/projection filter may diffuse light. Epstein also discloses that the brightness enhancement layer may comprise a layer of prismatic elements, which collimate light. Epstein [0074].

123. Likewise, Ko describes a brightness enhancing layer 128 that also comprises a reflecting polarizer 124 layer as show in Figure 1.

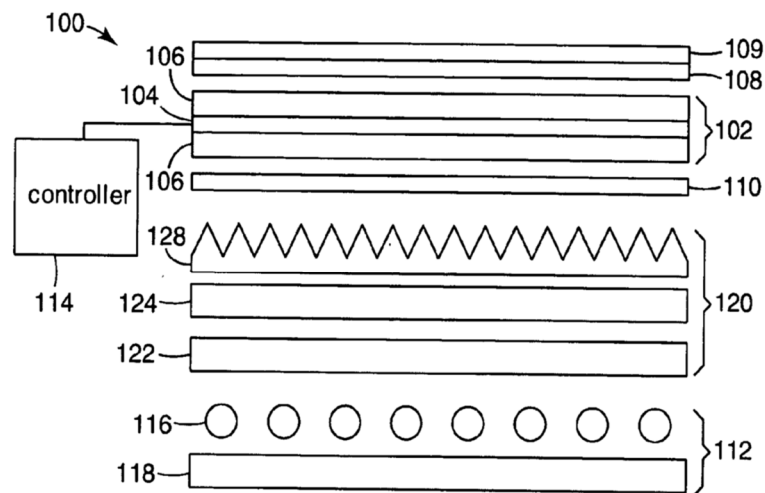


FIG. 1

Ko Figure 1.

N. It was Known in the Art to Include on a Backlight a Heatsink Panel Configured to Draw Heat Away from the Panel in a Direction Opposite to the Direction of Light Emission (Claim 14)

124. Claim 14 of the '835 Patent requires “a heatsink panel on a second side of the at least one substrate opposite to the first side and configured to draw heat away from the at least one substrate in a direction opposite to a direction of light emission from the at least one substrate.” Such heatsink panels were known in the art and would have been obvious to include in any of these systems.

125. Mok identifies and recognizes the issue of heat generation and dissipation. Mok, [0004] and [0006]. Mok further discloses the use of printed circuit board for a base panel. Mok, [0019]. It was well known at the time, and a

person of skill in the art would have recognized that a printed circuit board is a heat sink, as heat is dissipated through electrical connections and the metal base of the printed circuit board.

126. Heat sinks were well known in the art, as demonstrated by Holman. Holman, like Mok, recognizes the need for heat extraction from LEDs which emit light. *See, e.g.*, Holman, pp. 7, 32, and 38. To solve this issue, Holman mentions a need for “adequate heat sinking.” Holman, p. 30. Holman describes a base layer 220 that functions as part of a heat sink. Holman, p. 39. In Holman, the LEDs 70 are mounted to the base layer 220. *See* Holman, Figs. 7 and 13. Light is emitted from the LEDs 70 in a direction away from the base layer 220 and the base layer draws heat away from the LEDs 70 in the direction opposite the direction of light emission. A person of ordinary skill in the art would understand that a base layer that is a heat sink could be easily modified so that a heat sink panel was on one side of the base layer as the purpose of a heat sink is to draw heat away from heat sensitive components, such as light emitting devices.

Similarly, Epstein discloses that “[t]he substrate 408 may be provided with a metallic layer on its lower surface (not shown) for extracting heat generated by the LEDs 420. In addition, the conductors 421 may be provided with large area pads 421a to aid in spreading the heat generated by the LEDs 420.” Epstein, [0054]. A person of skill in the art would have understand and recognized that a metallic layer

for extracting heat is a heatsink panel. The metallic layer for extracting heat is on the opposite side of the substrate as the LEDs, and thus draws heat away from the direction opposite to the direction of light emission.

127. Kretman recognizes that heat may have a negative effect on lighting systems. Kretman, [005], [0032], [0076], [0084]. The arrangement of components in Kretman means “less energy is used to achieve a given level of illumination than with prior known designs.” Kretman, [0084]. Further, Kretman discloses the use of sides 34 made of materials like aluminum that transfer heat well, and which a person of ordinary skill in the art would have recognized was commonly used for a heat sink.

VIII. Combination of Mok, Holman, and Lamb

128. As described above, each element of claims 1-5 and 7-14 was known in the art. Further, in my opinion, a person of ordinary skill in the art would have been motivated to modify Mok based on the disclosures of Holman and Lamb discussed above.

129. As of April 21, 2006 a person of ordinary skill in the art would have had the capability to, and would have been motivated to modify the light emitting panel described in Mok to include both (1) features such as the brightness enhancement film and arrangement thereof, reflector sheet comprising a plastic foam and arrangement thereof, fresnel-type lenses, and heatsink panel described in

Holman, and (2) features such as the brightness enhancement film with a plurality of three dimensional light extraction features, and a diffuser sheet between the reflector and the brightness enhancement film described in Lamb.

130. A person of ordinary skill in the art would recognize that each of Mok, Holman, and Lamb are in the same field of endeavor, i.e., LED-based lighting devices to provide backlighting for display elements. Consequently, a person of ordinary skill in the art addressing Mok's system would have looked to improvements in similar systems like Holman and Lamb.

131. Mok recognizes certain challenges with lighting panels, such as efficiency. Mok [0006]. Those same challenges are recognized in both Holman and Lamb as well. Holman p. 2, Lamb [0006]. A primary motivation of one of ordinary skill in the art would have been to create a more efficient lighting panel. A person of ordinary skill in the art would have recognized that combining features within Holman would have provided a more efficient lighting panel. For example, Holman states numerous times that an "object of the invention to provide an improved system and a method for homogenizing ... uneven light distribution," which creates a more "efficient and homogenous" illumination system. Holman p. 3-5. Holman aims to do so by using components such as a reflector, diffuser, and brightness enhancement film in various configurations. *See, e.g.*, Holman, pp. 119, 159-160. Those same components are used in various configurations in Mok as

well. *See, e.g.*, Mok [0021], [0024], [0028]. Lamb further states that “there remains a need in the field of backlights for large high-performance LCDS for backlighting systems that... are more efficient” and does so by using components described in Mok, such as a reflector, diffuser, and brightness enhancement film to create a more efficient backlighting system. *See, e.g.*, Lamb [0010], [0017], [0035], [0048].

132. Modifying Mok to include Holman’s specific BEF configuration, wherein the BEF is positioned on a reflector sheet without an intervening air gap would beneficially allow for a thinner panel while maintaining light uniformity. *See, e.g.*, Holman p. 16. A person of ordinary skill in the art would thus be motivated to make this combination. Similarly, incorporating Holman’s plastic diffuse reflector in Mok would provide uniform lighting quality at a lower cost and weight than traditional metal reflectors, and thus a person of ordinary skill in the art would be motivated to make this combination. *See, e.g.*, Holman p. 8. Further, a person of ordinary skill in the art would be motivated to use Holman’s lens array 62 of Fresnel-lenses to increase light diffusion, which improves light uniformity, hence quality for the viewer. In addition, applying Holman’s heatsink panel to Mok to improve cooling and efficient operation of LEDs. A person of ordinary skill in the art would make this modification to maintain operating temperature of the LEDs and their control circuit and thereby enhance longevity.

133. A person of ordinary skill in the art would further have been motivated to apply Lamb's BEF to Mok to eliminate thick diffuser plates, provide increased brightness by recycling light, and increase the exit light's spatial uniformity. Lamb [0008], [0035], [0048]. Further including Lamb's BEF would both increase on axis light, a desirable feature recognized by Lamb and Mok, and increase efficiency by recycling light, another desirable feature of lighting panels.

134. A person of ordinary skill in the art would recognize that each of Mok, Holman, and Lamb describes known methods for improving the lighting quality and efficiency of similar LED-based backlighting systems. Thus, in my opinion a person of ordinary skill in the art would have been motivated to use the improvements described within Holman and Lamb to improve the quality of backlighting provided by the backlighting system described in Mok.

135. As one example of an improvement of this combination, a person of ordinary skill in the art would recognize that the combination of Mok, Holman, and Lamb would provide better light diffusion and thus a better display quality as well as improved efficiency, and this would have provided a motivation to make the combination.

136. Further, because each of these references is in a similar field of endeavor, a person of ordinary skill in the art would have recognized that the combination of these references is nothing more than the combination of known

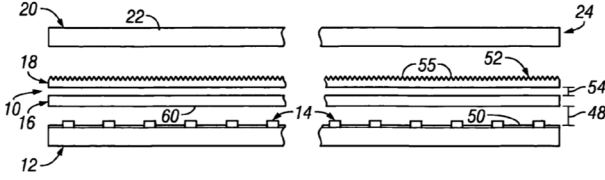
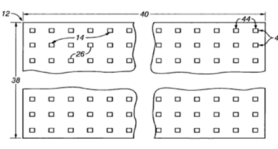
elements in the same field. Thus, combining these three references—Mok, Holman, and Lamb—that all use the same components to achieve the same goal would have been obvious to a person of ordinary skill in the art.

137. With the development of LED backlit LCD technology there were various technical challenges similar to the challenges with CCFL backlit LCDs. The challenges involve trade-offs between efficiency, optical uniformity, display performance, cost, and thickness of the backlit system. Engineers would use well known components and optical understanding to adjust the technology for use with LEDs and to achieve optimal performance among the known trade-offs.

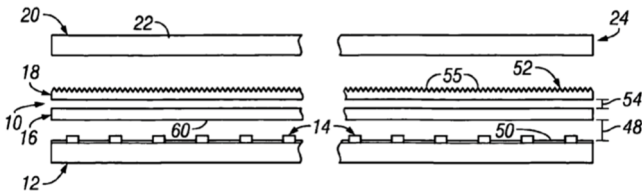
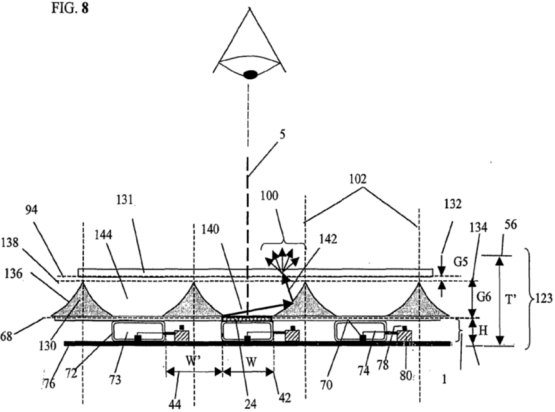
138. Mok describes the basic elements of a LED backlight system including a diffuser and brightness enhancing film located adjacent to the LEDs deployed on a substrate with a reflective coating. While Mok's embodiment does describe recycling of light that is back reflected from the various optical interfaces, Holman and Lamb provide further guidance as to how light outside of the desired emission angle could be recycled, thereby improving efficiency and display performance of the system. Lamb and Holman further describe the use of a diffuser to randomize the light output. As discussed above, the use of random optical features was well understood at the time to reduce interference effects and optical dispersion effects caused by resonant coupling of the light with regular patterns within the optical elements, and thus a person of ordinary skill in the art

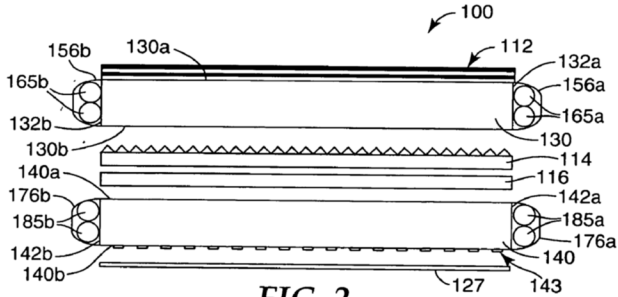
would have been motivated to use these random optical features in the BEF described in Mok.

139. The claim chart below further demonstrates that the combination of Mok, Holman, and Lamb discloses or render obvious to a person of ordinary skill in the art each element of claims 1-5 and 7-14 of the '835 Patent.

Claims of the '835 Patent	Mok, Holman, and Lamb
['835 Claim 1 Preamble] A lighting panel, comprising:	“a light emitting panel.” Mok, Abstract
['835 Claim 1A] at least one substrate having a first side parallel to a principal plane of the lighting panel;	<p>a base panel 12 that “provides a convenient mounting location for the various light emitting elements” Mok, [0019].</p> <p>Mok, Fig. 1</p>  <p style="text-align: center;">FIG. 1</p>
['835 Claim 1B] a plurality of solid state lighting devices arranged on the first side of the at least one substrate and configured to emit light;	<p>“[t]he 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 and width 40 of the base panel 12.” Mok, [0019]. Mok describes the use of a “plurality of LEDs arranged in a two-dimensional array” [0005]. LEDs are a type of solid state lighting devices.</p> <p>Mok, Fig. 2</p>  <p style="text-align: center;">FIG. 2</p>

Claims of the '835 Patent	Mok, Holman, and Lamb
[’835 Claim 1C] a reflector on the first side of the at least one substrate;	<p>“[t]he reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12.” Mok, [0021].</p> <p>Mok, Fig. 1</p>
[’835 Claim 1D] a brightness enhancement film on the reflector,	<p>“the brightness enhancer 18 comprises a brightness enhance film (BEF) available from 3M and sold under the registered trademark Vikuiti®. Alternatively, other types of brightness enhancers could be used.” Mok, [0024].</p> <p>Mok, Fig. 1</p> <p>the prism sheet “may be one of the 90-degree offerings manufactured by the Minnesota Mining & Manufacturing Company (3M) under the trade name BEF, as in brightness enhancement film.” Holman, pp.7-8.</p> <p>Holman, Figs. 7, 8</p> <p>FIG. 7</p>
[’835 Claim 1E] wherein the reflector is arranged between the at least one substrate and the brightness enhancement film and	<p>Mok, Figs. 1. Reflector is element 50, substrate is element 12 (referred to as a base panel) which has a plurality of light emitting elements, and a brightness enhancing film is element 18. Mok [0015]</p>

Claims of the '835 Patent	Mok, Holman, and Lamb
	 <p style="text-align: center;">FIG. 1</p> <p>Holman, Fig. 8</p> 
<p>[’835 Claim 1F] 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</p>	<p>Mok, [0015] (Mok describes the use of “light conditioners” to, on the one hand, diffuse light to create uniform lighting within the panel and on the other hand to use a “brightness enhancer” to collect diffused light and direct it out of a front surface to “maximize the on-axis brightness of the light emitting panel.”)</p> <p>Mok, [0024]. (“the brightness enhancer 18 comprises a brightness enhance film (BEF) available from 3M and sold under the registered trademark Vikuiti®. Alternatively, other types of brightness enhancers could be used.”)</p> <p>According to basic optical principles, light beyond the critical angle based on Snell’s law corresponds to a second orientation that will be reflected back from the back surface of the BEF.</p>

Claims of the '835 Patent	Mok, Holman, and Lamb
	<p>Lamb, [0035] (“The enhancement film 14 refracts light within a certain angle toward the Viewer. Light outside that angle is ‘recycled,’ i.e., reflected back into the backlight 10, where it travels within the System until reaching the proper angle for exiting the system.”)</p>
<p>[’835 Claim 1G] a generally planar diffuser sheet between the reflector and the brightness enhancement film, wherein the light having the second orientation that is reflected back into the lighting panel is recycled within at least the diffuser sheet.</p>	<p>“diffuser 16 is positioned in spaced-apart relation to the base panel 12 so that it receives and diffuses light produced by the light emitting elements 14 as well as light that maybe reflected by the reflective surface 50 provided on base panel 12.” Mok, [0022].</p> <p>Mok, Fig. 1</p> <p>Light reflected back at the interface of the rear surface of the BEF will then enter the diffuser 16 or be reflected back up again to the BEF. At every optical interface, difference in index of refraction between two optical media, there will be some reflection and refraction.</p> <p>the diffuser “serves to increase spatial uniformity of the light exiting the second lightguide 140, as well as to aid in randomizing polarization of the light reflected back into the backlight 100.” Lamb, [0048].</p> <p>Lamb, Fig. 2</p>  <p style="text-align: center;">FIG. 2</p>

Claims of the '835 Patent	Mok, Holman, and Lamb
[’835 Claim 2] The lighting panel of claim 1, wherein the reflector comprises a coating on the substrate that is configured to reflect and scatter light incident thereon.	“The reflective surface 50 may comprise a specular reflective Surface (e.g., aluminum), or a diffuse reflective surface (e.g., white paint).... the reflective surface 50 may be deposited directly on the base panel 12 by any of a wide range of processes suitable for depositing the particular type of reflective material that is to be used.” Mok, [0021] By definition, a diffuse reflective surface will reflect and scatter incident light.
[’835 Claim 3] The lighting panel of claim 1, wherein the reflector comprises a reflector sheet that is configured to reflect and scatter light incident thereon.	“The reflective surface 50 may comprise a specular reflective surface (e.g., aluminum), or a diffuse reflective surface (e.g., white paint). The reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12.” Mok, [0021]
[’835 Claim 4] The lighting panel of claim 1, further comprising at least one additional layer on the brightness enhancement film configured to diffuse, polarize, collimate and/or reflect light.	“Light extraction from the second lightguide 340 may be accomplished by placing an extractor 343, preferably a diffuse extractor, at a surface of the lightguide 340.” Lamb, [0058]
[’835 Claim 5] The lighting panel of claim 3, wherein the reflector sheet includes a plurality of apertures therethrough, wherein respective ones of the plurality of apertures aligned with corresponding ones of the	“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 and width 40 of the base panel 12.” Mok, [0019] Mok, Figs. 1, 2

Claims of the '835 Patent	Mok, Holman, and Lamb
plurality of solid state lighting devices.	
[’835 Claim 7] The lighting panel of claim 3, wherein the reflector sheet comprises a plastic foam.	Holman discloses a reflector that may be composed of a plastic material. Holman, p. 8. Plastic is a generic term, and plastic foams were well known in the art as shown by Ko (Ko, [0056] (“[p]olymer foams may also be used” to form the substrate)) such that using a plastic foam as the plastic described in Holman in the backlighting panels of Mok.
[’835 Claim 8] The lighting panel of claim 1, further comprising a diffuser sheet between the reflector sheet and the brightness enhancement film.	<p>“A reflective surface 50 may be provided on the base panel 12 to “recycle” (i.e., reflect) light which may be reflected by the back surface 60 of diffuser 16 (i.e., light incident on the back surface 60 of the diffuser 16 at an angle that exceeds the critical angle for the particular diffuser 16.” Mok, [0021].</p> <p>Mok, Fig. 1</p>
[’835 Claim 9] The lighting panel of claim 1, 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.	<p>“brightness enhancer 18 comprises a plurality of optical elements, such as prisms 55 defined by the front surface 52 of the brightness enhancer 18, that collect light from the diffuser 16 and direct it out the front surface 52 of the brightness enhancer 18. The brightness enhancer 18 thereby maximizes the on-axis brightness of the panel 10.” Mok, [0021].</p> <p>Prismatic structures “redirect and recycle light to increase on-axis output brightness of the backlighting system 200 by refracting toward the viewer light within a certain angle and reflecting back light outside that angle.” Lamb, [0052]</p>

Claims of the '835 Patent	Mok, Holman, and Lamb
[’835 Claim 10] The lighting panel of claim 9, wherein the light extraction features are random features.	Lamb, [0042] discusses randomization of light direction. Random optical extraction features were a known optical concept to reduce dispersion and interference effects caused by regular patterns.
[’835 Claim 11] The lighting panel of claim 9, wherein the brightness enhancement film is configured to limit direct emission from the lighting panel of light emitted by the plurality of solid state light emitting devices to thereby encourage light recycling/diffusion in the lighting panel.	<p>Mok discloses a BEF. Mock, [0024] (“the brightness enhancer 18 comprises a brightness enhance film (BEF).”).</p> <p>Lamb discloses recycling enhancement structures 112 and 114, which are BEFs. Lamb, [0042] and [0044].</p> <p>“the second recycling enhancement structure 114 includes prismatic structures, e.g., prismatic structured film, that would aid in redirecting and recycling light to increase on-axis brightness of the backlight 100 by refracting toward the viewer light within a certain angle and reflecting back light outside that angle.” Lamb, [0045].</p>
[’835 Claim 12] The lighting panel of claim 9, wherein the light extraction features comprise fresnel-type lenses.	“lens 356 may be a Fresnel or a pair of Fresnel lens elements.” Holman, pp. 69.
[’835 Claim 13] The lighting panel of claim 9, wherein the brightness enhancement film is configured to substantially collimate light emitted by the lighting panel.	“[t]he brightness enhancer 18 collects diffused light from the diffuser 16 and directs it out of a front surface 52 of the brightness enhancer 18 to maximize the on-axis brightness of the light emitting panel 10.” Mok, [0015].

Claims of the '835 Patent	Mok, Holman, and Lamb
['835 Claim 14] The lighting panel of claim 1, further comprising a heatsink panel on a second side of the at least one substrate opposite to the first side and configured to draw heat away from the at least one substrate in a direction opposite to a direction of light emission from the at least one substrate.	<p>Mok, [0004], [0006] discuss heat generation and dissipation.</p> <p>Holman, pp. 7, 32, and 38 discusses heat extraction from LEDs.</p> <p>Holman discusses a base layer 220 that functions as part of a heat sink. Holman, p. 39</p>

IX. Combination of Epstein, Holman, and Lamb

140. As described above, each element of claims 1-5 and 7-14 was known in the art. Further, in my opinion, a person of ordinary skill in the art would have been motivated to modify Epstein based on the disclosures of Holman and Lamb discussed above.

141. As of April 21, 2006 a person of ordinary skill in the art would have had the capability to, and would have been motivated to modify the light emitting panel described in Epstein to include both (1) features such as the brightness enhancement film on a reflector and the reflector sheet comprising a plastic foam described in Holman, (2) features such as the brightness enhancement film and other features disclosed in Lamb, and (3) to include random features on the brightness enhancement film.

142. A person of ordinary skill in the art would recognize that each of Epstein, Holman, and Lamb are in the same field of endeavor, i.e., LED-based lighting devices to provide backlighting for display elements. Consequently, a person of ordinary skill would have had a reasonable expectation of success in combining their various disclosures to produce a lighting panel. Furthermore, it was well within the technical ability of a person of ordinary skill at the time to incorporate the improvements to backlighting systems described in Holman and Lamb into the lighting device disclosed by Epstein.

143. Epstein, Holman, and Lamb are all aimed at the same goal—increasing the efficiency of lighting systems. Epstein [0121]; Holman p. 2, Lamb [0006]. Epstein and Holman describe accomplishing those similar functions by using the same components—LED light sources, reflectors, diffusers, and brightness enhancement films—in a variety of configurations. The same is true for Epstein and Lamb, which also both describe improved backlighting systems using similar components like a reflector, a diffuser, and a brightness enhancement film. *See, e.g.*, Lamb [0035], [0048]. The three references similarly discuss ways to improve light output and manage light uniformity by using a variety of films, layers, and structures and by modifying and arranging these structures in a variety of physical configurations.

144. A person of ordinary skill in the art would have recognized that each of Epstein, Holman, and Lamb describes known methods for improving the lighting quality and efficiency of similar LED-based backlighting systems. A person of ordinary skill in the art would have been motivated to use the improvements described within Holman and Lamb to improve the quality of backlighting provided by the backlighting system described in Epstein. A person of ordinary skill would have recognized that the combination would have provided better light diffusion and thus a better display quality as well as improved efficiency, and this would have provided a motivation to make the combination. This combination is nothing more than the combination of known elements from similar references in a similar area.

145. Epstein, Lamb, Holman describe similar approaches of using known optical principles and elements to balance efficiency, display performance, thickness, and cost factors. To the extent a specific optical element is not explicitly described in one of these references, it would be obvious to use known optical elements which are described in the other references and were generally known at the time. As discussed above, the use of random optical features was well understood at the time to reduce interference effects and optical dispersion effects caused by resonant coupling of the light with regular patterns within the

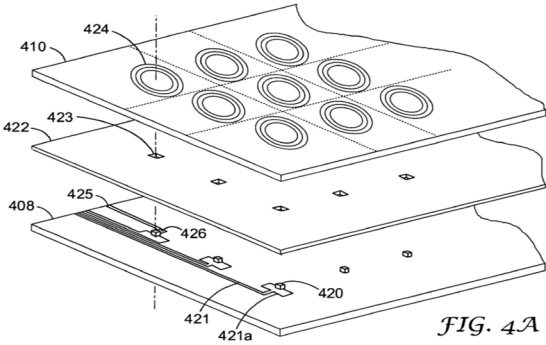
optical elements, and thus a person of ordinary skill in the art would have been motivated to use these random optical features in the BEF described in Epstein.

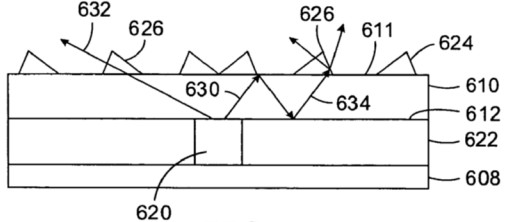
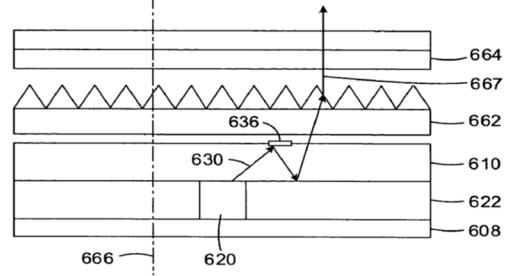
146. A person of ordinary skill in the art would be motivated to modify Epstein to include Holman's specific arrangement of BEF configuration, wherein the BEF is positioned on a reflector sheet without an intervening air gap. This positioning allows for a thinner panel while maintaining light uniformity. *See, e.g.,* Holman p. 16. A person of ordinary skill in the art would be motivated to make this combination in order to produce a thinner display panel. Further, a person of ordinary skill in the art would be motivated to use Holman's plastic diffuse reflector in Epstein to provide uniform lighting quality at a lower cost and weight than traditional metal reflectors. *See e.g.,* Holman p. 8. A person of ordinary skill in the art would further have been motivated to apply Lamb's BEF to the Epstein-Holman combination to eliminate thick diffuser plates, provide increased brightness by recycling light, and increase the exit light's spatial uniformity. Lamb [0008], [0035], [0048].

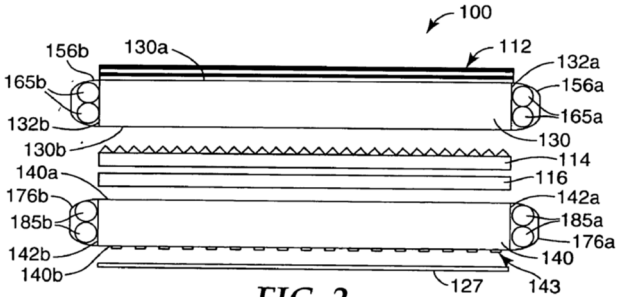
147. Further, a person of ordinary skill in the art would be motivated to use plastic foam as the reflector sheet. Plastic foams are lightweight, thin, and inexpensive, and thus a person of ordinary skill in the art would be motivated to use a plastic foam as a reflector sheet. As a transparent diffuser option, the use of plastic foam as a diffuse reflector would have similar and predictable reflective

performance. The reflectance and diffusion properties would be a function of the specific plastic foam properties, thickness, and substrate material. A person of skill in the art would have further recognized that the selection of a plastic foam to act as the reflector is simply a design-choice that a person of ordinary skill in the art would have made based on the desired thickness and reflectance of the foam material.

148. The claim chart below further demonstrates that the combination of Epstein, Holman, and Lamb discloses or render obvious to a person of ordinary skill in the art each element of claims 1-5 and 7-14 of the '835 Patent.

Claims of the '835 Patent	Epstein, Holman, and Lamb
['835 Claim 1 Preamble] A lighting panel, comprising:	“backlighting of liquid crystal displays.” Epstein Abstract.
['835 Claim 1A] at least one substrate having a first side parallel to a principal plane of the lighting panel;	<p>“lighting unit 400 comprises a substrate 408 on which are arrayed a number of LEDs 420.” Epstein, [0046].</p> <p>Epstein, Fig. 4A</p>  <p style="text-align: right;"><i>FIG. 4A</i></p>
['835 Claim 1B] a plurality of solid state lighting devices arranged on the first side of the at least one	Epstein, [0046] discusses LEDs in an array on substrate 408.

Claims of the '835 Patent	Epstein, Holman, and Lamb
substrate and configured to emit light;	
<p data-bbox="186 279 613 405">['835 Claim 1C] a reflector on the first side of the at least one substrate;</p>	<p data-bbox="641 279 1393 363">Epstein, [0048] & [0067] discuss a reflector on a substrate</p> <p data-bbox="641 405 1372 447">Also figure 4D element 422, also 622 of figure 6</p> <p data-bbox="641 489 860 531">Epstein, Fig. 6</p>  <p data-bbox="901 741 1031 783"><i>FIG. 6</i></p>
<p data-bbox="186 814 552 940">['835 Claim 1D] a brightness enhancement film on the reflector,</p>	<p data-bbox="641 814 1104 856">Epstein, Figs. 4, 6, 10A, 11, 12</p>  <p data-bbox="885 1129 1015 1171"><i>FIG. 11</i></p> <p data-bbox="641 1224 1380 1434">the prism sheet “may be one of the 90-degree offerings manufactured by the Minnesota Mining & Manufacturing Company (3M) under the trade name BEF, as in brightness enhancement film.” Holman, pp.7-8.</p> <p data-bbox="641 1476 787 1518">Figs. 7, 8</p>

Claims of the '835 Patent	Epstein, Holman, and Lamb
	back into the backlight 10, where it travels within the System until reaching the proper angle for exiting the system.”)
<p>[’835 Claim 1G] a generally planar diffuser sheet between the reflector and the brightness enhancement film, wherein the light having the second orientation that is reflected back into the lighting panel is recycled within at least the diffuser sheet.</p>	<p>“light in the polarization state that is reflected by the reflective polarizer is reflected back towards the substrate 608. One of the layers, for example the intermediate layer 622 may be treated to reflect the light reflected by the reflective polarizer in a manner that causes some depolarization, so that the light reflected by the reflective polarizer may be recycled and eventually passed through the reflective polarizer.” Epstein, [0075].</p> <p>Epstein, Fig. 7.</p> <p>the diffuser “serves to increase spatial uniformity of the light exiting the second lightguide 140, as well as to aid in randomizing polarization of the light reflected back into the backlight 100.” Lamb, [0048].</p> <p>Lamb, Fig. 2</p>  <p style="text-align: center;">FIG. 2</p>

Claims of the '835 Patent	Epstein, Holman, and Lamb
<p>[’835 Claim 2] The lighting panel of claim 1, wherein the reflector comprises a coating on the substrate that is configured to reflect and scatter light incident thereon.</p>	<p>Epstein discloses a reflector that may comprise a “multilayer dielectric coating.” Epstein [0048] (“intermediate layer 422 may also include some other type of reflector, such as a metalized layer or multilayer dielectric coating.”).</p> <p>Epstein, [0081] (“Another example is schematically illustrated in FIG. 15B, in which the upper surface of the reflective intermediate layer 622, and/or the lower surface of the guiding layer 610, is provided with patches 695 of diffusely reflective light extraction material, such as a white pigmented material.”)</p> <p>Further, “different types of reflector may be used on the lower surface 612. For example, the lower surface 612 may be coated with a reflecting film.” Epstein [0079].</p>
<p>[’835 Claim 3] The lighting panel of claim 1, wherein the reflector comprises a reflector sheet that is configured to reflect and scatter light incident thereon.</p>	<p>“The intermediate layer 422 may comprise, for example, a multi-layer polymer reflective film such as Vikuliti ESR film available from 3M Company, St. Paul, Minn. The intermediate layer 422 may also be a white diffuse reflector such as a matrix containing diffusely reflecting particles, for example titanium dioxide particles.” Epstein, [0048].</p>
<p>[’835 Claim 4] The lighting panel of claim 1, further comprising at least one additional layer on the brightness enhancement film configured to diffuse, polarize, collimate and/or reflect light.</p>	<p>Epstein, [0074]-[0075] discusses contrast/projection filter 668.</p> <p>“Light extraction from the second lightguide 340 may be accomplished by placing an extractor 343, preferably a diffuse extractor, at a surface of the lightguide 340.” Lamb, [0058]</p>
<p>[’835 Claim 5] The lighting panel of claim 3, wherein the reflector sheet includes a plurality of apertures therethrough, wherein</p>	<p>“the guiding layer 410 may include an array of light extraction elements 424 associated with each LED 420. The intermediate layer 422 includes apertures 423, also referred to as vias, that are</p>

Claims of the '835 Patent	Epstein, Holman, and Lamb
respective ones of the plurality of apertures aligned with corresponding ones of the plurality of solid state lighting devices.	registered to the LEDs 420 disposed on the substrate 408.” Epstein, [0048]. Epstein, Fig. 4A
[’835 Claim 7] The lighting panel of claim 3, wherein the reflector sheet comprises a plastic foam.	Epstein, [0008] discusses a reflector sheet. Holman discusses a reflector may be composed of a plastic material. Holman, p. 8. Plastic is a generic term, and plastic foams were well known in the art as shown by Ko (“[p]olymer foams may also be used” to form the substrate. Ko, [0056]).
[’835 Claim 8] The lighting panel of claim 1, further comprising a diffuser sheet between the reflector sheet and the brightness enhancement film.	Epstein, [0048], [0074], [0084]; Figs. 11, 19A.
[’835 Claim 9] The lighting panel of claim 1, 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.	BEF “typically comprise[s] a plurality of prismatic refractive elements which, when illuminated from the base side of the prismatic elements, refract the transmitted light in a direction more parallel to the axis.” Epstein, [0074]. Epstein, Fig. 11. Prismatic structures “redirect and recycle light to increase on-axis output brightness of the backlighting system 200 by refracting toward the viewer light within a certain angle and reflecting back light outside that angle.” Lamb, [0052]
[’835 Claim 10] The lighting panel of claim 9, wherein the light extraction features are random features.	“[t]he present invention should not be considered limited to the particular examples described above, but rather should be understood to cover all aspects of the invention as fairly set out in the attached claims. Various modifications, equivalent processes, as well as numerous structures to which

Claims of the '835 Patent	Epstein, Holman, and Lamb
	<p>the present invention may be applicable will be readily apparent to those of skill in the art to which the present invention is directed upon review of the present specification. The claims are intended to cover such modifications and devices.” Epstein [0123].</p> <p>Epstein, [0074], [0075].</p> <p>Lamb, [0042] discusses randomization of light direction</p>
<p>[’835 Claim 11] The lighting panel of claim 9, wherein the brightness enhancement film is configured to limit direct emission from the lighting panel of light emitted by the plurality of solid state light emitting devices to thereby encourage light recycling/diffusion in the lighting panel.</p>	<p>“one or more brightness enhancing films, available from 3M Company, St. Paul, Minn., under the trade name BEF.” Epstein, [0074].</p> <p>Epstein, [0075]</p> <p>Lamb, [0042], [0044], [0045] discuss light recycling</p>
<p>[’835 Claim 12] The lighting panel of claim 9, wherein the light extraction features comprise fresnel-type lenses.</p>	<p>“the lenses are formed on a lens sheet 1852 as prismatic lenses, for example Fresnel lenses.” Epstein, [0110].</p> <p>Epstein, claim 4.</p> <p>“lens 356 may be a Fresnel or a pair of Fresnel lens elements.” Holman, pp. 69.</p>
<p>[’835 Claim 13] The lighting panel of claim 9, wherein the brightness enhancement film is configured to substantially collimate light emitted by the lighting panel.</p>	<p>that “light 667 is refracted upon exiting the first brightness enhancing layer 662 in a second direction that is closer to the axis 666 than the first direction.” Epstein, [0074].</p> <p>Epstein, Fig. 11.</p>

Claims of the '835 Patent	Epstein, Holman, and Lamb
<p>['835 Claim 14] The lighting panel of claim 1, further comprising a heatsink panel on a second side of the at least one substrate opposite to the first side and configured to draw heat away from the at least one substrate in a direction opposite to a direction of light emission from the at least one substrate.</p>	<p>“The substrate 408 may be provided with a metallic layer on its lower surface (not shown) for extracting heat generated by the LEDs 420. In addition, the conductors 421 may be provided with large area pads 421a to aid in spreading the heat generated by the LEDs 420.” Epstein, [0054].</p> <p>Holman, pp. 7, 32, and 38 discusses heat extraction from LEDs.</p> <p>Holman discusses a base layer 220 that functions as part of a heat sink. Holman, p. 39</p>

X. Combination of Ko, Kretman, and Epstein

149. As described above, each element of claims 1-5 and 7-14 was known in the art. Further, in my opinion, a person of ordinary skill in the art would have been motivated to modify Ko based on the disclosures of Kretman and Epstein discussed above.

150. As of April 21, 2006 a person of ordinary skill in the art would have had the capability to, and would have been motivated to modify the light emitting panel described in Ko to include both (1) features such as the reflector and arrangement thereof, and the brightness enhancement layer described in Kretman, and (2) features such as the reflector and Fresnel lenses described in Epstein

151. As an initial matter, Ko specifically incorporates Kretman by reference. Ko [0043]. This would explicitly direct a person of ordinary skill in the

art to look to Kretman, and this provides an explicit motivation to combine the two references.

152. Each of Ko, Kretman, and Epstein are in the same field of endeavor, i.e., LED-based lighting devices to provide backlighting for display elements. Consequently, a person of ordinary skill in the art would have had a reasonable expectation of success in combining their various disclosures to produce a lighting panel. Furthermore, it was well within the technical ability of a person of ordinary skill in the art at the time to incorporate the improvements to backlighting systems described in Kretman and Epstein into the lighting device disclosed by Ko.

153. All three references address the same goal, which is “to increase the efficient use of light to illuminate.” Kretman [0078]; *see also* Epstein [0121]; Ko Abstract. To so, all three references use similar components, such as a reflector, a diffuser, and a brightness enhancing layer. Ko [0038], [0043], [0051]; Kretman [0078], [0080]; Epstein [0008], [0072]. Given that all three references use the same components to achieve the same goal, it would have been obvious to a person of ordinary skill in the art to use improvements taught by one configuration of these elements in a different configuration of the same elements.

154. A person of ordinary skill in the art would recognize that each of Ko, Kretman, and Epstein describes known methods for improving the lighting quality and efficiency of similar LED-based backlighting systems. A person of ordinary

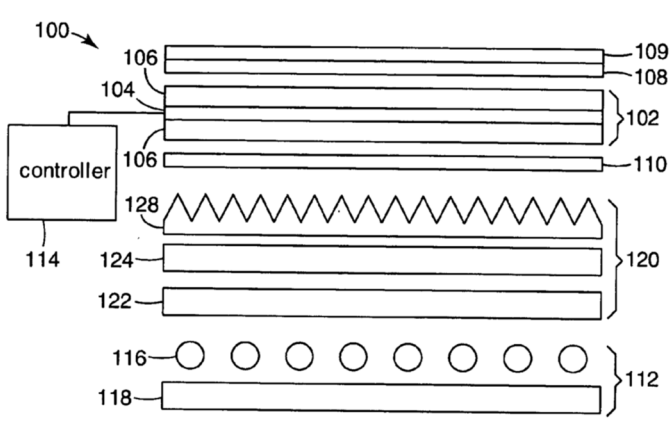
skill in the art would have been motivated to use the improvements described in Kretman and Epstein to improve the quality of backlighting provided by the backlighting system described in Ko. A person of ordinary skill in the art would recognize that the combination would have provided better light diffusion and thus a better display quality as well as improved efficiency, and this would have provided a motivation to make the combination.

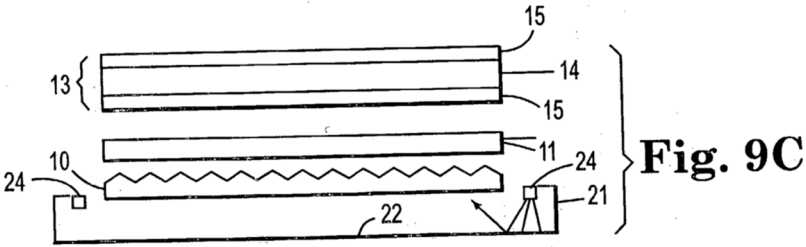
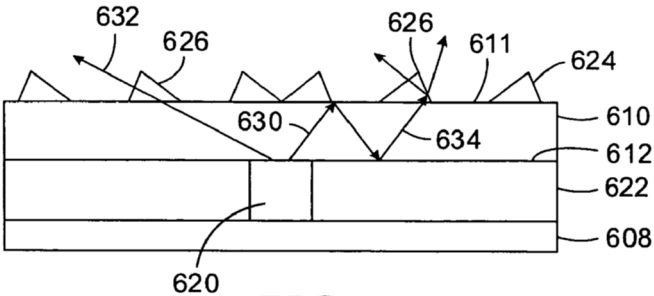
155. Ko, Kretman, and Epstein describe similar approaches of using known optical principles and elements to balance efficiency, display performance, thickness, and cost factors. To the extent a specific optical element is not explicitly described in one of these references, it would be obvious to use known optical elements which are described in the other references and were generally known at the time.

156. A person of ordinary skill in the art would be motivated to use random features in connection with a brightness enhancing film described by Ko. A person of ordinary skill in the art would further recognize that the LEDs in a backlight are positioned in uniform locations. Thus, including random features on a BEF helps avoid interference effects. This provides a motivation to use randomized patterns on the surface of the BEF. Further, randomized optical patterns also help to minimize optical dispersion which is the separation of colors, such as with a prism, where in a display the objective is to combine colors. This provides an additional

motivation for a person of ordinary skill in the art to apply random patterns to the surface of the BEF.

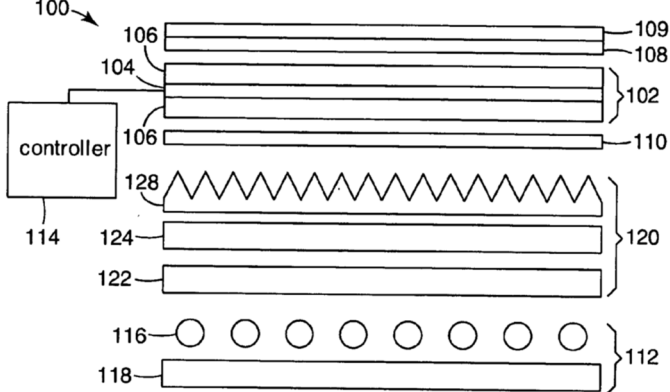
157. The claim chart below further demonstrates that the combination of Ko, Kretman, and Epstein discloses or render obvious to a person of ordinary skill in the art each element of claims 1-5 and 7-14 of the '835 Patent.

Claims of the '835 Patent	Ko, Kretman, and Epstein
['835 Claim 1 Preamble] A lighting panel, comprising:	“The invention relates to optical displays, and more particularly to liquid crystal displays (LCDS) that are directly illuminated by light sources from behind, such as may be used in LCD monitors and LCD televisions.” Ko, [0001].
['835 Claim 1A] at least one substrate having a first side parallel to a principal plane of the lighting panel;	<p>Ko, [0043], [0053], Fig. 1</p>  <p style="text-align: center;">FIG. 1</p>
['835 Claim 1B] a plurality of solid state lighting devices arranged on the first side of the at least one substrate and configured to emit light;	<p>“The backlight 112 includes a number of light sources 116 that generate the light that illuminates the LC panel 102...Other types of light sources may be used, however, such as ... light emitting diodes (LEDs)” Ko, [0042].</p> <p>Ko, Fig. 1</p>

Claims of the '835 Patent	Ko, Kretman, and Epstein
<p>[’835 Claim 1C] a reflector on the first side of the at least one substrate;</p>	<p>“The backlight 112 may also include a reflector 118 for reflecting light propagating downwards from the light sources 116, in a direction away from the LC panel 102. The reflector 118 may also be useful for recycling light within the display device 100, as is explained below. The reflector 118 may be a specular reflector or may be a diffuse reflector.” Ko, [0043]</p> <p>“forming a plurality of surface elements in the diffuse reflective material. These surface elements are positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026].</p> <p>Kretman, [0087]; Fig. 9C.</p>  <p>Epstein further discloses that LEDs on a substrate in a planar array and that when doing so, it is useful to place a reflector on the surface of the substrate to reflect light that is being recycled within the panel. See Epstein, [0048] & [0067].</p> 

Claims of the '835 Patent	Ko, Kretman, and Epstein
[’835 Claim 1D] a brightness enhancement film on the reflector,	Ko, [0005], [0045], and [0051] discuss a BEF on a reflector. Ko, [0073]; Fig. 1
[’835 Claim 1E] wherein the reflector is arranged between the at least one substrate and the brightness enhancement film and	Ko, FIG 1, [0005], [0045], [0051].
[’835 Claim 1F] 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	<p>“the amount of light propagating on-axis through the LC layer 104, thus increasing the brightness of the image seen by the viewer. One example is a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051].</p> <p>Ko, [0085]</p> <p>“reflector can be used to reflect incident light between layer 10 and the diffuse reflective layer 17 to increase display luminance by controlling the angles over which light is emitted. The reflected light is scattered by the diffuse reflector 17 into all angles. The light within the transmission angles of the brightness enhancing layer 10 is transmitted towards the viewer. Light in the second angular range is reflected for additional scattering.” Kretman, [0082]</p>
[’835 Claim 1G] a generally planar diffuser sheet between the reflector and the brightness enhancement film,	<p>“the arrangement 120 of light management layers may include a diffuser plate 122” which is “is used to diffuse the light received from the light sources.” Ko, [0044].</p> <p>Ko, [0045], [0051]; Fig. 1</p>

Claims of the '835 Patent	Ko, Kretman, and Epstein
wherein the light having the second orientation that is reflected back into the lighting panel is recycled within at least the diffuser sheet.	
['835 Claim 2] The lighting panel of claim 1, wherein the reflector comprises a coating on the substrate that is configured to reflect and scatter light incident thereon.	“are positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026].
['835 Claim 3] The lighting panel of claim 1, wherein the reflector comprises a reflector sheet that is configured to reflect and scatter light incident thereon.	<p>“may be a specular reflector or may be a diffuse reflector.” Ko, [0043].</p> <p>“positioned to reduce or eliminate optical coupling with a substrate against which the diffuse reflective material is subsequently placed.” Kretman, [0026].</p>
['835 Claim 4] The lighting panel of claim 1, further comprising at least one additional layer on the brightness enhancement film configured to diffuse, polarize,	Ko describes a brightness enhancing layer 128 that also comprises a reflecting polarizer 124. <i>See</i> Ko, Fig. 1

Claims of the '835 Patent	Ko, Kretman, and Epstein
collimate and/or reflect light.	 <p style="text-align: center;">FIG. 1</p>
[’835 Claim 5] The lighting panel of claim 3, 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.	<p>“diffuse reflector lining a portion of the cavity and partially wrapping around the light source so as to direct light from the light source into the optical cavity.” Kretman, [0019].</p> <p>“the guiding layer 410 may include an array of light extraction elements 424 associated with each LED 420. The intermediate layer 422 includes apertures 423, also referred to as vias, that are registered to the LEDs 420 disposed on the substrate 408.” Epstein, [0048].</p> <p>Epstein, Fig. 4A.</p> <p>Ko, [0042]</p>
[’835 Claim 7] The lighting panel of claim 3, wherein the reflector sheet comprises a plastic foam.	<p>“Polymer foams may also be used” as a diffusing material. Ko, [0056]</p>
[’835 Claim 8] The lighting panel of claim 1, further comprising a diffuser sheet between the	<p>Ko, [0044]-[0045], [0051], Fig. 1.</p>

Claims of the '835 Patent	Ko, Kretman, and Epstein
reflector sheet and the brightness enhancement film.	
[’835 Claim 9] The lighting panel of claim 1, 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.	<p>“brightness enhancing layer is one that includes a surface structure that redirects off-axis light in a direction closer to the axis of the display. This increases the amount of light propagating on-axis through the LC layer 104, thus increasing the brightness of the image seen by the viewer. One example is a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051].</p> <p>Ko, Fig. 1</p> <p>“the gain obtained on a backlight that is 70% reflective on average is 1.6 if a prismatic brightness enhancing sheet is used that has a refractive index of 1.59 with 90 degree facet angles. Increasing the average reflectance of the backlight to 90% increases the gain to 1.8. The gain increases to 2.0 if there is no absorption loss in the backlight. Thus, a 90% reflectance allows close to the highest possible increase in luminance.” Kretman, [0081]</p>
[’835 Claim 10] The lighting panel of claim 9, wherein the light extraction features are random features.	<p>Ko also states that “[t]he present invention should not be considered limited to the particular examples described above, but rather should be understood to cover all aspects of the invention as fairly set out in the attached claims. Various modifications, equivalent processes, as well as numerous structures to which the present invention may be applicable will be readily apparent to those of skill in the art to which the present invention is directed upon review of the present specification.” Ko [0124].</p> <p>Ko [0050]-[0054].</p>
[’835 Claim 11] The lighting panel of claim 9, wherein the brightness	Ko, [0045], [0083]; claims 11, 12.

Claims of the '835 Patent	Ko, Kretman, and Epstein
enhancement film is configured to limit direct emission from the lighting panel of light emitted by the plurality of solid state light emitting devices to thereby encourage light recycling/diffusion in the lighting panel.	<p>“If the light is not at the correct range of viewing angles, nor of the correct polarization, it is reflected back towards the light guide 6.” Kretman, [0080].</p> <p>“diffuse reflecting article 17 acts as a light recycler by (1) reflecting the light rejected from the reflective polarizing film 11 and for from the brightness enhancement film 10 and (2) giving that light another opportunity to reach a viewer. This rejecting and recycling can occur numerous times increasing the amount of light directed towards the viewer.” Kretman, [0081]</p>
[’835 Claim 12] The lighting panel of claim 9, wherein the light extraction features comprise fresnel-type lenses.	<p>“the lenses are formed on a lens sheet 1852 as prismatic lenses, for example Fresnel lenses.” Epstein, [0110].</p> <p>Ko, [0038], [0043], [0051]; Epstein, [0008], [0031], [0055]; claim 4.</p>
[’835 Claim 13] The lighting panel of claim 9, wherein the brightness enhancement film is configured to substantially collimate light emitted by the lighting panel.	<p>“a prismatic brightness enhancing layer, which has a number of prismatic ridges that redirect the illumination light, through refraction and reflection.” Ko, [0051].</p> <p>“the gain obtained on a backlight that is 70% reflective on average is 1.6 if a prismatic brightness enhancing sheet is used that has a refractive index of 1.59 with 90 degree facet angles. Increasing the average reflectance of the backlight to 90% increases the gain to 1.8. The gain increases to 2.0 if there is no absorption loss in the backlight. Thus, a 90% reflectance allows close to the highest possible increase in luminance.” Kretman, [0083].</p>
[’835 Claim 14] The lighting panel of claim 1, further comprising a heatsink panel on a second side of the at least one	<p>“[t]he substrate 408 may be provided with a metallic layer on its lower surface (not shown) for extracting heat generated by the LEDs 420. In addition, the conductors 421 may be provided with large area pads 421 a to aid in spreading the heat generated by the LEDs 420.” Epstein, [0054].</p>

Claims of the '835 Patent	Ko, Kretman, and Epstein
substrate opposite to the first side and configured to draw heat away from the at least one substrate in a direction opposite to a direction of light emission from the at least one substrate.	<p>“less energy is used to achieve a given level of illumination than with prior known designs.” Kretman, [0084].</p> <p>Epstein, Fig. 4A.</p> <p>Kretman, [005], [0032], [0076], [0084].</p>

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.

July 2, 2023

Date



Dr. P. Morgan Pattison