

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.

Brightplus Ventures LLC
Patent Owner

Patent No. 7,872,705
Filing Date: July 29, 2007
Issue Date: January 18, 2011
Title: LED Backlight System for LCD Displays

Inter Partes Review No. IPR2023-01411

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 '705 Patent.....	11
A. Person of Ordinary Skill in the Art of the '705 Patent.....	12
B. Construction of Claim Terms of the '705 Patent	13
V. Materials Considered	13
VI. State of the Art as of July 29, 2007.	14
A. General Display Technology Background	14
B. Johnson	14
C. Suzuki	16
D. Fine	19
VII. The Prior Art Renders Every Element of Claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31, 32, 33, and 34 of the '705 Patent Obvious.	20
A. Liquid Crystal Display (LCD) Systems Such as a Television or a Computer Monitor with an LCD Panel Were Known in the Art (Claims 1A, 32, 33)	20
B. LCD Systems with a Waveguide Having Multiple Light Entry Regions Were Known in the Art (Claims 1B, 2)	23
C. Multiple Light-Emitting Sources Each Having Multiple LEDs Arranged in a Strip and Each LED Linearly Arranged to Emit Light into a Light Entry Region of the Waveguide Element Were Known in the Art (Claims 1C, 1D, 13, 16)	27
D. A Common Control Circuit in Electrical Communication with Each LED in One Set or Each Set of LEDs Was Known in the Art (Claims 1E, 11, 14)	32

E.	Multiple Light Emitting Sources Having Multiple LEDs that Can Emit White Light and/or Single Color Light, and/or Can Output Substantially the Same Wavelength Were Known in the Art (Claims 5, 9).....	36
F.	Multiple Light Emitting Sources Having Multiple LEDs that Can Include Direct LEDS Were Known in the Art (Claim 6)	41
G.	One or More of the Light-Emitting Sources Optically Coupled to the Waveguide Element Were Known in the Art (Claims 17, 22)	45
H.	One or More of the Light-Emitting Sources Disposed Along an Edge Region of the Waveguide Element and/or a Center Region of the LCD System Were Known in the Art (Claims 28, 29)	49
I.	LCD Systems with Three Light-Emitting Sources Arranged to Emit Light into a Waveguide Element to Provide Direct Backlight Were Known in the Art (Claim 31, 34)	53
VIII.	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31 32, 33, and 34 of the '705 Patent.....	56
IX.	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1, 2, 5, 11, 13, 14, 16, 17, 32, and 34 of the '705 Patent.	75
X.	Johnson and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 32 and 33 of the '705 Patent.	87
XI.	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 6, 22, 28, 29, and 32 of the '705 Patent. ..	91

I, P. Morgan Pattison, declare as follows:

I. Introduction

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

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Review of U.S. Patent No. 7,872,705 (“the ’705 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, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31, 32, 33, and 34 of the ’705 Patent are invalid.

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

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

II. Qualifications

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

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

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

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

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

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

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

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

fabrication and characterization of gallium nitride based micro-cavity LEDs. I obtained a Master's Degree in Electrical Engineering, Electronics and Photonics from UCSB in 2003, and I obtained a Bachelor's Degree in Electrical Engineering, Electronic Devices and Materials from UC San Diego in 1996.

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

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

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

III. Summary of Legal Issues

16. I am not a lawyer. Thus, in expressing my opinions and considering the subject matter of the claims of the '705 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 '705 Patent

24. The '705 Patent is entitled "LED Backlight System for LCD Displays" and was filed on July 29, 2007. I am informed that the earliest claimed priority date of the '705 Patent is July 29, 2007. I am informed that each of the prior art references I address herein was available prior to that date, thus I have not analyzed whether each claim of the '705 Patent is entitled to an earlier priority date.

A. Person of Ordinary Skill in the Art of the '705 Patent

25. The field of the '705 Patent relates to “liquid crystal displays, and more specifically, to liquid crystal displays having enhanced lighting uniformity.” '705 Patent, 1:6-8.

26. I am informed and understand that in a corresponding litigation, the Petitioner, Hisense, has argued that as of July 29, 2007, a person of ordinary skill in the art “would have had at least a graduate degree in mechanical engineering, physics, materials science, electrical engineering, or a related discipline, coupled with at least four years’ experience in designing backlighting systems for displays; the level of ordinary skill in the art is approximate and additional education could make up for a lack of experience or vice-versa.”

27. I am informed and understand that in a corresponding litigation, the Patent Owner, Brightplus has argued that as of July 29, 2007, a person of ordinary skill in the art “would possess the following qualifications: (a) A Bachelor of Science degree in a technical field and at least four years of experience in the field of design and/or manufacture of display systems; (b) a Master of Science degree in a technical field and at least two years of experience in the field of design and/or manufacture of display systems; or (c) a PhD in a technical field relating to the design and/or manufacture of display systems.”

28. In my opinion, a person with any of these levels of skill in the art would find the claims of the '705 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 '705 Patent for many years. As of July 29, 2007, which I understand to be the time of the alleged invention, I was a person of ordinary skill in the art under either level.

B. Construction of Claim Terms of the '705 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 '705 Patent.

V. Materials Considered

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

Exhibit	Description
1001	U.S. Patent No. 7,872,705 (“the '705 Patent”)
1002	Prosecution History of U.S. Patent No. 7,872,705
1005	US 6,608,614 to Johnson (“Johnson”)
1006	US 2006/0220040 to Suzuki (“Suzuki”)
1007	US 8,128,272 to Fine (“Fine”)

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

VI. State of the Art as of July 29, 2007.

A. General Display Technology Background

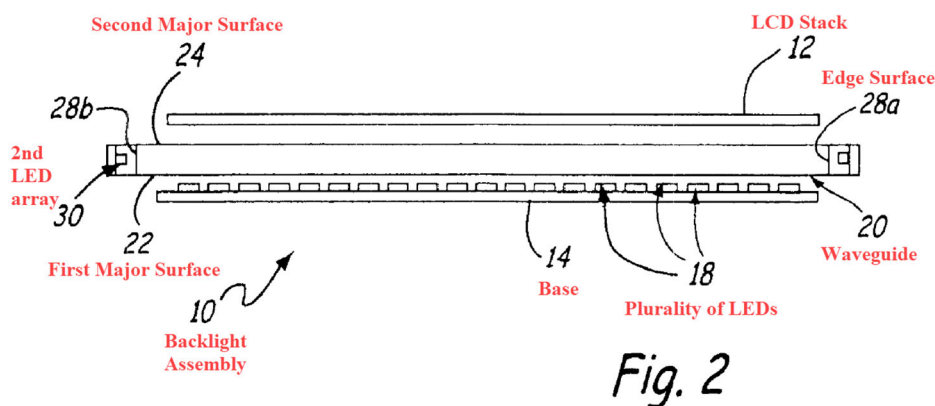
32. By 2007 liquid crystal display (LCD) technology and the supporting backlighting technology were well understood. Liquid crystal displays require a light to illuminate color filters within liquid crystal shutters that create an image. In this timeframe the backlight light source technology was transitioning 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 engendered different performance, cost, efficiency, and display panel thickness trade-offs. Each had similar general challenges that differed in the details of the solution, but the optical concepts and techniques to solve the challenges were similar.

B. Johnson

33. I am informed that Johnson is prior art to the '705 Patent. Johnson “relates to displays, and more particularly, to an LED-based backlight for a liquid-crystal display (LCD).” Johnson, 1:7-9. Johnson proposes using LEDs as a

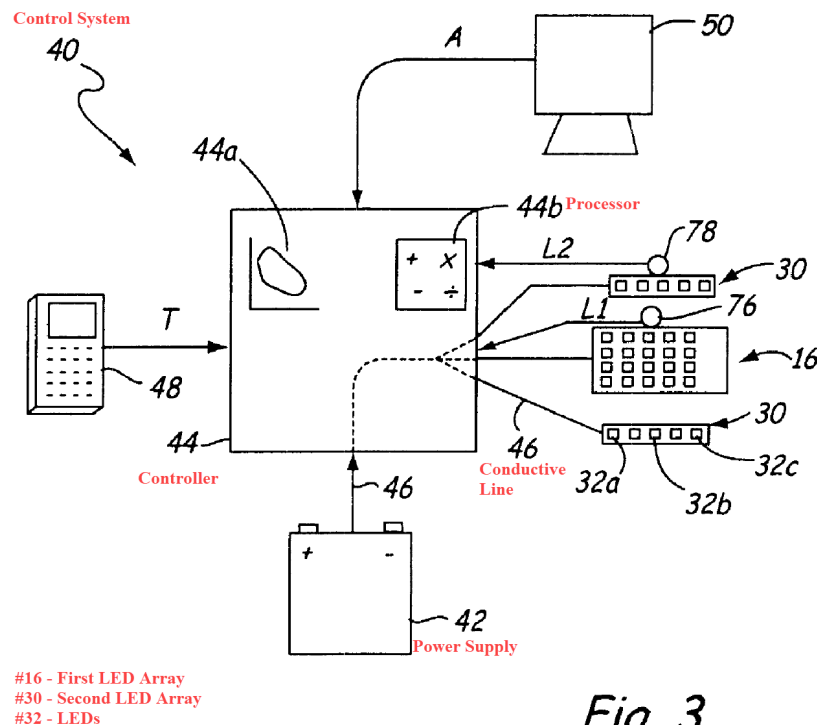
backlight source for LCDs, offering advantages such as lower cost (using available light sources, not specialty light sources), longer lifespan, increased durability, and higher brightness. Johnson, 1:7-9; 1:50-63. Further, the Johnson device uses a waveguide with multiple light entry regions “to accept light from one or more light sources and uniformly deliver the light to LCD stack 12.” Johnson, 2:64-67; *see also id.* at 3:24-27.

34. Johnson discloses adjusting the brightness of different sets of LEDs to control the chromaticity of the combined light. Johnson, 1:56-59 (“A feature of the invention is the varying of the brightness of a first set of LEDs relative to the brightness of a second set of LEDs to adjust the chromaticity of the combined light from the first and second sets of LEDs.”). Further, Johnson broadly discusses geometry and operation of a backlight assembly that includes LED arrays and a waveguide. Johnson, 1:66-2:31; 2:49-3:33; 3:59-4:12; Figs. 1-2.



Johnson, Fig. 2. Finally, Johnson discloses a control system that adjusts the backlight color by varying the power supplied to the LEDs in the LED arrays.

Johnson 2:5-8 (“A control system is operationally connected to the second LED array. The controller adjusts the brightness of at least one LED in the second LED array, thereby adjusting the chromaticity of the combined light.”); 2:9-18; 3:40-5:43; Figs. 3-5.



Johnson, Fig. 3.

C. Suzuki

35. I am informed that Suzuki is prior art to the '705 Patent. Suzuki discloses a surface illuminator for a liquid crystal display comprising a liquid crystal

display panel, a light guide, an array of discrete LED light sources, and a LED driving circuit. Suzuki, ¶0004 (“A liquid crystal display is provided with a surface illuminator on a front side or back side of a liquid crystal display panel thereof. Backlight units which are surface illuminators disposed on the back side of a panel include side light (edge light) types including a light source disposed along a side edge of a light guide for guiding light and direct types including a light source disposed directly under a liquid crystal display panel.... LEDs (light-emitting diodes) have been developed as light sources to replace cold-cathode tubes, and LEDs are regarded as promising next generation light sources.”).

36. Suzuki also depicts a backlight unit in which the light sources (15) are located at two different light entry regions (12T, 12B) of the light guide (11). Suzuki, Figs. 1, 2, 4 and associated discussion. Further, Suzuki broadly discusses the LED driving circuit that is controlling the emission of end light sources (8R) from the array of two light sources, which suggests that the driving circuit is controlling both the first and second light sources. Suzuki, ¶0044 (“FIG. 4 shows a positional relationship between a light exit surface 16 of a light guide 11 of the backlight unit 6 and LED light sources 15 in the present embodiment in a view of the unit taken in a direction normal to the light exit surface 16. ... As a general LED driving circuit (not shown), the end light source LEDs 8R may be made to emit light in a quantity smaller than that emitted by the other LEDs 7R by a predetermined amount by

supplying the end light source LEDs 8R with a current smaller than a current supplied to the LEDs 7R by a predetermined amount. Alternatively, R (red) emission LEDs having low emission efficiency may be used as the end light source LEDs 8R.”). I have included Figs. 1, 2, and 4 from Suzuki below.

FIG.1

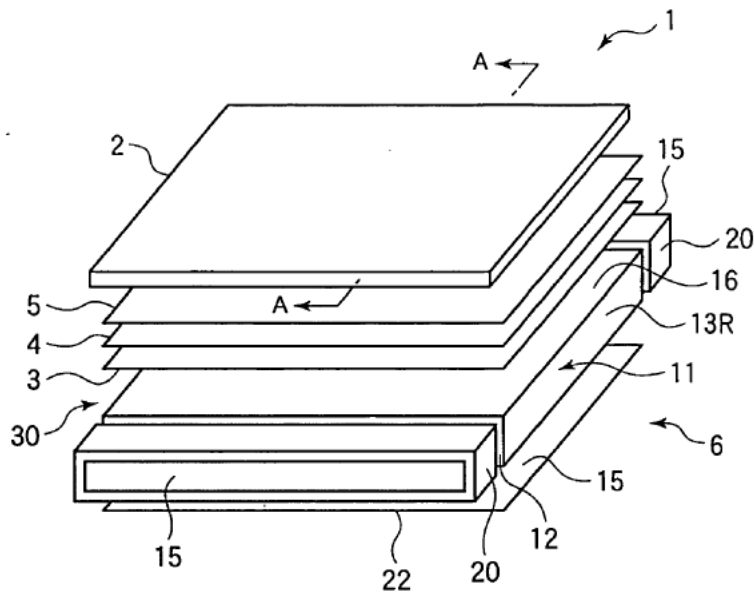


FIG.2

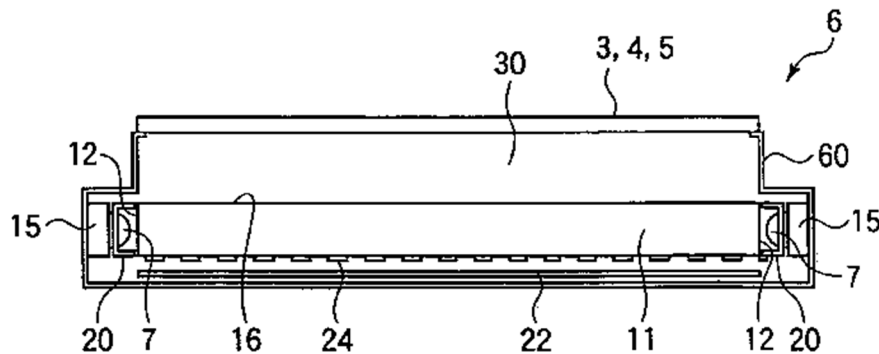
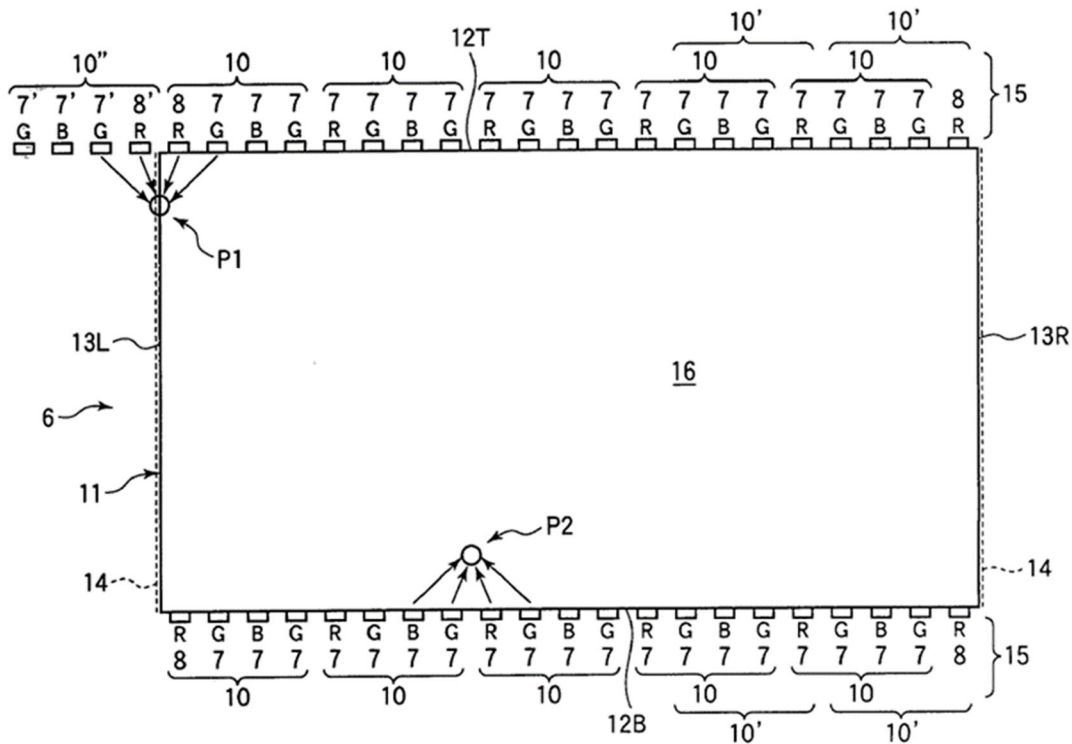


FIG.4



D. Fine

37. I am informed that Fine is prior art to the '705 Patent. Fine discloses “an illumination apparatus capable of providing light at any intensity profile and any color profile, including, without limitation, uniform white light.” Fine, 1:16-20. Fine’s device “comprises one or more light emitting sources [*i.e.* LEDs] embedded in a waveguide material.” Fine, 5:14-15. Further, Fine’s device can serve “as a component in a liquid crystal display device.” Fine, 5:25-27.

38. Finally, Fine discloses “a method of providing illumination, comprising applying forward bias on one or more light emitting sources embedded in a

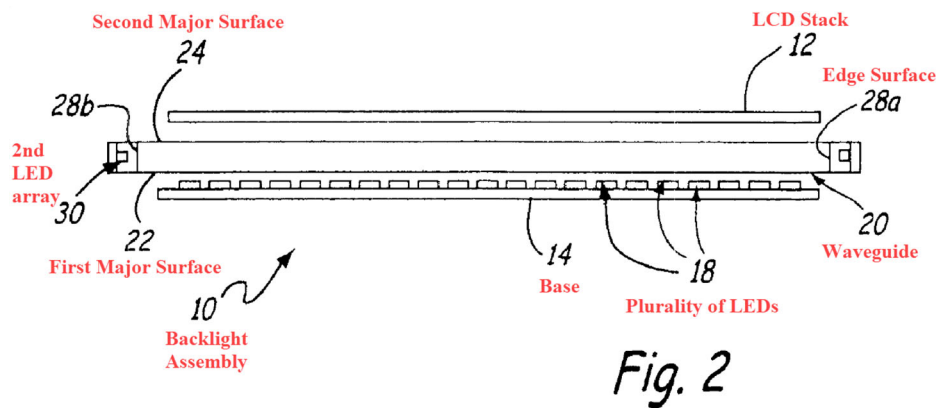
waveguide material to effect emission of light from the light emitting source(s). The waveguide material is capable of propagating the light such that at least a portion of the light is diffused within the waveguide material and exits through at least a portion of its surface, thereby providing the illumination.” Fine, 5:29-36.

VII. The Prior Art Renders Every Element of Claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31, 32, 33, and 34 of the '705 Patent Obvious.

39. In the analysis below I break down the elements of claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31, 32, 33, and 34 of the '705 Patent and demonstrate that each of these elements were known in the art before the July 29, 2007, priority date of the '705 Patent.

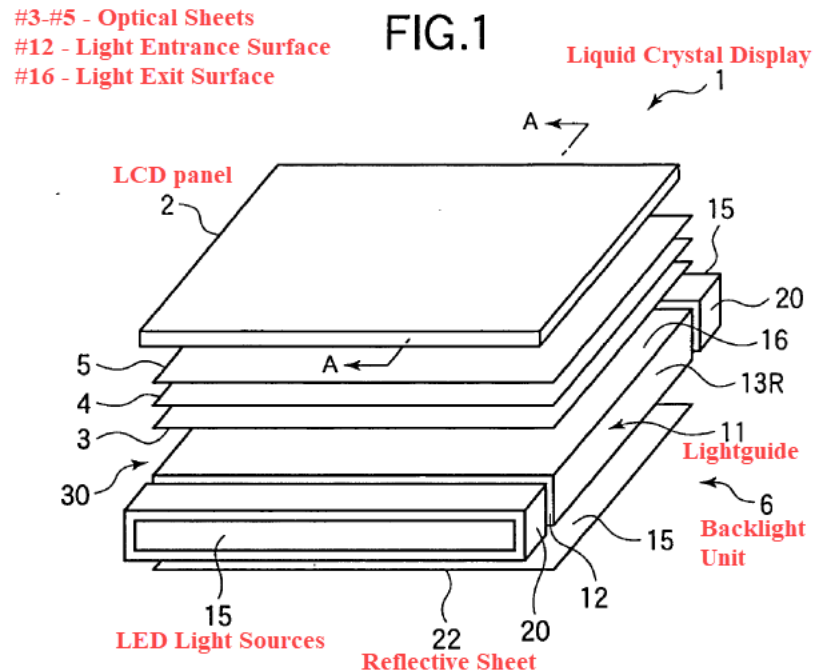
A. Liquid Crystal Display (LCD) Systems Such as a Television or a Computer Monitor with an LCD Panel Were Known in the Art (Claims 1A, 32, 33)

40. LCD systems using an LCD panel were well known in the art. Johnson describes Figure 2 stating that “[b]acklight assembly 10 provides light to an LCD stack, shown schematically at 12.” Johnson, 2:49-52; Fig. 2.



Johnson, Fig. 2. In my opinion, a person of ordinary skill in the art would understand that an LCD stack is an LCD panel. For example, Johnson describes its Backlight Assembly 10 as used for backlighting an LCD. Johnson, 1:66-67. As one of skill in the art would understand, Liquid Crystal Displays used backlighting systems with LCD panels or stacks. The LCD panel or stack refers to the layer of filters, diffusers, brightness enhancement layers and other optical components that are used in a traditional LCD. The '705 Patent recognizes that these well-known components and arrangements existed in the prior art as well. '705 Patent, 2:22-25. Johnson similarly recognizes the well-known arrangement and existence of these layers and arrangements. Johnson, 1:5-2:24. Further, to the extent that it is alleged that an LCD stack is different from an LCD panel, it would have been obvious to a person of ordinary skill in the art to use an LCD panel in the place of an LCD stack as both are used for LCD displays, which is precisely what both the '705 Patent and Johnson are directed to.

41. Suzuki explicitly discloses a LCD panel and specifically describes Figures 1-3 stating that “the liquid crystal display 1 of the present embodiment includes a liquid crystal display panel 2 provided by sealing a liquid crystal between a pair of substrates and the backlight unit 6 which is a surface illuminator.” Suzuki, ¶0024; Suzuki ¶0028, Figs. 1-2.



Suzuki, Fig. 1.

42. Further, LCD systems used in televisions were well known in the art. Johnson discloses a general LCD backlight assembly that can be used for various types of LCD devices. Johnson, 6:43-47 (“Yet another advantage is that a regular-production LCD backlight may be custom-tuned according to the requirements of different applications. Eliminating multiple LCD backlight production lines provides significant savings to a manufacturer.”) And although Johnson only mentions one particular application specifically, e.g. avionic displays, Johnson repeatedly describes its invention as applicable to LCD displays generally and further explains that its invention can be used in a variety of applications. In my opinion, one of skill in the art would have known that at the time of Johnson, LCD

displays were used in televisions and computer monitors for decades before Johnson's filing date and that improving the chromaticity of light in a television and a computer monitor is a desirable attribute. Accordingly, in my opinion, it would have been obvious by the '705 Patent's priority date for person of ordinary skill in the art to embody Johnson's LCD system in a television and a computer monitor.

43. Additionally, for the reasons stated above, in my opinion, it would have been obvious for a person of skill in the art in view of Suzuki to embody the LCD system of Suzuki in a television. Further, the corresponding address of the applicant is to Sharp Kabushiki Kaisha which is also known as Sharp Electronics. Ex. 1006 at ¶(76). Thus, in my opinion, a person of ordinary skill in the art would recognize that Suzuki's disclosures related to LCD technology is applicable to televisions given Sharp was a well-known TV manufacturer.

B. LCD Systems with a Waveguide Having Multiple Light Entry Regions Were Known in the Art (Claims 1B, 2)

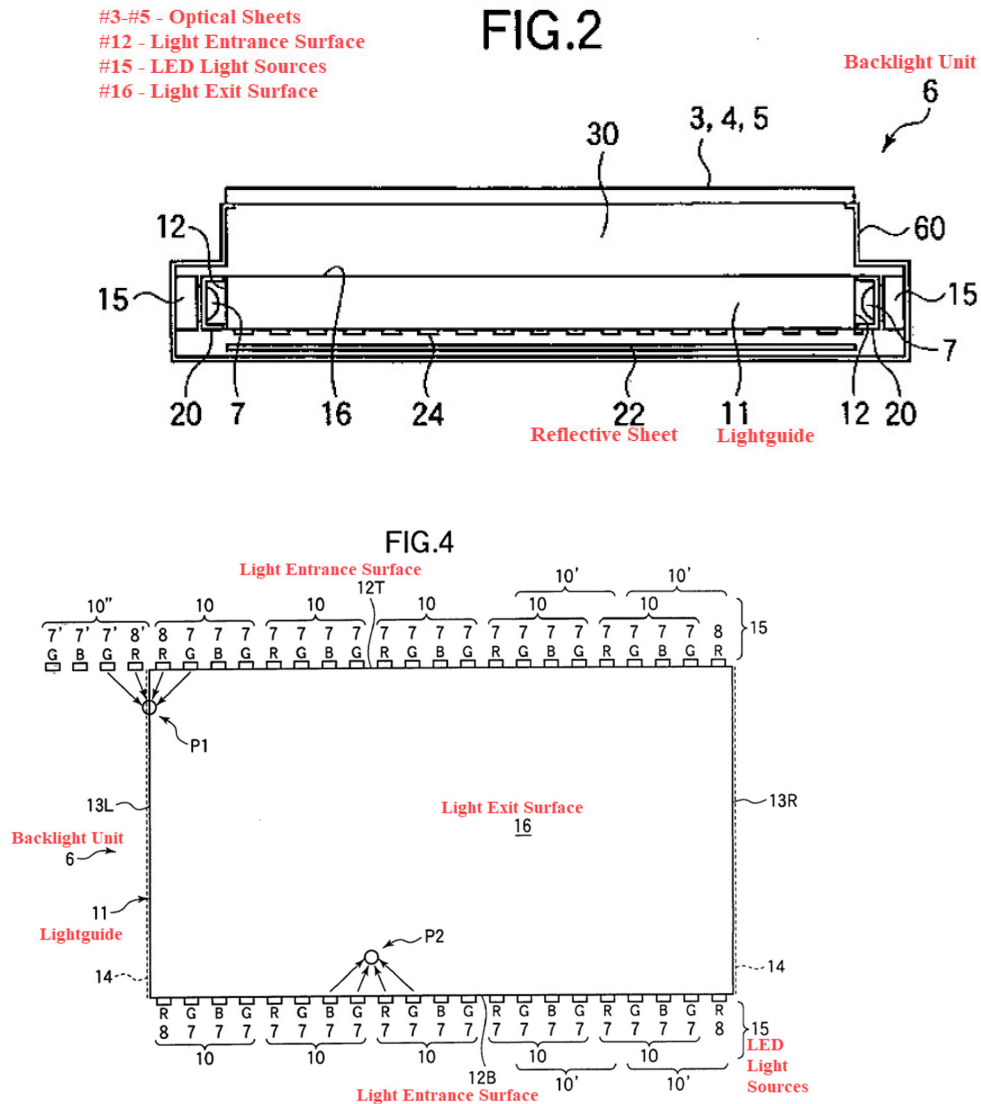
44. LCD systems using a waveguide element with multiple light entry regions were well known in the art. Johnson explicitly discloses a waveguide element with multiple light entry regions. Johnson, Fig. 2; 2:64-67 ("A waveguide 20 is disposed between base 14 and LCD stack 12. Waveguide 20 is made of a generally planar material that is designed to accept light from one or more light sources and uniformly deliver the light to LCD stack 12"). Further, Johnson

describes that the waveguide comprises a plurality of light entry regions, including an edge surface 28a as well as a first major surface 22. Johnson, Fig. 2; 3:24-27 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28.”)

45. Suzuki discloses a lightguide 11. Suzuki, ¶¶0025; 0026. In my opinion, a person of ordinary skill in the art would understand that a lightguide 11 is a waveguide. Further to the extent that it is alleged that a lightguide is different from a waveguide, in my opinion it would have been obvious to a person of ordinary skill in the art to use a waveguide in the place of a lightguide as both are used for directing electromagnetic waves in a particular direction. Further, directing electromagnetic waves (light) toward a LCD Panel is precisely what both the '705 Patent and Suzuki are directed to.

46. Suzuki discloses that the lightguide 11 has a plurality of light entry regions, *i.e.*, two light entry surfaces 12. Suzuki, ¶¶0025; 0026 (“The region sandwiched by the light exit surface 16 of the light guide 11 and the light scattering surface opposite to the same is a light guide region for guiding light to the light exit surface 16. Among four side portions of the light guide around the peripheries of the light exit surface 16 and the light scattering surface, both side portions along two sides of the light guide opposite to each other, e.g., the longer sides thereof,

constitute light entrance surfaces 12 through which light enters the light guide region.”); 0027 (“LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11.”); Figs. 2, 4.



Suzuki, Figs. 2, 4.

47. Additionally, a LCD panel with a viewable surface, a waveguide with a transmissive surface where the transmissive surface is approximately the same

size as the viewable surface were well known in the art. Johnson discloses that the LCD panel, LCD stack 12, has a viewable surface. Johnson, 2:56-59. For example, Johnson discusses displaying select colors via the LCD stack. Johnson, 1:20-26 (“This is important in fields such as avionics, where the colors displayed on a critical-function aircraft display must be exact. A slight difference in chromaticity of the backlight might adversely affect the color of the display.”). Further, the waveguide element in Johnson has a transmissive surface. Johnson, 2:63-3:14 (“A waveguide 20 is disposed between base 14 and LCD stack 12. Waveguide 20 is made of a generally planar material that is designed to accept light from one or more light sources and uniformly deliver the light to LCD stack 12.”).

48. Finally, as shown in Johnson’s Fig. 2 above, the waveguide’s 20 transmissive surface is approximately the same size as the viewable surface of the LCD Stack 12. Johnson, 2:49-54 (“FIGS. 1 and 2 depict a preferred embodiment of a backlight assembly 10 according to the invention. Backlight assembly 10 provides light to an LCD stack, shown schematically at 12. The specific details of the construction of LCD stack 12 do not form part of the invention and therefore will not be further described. Backlight assembly 10 includes a base 14 that has a principal or first LED array 16 disposed thereon.”); Johnson, Figs. 1-2 (compare waveguide 20 and LCD stack 12).

49. Additionally, Suzuki discloses a LCD Panel with a viewable surface. For example, Suzuki describes the disclosed device as “capable of achieving high display quality[.]” Suzuki, Abstract. Moreover, Suzuki discloses that the “light guide 11 has a light exit region (hereinafter referred to as a light exit surface) 16 which spreads in the form of a plane on a side of the light guide facing the liquid crystal display panel 2 and from which light exits.” Suzuki, ¶0025. In my opinion, a person of ordinary skill in the art would understand that in Suzuki’s device, the LCD Panel 2 surface that faces the user has a viewable surface – capable of achieving high display quality.

50. Further, as shown above in Fig. 1 of Suzuki, the transmissive surface, light exit surface 16, is approximately the same size as the viewable surface, LCD Panel 2.

C. Multiple Light-Emitting Sources Each Having Multiple LEDs Arranged in a Strip and Each LED Linearly Arranged to Emit Light into a Light Entry Region of the Waveguide Element Were Known in the Art (Claims 1C, 1D, 13, 16)

51. Light emitting sources having multiple LEDs arranged in a strip and each LED linearly arranged to emit light into a light entry region of a waveguide was well known in the art and is disclosed by both Johnson and Suzuki. Johnson discloses a plurality of LEDS 18 in an LED array 16 (a first light-emitting source comprising a plurality of LEDs). In my opinion, in view of Figs. 1-2 of Johnson

shown below, a person of ordinary skill in the art would understand that the LEDs 18 (shown in yellow below) are arranged in a strip.

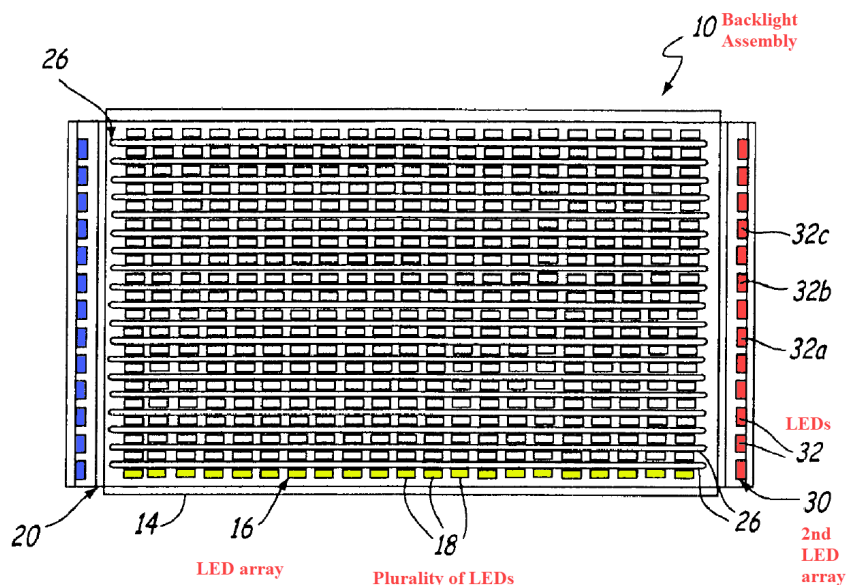


Fig. 1

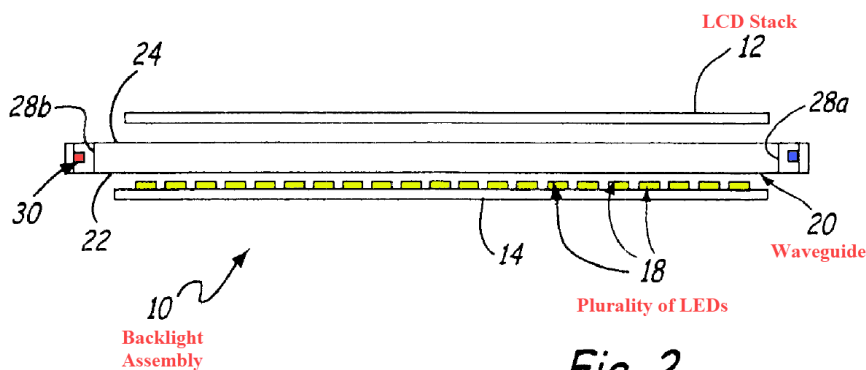


Fig. 2

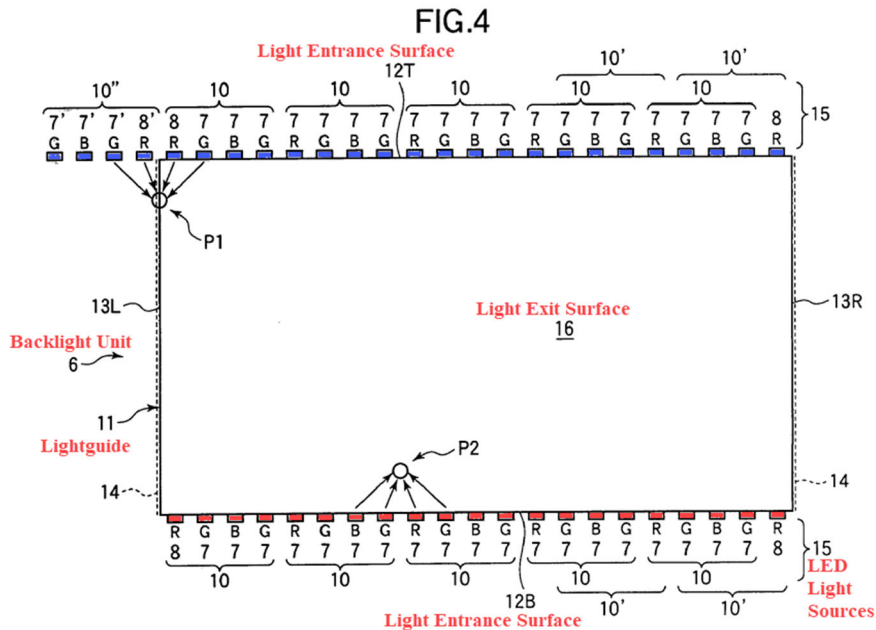
Johnson, Figs. 1-2. Further, LED array 16 is positioned to emit light into waveguide 20 through a first light entry region (first major surface 22). Johnson, 3:25-26 (“white light from first LED array 16 enters waveguide 20 through first major surface 22”).

52. Johnson also describes a plurality of LEDS 32 in a second array 30 and in my opinion a person of ordinary skill in the art would understand that the LEDS 32 (shown in red) are arranged in a strip, as depicted above in Figs. 1-2 of Johnson and as shown in elements 32, 32a, 32b, 32c, etc. Further, LED array 30 is positioned to emit light into waveguide 20 through a second light entry region (edge surface 28). Johnson, 3:26-29 (“light from second LED array 30 enters waveguide 20 through edge surface 28”); Figs. 1-2.

53. Johnson discusses both a first 16 and second 30 plurality of LEDs described as LED arrays. In my opinion, a person of ordinary skill in the art would understand that the LED arrays disclosed in Johnson are linear arrangements of LEDs. Shown above, FIG. 1 shows “a top plan view of an LCD backlight assembly,” Johnson 2:34, and illustrates numerous linear arrangements (rows) of LEDs 18 in a first LED array 16 (one of many depicted in yellow), LEDs 32 in second LED array 30 (in red), and a third LED array (in blue). The first LED array 16, in yellow, is part of two-dimensional array located behind the LED stack 12, shown in Fig. 2. The first LED array from Johnson is composed of multiple linear arrangements of LEDs deployed under “light scattering strips” 26. In my opinion, a person of ordinary skill in the art would understand that the nomenclature first, second, and third could apply to any of the arrays, i.e. each linear arrangement of

LED array 16 and each edge array 30, as long as it is used consistently. Johnson 6:57-60.

54. Turning now to Suzuki, as shown in Fig. 4 below, Suzuki discloses first emitting light sources, LED light sources 15 with LEDs 7 (shown in red), arranged in series by pluralities of sets 10, arrayed along first light entrance surface 12B, of a waveguide element, lightguide 11. Specifically, Suzuki notes that “LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11. The LED light sources 15 are formed by alternately and discretely arranging plural types of LEDs 7 emitting beams of light having different emission wavelength spectra along the light entrance surfaces 12.” Suzuki, ¶ 0027. Further, a “plurality of LED sets (hereinafter also referred to as “RGBG” sets as occasion demands) 10 are arranged in series along the light entrance surfaces 12T and 12B of the light guide 11 starting in the neighborhood of the left ends of the light entrance surfaces 12T and 12B (for example, five LED sets may be provided as shown).” Suzuki, ¶0034; ¶0030; Fig. 4.



Suzuki, Fig. 4. As shown in Fig. 4 above, Suzuki also discloses second emitting light sources, LED light sources 15 with LEDs 7 (shown in blue), arranged in series by pluralities of sets 10, arrayed along second light entrance surface 12T, of a waveguide element, lightguide 11. Fig. 4; Suzuki, ¶ 0027. In my opinion, in view of Fig. 4 of Suzuki shown above, a person of ordinary skill in the art would understand that the LEDs 7 (shown in red and blue) are both arranged in a strip.

55. Suzuki further discusses first emitting light sources, LED light sources 7 (shown in red above), arranged in series by pluralities of sets 10, arrayed along first light entrance surface 12B, of a waveguide element, lightguide 11 and with a similar positional relationship for LEDs in the second plurality of LEDs (shown in blue above) and second light entry surface 12T. In my opinion, a person of ordinary skill in the art would understand that an array of LEDs for backlighting

a LCD through the edge of a waveguide is a linear arrangement due to the basic geometry of the LEDs being deployed along the thin edge of a waveguide. As shown above, Fig. 4 shows “a positional relationship between a light exit surface 16 of a light guide 11 of a backlight unit 6 and LED light sources 15” Suzuki, ¶0021, and illustrates the linear arrangements of first LED array and second LED array.

D. A Common Control Circuit in Electrical Communication with Each LED in One Set or Each Set of LEDs Was Known in the Art (Claims 1E, 11, 14)

56. Common control circuits in electrical communication with LEDs were well known in the art and are explicitly disclosed by both Johnson and Suzuki. Johnson describes a common control circuit (control system 40), including a processor 44b and controller 44, that is in electrical communication (via conductive lines 46) with the first plurality of LEDs (LEDs 18 in LED array 16) and the second plurality of LEDs (LEDs 32 in second LED array 30). Johnson, 3:43-47 (“As schematically depicted in FIG. 3, a control system 40 according to the invention includes a power supply 42 that supplies power to the LED arrays. A controller 44 connects power supply 42 with first and second LED arrays 16, 30 through conductive lines 46.”); Fig. 3. Further, the processor driven controller electrically communicates commands to vary the power supplied to the LEDs. Johnson, 3:66-4:6 (“Processor 44b then refers to the chromaticity data stored in

memory 44a to determine how to adjust LEDs 32 in second LED array 30 to correct or compensate for the difference between actual chromaticity A and target chromaticity T. Processor 44b then instructs controller 44 to vary the power to LEDs 32 in second LED array 30, thereby varying the brightness of LEDs 32.”).

Fig. 3

57. Further, the common control circuit is in electric communication with each LED 32 in the plurality of LEDs that is the second LED array 30. Specifically, “[p]rocessor 44b [of the common control circuit] then refers to the chromaticity data stored in memory 44a to determine how to adjust LEDs 32 in second LED array 30 to correct or compensate for the difference between actual

chromaticity A and target chromaticity T. Processor 44b then instructs controller 44 to vary the power to LEDs 32 in second LED array 30, thereby varying the brightness of LEDs 32.” Johnson, 3:66-4:6.

58. The common control circuit is also in electric communication with each LED 18 in the plurality of LEDs that is the first LED array 16. For example, Figure 5 shown below, depicts “decision logic 80 that may be used by controller 44 to adjust the chromaticity of the backlight assembly based on changes in relative brightness of the LED arrays.” Johnson, 5:8-11.

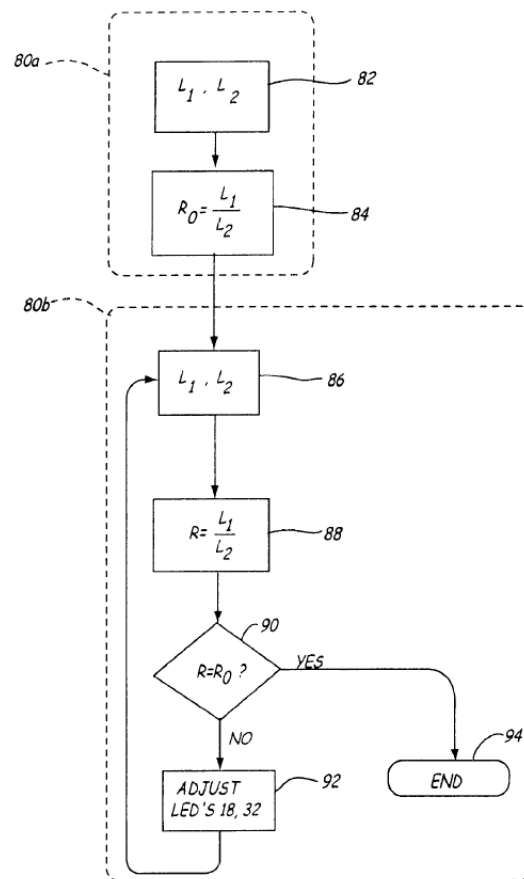


Fig. 5

Johnson, Fig. 5. As shown in Fig. 5, in Step 82 the luminance is measured for LED arrays 16, 30. Johnson, 5:8-17. Step 84 then determines and stores the relative luminance, R_o , of the first LED array to the second LED array. Johnson, 5:17-22. Step 88 occurs after a time of use where the processor calculates new ratio, R , and compares this value to the baseline ratio. Johnson, 5:22-31. Finally, if there is a difference between the newly calculated ratio, R , and the initial relative luminance, R_o , then “in step 92 the brightness of first and/or second LED arrays are adjusted to correct the difference.” Johnson, 5:32-24.

59. Turning to Suzuki, Suzuki discloses a control circuit, LED driving circuit, in electrical communication with at least LEDs 7R and 8R which can vary the current supplied to the LEDs. For example, Fig. 4 “shows a positional relationship between a light exit surface 16 of a light guide 11 of the backlight unit 6 and LED light sources 15 in the present embodiment in a view of the unit taken in a direction normal to the light exit surface 16. ... As a general LED driving circuit (not shown), the end light source LEDs 8R may be made to emit light in a quantity smaller than that emitted by the other LEDs 7R by a predetermined amount by supplying the end light source LEDs 8R with a current smaller than a current supplied to the LEDs 7R by a predetermined amount.” Suzuki, ¶0044; Fig. 4.

60. In my opinion, a person of ordinary skill in the art would understand that the common control circuit (the LED driving circuit) of Suzuki is in communication with each LED (8R, 7R) at the least to turn the LED on/off. For example, Suzuki discloses that “a general LED driving circuit (not shown), the end light source LEDs 8R may be made to emit light in a quantity smaller than that emitted by the other LEDs 7R by a predetermined amount by supplying the end light source LEDs 8R with a current smaller than a current supplied to the LEDs 7R by a predetermined amount. Alternatively, R (red) emission LEDs having low emission efficiency may be used as the end light source LEDs 8R.” Suzuki, ¶0044. Fig. 4 indicates that LEDs 8R are present in both the first and second plurality of LEDs. As such, in my opinion, a person of ordinary skill in the art would understand that common control circuit (the LED driving circuit) of Suzuki is in electrical communication with each LED (8R, 7R).

E. Multiple Light Emitting Sources Having Multiple LEDs that Can Emit White Light and/or Single Color Light, and/or Can Output Substantially the Same Wavelength Were Known in the Art (Claims 5, 9)

61. Multiple LEDs emitting white light or a single color was well known in the art. For example, Johnson describes LED array 16 and second LED array 30, where LED array 16 emits white light and LED array 30 emits colored light. Johnson, 3:25-28 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED

array 30 enters waveguide 20 through edge surface 28”). *See also* Figs. 1-2.

Further, LED array 16 is comprised of multiple of LEDs 18, each depicted in yellow below, and LED array 30 is comprised of multiple LEDs 32, each depicted in red below.

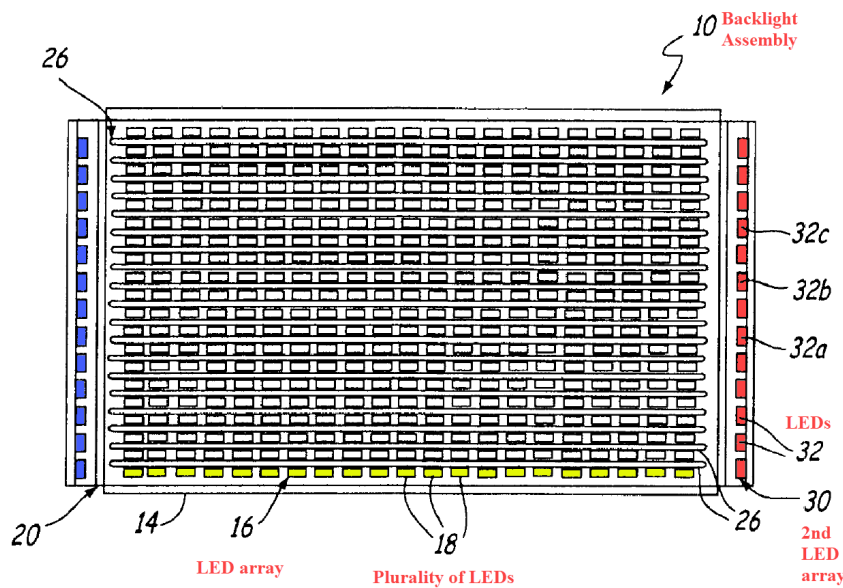


Fig. 1

Johnson, Fig. 1. Finally, the light from second LED array 30 may be the same chromaticity, each LED 32 may have the same color. Johnson, 6:15-17 (“It may also be possible that second LED array 30 is comprised of LEDs all having the same chromaticity output.”). In my opinion, a person of ordinary skill in the art would recognize if the chromaticity output of each LED is the same, then each LED is emitting light at substantially the same wavelength.

62. Turning now to Suzuki, Suzuki discloses that the first light source and the second light source can emit either white light or a single color. Suzuki discusses the possibility “to provide a surface illuminator having high color uniformity and a liquid crystal display having the same. The generation of mixed white suffering from an extreme shortage of red components can be suppressed at an arbitrary point in the neighborhood of an end of a light entrance surface 12T, and color irregularities can be made unnoticeable.” Suzuki, ¶0040. Further, Suzuki discusses achieving a desired color by mixing red, blue, and green LED emission. Specifically, “[w]hen such a configuration is employed, at an arbitrary point P2 inside the light exit surface 116, four beams of light from a G emission LED 77G, a B emission LED 77B, another G LED emission 77G, and an R emission LED 77R in the neighborhood of the arbitrary point P2 can be mixed to generate a beam of light in a desired color.” Suzuki, ¶0010; FIG. 6; claim 6.

63. That is, the 7R LEDs on the 12T light entrance surface may be considered a plurality of LEDs that emits one color, red. The 77B, 77G, and 77R set may also be considered a plurality of LEDs; which may emit white light.

64. Additionally, multiple LEDs outputting substantially the same wavelength was well known in the art. Johnson describes a first plurality of LEDs, “[f]irst LED array 16 [] designed to provide the substantial majority of the light required for LCD stack 12. Together, LEDs 18 provide light with a first

chromaticity, which in the present embodiment is white or near-white.” Johnson, 2:59-62. Johnson further discusses that “[s]econd LED array 30 includes a plurality of LEDs 32 that, individually and/or collectively, emit light with a chromaticity that is different from the chromaticity of light emitted by first LED array 16.” Johnson, 3:18-28.

65. In my opinion, a person of ordinary skill in the art would recognize that the defined difference in chromaticity is not bound; therefore, chromaticity of the second array could be marginally (i.e. near-white) or grossly (i.e. red, green, purple, etc.) different from the chromaticity of the white of the first LED array. Further, in my opinion, a person of ordinary skill in the art would understand that for a set of LEDs, i.e. first LED array 16, to emit white light, either each LED in that set would either emit white light or have the appropriate relative wavelength to combine to achieve white light.

66. Further, Johnson states “[i]t may also be possible that second LED array 30 is comprised of LEDs all having the same chromaticity output.” Johnson, 6:15-17. Thus, in my opinion, a person of ordinary skill in the art would understand that each LED in the second LED array 30 may emit light at a wavelength that is near-white and, thus, at substantially the same wavelength as each LED in the first LED array 16.

67. Alternatively, as above in Figs 1, 2 of Johnson, the plurality of LEDs 32 ("blue plurality" - in blue) emitting light into the edge surface 28a of waveguide 20 and the plurality of LEDs 32 ("red plurality" - in red) emitting light into edge surface 28b may have the same chromaticity output, hence color. Johnson, 6:15-17 ("It may also be possible that second LED array 30 is comprised of LEDs all having the same chromaticity output."). Therefore, in my opinion, a person of skill in the art would find it obvious that each LED in the "red plurality" and each LED in the "blue plurality" can be adapted to have substantially the same wavelength.

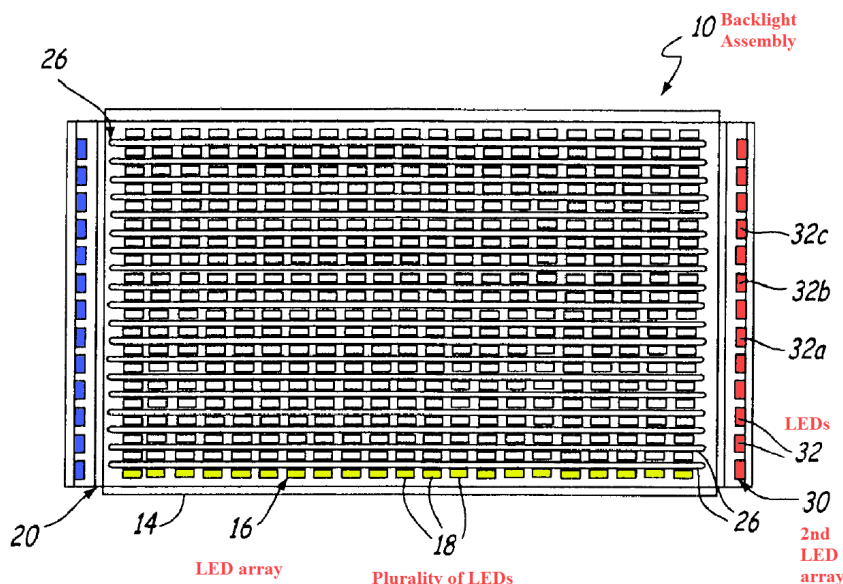


Fig. 1

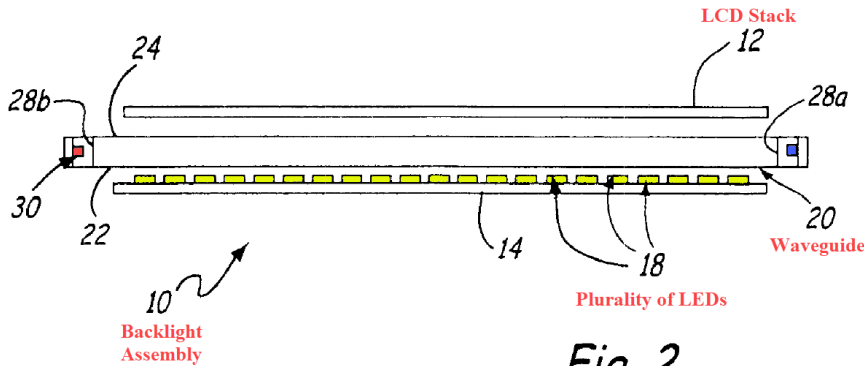
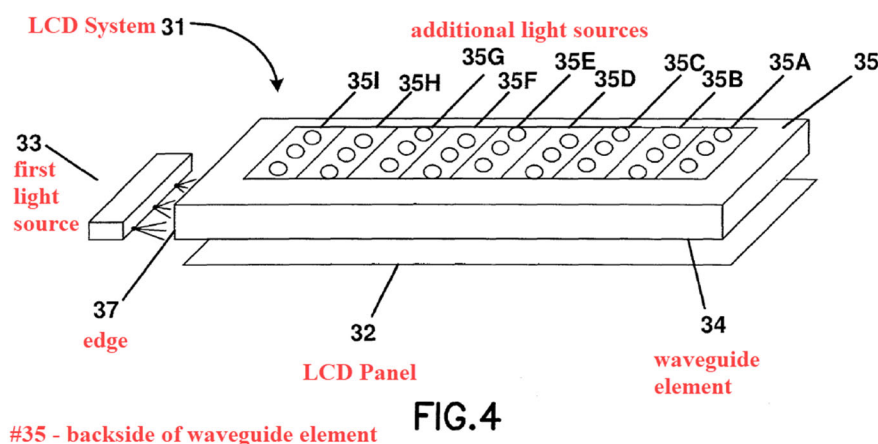


Fig. 2

F. Multiple Light Emitting Sources Having Multiple LEDs that Can Include Direct LEDs Were Known in the Art (Claim 6)

68. Johnson discloses that the LEDs in the light-emitting sources can be direct LEDs. First, I want to discuss “direct LEDs” in the context of the ’705 Patent. The ’705 Patent states that “Current LED lighting techniques for transmissive LCDs include either **direct backlighting** or backlighting by edge illumination. While a **backlight will light the pixels from the backside**, that **light may come from directly behind the center of the pixels (direct backlighting)** or from behind the sides of the pixels (backlighting by edge illumination). While both techniques are recognized as backlighting, **direct backlighting refers to illumination directed axially (centrally) through the backside of pixels.**” ’705 Patent, 1:54-62 (emphasis added). The ’705 Patent further discusses the positioning of waveguide element 34 to the LCD panel 32. ’705 Patent, 13:10-16 (“FIG. 4 is a schematic perspective view illustration view of an exemplary LCD System 31 according to one embodiment of the invention. The system 31 includes

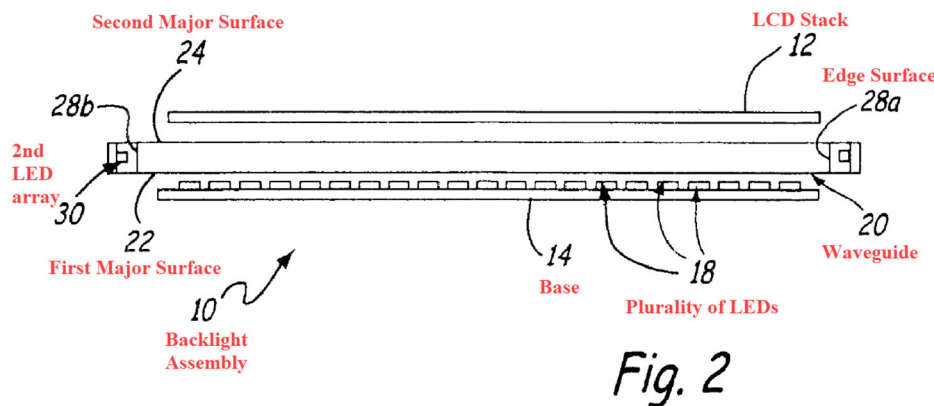
a LCD panel 32, a waveguide element 34, a first light source 33 optically coupled to an edge 37 of the waveguide element 34, and additional light sources [35A-35I] optically coupled to the back side 35 of the waveguide element 34.”). A person of skill in the art would recognize that light sources 35A-35I from the ’705 Patent positioned on the backside of the waveguide element, i.e., directly behind the center of pixels, are direct LEDs. ’705 Patent, 4:11-17.



’705 Patent, Fig. 4 (annotated).

69. Johnson similarly describes direct LEDs. As shown in Fig. 2 below, Johnson describes a generally planar waveguide where the first major surface 22 faces away from LCD stack 12 and towards base 14. Further, the second major surface, which faces LCD stack 12, is parallel to the first major surface. Johnson, 2:64-3:2 (“Waveguide 20 is made of a generally planar material that is designed to accept light from one or more light sources and uniformly deliver the light to LCD stack 12. Waveguide 20 has a first major surface 22 that faces base 14. Waveguide

20 has a second major surface 24, generally parallel to first major surface 22, that faces LCD stack 12.”); Fig. 2.



Johnson, Fig. 2. Further, LEDs 18 are optically coupled to the back side of waveguide 20 providing direct backlighting. Therefore, in my opinion, one of ordinary skill in the art would understand that LEDs 18 are direct LEDs.

Specifically, “[i]n operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28”). Johnson, 3:25-28. Finally, LEDs in the second LED array may also be positioned along the base such that they are optically coupled to the first major surface 22 of the waveguide 20 providing direct backlighting. Thus, in my opinion, one of ordinary skill in the art would understand that in this embodiment the second LED array would also consist of direct LEDs. Johnson, 5:48-52 (“the embodiment shown in FIGS. 1 and 2 may be modified such that LEDs 32 from second LED array 30 and LEDs 18 from first

LED array 16 are intermingled along base 14 and along the edge surfaces 28a, 28b”).

70. Turning now to Suzuki and Fine, Suzuki teaches that “LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11.” Suzuki, ¶0027. Modifying Suzuki’s device to account for Fine’s embedded light sources would allow for more light to be coupled into the waveguide, hence the LCD panel. Fine describes how optical coupling between light source and the waveguide can be improved by removing the need for the LED light to first be emitted into air, then continue from air into the waveguide. Fine 13:7-23. Further, Fine teaches that the difference in the index of refraction between the LED and the waveguide can be better matched to reduce coupling losses. *Id.* Additionally, as Suzuki’s device has a gas space between the lightguide and other optical elements, it would be obvious that an LED may work well in this space. Suzuki, ¶0029 (“the backlight unit 6 has a configuration in which a reflective sheet 22, the light guide 11, the gas space 30, and the optical sheets 3, 4, and 5 are provided one over another in the order listed.”). As shown below, FIG. 2b of Fine “schematically illustrat[es] the embodiment in which light source 12 is embedded near surface 18.” Fine, 14:3-4, and illustrates light sources at the bottom the waveguide 14 emitting light toward top surface 16.

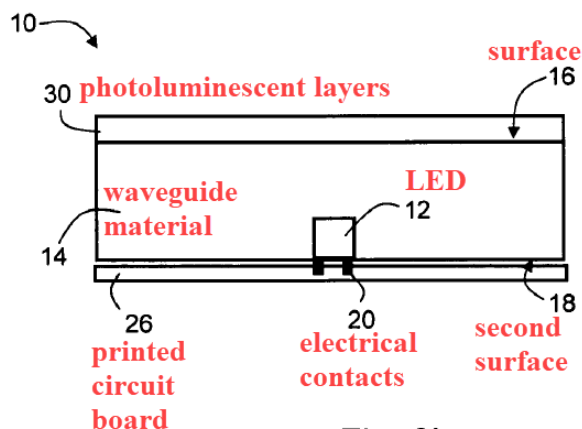


Fig. 2b

Fine, Fig. 2b. Specifically, Fine defines surface 18 as the bottom surface of waveguide 14. Fine, 12:16-17 (“As used herein, “top” refers to furthest away from surface 18, while “bottom” refers to closest to surface 18.”). Fine further specifies the in “light source 12 [may be] embedded near surface 18 of material 14[.]” Fine, 14:45-46. Thus, in my opinion, a person of ordinary skill in the art would understand that Suzuki’s device modified by Fine teaches that LEDs 12 (of a light source) that are positioned in the back of a waveguide 14 emit light toward the top surface 16 of the wave guide as well as the LCD Panel and that LEDs 12 as so modified would be direct LEDs.

G. One or More of the Light-Emitting Sources Optically Coupled to the Waveguide Element Were Known in the Art (Claims 17, 22)

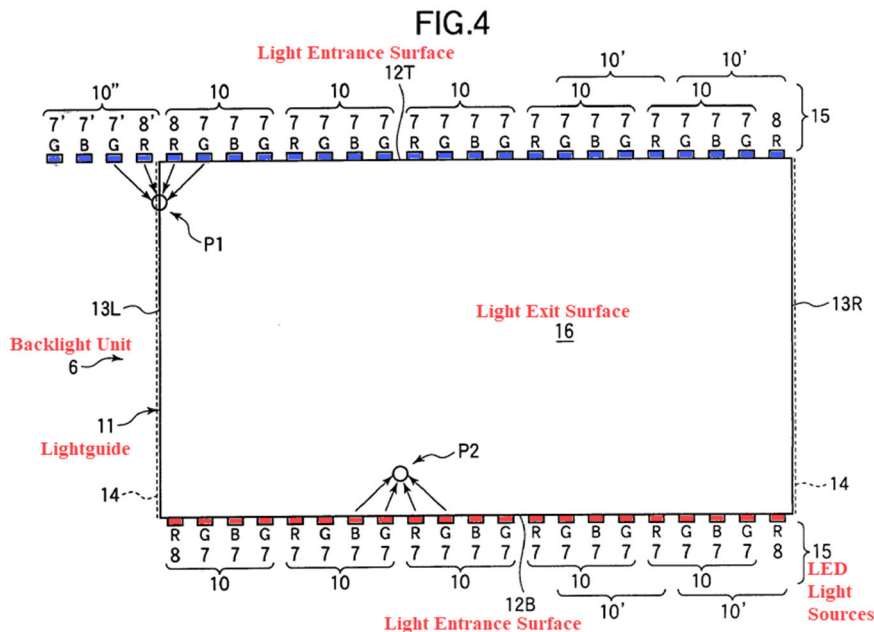
71. Johnson discloses the first LED array 16 (first light-emitting source) is optically coupled to the waveguide 20 via at least the first major surface 22 and the second LED array 30 (second light-emitting source) is optically coupled to the waveguide 20 via at least the edge surface 28. For example, Johnson states (“white

light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28.” Johnson, 3:25-33; 5:66-6:2; FIGS. 1-2. In my opinion, a person of ordinary skill in the art would understand that the LED arrays of Johnson are optically coupled to the waveguide element, because they are emitting light into the waveguide element. As Johnson describes, a “waveguide (20) is made of a generally planar material that is designed to accept light from one or more light sources and uniformly deliver the light to LCD stack 12”, Johnson 2:63-65. So the LED light entering or being accepted into the waveguide, is synonymous with coupling LED light into the waveguide, since the same effect is being described.

72. Moreover, the first major surface 22 as disclosed by Johnson is the back portion of the waveguide element 20. Thus, a person of ordinary skill in the art would understand that Johnson teaches that the first light-emitting source is optically coupled to the back portion (i.e., the first major surface 22) of the waveguide element 20. Further, Johnson states that “[t]he invention may also be varied such that a mixed arrangement of LEDs from the first and second LED arrays emits light into waveguide 20 only through first major surface 22.”

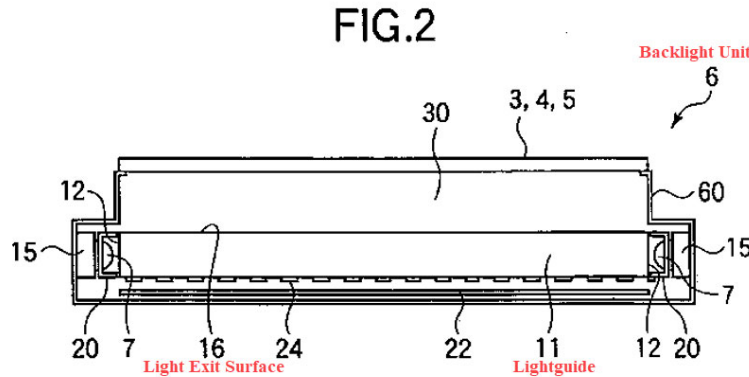
Johnson, 5:66-6:2; *see also* FIGs. 1-2. Thus, Johnson discloses a system where the first and second light-emitting sources can both be optically coupled to the back portion of the waveguide element.

73. Turning now to Suzuki, as shown in Fig. 4 below, Suzuki discloses first emitting light sources, LED light sources 15 with LEDs 7 (shown in red), arranged in series by pluralities of sets 10, optically coupled to first light entrance surface 12B, of a waveguide element, lightguide 11, as well as second emitting light sources, LED light sources 15 with LEDs 7 (shown in blue), arranged in series by pluralities of sets 10, optically coupled to second light entrance surface 12T, of a waveguide element, lightguide 11. Suzuki, ¶ 0027. In my opinion, a person of ordinary skill in the art would understand that the LED arrays of Suzuki are optically coupled to the waveguide element, because they are emitting light into the waveguide element.



Suzuki, Fig. 4.

74. As shown in Fig. 2 below, Suzuki discloses “the light exit surface 16” at the top of lightguide 11.

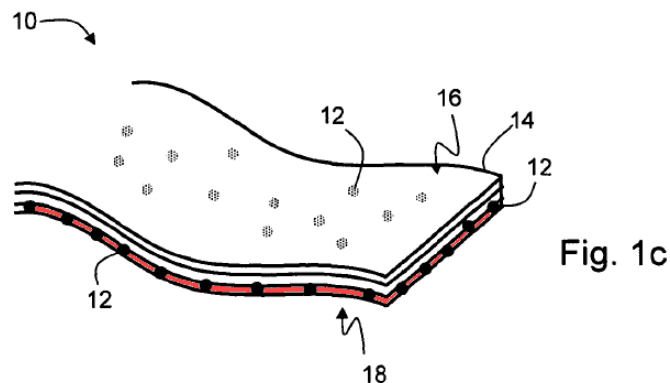


Suzuki, Fig. 2. Fine defines the top 16 and bottom (back portion) 18 surfaces of waveguide 14. Fine 12:16-17 (“As used herein, “top” refers to furthest away from surface 18, while “bottom” refers to closest to surface 18.”). Fine further specifies that “light source 12 [may be] embedded near surface 18 of material 14[.]” Fine 14:45-46. Thus, in my opinion, a person of ordinary skill in the art would understand that Suzuki’s device modified by Fine teaches that LEDs 12 (of a light source) may be positioned at the back portion 18 of waveguide 14.

75. Additionally, Fine notes that embedding a light source in a waveguide efficiently (optically) couples the light source to the waveguide. Fine, 12:66-13:6 (“There are several advantages for embedding the light source within the waveguide material. One advantage is that all the light emitted from the light source eventually arrives at the waveguide material. When the light source is externally coupled to the waveguide material, some of the light scatters at wide

angle and does not impinge the waveguide material. Thus, the embedding of light source 12 in waveguide material 14 allows to efficiently collect the emitted light.”).

76. Further, Fig. 1c below, shows LEDs 12 embedded in the back portion (shown in red) of waveguide 14.



Fine, Fig. 1c. Thus, in my opinion, it would have been obvious to a person of ordinary skill in the art to modify Suzuki to optically couple LEDs 12 to the back portion of waveguide 14.

H. One or More of the Light-Emitting Sources Disposed Along an Edge Region of the Waveguide Element and/or a Center Region of the LCD System Were Known in the Art (Claims 28, 29)

77. As shown in Fig. 2 below, Johnson discusses light being emitted from a light source (LED array 16) situated at the back side (first major surface 22) of the waveguide 20 and light being emitted from light source (LED array 30) along the edge region (edge surfaces 28a) of the waveguide 20.

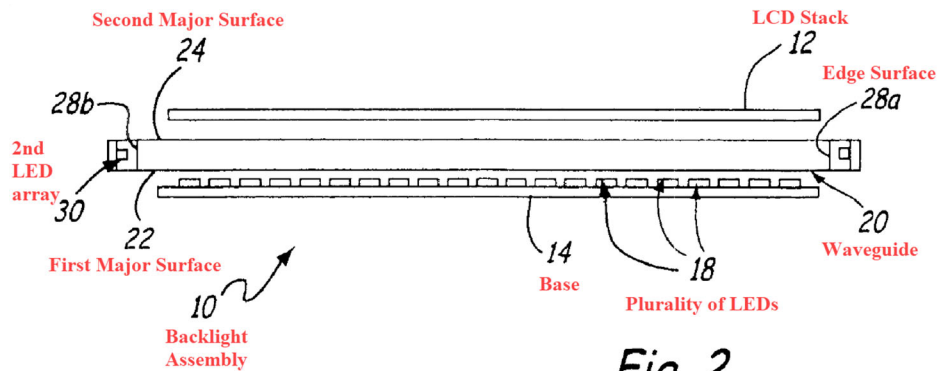


Fig. 2

Johnson, Fig. 2; 3:25-32 (“[i]n operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12.”). Moreover, as shown below in Fig. 1 highlighted in yellow, several of the LEDs are disposed along a center region of the LCD system behind the LCD panel.

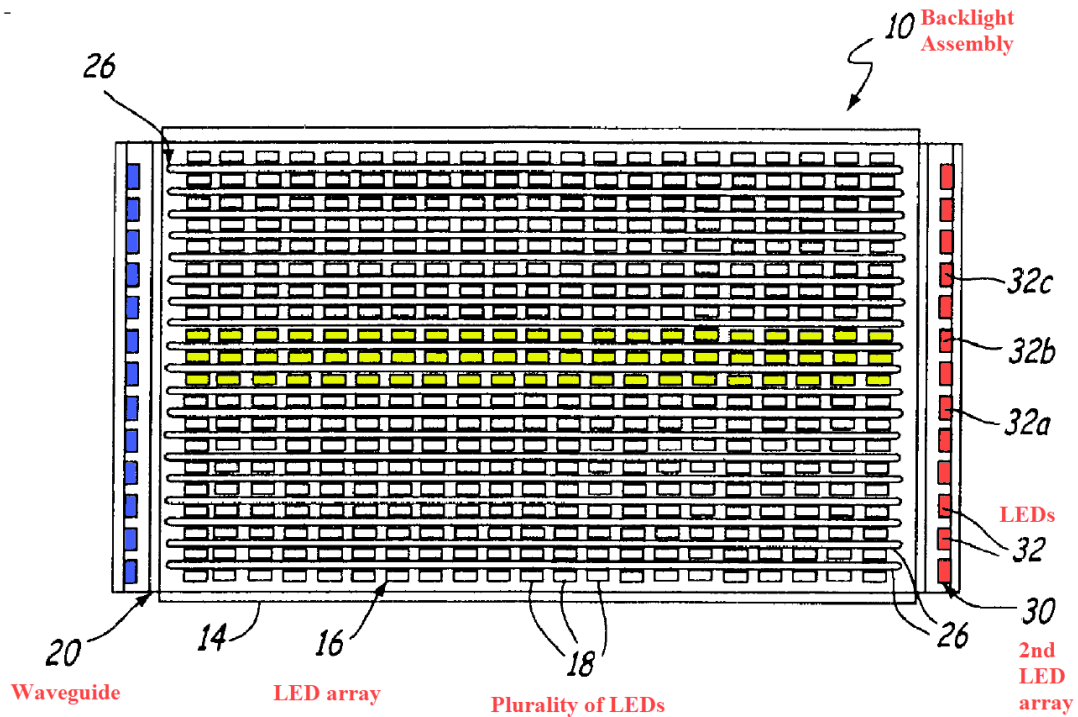
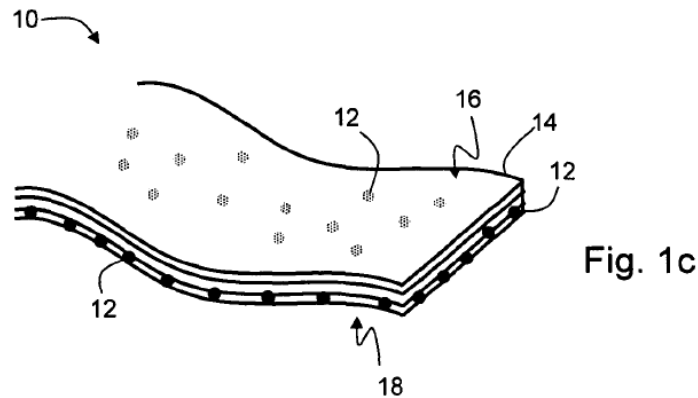


Fig. 1

Johnson, Fig. 1. Further, Johnson teaches that the second light-emitting sources (LED array 30) may also be situated at the back side of the waveguide in that “a mixed arrangement of LEDs from the first and second LED arrays [may emit] light into waveguide 20 only through first major surface 22.” Johnson, 5:66-6:2.

78. Turning now to Suzuki and Fine, as shown below, FIG. 1c of Fine “schematically illustrates a perspective view of apparatus 10 in a preferred embodiment in which waveguide material 14 is non-planar[,]” Fine, 12:50-52, and illustrates light sources throughout the waveguide 14, including the center region, emitting light into the back side of waveguide 14.



Fine, Fig. 1c. Further, Fine states that LEDs 12 “can be embedded in the bulk of waveguide material 14 or near surface 18.” Fine, 1:66-67. Thus, in my opinion, a person of ordinary skill in the art would understand that Suzuki’s device modified by Fine’s teachings would account for LEDs 12 optically coupled to the back portion 18 of a waveguide element 14.

79. Further, Fine discusses the “[t]ypical backlight assembly of LCD [which] includes an array of white LEDs for emitting white light, a light guiding plate for guiding the light toward the LCD panel[.]” Fine 3:65-67. Thus, in view of Fine, in my opinion, a person of ordinary skill in the art would understand the Suzuki assembly includes that light emitted from LEDs 12 on the back side of waveguide element 14, including LEDs in the center region, is transmitted from the top surface 16 of waveguide element 14 to the LCD Panel.

I. LCD Systems with Three Light-Emitting Sources Arranged to Emit Light into a Waveguide Element to Provide Direct Backlight Were Known in the Art (Claim 31, 34)

80. LCD systems with multiple light emitting sources positioned to emit light into a waveguide element were well known in the art. Johnson explicitly discloses three light emitting sources each one positioned to emit light into the waveguide element. As shown in Figs. 1 and 2 below Johnson discloses a third light emitting source (shown in blue) that emits light into the waveguide element 20 at edge surface 28a in addition to the two other light emitting sources shown in yellow and red below.

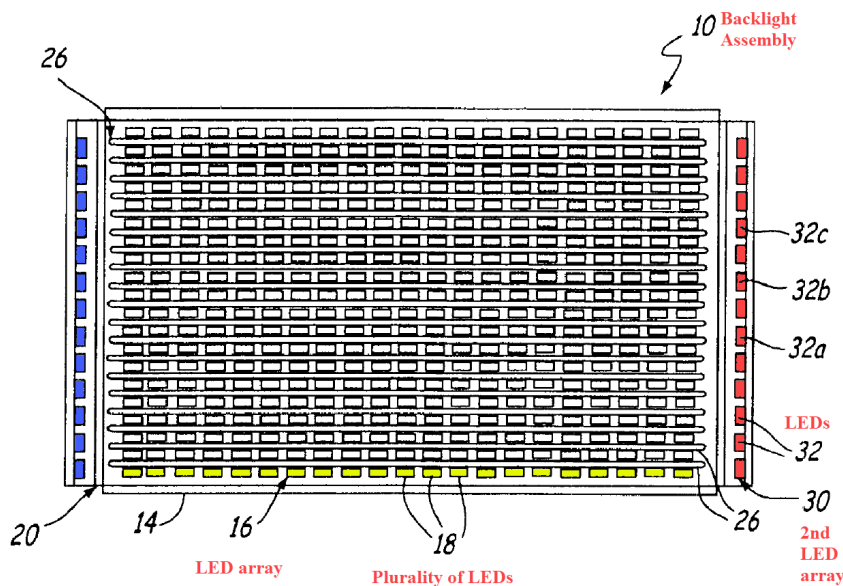


Fig. 1

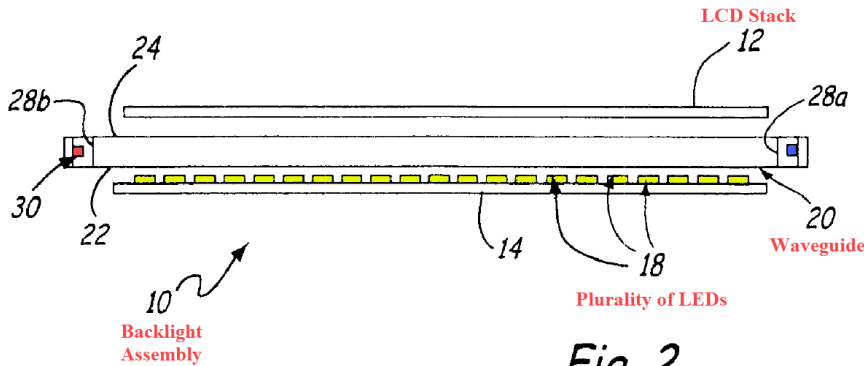
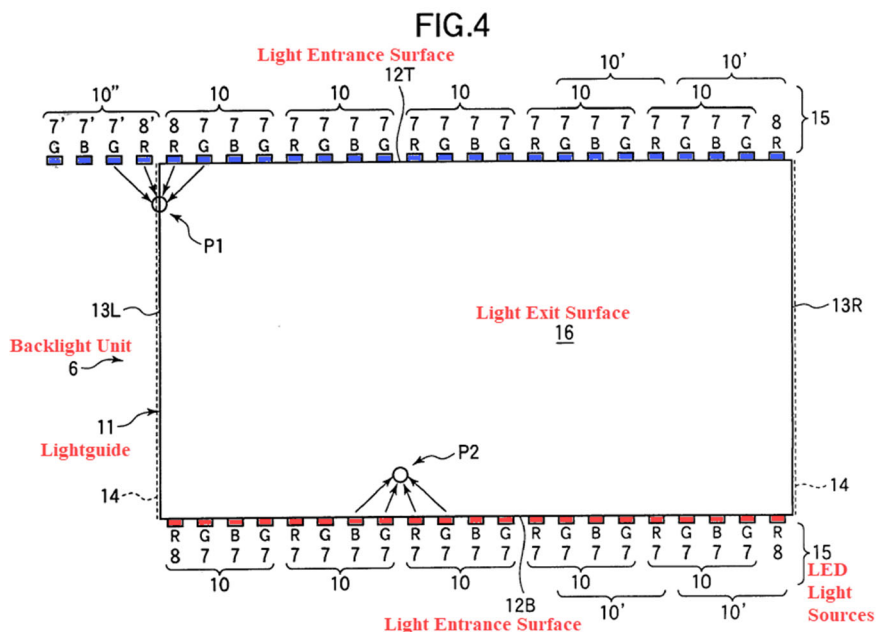


Fig. 2

Johnson, Figs. 1, 2. Moreover, as discussed above, Johnson discloses that all of the LED arrays could be direct arrays. *See*, Johnson, 5:48-52 (“the embodiment shown in FIGS. 1 and 2 may be modified such that LEDs 32 from second LED array 30 and LEDs 18 from first LED array 16 are intermingled along base 14 and along the edge surfaces 28a, 28b”). Therefore, in my opinion, a person of ordinary skill in the art would understand from Johnson that the third light-emitting source could be positioned to provide direct backlighting to the LCD panel.

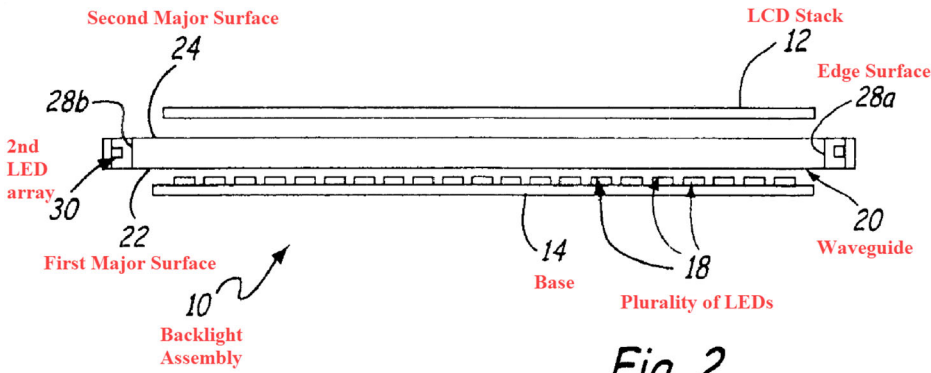
81. Turning now to Suzuki and Fine, as shown in Fig. 4 below, Suzuki discloses first emitting light sources, LED light sources 15 with LEDs 7 (shown in red), arranged in series by pluralities of sets 10, optically coupled to first light entrance surface 12B, of a waveguide element, lightguide 11, as well as second emitting light sources, LED light sources 15 with LEDs 7 (shown in blue), arranged in series by pluralities of sets 10, optically coupled to second light entrance surface 12T, of a waveguide element, lightguide 11. Suzuki, ¶ 0027.



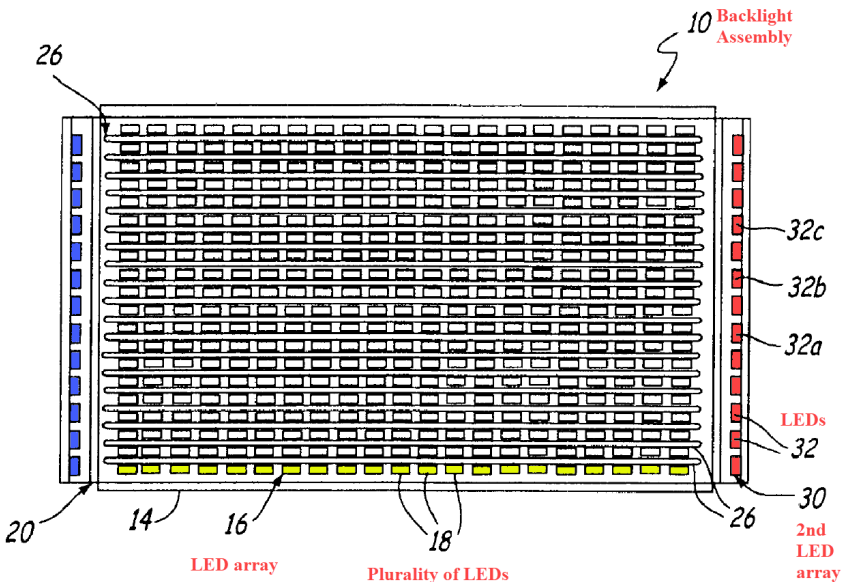
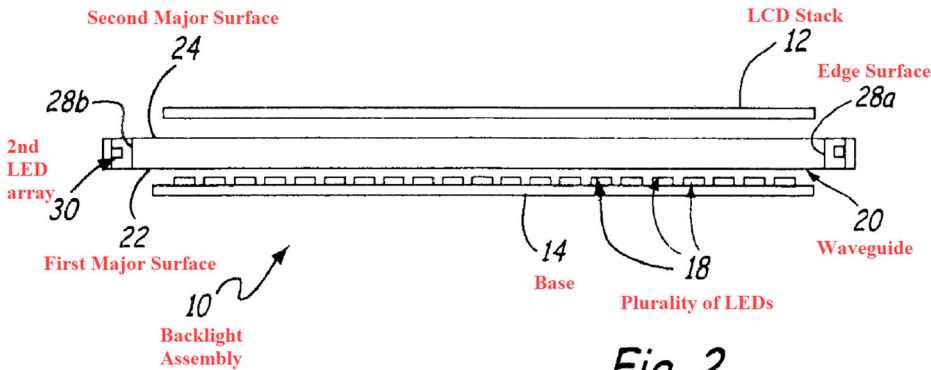
Suzuki, Fig. 4. Further, as I discuss above in the context of claim 22 Suzuki in view of Fine illustrates that light sources may be optically coupled to the back portion of waveguide 14. Notably, Fine notes that the “term ‘light source’ as used herein refers to one or more light sources.” Fine, 11:60-61. Therefore, in my opinion, a person of ordinary skill in the art would understand that Fine discloses an indeterminate plurality of LEDs or light sources optically coupled to waveguide 14. Thus, in my opinion, a person of ordinary skill in the art would find it obvious in view of Suzuki and Fine to have at least three light emitting sources that are positioned to emit light into at least one waveguide element, 12B, 12T, and opposite light exit surface 16.

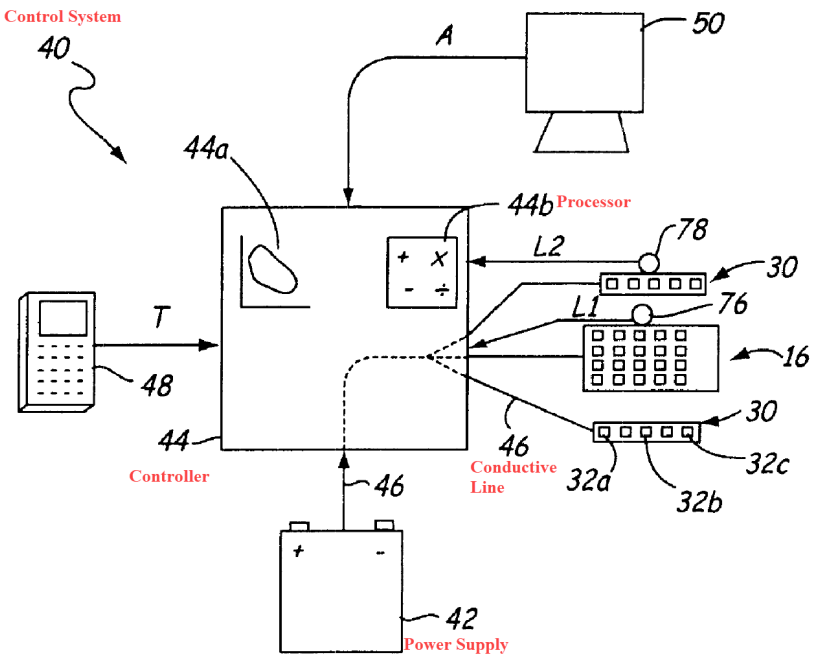
VIII. Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31 32, 33, and 34 of the '705 Patent.

82. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1, 2, 5, 6, 9, 11, 13, 14, 16, 17, 22, 28, 29, 31, 32, 33, and 34 was obvious in view of Johnson. This is further demonstrated by the claim chart below.

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
[1 Preamble] A liquid crystal display (LCD) system comprising:	Johnson describes “[t]he present invention relates to displays, and more particularly, to an LED-based backlight for a liquid-crystal display (LCD)” Johnson, 1:7-9. Johnson, 1:66-67 (“The invention provides a backlight for a liquid-crystal display.”)
[1A] a LCD panel;	Johnson describes “[b]acklight assembly 10 provides light to an LCD stack, shown schematically at 12.” Johnson, 2:49-52; Fig. 2.  <i>Fig. 2</i>
[1B] at least one waveguide element comprising a	Johnson describes “[a] waveguide 20 is disposed between base 14 and LCD stack 12. Waveguide 20 is made of a generally planar material that is designed to accept light from one or

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
plurality of light entry regions;	more light sources and uniformly deliver the light to LCD stack 12.” Johnson, 2:64-67. Johnson, 3:24-27 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28.”)
[1C] a first light-emitting source comprising a first plurality of LEDs arranged in a first strip and positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions;	Johnson, 3:25-26 (“white light from first LED array 16 enters waveguide 20 through first major surface 22”). Fig. 1 Fig. 2
[1D] a second light-emitting source	Johnson, 3:26-29 (“light from second LED array 30 enters waveguide 20 through edge surface 28”).

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
comprising a second plurality of LEDs arranged in a second strip and positioned to emit light into the at least one waveguide element at a second light entry region of the plurality of light entry regions; and	 <i>Fig. 1</i>  <i>Fig. 2</i>
[1E] a common control circuit in electrical communication with at least one of the first plurality of LEDs and the second plurality of LEDs.	Johnson, 3:43-47 (“As schematically depicted in FIG. 3, a control system 40 according to the invention includes a power supply 42 that supplies power to the LED arrays. A controller 44 connects power supply 42 with first and second LED arrays 16, 30 through conductive lines 46.”). Johnson, 3:66-4:6 (“Processor 44b then refers to the chromaticity data stored in memory 44a to determine how to adjust LEDs 32 in second LED array 30 to correct or

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	compensate for the difference between actual chromaticity A and target chromaticity T. Processor 44b then instructs controller 44 to vary the power to LEDs 32 in second LED array 30, thereby varying the brightness of LEDs 32.”).  <i>Fig. 3</i>
2. The LCD system of claim 1, wherein the LCD panel has a viewable surface, the at least one waveguide element has a transmissive surface, and the transmissive	Johnson, 2:56-59 (“First LED array 16 is comprised of a plurality of LEDs 18 that are selected and arranged according to the lighting and viewing requirements of LCD Stack 12.”). Johnson, 1:20-26 (“This is important in fields such as avionics, where the colors displayed on a critical-function aircraft display must be exact. A slight difference in chromaticity of the backlight might adversely affect the color of the display.”). Johnson, 2:63-3:14 (“A waveguide 20 is disposed between base 14 and LCD stack 12. Waveguide 20 is made of a generally planar material that is designed to accept light from

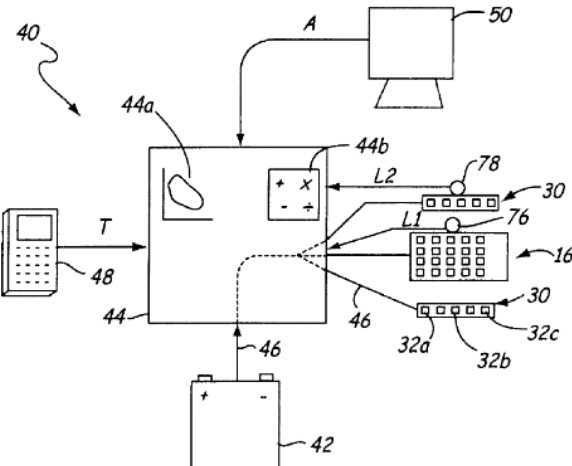
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
surface is approximately the same size as the viewable surface.	one or more light sources and uniformly deliver the light to LCD stack 12.”). Johnson, 2:49-54 (“FIGS. 1 and 2 depict a preferred embodiment of a backlight assembly 10 according to the invention. Backlight assembly 10 provides light to an LCD stack, shown schematically at 12. The specific details of the construction of LCD stack 12 do not form part of the invention and therefore will not be further described. Backlight assembly 10 includes a base 14 that has a principal or first LED array 16 disposed thereon.”) <i>Fig. 1</i> <i>Fig. 2</i>

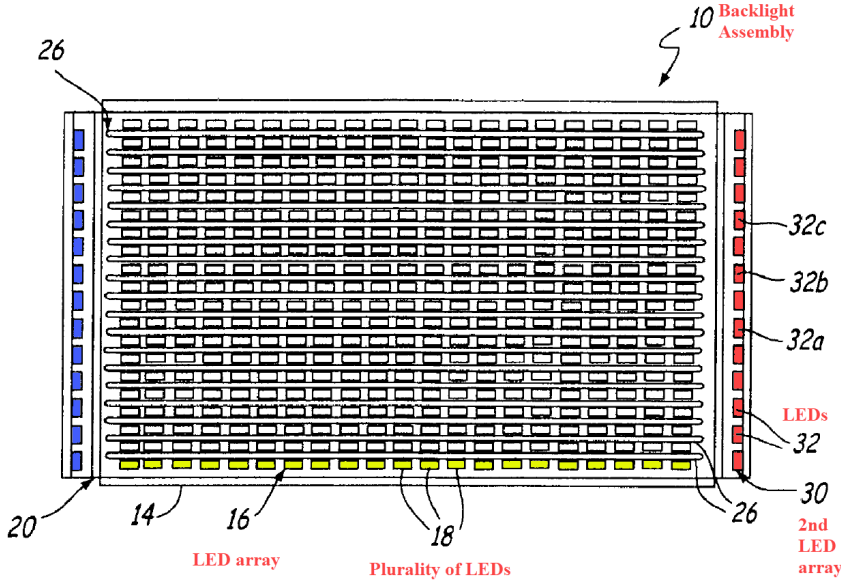
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
5. The LCD system of claim 1, wherein any of the first light-emitting source and the second light-emitting source comprises a plurality of LEDs adapted to emit any of white light and single color light.	Johnson, 3:25-28 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28”). Johnson, 6:15-17 (“It may also be possible that second LED array 30 is comprised of LEDs all having the same chromaticity output.”). <i>Fig. 1</i> <i>Fig. 2</i>
6. The LCD system of claim	Johnson, 2:64-3:2 (“Waveguide 20 is made of a generally planar material that is designed to accept light from one or

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
5, wherein any of the first light-emitting source and the second light-emitting source comprises a plurality of direct LEDs.	more light sources and uniformly deliver the light to LCD stack 12. Waveguide 20 has a first major surface 22 that faces base 14. Waveguide 20 has a second major surface 24, generally parallel to first major surface 22, that faces LCD stack 12.”). Johnson, 3:25-28 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28”. Johnson, 5:48-52 (“the embodiment shown in FIGS. 1 and 2 may be modified such that LEDs 32 from second LED array 30 and LEDs 18 from first LED array 16 are intermingled along base 14 and along the edge surfaces 28a, 28b”). <i>Fig. 2</i>
9. The LCD system of claim 1, wherein each LED of the first plurality of LEDs and second plurality of LEDs is adapted to output substantially	Johnson describes “[f]irst LED array 16 [] designed to provide the substantial majority of the light required for LCD stack 12. Together, LEDs 18 provide light with a first chromaticity, which in the present embodiment is white or near-white.” Johnson, 2:59-62. Johnson describes “[s]econd LED array 30 includes a plurality of LEDs 32 that, individually and/or collectively, emit light with a chromaticity that is different from the chromaticity of light emitted by first LED array 16.” Johnson, 3:18-21.

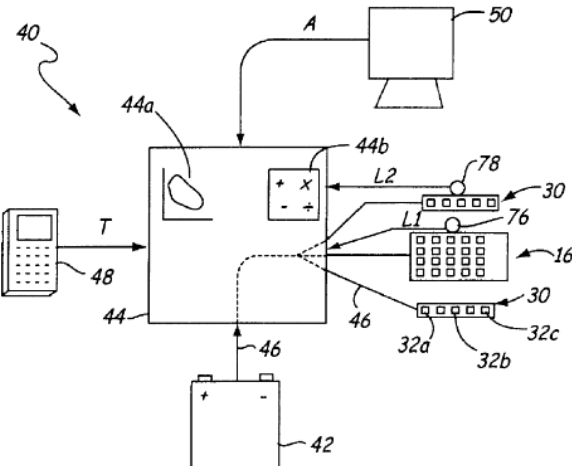
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
the same wavelength.	Johnson, 3:25-28 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28”). Johnson, 6:15-17 (“It may also be possible that second LED array 30 is comprised of LEDs all having the same chromaticity output.”) <i>See</i> 1[C] and 1[D] regarding edge surfaces 28.
11. The LCD system of claim 1, further comprising a common control circuit in electrical communication with each LED of at least one of the first plurality of LEDs and the second plurality of LEDs.	Johnson describes “a control system 40 according to the invention includes a power supply 42 that supplies power to the LED arrays. A controller 44 connects power supply 42 with first and second LED arrays 16, 30 through conductive lines 46.” Johnson, 3:43-47. Johnson describes “[p]rocessor 44b [of the common control circuit] then refers to the chromaticity data stored in memory 44a to determine how to adjust LEDs 32 in second LED array 30 to correct or compensate for the difference between actual chromaticity A and target chromaticity T. Processor 44b then instructs controller 44 to vary the power to LEDs 32 in second LED array 30, thereby varying the brightness of LEDs 32.” Johnson, 3:66-4:6. Johnson describes “decision logic 80 that may be used by controller 44 to adjust the chromaticity of the backlight assembly based on changes in relative brightness of the LED arrays.” Johnson, 5:8-11. Johnson, 5:8-43(“FIG. 5 shows a set of decision logic 80 that may be used by controller 44 to adjust the chromaticity of the backlight assembly based on changes in relative brightness of the LED arrays. Decision logic 80 includes a preliminary operation 80 a that is performed after the chromaticity of the backlight has been initially calibrated as described above.

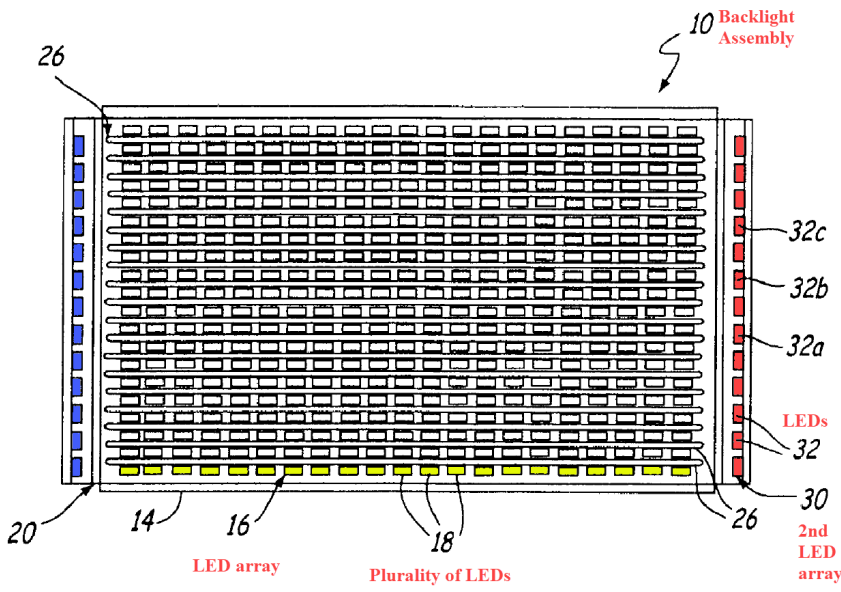
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	Preliminary operation 80 a includes a step 82 in which the luminance L_1 of first LED array 16 is measured by first photodiode 76 and the luminance L_2 of second LED array 30 is measured by second photodiode 78. In step 84, a baseline ratio R_0 of luminances L_1 and L_2 is calculated by processor 44 b and stored in memory 44 a. Baseline ratio R_0 represents the relative luminance or brightness of the first and second LED arrays when the chromaticity of the backlight has been calibrated using spectroradiometer 50. In a subsequent operation 80 b, which controller 44 may be programmed to periodically repeat as desired, the luminances of the LED arrays are measured and compared to the baseline ratio. Specifically, in step 86 luminances L_1 and L_2 are again measured by first and second photodiodes 76, 78, respectively. In step 88, processor 44 b calculates a ratio R, which represents the relative luminance of the first and second LED arrays after a period of use. In step 90, ratio R is compared to baseline ratio R_0 that is stored in memory 44 a. If there is a difference between ratio R and ratio R_0, in step 92 the brightness of first and/or second LED arrays are adjusted to correct the difference. Such adjusting of the relative brightness of the LED arrays also adjusts the chromaticity of the combined light created by the first and second LED arrays. Steps 86, 88, 90 and 92 are repeated until in step 90 it is determined that there is no difference between ratio R and baseline ratio R_0. The operation then ends at 94. As previously stated, subsequent operation 80 b may be repeated as often as necessary to ensure that the chromaticity of the light supplied by the backlight assembly remains constant over time.”).

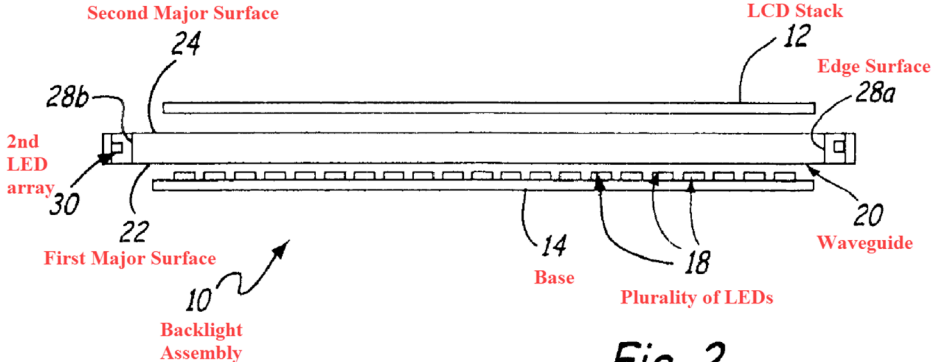
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 <i>Fig. 3</i>
13. The LCD system of claim 1, wherein each LED of at least one of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.	Johnson describes “a top plan view of an LCD backlight assembly,” Johnson 2:34. Johnson, 3:25-33 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12. Light-scattering strips 26 aid in scattering and reflecting light toward the LCD stack.”)

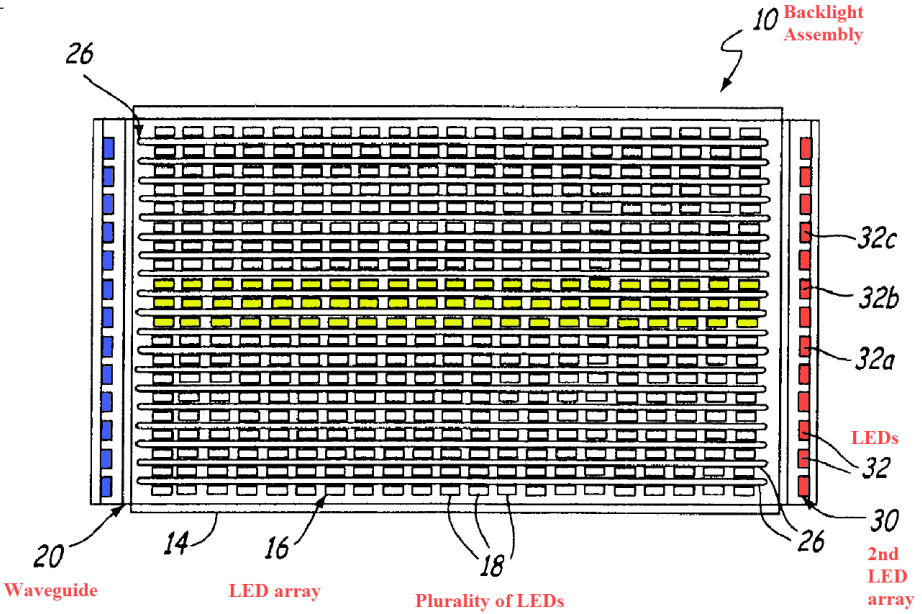
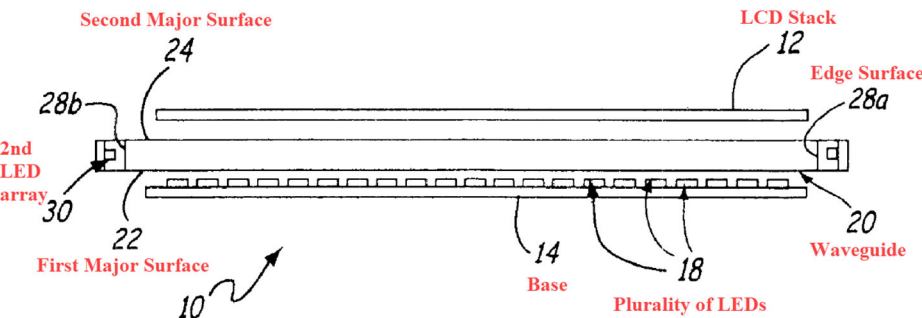
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 <i>Fig. 1</i>
14. The LCD system of claim 1, wherein the common control circuit is in electrical communication with each of the first plurality of LEDs and the second plurality of LEDs.	Johnson, 3:34-58 (“The above configuration may be sufficient to achieve a desired chromaticity if the relevant properties of all of the LEDs in the first and second LED arrays are known and are constant over time. However, as mentioned previously, there may be some variation in the chromaticity of mass-produced LEDs, and these variations may introduce some uncertainty in the expected performance of the LEDs. A control system may therefore be provided to calibrate the chromaticity of the backlight assembly to thereby compensate for such uncertainty. As schematically depicted in FIG. 3, a control system. 40 according to the invention includes a power supply 42 that supplies power to the LED arrays. A controller 44 connects power supply 42 with first and second LED arrays 16, 30 through conductive lines 46. Controller 44 includes a memory 44 a in which chromaticity data is stored. Controller 44 also includes a processor 44 b that computes a chromaticity correction, as will be described below. An input device 48 is removably connected to the controller. Input device 48 permits a user to give instructions to the controller to adjust the chromaticity of first and second LED arrays 16, 30. A spectroradiometer 50, such as the model-

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	PR-705 spectroradiometer manufactured by Photo Research, Inc., is removably connected to controller 44. Spectroradiometer 50 measures the chromaticity of backlight assembly 10 and provides data to controller 44 regarding such measurement.”) Johnson, 3:59-4:12 (“In operation, the chromaticity of light emanating from backlight assembly 10 is measured by spectroradiometer 50. If it is desired to adjust the chromaticity of backlight assembly 10, the user inputs a desired or a target chromaticity T into input device 48. The input device transmits target chromaticity T to controller 44. Processor 44 b compares target chromaticity T to the actual chromaticity A as measured by spectroradiometer 50. Processor 44 b then refers to the chromaticity data stored in memory 44 a to determine how to adjust LEDs 32 in second LED array 30 to correct or compensate for the difference between actual chromaticity A and target chromaticity T. Processor 44 b then instructs controller 44 to vary the power to LEDs 32 in second LED array 30, thereby varying the brightness of LEDs 32. The exact amount that the power to LEDs 32 is varied depends on the amount of deficiency and on empirically obtained correlation data relating power input and color output of each LED. When the brightness-adjusted light from second LED array 30 is combined in waveguide 20 with light from first LED array 16, the chromaticity of the combined light is also adjusted or changed.”)

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 <i>Fig. 3</i>
16. The LCD system of claim 1, wherein each of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.	<i>See supra</i> Claim 13.
17. The LCD system of claim 1, wherein any of the first light-emitting source and the a second light-emitting source is optically coupled to the at least one	Johnson, 3:25-33 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12. Light-scattering strips 26 aid in scattering and reflecting light toward the LCD stack.”)

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
waveguide element.	Johnson, 5:66-6:2 (“The invention may also be varied such that a mixed arrangement of LEDs from the first and second LED arrays [may emit] light into waveguide 20 only through first major surface 22.”)
22. The LCD system of claim 1, wherein any of the first light-emitting source and the second light-emitting source is optically coupled to a back portion of the at least one waveguide element.	Johnson, 3:25-33 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12. Light-scattering strips 26 aid in scattering and reflecting light toward the LCD stack.”) Johnson, 5:66-6:2 (“The invention may also be varied such that a mixed arrangement of LEDs from the first and second LED arrays [may emit] light into waveguide 20 only through first major surface 22.”)  <i>Fig. 1</i>

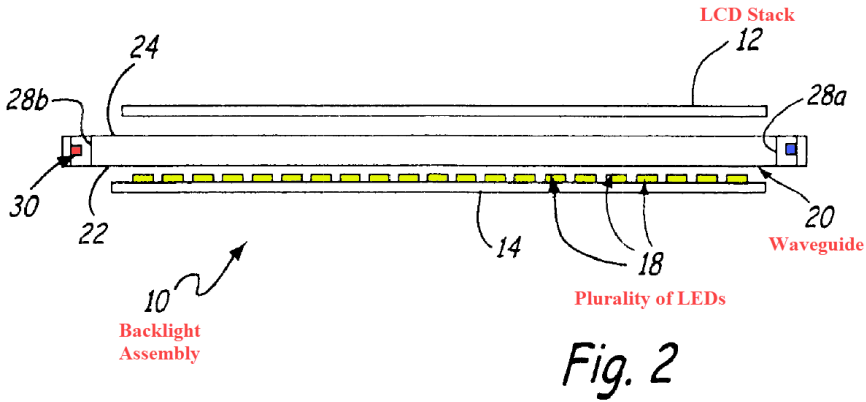
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 <i>Fig. 2</i>
28. The LCD system of claim 1, wherein any of the first light emitting source and the second light-emitting source is disposed along a center region of the LCD system behind the LCD panel, and is positioned to emit light into a back side of the at least one waveguide element.	Johnson, 3:25-33 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12. Light-scattering strips 26 aid in scattering and reflecting light toward the LCD stack.”) Johnson, 5:66-6:2 (“The invention may also be varied such that a mixed arrangement of LEDs from the first and second LED arrays [may emit] light into waveguide 20 only through first major surface 22.”)

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 Fig. 1  Fig. 2
29. The LCD system of claim 1, wherein any of the first light emitting source and the second light-emitting source is disposed at a location selected from:	Johnson, 3:25-33 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28. The light from the LED arrays is combined in waveguide 20, thereby altering the chromaticity of the light from first LED array 16. The combined light exits the waveguide through second major surface 24, traveling toward LCD stack 12. Light-scattering strips 26 aid in scattering and reflecting light toward the LCD stack.”)

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
(a) along an edge region of the LCD system, positioned to emit light into an edge of the at least one waveguide element, and (b) along a center region of the LCD system behind the LCD panel, positioned to emit light into a back side of the at least one waveguide element.	Johnson describes “the embodiment shown in FIGS. 1 and 2 may be modified such that LEDs 32 from second LED array 30 and LEDs 18 from first LED array 16 are intermingled ... along edge surfaces 28a, 28b.” Johnson 5:48-52 <i>Fig. 1</i> <i>Fig. 2</i>

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
31. The LCD system of claim 1 further comprising at least a third light-emitting source, positioned to emit direct backlighting onto the LCD panel.	Fig. 1 Fig. 2 Johnson, 2:64-3:2 (“Waveguide 20 is made of a generally planar material that is designed to accept light from one or more light sources and uniformly deliver the light to LCD stack 12. Waveguide 20 has a first major surface 22 that faces base 14. Waveguide 20 has a second major surface 24, generally parallel to first major surface 22, that faces LCD stack 12.”). Johnson, 3:25-28 (“In operation, white light from first LED array 16 enters waveguide 20 through first major surface 22, and colored light from second LED array 30 enters waveguide 20 through edge surface 28”).

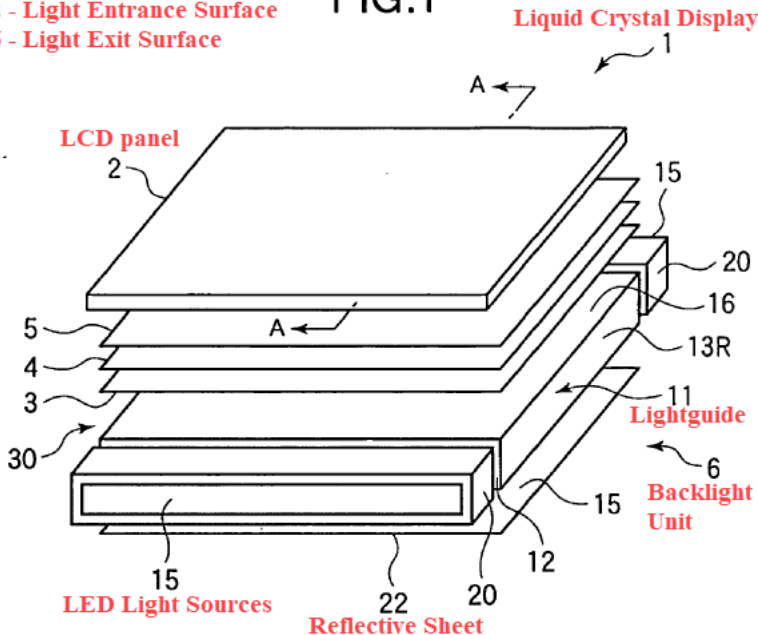
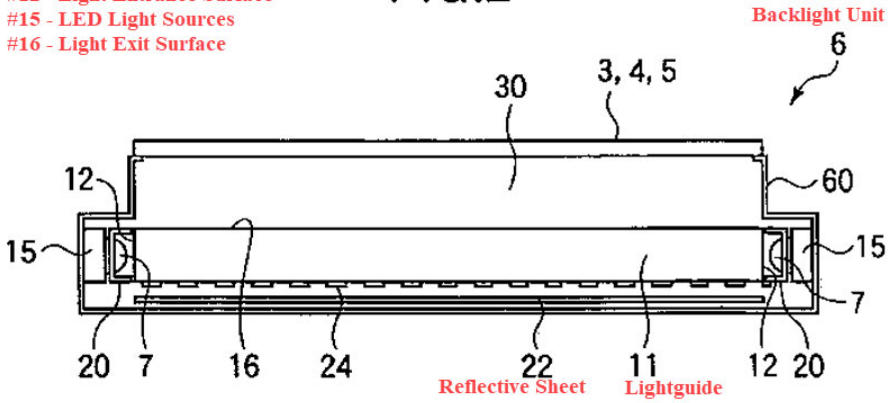
'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	Johnson, 5:48-52 (“the embodiment shown in FIGS. 1 and 2 may be modified such that LEDs 32 from second LED array 30 and LEDs 18 from first LED array 16 are intermingled along base 14 and along the edge surfaces 28a, 28b”).
32. The LCD system of claim 1, embodied in a television.	Johnson, 6:43-47 (“Yet another advantage is that a regular-production LCD backlight may be custom-tuned according to the requirements of different applications. Eliminating multiple LCD backlight production lines provides significant savings to a manufacturer.”)
33. The LCD system of claim 1, embodied in a computer monitor.	<i>See supra</i> Claim 32.
34. The LCD system of claim 1, further comprising a third light-emitting source positioned to emit light into the at least one waveguide element.	<i>Fig. 1</i>

'705 Patent	Johnson in View of the Knowledge of a Person of Ordinary Skill in the Art
	 <i>Fig. 2</i>

IX. Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 1, 2, 5, 11, 13, 14, 16, 17, 32, and 34 of the '705 Patent.

83. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 1, 2, 5, 11, 13, 14, 16, 17, 32, and 34 was obvious in view of Suzuki. This is further demonstrated by the claim chart below.

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
[1 Preamble] A liquid crystal display (LCD) system comprising:	Suzuki describes that “[t]he present invention relates to a surface illuminator utilizing an array of discrete light sources and a liquid crystal display having the same.” Suzuki, ¶0002 Suzuki, ¶0018 (“FIG. 1 is an exploded perspective view showing a schematic structure of a liquid crystal display having a backlight unit as a surface illuminator according to a first embodiment of the invention;”)
[1A] a LCD panel;	Suzuki describes “the liquid crystal display 1 of the present embodiment includes a liquid crystal display panel 2 provided by sealing a liquid crystal between a pair of substrates and the backlight unit 6 which is a surface illuminator.” Suzuki, ¶0024.

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	Suzuki, ¶0028 (“Optical sheets such as a transmissive diffusing plate 3 having a thickness of, for example, about 2 mm and lens sheets 4 and 5 are provided between the gas space 30 and the liquid crystal display panel 2.”) #3-#5 - Optical Sheets #12 - Light Entrance Surface #16 - Light Exit Surface FIG.1  #3-#5 - Optical Sheets #12 - Light Entrance Surface #15 - LED Light Sources #16 - Light Exit Surface FIG.2 
[1B] at least one waveguide element comprising a plurality of	Suzuki, ¶0025 (“The backlight unit 6 includes a light guide 11 which is constituted by, for example, a transparent member in the form of a rectangular thin plate having a predetermined thickness.”)

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
light entry regions;	Suzuki, ¶0026 (“The region sandwiched by the light exit surface 16 of the light guide 11 and the light scattering surface opposite to the same is a light guide region for guiding light to the light exit surface 16. Among four side portions of the light guide around the peripheries of the light exit surface 16 and the light scattering surface, both side portions along two sides of the light guide opposite to each other, e.g., the longer sides thereof, constitute light entrance surfaces 12 through which light enters the light guide region.”). Suzuki, ¶0027 (“LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11.”). #3-#5 - Optical Sheets #12 - Light Entrance Surface #15 - LED Light Sources #16 - Light Exit Surface FIG.2 Backlight Unit 6 30 3, 4, 5 60 15 7 20 12 16 24 22 11 12 20 Reflective Sheet Lightguide

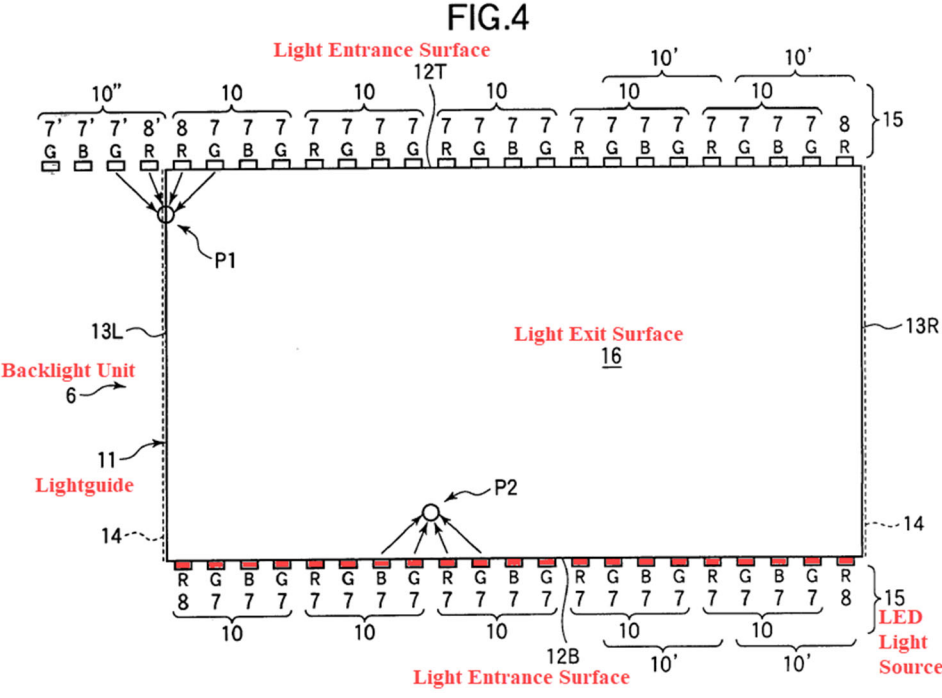
'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	FIG.4
[1C] a first light-emitting source comprising a first plurality of LEDs arranged in a first strip and positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions;	Suzuki describes “LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11. The LED light sources 15 are formed by alternately and discretely arranging plural types of LEDs 7 emitting beams of light having different emission wavelength spectra along the light entrance surfaces 12.” Suzuki, ¶ 0027. Suzuki, ¶0030 (“As shown in FIG. 2, beams of light emitted by the LED light sources 15 to enter the light entrance surfaces 12 of the light guide 11 are guided through the light guide region[.]”) Suzuki describes a “plurality of LED sets (hereinafter also referred to as “RGBG” sets as occasion demands) 10 are arranged in series along the light entrance surfaces 12T and 12B of the light guide 11 starting in the neighborhood of the left ends of the light entrance surfaces 12T and 12B (for example, five LED sets may be provided as shown).” Suzuki, ¶0034.

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	FIG.4
[1E] a common control circuit in electrical communication with at least one of the first plurality of LEDs and the second plurality of LEDs.	Suzuki, ¶0044 (“shows a positional relationship between a light exit surface 16 of a light guide 11 of the backlight unit 6 and LED light sources 15 in the present embodiment in a view of the unit taken in a direction normal to the light exit surface 16. ... As a general LED driving circuit (not shown), the end light source LEDs 8R may be made to emit light in a quantity smaller than that emitted by the other LEDs 7R by a predetermined amount by supplying the end light source LEDs 8R with a current smaller than a current supplied to the LEDs 7R by a predetermined amount.”).

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	#3-#5 - Optical Sheets #12 - Light Entrance Surface #16 - Light Exit Surface FIG.1 Liquid Crystal Display LCD panel LED Light Sources Reflective Sheet Lightguide Backlight Unit
5. The LCD system of claim 1, wherein any of the first light-emitting source and the second light-emitting source comprises a plurality of LEDs adapted to emit any of white light and single color light.	Suzuki, Claim 6 (“A surface illuminator according to claim 1, wherein the array of discrete light sources includes a light source set comprising three light sources, i.e., a light source in a color X, a light source in a color Y, and a light source in a color Z provided in series at a side end of the reflective surface and wherein the end light source is the light source among the light source set which is closest to the side end of the reflective surface”) Suzuki, ¶0010 (“When such a configuration is employed, at an arbitrary point P2 inside the light exit surface 116, four beams of light from a G emission LED 77G, a B emission LED 77B, another G LED emission 77G, and an R emission LED 77R in the neighborhood of the arbitrary point P2 can be mixed to generate a beam of light in a desired color.”). Suzuki, ¶0040 (“It is therefore possible to provide a surface illuminator having high color uniformity and a liquid crystal display having the same. The generation of mixed white suffering from an extreme shortage of red components can be

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	suppressed at an arbitrary point in the neighborhood of an end of a light entrance surface 12T, and color irregularities can be made unnoticeable.”).
11. The LCD system of claim 1, further comprising a common control circuit in electrical communication with each LED of at least one of the first plurality of LEDs and the second plurality of LEDs.	Suzuki describes “a general LED driving circuit (not shown), the end light source LEDs 8R may be made to emit light in a quantity smaller than that emitted by the other LEDs 7R by a predetermined amount by supplying the end light source LEDs 8R with a current smaller than a current supplied to the LEDs 7R by a predetermined amount. Alternatively, R (red) emission LEDs having low emission efficiency may be used as the end light source LEDs 8R.” Suzuki, ¶0044.
13. The LCD system of claim 1, wherein each LED of at least one of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.	Suzuki describes “a positional relationship between a light exit surface 16 of a light guide 11 of a backlight unit 6 and LED light sources 15[,]” Suzuki, ¶21.

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.	
17. The LCD system of claim 1, wherein any of the first light-emitting source and the a second light-emitting source is optically coupled to the at least one waveguide element.	<i>See supra</i> Claim 1[C]. <i>See supra</i> Claim 1[D]. Suzuki, ¶0027 (“LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11. The LED light sources 15 are formed by alternately and discretely arranging plural types of LEDs 7 emitting beams of light having different emission wavelength spectra along the light entrance surfaces 12. Reflectors 20 for allowing light from the LED light sources 15 to efficiently enter the light guide 11 are provided around the LED light sources 15.”)

'705 Patent	Suzuki in View of the Knowledge of a Person of Ordinary Skill in the Art
	FIG.4 

X. Johnson and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 32 and 33 of the '705 Patent.

84. As discussed above Johnson broadly discusses geometry and operation of a LCD backlight assembly that includes LED arrays and a waveguide. Johnson does not expressly the specific use of the system as a television. However Fine discloses an illumination apparatus for use in a LCD backlight assembly comprising a waveguide. Fine, Claims 1, 3.

85. In my opinion, a person of ordinary skill in the art would have been motivated to combine Johnson and Fine. Both discuss Light Emitting Diode (LED) based backlighting for LCDs. Johnson 1:7-9; Fine, 3:65-4:8. Specifically,

Fine discusses “a liquid crystal display device, comprising a liquid crystal panel and a backlight unit, which preferably comprises the illumination apparatus described herein.” 5:37-40.

86. In my opinion, a person of ordinary skill in the art would have been motivated to apply Fine’s illumination apparatus to Johnson’s backlight unit “[t]he present invention relates to artificial illumination and, more particularly, but not exclusively to an illumination apparatus capable of providing light at any intensity profile and any color profile, including, without limitation, uniform white light.” Fine, 1:16-20. Fine provides an express motivation to combine, explaining that “[t]he background art does not teach or suggest illumination apparatus capable of generating light while, at the same time, propagating, diffusing and emitting the light through its surface area or a portion thereof. The background art also does not teach or suggest such illumination apparatus having superior optical and/or geometrical properties, including, without limitation, a thickness of a few centimeters or less, and high light quality in terms of brightness, intensity and/or color profiles” Fine, 4:66-5:7. An LCD display, which is an example given by Johnson, is exactly the type of display device described in Johnson. Johnson, 1:47-49 (“an object of the invention to extend the range of chromaticities that can be supplied by an LED-based LCD backlight”).

87. Fine discloses “[t]he apparatus of the present embodiments can be incorporated in a passive display device or it can serve for providing signage or for providing illumination at various decorative patterns of significant aesthetic interest. In various exemplary embodiments of the invention the apparatus serves as a component in a liquid crystal display device.” Fine, 5:22-27. And “passive display devices include liquid crystal display (LCD)[.]” Fine, 3:37-40. Including the illumination apparatus disclosed by Fine with the backlight unit disclosed by Johnson would allow the LCD display to be “capable of providing light at any intensity profile and any color profile, including, without limitation, uniform white light.” Fine, 1:16-20.

88. In my opinion, a person of ordinary skill in the art would recognize that Johnson focuses on supplying “light with a predictable chromaticity” in a LED-based LCD backlit device. Johnson, 1:50-52. A person of ordinary skill in the art, in my opinion, would have been motivated by the ability to provide any intensity and any color profile. Fine, 1:16-20.

89. Johnson and Fine are in the same field of backlight assembly units for display devices describing known methods for improving the color and brightness uniformity of the lighting system. A person of ordinary skill in the art, in my opinion, would recognize that this combination is nothing more than the use of a known solution described by Fine in a similar system described by Johnson. This

combination would have been within the skillset of a person of ordinary skill in the art at the time.

90. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 32 and 33 were obvious in view of the combination of Johnson and Fine. This is further demonstrated by the claim chart below.

'705 Patent	Johnson and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
32. The LCD system of claim 1, embodied in a television.	Fine, 4:21-25 (“LCD devices are currently employed in many applications (cellular phones, personal acceptance devices, desktop monitors, portable computers, television displays, etc.), and there is a growing attention to devise backlight high-quality assemblies for improving the image quality inn these applications.”) Fine describes “embodiments [that] further comprise a portable computer system comprising the liquid crystal display device, a computer monitor comprising the liquid crystal display device, a personal digital assistant system comprising the liquid crystal display device, a cellular communication system comprising the liquid crystal display device, and a television system comprising the liquid crystal display device.” Fine, 5:41-48. Fine, 20:4-9 (“Display device 40 can be incorporated in may applications. Representative examples include, without limitation, a portable computer system (e.g., a laptop), a computer monitor, a personal digital assistant system, a cellular communication system (e.g., a mobile telephone), a portable navigation system, a television system and the like.”)
33. The LCD system of claim 1, embodied	<i>See supra</i> Claim 32.

'705 Patent	Johnson and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
in a computer monitor.	

XI. Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art Renders Obvious Claims 6, 22, 28, 29, and 32 of the '705 Patent.

91. As discussed above, Suzuki discusses a surface illuminator for a liquid crystal display comprising a liquid crystal display panel, a light guide, an array of discrete LED light sources, and a LED driving circuit. Suzuki, ¶0004. Similarly, Fine discloses an illumination apparatus for use in a LCD backlight assembly comprising a waveguide. Fine, Claims 1, 3.

92. In my opinion, a person of ordinary skill in the art would have been motivated to combine Suzuki and Fine. Both discuss Light Emitting Diode (LED) based backlighting for LCDs. Suzuki, ¶0004; Fine, 3:65-4:8. Specifically, Fine discusses “a liquid crystal display device, comprising a liquid crystal panel and a backlight unit, which preferably comprises the illumination apparatus described herein.” 5:37-40.

93. In my opinion, a person of ordinary skill in the art would have been motivated to apply Fine’s illumination apparatus to Johnson’s surface illuminator “[t]he present invention relates to artificial illumination and, more particularly, but not exclusively to an illumination apparatus capable of providing light at any intensity profile and any color profile, including, without limitation, uniform white

light.” Fine, 1:16-20. Fine provides an express motivation to combine, explaining that “[t]he background art does not teach or suggest illumination apparatus capable of generating light while, at the same time, propagating, diffusing and emitting the light through its surface area or a portion thereof. The background art also does not teach or suggest such illumination apparatus having superior optical and/or geometrical properties, including, without limitation, a thickness of a few centimeters or less, and high light quality in terms of brightness, intensity and/or color profiles” Fine, 4:66-5:7. An illuminating a LCD display with LEDs, which is an example given by Fine, is exactly the type of display device described in Suzuki. *See* Suzuki, ¶0015 (“[i]t is an object of the invention to provide a surface illuminator which employs an array of discrete light sources to provide high display quality and a liquid crystal display having the same.”); Suzuki, ¶0017 (“The invention makes it possible to provide a surface illuminator employing an array of discrete light sources to provide high display quality and a liquid crystal display having the same.”). “The apparatus of the present embodiments can be incorporated in a passive display device or it can serve for providing signage or for providing illumination at various decorative patterns of significant aesthetic interest. In various exemplary embodiments of the invention the apparatus serves as a component in a liquid crystal display device.” Fine, 5:22-27. And “passive display devices include liquid crystal display (LCD)[.]” Fine, 3:37-40. Including

the illumination apparatus disclosed by Fine with the backlight unit disclosed by Johnson would allow the LCD display to be “capable of providing light at any intensity profile and any color profile, including, without limitation, uniform white light.” Fine, 1:16-20.

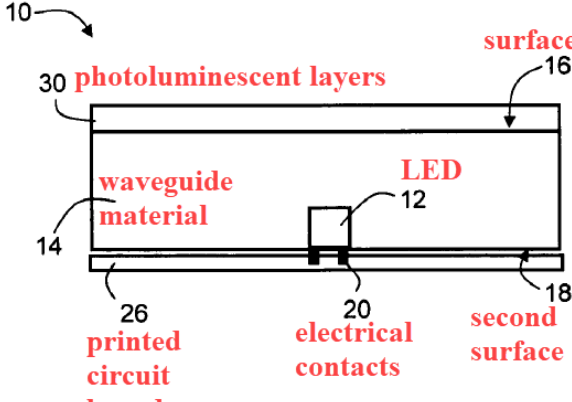
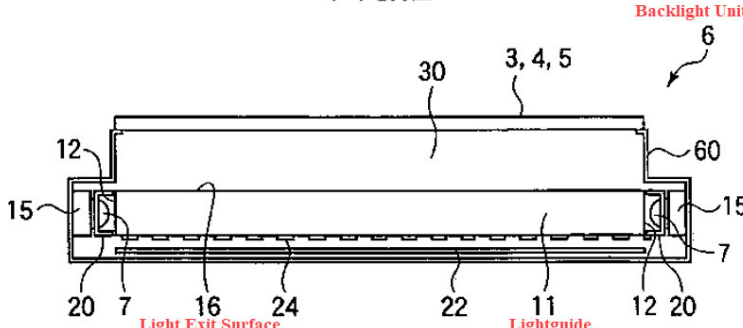
94. A person of ordinary skill in the art, in my opinion, would recognize that Suzuki focuses on “achieving a vast range of color reproducibility.” Suzuki, ¶0005. A person of ordinary skill in the art would have been motivated by the ability to provide any intensity and any color profile. Fine, 1:16-20. “The present embodiments overcome these deficiencies of the background art by providing an illumination apparatus, which generates and diffuses light. The illumination apparatus comprises one or more light emitting sources embedded in a waveguide material. The waveguide material is capable of propagating light generated by the light emitting source(s), such that at least a portion of the light is diffused within the waveguide material and exits through at least a portion of its surface.” Fine, 5:11-20.

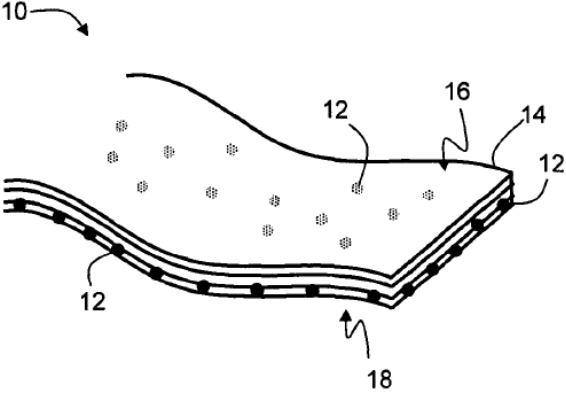
95. Suzuki and Fine are in the same field of backlight assembly units for display devices describing known methods for improving the color and brightness uniformity of the lighting system. A person of ordinary skill in the art would recognize that this combination is nothing more than the use of a known solution described by Fine in a similar system described by Suzuki. This combination

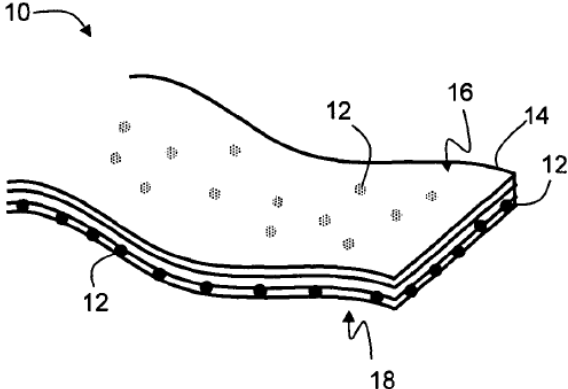
would have been within the skillset of a person of ordinary skill in the art at the time.

96. In my opinion, a person of ordinary skill in the art would have recognized that each element of claims 6, 22, 28, 29, and 32 was obvious in view of the combination of Suzuki and Fine. This is further demonstrated by the claim chart below.

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
6. The LCD system of claim 5, wherein any of the first light-emitting source and the second light-emitting source comprises a plurality of direct LEDs.	Suzuki describes “LED light sources 15, which are arrays of discrete light sources, are provided on the light entrance surfaces 12 of the light guide 11.” Suzuki, ¶0027. Suzuki, ¶0029 (“the backlight unit 6 has a configuration in which a reflective sheet 22, the light guide 11, the gas space 30, and the optical sheets 3, 4, and 5 are provided one over another in the order listed.”). Fine 12:16-17 (“As used herein, “top” refers to furthest away from surface 18, while “bottom” refers to closest to surface 18.”). Fine “schematically illustrat[es] the embodiment in which light source 12 is embedded near surface 18.” Fine, 14:3-4. Fine describes “light source 12 [may be] embedded near surface 18 of material 14[.]” Fine 14:45-46.

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
	 Fig. 2b Fine, Fig. 2b.
22. The LCD system of claim 1, wherein any of the first light-emitting source and the second light-emitting source is optically coupled to a back portion of the at least one waveguide element.	FIG.2  Suzuki, Fig. 2. Fine 12:16-17 (“As used herein, “top” refers to furthest away from surface 18, while “bottom” refers to closest to surface 18.”). Fine, 12:66-13:6 (“There are several advantages for embedding the light source within the waveguide material. One advantage is that all the light emitted from the light source eventually arrives at the waveguide material. When the light source is externally coupled to the waveguide material, some of the light scatters at wide angle and does not impinge the waveguide material. Thus, the embedding of light source 12 in waveguide material 14 allows to efficiently collect the emitted light.”).

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
	Fine describes that “light source 12 [may be] embedded near surface 18 of material 14[.]” Fine 14:45-46.  Fig. 1c Fine Fig. 1c.
28. The LCD system of claim 1, wherein any of the first light emitting source and the second light-emitting source is disposed along a center region of the LCD system behind the LCD panel, and is positioned to emit light into	<i>See supra</i> Claim 22. Fine describes a “[t]ypical backlight assembly of LCD [which] includes an array of white LEDs for emitting white light, a light guiding plate for guiding the light toward the LCD panel[.]” Fine 3:65-67. Fine describes that Fig. 1c “schematically illustrates a perspective view of apparatus 10 in a preferred embodiment in which waveguide material 14 is non-planar[.]” Fine, 12:50-52.

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
a back side of the at least one waveguide element.	 Fig. 1c Fine, Fig. 1c.
29. The LCD system of claim 1, wherein any of the first light emitting source and the second light-emitting source is disposed at a location selected from: (a) along an edge region of the LCD system, positioned to emit light into an edge of the at least one waveguide element, and (b) along a center region	<i>See supra</i> Claim 28. Suzuki describes “LED light sources 115 are provided on both of side surfaces (light entrance surfaces) 112T and 112B along the longer sides of a rectangular light-emitting surface 116 of a light guide 110 in the form of a thin plate.” Suzuki, ¶0007. Suzuki, ¶0026 (“The region sandwiched by the light exit surface 16 of the light guide 11 and the light scattering surface opposite to the same is a light guide region for guiding light to the light exit surface 16. Among four side portions of the light guide around the peripheries of the light exit surface 16 and the light scattering surface, both side portions along two sides of the light guide opposite to each other, e.g., the longer sides thereof, constitute light entrance surfaces 12 through which light enters the light guide region. Two side surfaces of the light guide extending to connect both ends of the two opposite light entrance surfaces 12 respectively constitute reflective surfaces 13 for reflecting light in the light guide region.”) Suzuki, Figs. 2,4.

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
of the LCD system behind the LCD panel, positioned to emit light into a back side of the at least one waveguide element.	
32. The LCD system of claim 1, embodied in a television.	Fine describes “embodiments further comprise a portable computer system comprising the liquid crystal display device, a computer monitor comprising the liquid crystal display device, a personal digital assistant system comprising the liquid crystal display device, a cellular communication system comprising the liquid crystal display device, and a television system comprising the liquid crystal display device.” Fine, 5:41-48
34. The LCD system of claim 1, further comprising a third light-emitting source positioned to emit light into the at least one waveguide element.	<i>See supra</i> Claim 17 regarding Suzuki in view of the knowledge of a person of ordinary skill in the art. FIG.4

'705 Patent	Suzuki and Fine in View of the Knowledge of a Person of Ordinary Skill in the Art
	Suzuki, Fig. 4. Fine describes the “term ‘light source’ as used herein refers to one or more light sources.” Fine ,11:60-61.

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

September 14, 2023

Date



Dr. P. Morgan Pattison