UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MERCEDES-BENZ USA, LLC and
MERCEDES-BENZ U.S. INTERNATIONAL, INC.,
Petitioners,
v.
INNOVATIVE DISPLAY TECHNOLOGIES LLC,
Patent Owner.

Inter Partes Review of U.S. Patent No. 6,755,547
Issue Date: June 29, 2004
Patent Title: Light Emitting Panel Assemblies
IPR Case No.: *To Be Assigned*

DECLARATION OF MICHAEL J. ESCUTI, PHD

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I. INTRODUCTION

1. My name is Dr. Michael J. Escuti, and I have been retained by the law firm of King & Spalding LLP on behalf of Mercedes-Benz U.S. International, Inc. and Mercedes-Benz USA, LLC as an expert in the relevant art.

2. I have been asked to provide my opinions and views on the materials I have reviewed in this case related to Ex. 1001, U.S. Patent No. 6,755,547 ("the '547 Patent") ("the patent-at-issue"), and the scientific and technical knowledge regarding the same subject matter before and for a period following the date of the first application for the patent-at-issue was filed.

3. I am compensated at the rate of $330/hour for my work, plus reimbursement for expenses. My compensation has not influenced any of my opinions in this matter and does not depend on the outcome of this proceeding or any issue in it.

4. My opinion and underlying reasoning for this opinion is set forth below.

A. Background and Qualifications

5. I am currently a tenured Associate Professor at North Carolina State University ("NCSU"), in the Department of Electrical and Computer Engineering. As detailed below, I have over 16 years of experience directly relevant to the '547 Patent, including in the fields of liquid crystal display ("LCD") technologies, backlight design, optical physics, and electronic materials.

6. I received my Ph.D. in Electrical Engineering from Brown University in Providence, RI, in 2002. My dissertation topic focused on novel LCD systems and

devices, including both experimental and theoretical study. Upon earning my Ph.D., I apprenticed as a Postdoctoral Scholar in the Department of Chemical Engineering at Eindhoven University of Technology (Netherlands), where my research focused on LCDs, novel backlight approaches, diffractive optical films/sheets, and polymer-based organic electronics. Since 2004, I have been on the faculty of NCSU in Raleigh, NC, currently as a tenured Associate Professor in the Department of Electrical and Computer Engineering. I have supervised the graduation of seven Ph.D. and three M.S. students, and currently advise an additional three Ph.D. students. In addition, I have mentored nineteen undergraduate researchers.

7. In 2005, I co-founded ImagineOptix Corporation, which commercializes components, systems, and optical thin-film technology developed within my academic laboratory. The primary markets are LCDs, projectors, and telecommunications hardware. Since its inception, I have been a part-time advisor to the company with the title of Chief Scientific Officer, and in 2013, I joined the Board of Directors.

8. With my students and collaborators, I have authored over 102 publications, including journal articles, refereed conference proceedings, and book chapters. I am a named inventor on 11 issued and 19 pending United States patents, and several additional foreign patents. I have offered 29 invited research presentations.

9. I have received numerous awards and distinctions, including the following:

a. (2011) Presidential Early Career Award for Scientists and Engineers ("PECASE"), the U.S. Government's highest award for young researchers;

b. (2011) Alcoa Foundation Engineering Research Achievement Award, awarded to one faculty NCSU member annually recognizing outstanding research;

c. (2010) Faculty Early Career Development (CAREER) Award, from the National Science Foundation ("NSF");

d. (2004) Glenn H. Brown Prize for Outstanding Ph.D. Dissertation, from the International Liquid Crystal Society ("ILCS");

e. (2002) New Focus Award, Top Winner, from the Optical Society of America ("OSA"); (2001) Graduate Student Silver Award, from the Materials Research Society;

f. (2001) Sigma Xi Outstanding Graduate Student Research Award, from Brown University chapter;

g. (1999) Best Student Paper Award, Society for Information Display;

h. Member of the Institute of Electrical and Electronics Engineers ("IEEE"), Society of Photo-optical and Instrumentation Engineers ("SPIE"), OSA, and SID.

10. My research at NCSU over the last ten years has been supported by more than $8M in external research funds, in part from several government agencies, including the NSF, the United States Air Force Research Laboratory (AFRL), the Defense Advanced Research Projects Agency (DARPA), and the National Aeronautics and Space Administration (NASA). A further part of this support also comes from several

strong partnerships with industry, including Raytheon, Lockheed Martin, Teledyne Scientific & Imaging, Boulder Nonlinear Systems, and ImagineOptix.

11. My central expertise via training and research experience is in LCD system design, materials, technology, and optical modeling. I began working with technologies to improve viewing angle problems in 1998, and in 1999 published my first journal article on this topic (M.J. Escuti, et al., Enhanced Dynamic Response of the In-plane Switching Liquid Crystal Display Mode Through Polymer Stabilization, *Appl. Phys. Lett.*, vol. 75, pp. 3264-3266 (1999)). In 2002, I co-authored an invited chapter reviewing LCD technology (G.P. Crawford and M.J. Escuti, Liquid Crystal Display Technology, in "Encyclopedia of Imaging Science and Technology," ed. J.P. Hornak (John Wiley & Sons, Inc., 2002)). In 2005, I co-authored a journal article focused on an advanced LCD backlight (C. Sanchez, M.J. Escuti, et al., "An efficient illumination system for LCDs incorporating an anisotropic hologram," *Appl. Phys. Lett.*, vol. 87, art. no. 094101, (2005)), and I currently am leading multiple projects at NCSU on backlights that are largely unpublished.

12. As a student, I used and reviewed several textbooks and reference books, including those listed below (a-f). Also listed is an additional book I use in the class I teach on liquid crystal displays for undergraduate and graduate students that I developed at NCSU with support from the NSF.

a. J. A. Castellano, *Handbook of Display Technology*, Academic Press Inc., San Diego (1992);

b. D. E. Mentley and J. A. Castellano, *Liquid Crystal Display Manufacturing*, Stanford Resources, Inc., San Jose (1994);

c. *Liquid Crystals: Applications and Uses* (Vol. 1), edited by B. Bahadur, World Scientific (1995);

d. P. Collings and J. Patel, eds., *Handbook of Liquid Crystal Research*, Oxford University Press, New York (1997);

e. Pochi Yeh and Claire Gu, *Optics of Liquid Crystal Displays*, Wiley & Sons (1999);

f. Ernst Lueder, *Liquid Crystal Displays: Addressing schemes & electro-optical effects*, New York: Wiley (2001);

g. Willem den Boer, *Active Matrix Liquid Crystal Displays: Fundamentals & Applications*, Elsevier: Newnes (2005).

13. In my academic research, I direct both applied and fundamental research for applications including efficient LCDs, backlights, and optical films relevant to both. We also study techniques for low-loss fiber optic telecommunications switches, laser beam steering for high energy applications and laser communications, IR/MIR polarization imaging, opto-fluidics, novel diffractive lenses, and vortex beam optics. We routinely use and often fabricate our own devices, backlights, compensation films, and fully functional systems for direct-view and projection-displays and other applications including telecommunications, remote sensing, and laser beam steering. I routinely use commercial ray-tracing software for display system modeling. Over the

last 16 years, I have written and used multiple numerical simulation tools for optical and liquid crystal modeling, including custom code for modeling of optical waves in stratified birefringent media (matrix methods), exact solutions to Maxwell's equations in anisotropic media, and liquid crystal alignment physics.

14. I have served twice as an expert within *inter partes* review proceedings before the U.S. Patent and Trademark Office, both concluding in 2013, where I was deposed. I also serve as an expert for pending petitions to review U.S. Patent Nos. 7,300,194 (IPR2014-01097), 7,434,974 (IPR2014-01092), 7,404,660 (IPR2014-01094), 7,537,370 (IPR2014-01096), and 8,215,816 (IPR2014-01095). In addition, I have previously served three times as an expert before the U.S. International Trade Commission ("ITC"), beginning in 2011, where I was deposed, and in two of the cases, testified at the hearing. I have also served as an expert in several district court cases.

15. A detailed record of my professional qualifications, including a list of publications, awards, and professional activities, is set forth in my curriculum vitae, attached to this report as Appendix A.

B. Information Considered

16. In addition to my general knowledge gained as a result of my education and experience in this field, I have reviewed and considered, among other things, the '547 Patent, the prosecution history of the '547 Patent, and the prior art of record.

17. The full list of information that I have considered in forming my opinions for

this report is set forth throughout the report and listed in the attached Appendix B.

II. LEGAL STANDARDS

18. In forming my opinions and considering the patentability of the claims of the '547 Patent, I am relying upon certain legal principles that counsel has explained to me.

19. I understand that for an invention claimed in a patent to be found patentable, it must be, among other things, new and not obvious in light of what came before it. Patents and publications which predated the invention are generally referred to as "prior art."

20. I understand that in this proceeding the burden is on the party asserting unpatentability to prove it 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 than not.

21. I understand that in this proceeding, the claims must be given their broadest reasonable interpretation consistent with the specification. The claims after being construed in this manner are then to be compared to information that was disclosed in the prior art.

A. Person of Ordinary Skill in the Art

22. I have been informed that the claims of a patent are judged from the perspective of a hypothetical construct involving "a person of ordinary skill in the art." The "art" is the field of technology to which the patent is related. I understand

that the purpose of using a person of ordinary skill in the art's viewpoint is objectivity. Thus, I understand that the question of validity is viewed from the perspective of a person of ordinary skill in the art, and not from the perspective of (a) the inventor, (b) a layperson, or (c) a person of extraordinary skill in the art. I have been informed that the claims of the patent-at-issue are interpreted as a person of ordinary skill in the art would have understood them in the relevant time period (*i.e.*, when the patent application was filed or earliest effective filing date).

23. It is my opinion that a person of ordinary skill in the art relevant to the '547 Patent would have at least an undergraduate degree in physics, optics, electrical engineering, or applied mathematics AND 3 years of work experience (or a graduate degree) in a field related to optical technology.

24. I understand that a "person of ordinary skill is also a person of ordinary creativity, not an automaton" and that would be especially true of anyone developing liquid crystal display structures.

B. Anticipation

25. I understand that the following standards govern the determination of whether a patent claim is "anticipated" by the prior art. I have applied these standards in my analysis of whether claims of the '547 Patent were anticipated at the time of the invention.

26. I understand that a patent claim is "anticipated" by a single prior art reference if that reference discloses each element of the claim in a single embodiment. A prior

art reference may anticipate a claim inherently if an element is not expressly stated, but only if the prior art necessarily includes the claim limitations.

27. I understand that the test for anticipation is performed in two steps. First, the claims must be interpreted to determine their meaning. Second, a prior art reference is analyzed to determine whether every claim element, as interpreted in the first step, is present in the reference. If all the elements of a patent claim are present in the prior art reference, then that claim is anticipated and is invalid.

28. I understand that it is acceptable to examine extrinsic evidence outside the prior art reference in determining whether a feature, while not expressly discussed in the reference, is necessarily present within that reference.

C. Obviousness

29. I understand that a claim can be invalid in view of prior art if the differences between the subject matter claimed and the prior art are such that the claimed 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.

30. I understand that the obviousness standard is defined at 35 U.S.C. §103(a). I understand that a claim is obvious over a prior art reference if that reference, combined with the knowledge of one skilled in the art or other prior art references disclose each and every element of the recited claim.

31. I also understand that the relevant inquiry into obviousness requires consideration of four factors:

a. The scope and content of the prior art;

b. The differences between the prior art and the claims at issue;

c. The knowledge of a person of ordinary sill in the pertinent art; and

d. Objective factors indicating obviousness or non-obviousness may be present in any particular case, such factors including commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; and that the patentee proceeded contrary to the accepted wisdom of the prior art.

32. I understand that when combining two or more references, one should consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissible hindsight. I have been informed that the application of the teaching, suggestion or motivation test should not be rigidly applied, but rather is an expansive and flexible test. For example, I have been informed that the common sense of a person of ordinary skill in the art can serve as motivation for combining references.

33. I understand that the content of a patent or other printed publication (i.e., a reference) should be interpreted the way a person of ordinary skill in the art would have interpreted the reference as of the effective filing date of the patent application

for the '547 Patent. I have assumed that the person of ordinary skill is a hypothetical person who is presumed to be aware of all the pertinent information that qualifies as prior art. In addition, the person of ordinary skill in the art makes inferences and creative steps. He or she is not an automaton, but has ordinary creativity.

34. I have been informed that the application that issued as the '547 Patent was filed in 2005. However, the application claims priority to a parent application that was filed on June 27, 1995. As a result, I will assume the relevant time period for determining what one of ordinary skill in the art knew is June 27, 1995, the effective filing date for purposes of this proceeding.

D. Claim Construction

35. I have been informed that a claim subject to *inter partes* review is given its "broadest reasonable construction in light of the specification of the patent in which it appears." I have been informed that this means that the words of the claim are given their plain meaning from the perspective of one of ordinary skill in the art unless that meaning is inconsistent with the specification. I understand that the "plain meaning" of a term means the ordinary and customary meaning given to the term by those of ordinary skill in the art at the time of the invention and that the ordinary and customary meaning of a term may be evidenced by a variety of sources, including the words of the claims, the specification, drawings, and prior art.

36. I understand that in construing claims "[a]ll words in a claim must be considered in judging the patentability of that claim against the prior art." (MPEP

§2143.03, citing *In re Wilson,* 424 F.2d 1382, 1385 (CCPA 1970)).

37. I understand that extrinsic evidence may be consulted for the meaning of a claim term as long as it is not used to contradict claim meaning that is unambiguous in light of the intrinsic evidence. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1324 (Fed. Cir. 2005) (citing *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583-84 (Fed. Cir. 1996)). I also understand that in construing claim terms, the general meanings gleaned from reference sources must always be compared against the use of the terms in context, and the intrinsic record must always be consulted to identify which of the different possible dictionary meanings is most consistent with the use of the words by the inventor. *See, e.g., Ferguson Beauregard/Logic Controls v. Mega Systems*, 350 F.3d 1327, 1338 (Fed. Cir. 2003) (citing *Brookhill-Wilk 1, LLC v. Intuitive Surgical, Inc.*, 334 F.3d 1294, 1300 (Fed. Cir. 2003)).

III. TECHNOLOGY BACKGROUND

A. Backlight Assemblies

38. The '547 Patent discloses a backlight assembly, also called a light emitting panel assembly, which according to the '547 Patent, is a device configured to produce a uniform illumination from a surface. This is a type of light box or luminaire, producing surface illumination. *See, e.g.,* Ex. 1011, U.S. Patent No. 5,160,195 ("Miller"). While these assemblies are used in many application contexts, *e.g.*, architectural lighting, signage illumination, and x-ray film viewing, the primary application is in LCDs and the various applications thereof. In the LCD context, a

light emitting panel assembly is usually called the "backlight" module, which is important since it generates the light needed by the display, and is primarily responsible for the brightness and power-efficiency of the whole system. The other major module of an LCD is the "LC panel," which is non-light emitting and instead modulates light passing through it to form an image, where each individual pixel acts as a shutter controlling how much light can pass through it. *See* Ex. 1012, J. A. Castellano, *Handbook of Display Technology,* Academic Press Inc., San Diego, 1992, at pp. 9-13 and Ch. 8. A typical cross-section of a light emitting panel assembly by the time of the '547 Patent is illustrated in Fig. 2 from Ciupke, where the light emitting panel assembly includes everything below element 12, and where element 12 is the LCD. (Fig. 2 from Ex. 1005, U.S. Patent No. 5,461,547 ("Ciupke")).

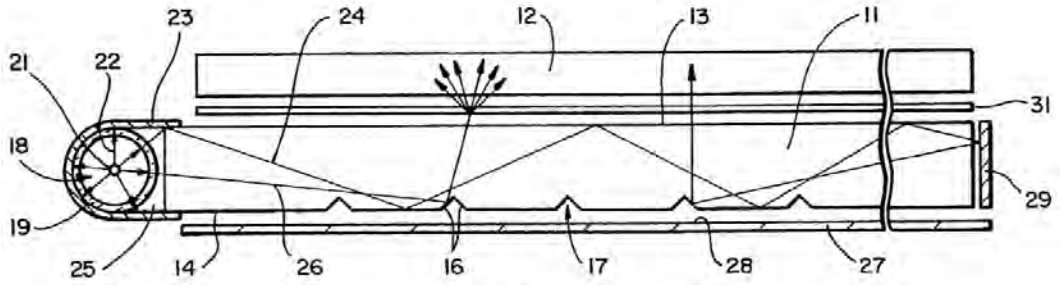


FIG_2

39. The principle aim of a light emitting panel assembly is to provide a surface of illumination that is as smooth as possible across its area, *i.e.*, to emit light uniformly from its entire spatial extent and into a desired angle distribution. Unfortunately, there are no bright and efficient light sources that emit inherently from a surface area commensurate with the size of an LCD, so point- and line-shaped light sources are

used instead. For example, light-emitting-diodes (LEDs) have small emission areas typically on the order of a few mm^2, and fluorescent lamps, with either cold- (CCFL) or hot- (HCL) cathodes, can be many cm long but only a few mm wide. The most critical engineering challenge for backlights, therefore, is to produce the surface illumination with the target brightness and uniformity at the lowest possible electrical power.

40. Light emitting panel assemblies are classified into two well-known[1] categories: "edge-lit" and "directly back-lit." *Compare* Fig. 9 from Ex. 1008, U.S. Patent No. 5,598,280 ("Nishio"), *with* Fig. 4 from Ex. 1013, U.S. Patent No. 5,384,658 ("Ohtake"). These two categories are illustrated in Fig. A below, with the light sources highlighted in each case. In the edge-lit category, the light source is at the edge, sending light substantially horizontally (in this illustration), which must then be turned upward to emit upward (in this illustration) through the emitting surface (and toward the display element in this illustration). In the direct back-lit category, the light sources are arranged instead directly below the emitting surface, usually with several films in between. Confusingly, the word "backlight" is commonly applied to both. The '547 Patent discloses an edge-lit light emitting panel assembly. Edge-lit light

[1] To be clear, when I refer to an element or concept as "well-known" or "known in the prior art," I particularly mean to say that the element or concept was well-known as of June 27, 1995.

emitting panel assemblies are often preferred because they can be physically thinner and lower weight.

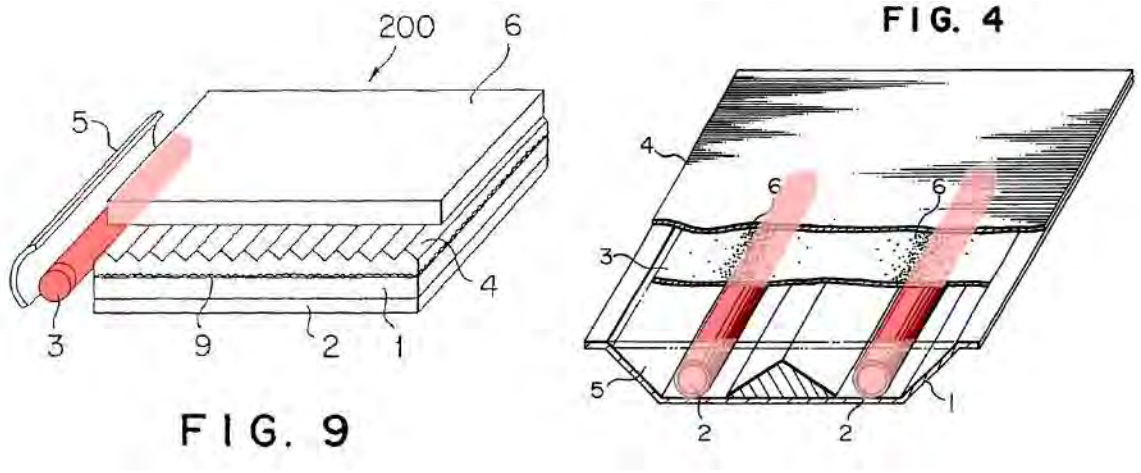
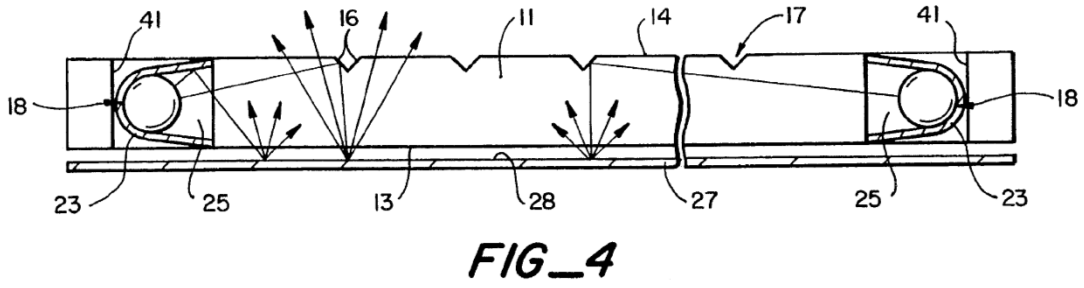


Figure A (annotated Fig. 9 of Ex. 1008, Nishio and Fig. 2 of Ex. 1013, Ohtake)

41. It was known by June 27, 1995 that one or more light sources may be employed. As representative examples, see Ex. 1005, Ciupke, at Fig. 4 below.



B. Common Light Control Structures and Films

42. Many standard optical elements and surfaces within LCDs are used to spatially homogenize and control the angular distribution of emitted light. These include light pipes, transition areas, reflectors, and various types of microstructured deformities (*e.g.*, microprisms, diffusers, and microlenses). *See*, *e.g.*, Ex. 1014, U.S. Patent No.

5,303,322 ("Winston"). We now discuss each of these.

43. The light pipe, also sometimes called a light guide or wave guide or optical conductor, accepts light injected from the side and distributes it across the emission area. *See, e.g.*, Ex. 1015, U.S. Patent No. 5,050,946 ("Hathaway"), at Abstract and 1:56-59. The light pipe is typically a transparent planar slab that confines the light within it using the principle of total-internal-reflection, in order to support the persistent goals in LCDs of thinner and lighter displays. *Id.* at 5:66-6:2. In some designs the light pipe has parallel surfaces and in other designs it has a wedge shape. *Id.* at Figs. 1 and 5. Light will generally only escape from the light pipe into the emission direction when disturbed by a structure – for example, a pattern of diffusing spots on the back surface, or microstructures on one or both surfaces. *Id.* at 7:15-22. For example, in the annotated Fig. B of Ex. 1005, Ciupke, below, the ray 24 is shown first emitting from the light source 18, entering the light pipe 11, bouncing off the top and bottom surfaces of the light pipe several times, reflecting on the right hand side by the edge reflector 29, hitting one of the groove 17 deformities, and only then emitting from the light pipe toward the LCD. Light pipes were generally known in the prior art. It is important to note that the '547 Patent employs several terms for the light pipe, including "transparent panel member" (*e.g.*, Ex. 1001, the '547 Patent, at 1:16-17), "light emitting panel member" (*e.g.*, *id.* at 1:30-31), and "transparent light emitting panel" (*e.g.*, *id.* at 2:65).

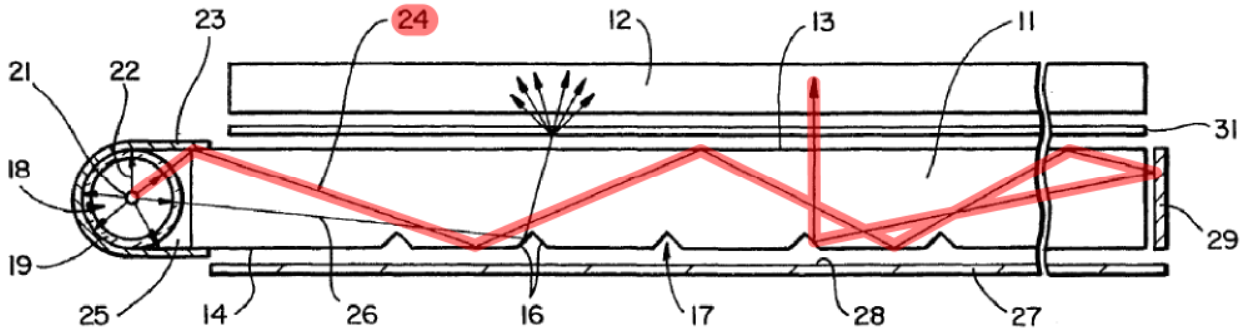


Figure B (annotated Fig. 2 of Ex. 1005, Ciupke)

44. A transition area (or region) is commonly employed between the light source and the light pipe, and is known in the art. Ex. 1001, the '547 Patent, at 2:64-3:4. This is a structure that usually has at least two functions: to securely position the light source relative to the light pipe, and to spread and transmit light to produce a more uniform input illumination. *See, e.g.,* Ex. 1015, Hathaway, at 6:3-24. The transition area may take many shapes, and is usually formed using a transparent material with a refractive index similar to the light guide. For example, in the annotated Fig. C of Ex. 1005, Ciupke below, the transition area 25 couples the light from the light sources 18 into the light pipe 11. *Cf.* Ex. 1015, Hathaway, at Fig. 11.

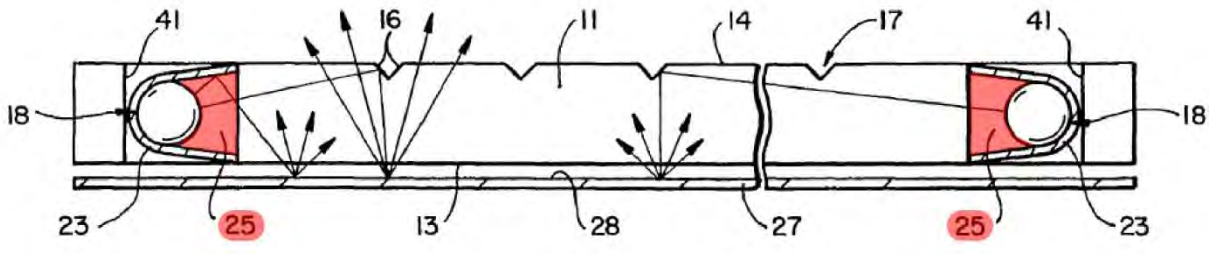
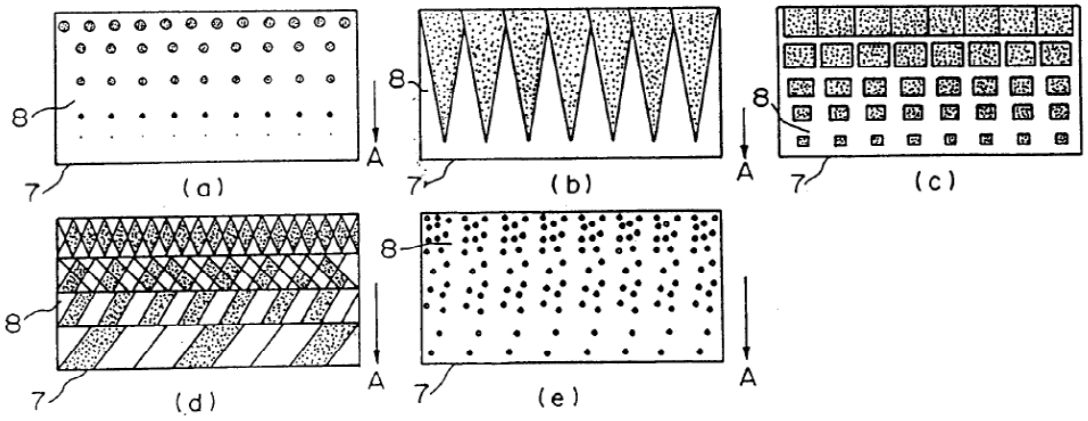


Figure C (annotated Fig. 4 of Ex. 1005, Ciupke)

45. Various types of deformities are employed to control the direction and spatial uniformity of light within light emitting panel assemblies. Two major categories are

those that are essentially microstructured grooves or protrusions on a surface, or those that involve a highly scattering material painted on a surface or formed into a sheet. It was known to a person of ordinary skill in the art at the time of the '547 Patent that these deformities may be random or regularly arranged, and may have features which vary spatially across the emitting area (*e.g.*, size, density, type, shape, *etc.*). For example, several types of spatial variation in deformities are shown in Fig. 5 of Ex. 1016, European Patent Application Publication No. EP500960 ("Ohe") below, where the light source is positioned at side 7.

FIG.5



46. One of the most common deformities is a microprism, which is a small groove or protrusion with two or more facets. These are shown in Figs. B and C above in paragraphs 43 and 44, respectively, as elements 17, on either side of the light pipe. When a light ray hits one of these microprisms, its direction can be substantially changed via refraction and/or reflection, nearly without loss. An illustration of both behaviors can be seen in Fig. D below, where I have highlighted the rays refracting

(red) and the rays reflecting (blue) because of the microprisms sheet (green) (Fig. 6 from Ex. 1008, Nishio). In fact, the blue ray on the right side is first reflected and then refracted. In some cases, an entire surface is formed into an array of prisms, either as a surface of the light pipe or as a separate sheet, but this is not required. In this configuration, the slanted surfaces are useful to turn light toward useful viewing directions, *e.g.*, from very oblique angles to on-axis angles, and visa versa. Because a large portion of the light emitted from a typical light pipe system is initially sent along oblique directions, the addition of a microprism sheet typically increases/enhances the brightness of the light emitting panel as seen by a viewer directly observing on-axis. By the early 1990s, the company 3M commercialized many films based on this effect, and the terminology of "brightness enhancement/enhancing film," or BEF, became essentially synonymous with microprism sheets. *See, e.g.*, the extended explanation in Ex. 1017, U.S. Patent No. 5,828,488 ("Ouderkirk"), at 6:63-8:8; and Ex. 1018, 3M product brochure 75-0500-0403-7, "Brightness Enhancement Film (BEF)," 2 pages (1993). Microprism deformities and sheets were generally known in the prior art.

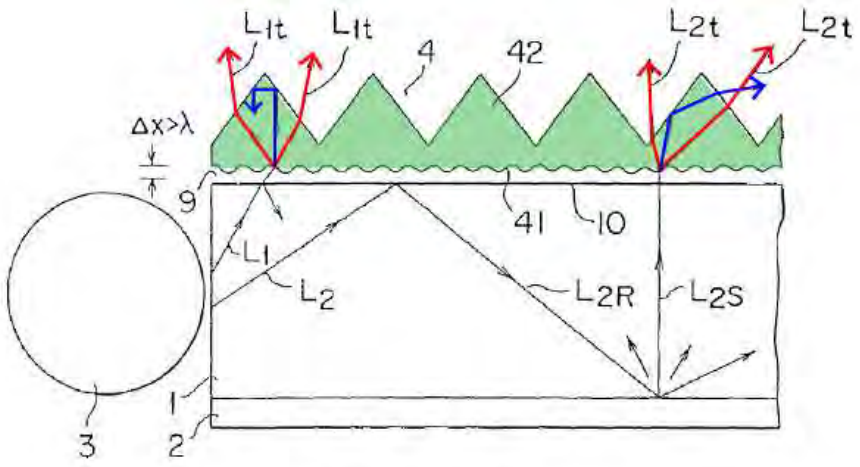


FIG. 6

Figure D (annotated Fig. 6 of Ex. 1008, Nishio)

47. A second common deformity is one that causes a diffusing effect, which at least partially randomizes the direction of light, increasing its divergence angle and reducing on-axis brightness. This will tend to blur shadows or brightness variations, making light more uniform. Diffusing deformities may be embodied as nearly any interruption on the surface of a planar optical sheet, including bumps or indentations of nearly any shape, microspheres, or white paint. For example: (i) irregular beads partially embedded on a surface, shown in Fig. E(i); (ii) micro-joints and cracks in the surface (*e.g.*, of a light pipe), shown in Fig. E(ii); (iii) roughened surface with random projections, shown in Fig. E(iii); and (iv) fully embedded particles within the bulk of a polymer binder, shown in Fig. E(iv).

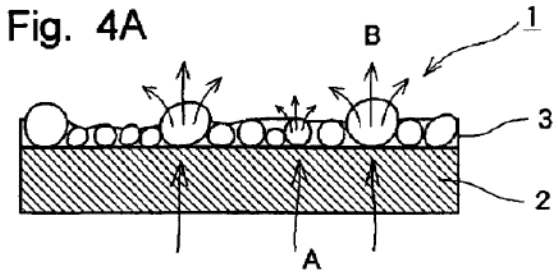


Figure E(i) (Fig. 4A of Ex. 1019,
U.S. Patent No. 5,706,134 ("Konno"))

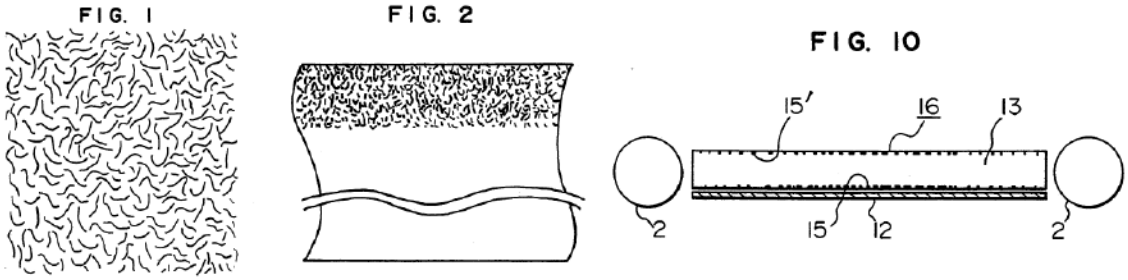


Figure E(ii) (Figs. 1, 2, and 3 of Ex. 1013, Ohtake)

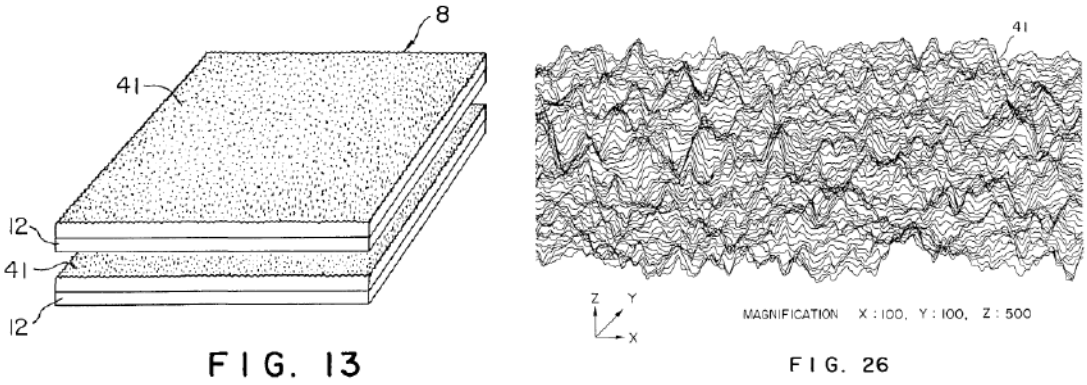


Figure E(iii) (Figs. 13 and 26 of Ex. 1020,
U.S. Patent No. 5,944,405 ("Takeuchi"))

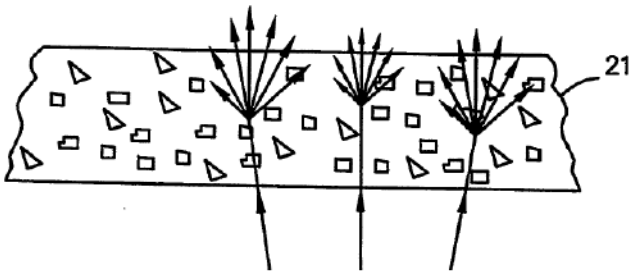


Figure E(iv) (cropped Fig. 5 of Ex. 1021,
U.S. Patent No. 5,381,309 ("Borchardt"))

48. Diffusing deformities may be arranged directly on either side of a light pipe, as in Figs. B and C, or they may be formed as a separate sheet, as in Fig. B as a transmissive diffuser 31 and Fig. C as a reflector 27 with a diffusing surface 28. Diffusing deformities and sheets were generally known in the prior art.

49. A third common deformity is a microlens, which are small cylindrical or spherical lenslets on a surface, in either a one- or two-dimensional arrangement. These are sometimes called lenticular surfaces. *See, e.g.,* Ex. 1008, Nishio, at 4:1-3 and Fig. 13. They may have a wide range of engineered shapes, including but not limited to convex (*i.e.*, ridges) and/or concave (*i.e.*, valleys) cross-sections. It is common, but not required, to arrange the lenslets into an array with little or no space between them. For example, a 1D array of cylindrical lenslets 42 and a 2D array of spherical lenslets 42 are illustrated in Figs. 13 and 15 below, respectively. *Id.* Also shown is a diffusing surface 41 on the opposite side. These may be arranged directly on one or both of sides of a light pipe, or they may be formed into a separate sheet. Microlens deformities and sheets were generally known in the prior art.

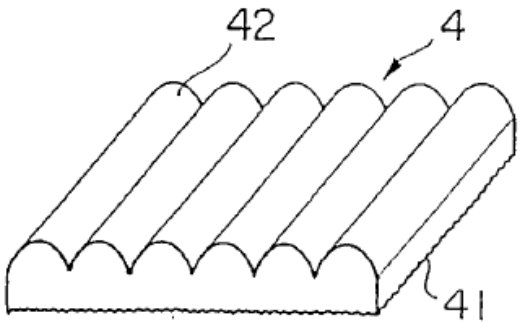


FIG. 13

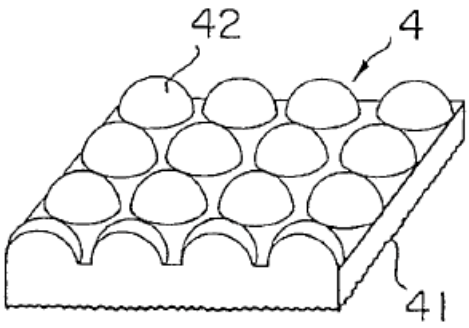


FIG. 15

C. Low Loss

50. The concept of optical efficiency is pervasive in the context of light emitting panel assemblies. Most generally, it refers to the fraction of optical power arriving at a chosen location and direction, relative to an input optical power. High optical efficiency is generally synonymous with low loss. In general, increasing the efficiency or lowering the loss of any part of a backlight or LCD system enables at least two important advantages: decreasing power consumption for the same brightness, or increasing brightness for the same power consumption. It is also common for panel assemblies to include reflective or refractive surfaces for changing the path or a portion of light to increase the efficiency of the panel members. For example, the Fig. 2 above from Ex. 1005, Ciupke shows reflectors 27 and 29 to reflect any light which escapes from the surface back into the light pipe and towards surface 13. *See also* Ex. 1005, Ciupke, at 3:10-19.

IV. THE '547 PATENT

A. Background of the '547 Patent

51. The '547 Patent relates to a backlight assembly having a light emitting member that is covered with a transparent film that is purported to control light emitted from the light emitting member and provide more efficient utilization of light.

52. The claims recite a transparent film incorporating a pattern of light extracting deformities or disruptions that purportedly directs light rays toward different directions to produce a desired light output distribution such that they will pass through a LCD with low loss. According to the '547 Patent's claims, deformities must be on the transparent film or sheet overlying the light emitting surface.

53. First, according to the '547 Patent, the deformities or disruptions define "any change in the shape or geometry of the panel surface and/or coating or surface treatment that causes a portion of the light to be emitted." Ex. 1001, the '547 Patent, at 4:42-46. The pattern of light extracting deformities can include a variable pattern which breaks up the light rays such that the internal angle of reflection of a portion of the light rays will be great enough to cause the light rays either to be emitted out of the panel through the side or sides on which the light extracting deformities are provided or reflected back through the panel and emitted out the other side. *Id.* at 4:46-53. The deformities may also be used to control the light output from the panels, provide uniform light output distribution, control the output ray angle distribution of emitted light, or adjust for light output variances attributed to light

extraction of the panel members. *Id.* at 5:1-30.

54. Figs. 4a-4b of the '547 Patent show such exemplary deformities and disruptions that can be incorporated on the surface of a panel member to control light output distribution. The deformities can have regular shapes such as prismatic surfaces 23 in Fig. 4b, or more irregular shapes like deformities 21 in Fig. 4a. In addition, the distribution of the deformities can vary depending on the amount of light output desired. *Id.* at 5:1-10.

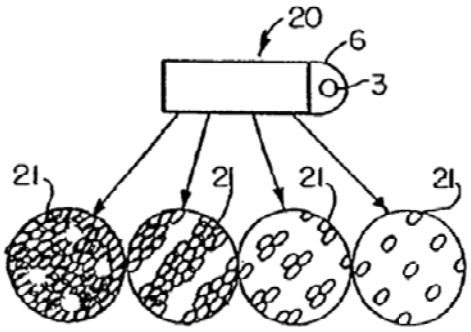


Fig. 4a

Fig. 4b

Fig. 4c

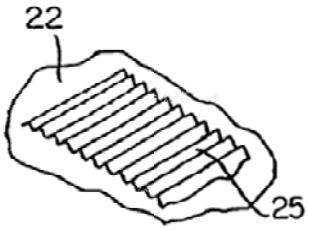


Fig. 4d

55. Second, the '547 Patent discloses that the film or sheet overly the light emitting area with an air gap therebetween. Ex. 1001, the '547 Patent. An example of the film, sheet, plate or substrate (27) and its relation to the light emitting surface of a light emitting panel member (14) is shown in annotated Fig. 5 of the '547 Patent with the air gaps highlighted in green.

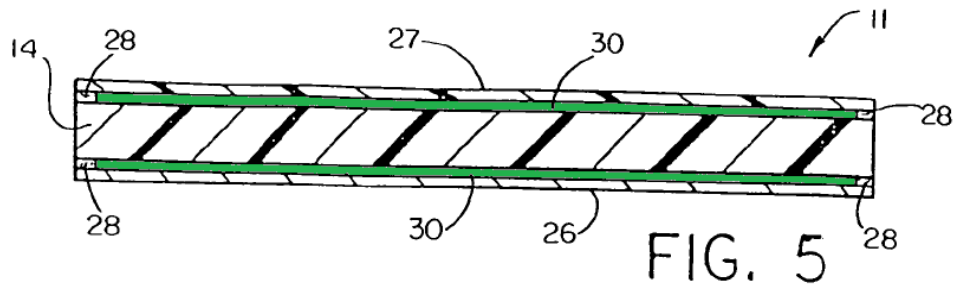


Figure F (annotated Fig. 5 of the Ex. 1001, the '547 Patent)

56. Third, "[t]he deformities may be printed on a sheet or film which is used to apply the deformities to the panel member. This sheet or film may become a permanent part of the light panel assembly for example by attaching or otherwise positioning the sheet or film against one or both sides of the panel member similar to the sheet or film 27 shown in FIGS. 3 and 5 in order to produce a desired effect." Ex. 1001, the '547 Patent, at 4:61-67.

57. According to the '547 Patent, the transparent film, sheet or plate 27 may be used to further improve the uniformity of the light output distribution. *Id.* at 6:34-35. Also, the "sheet or film 27 may be a colored film, a diffuser, or a label or display, a portion of which may be a transparent overlay that may be colored and/or have text or an image thereon. *Id.* at 6:35-38. Further, according to the '547 Patent, air gaps allow for use of longer panel members. *Id.* at 6:50-51.

B. Prosecution History (Ex. 1002)

58. The prosecution history of the '547 Patent involved three office actions on the merits followed by a Notice of Allowance.

59. On January 10, 2003, the USPTO mailed an Election Requirement for the

applicant to elect a single species for prosecution on the merits.

60. On February 10, 2003, the Applicant filed a response in which Applicant elected with traverse the species of Figs. 3, 5, on which claims 1-13, 15-23, 26-36, 39-46, 49-56, 59-67, 70, 71, 74-92, 94-101, 103-106, and 108-117 purportedly read.

61. On May 8, 2003, the USPTO mailed a Non-Final Office Action rejecting all pending claims. The various rejections include anticipation under 35 U.S.C. 102(e) by U.S. Patent No. 5,467,417 ("Nakamura") and anticipation under 35 U.S.C. 102(e) by U.S. Patent No. 6,129,439 ("Hou").

62. On August 5, 2003, Applicant filed an amendment in response to the Office Action dated May 8, 2003. Applicant canceled all pending claims and presented new claims 132-162. Applicant argued that the prior art applied by the examiner does not disclose varying the deformities at different locations to direct light in different directions to produce a desired output. In particular, Applicants argued that "Nakamura et al merely disclose that the light emitted from the light guide plate 3 is uniformly distributed through the scattering plate 5 over a wide range of angles, not that the angles of the deformities vary at different locations." August 5, 2003 Amendment, p. 11.

63. On November 3, 2003, the USPTO mailed a Non-Final Office Action rejecting claim 132 and objecting to claims 133-160. Claim 132 was rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-4, 6, 12, 17, and 25 of U.S. Patent No. 5,613,751. The remaining claims were

indicated to be allowable if rewritten in independent form.

64. On February 5, 2004, Applicant filed a response to the Office Action dated May 8, 2003. Applicant filed a terminal disclaimer to overcome the double patenting rejection.

65. On March 9, 2004, the USPTO mailed a Notice of Allowance allowing the pending claims.

C. Challenged Claims

66. My analysis will focus on claims 1-4, 16, and 26 of the '547 Patent. The claims themselves will be discussed in detail within the Prior Art Analysis section.

D. Claim Construction

67. I have been informed that in my analysis, I should interpret "deformities," as the term exists in claim 1-4, 16, and 26 of the '547 Patent, as "any change in the shape or geometry of a panel surface and/or coating or surface treatment that causes a portion of the light to be emitted." This term was specifically defined in the specification of the '547 Patent, as previously discussed. Ex. 1001, the '547 Patent, at 4:42-46; *see also supra*, at ¶53.

V. PRIOR ART ANALYSIS

68. I now turn to the references applied in the grounds for rejections discussed in Petition for *inter partes* review. In my analysis, I will specifically address the following references:

No.	Reference	Referred To As
1007	U.S. Patent No. 4,729,068	Ohe
1008	U.S. Patent No. 5,598,280	Nishio
1006	U.S. Patent No. 5,005,108	Pristash
1009	U.S. Patent No. 5,408,388	Kobayashi
1010	U.S. Patent No. 5,386,347	Matsumoto

A. U.S. Patent No. 4,729,068 ("Ohe")

69. Ohe is directed to a light diffusing device for illuminating a large display surface with a uniform brightness. Ex. 1007, Ohe, at 2:31-33. The objective of Ohe was to increase the uniformity of the brightness though the entire front surface of the device. *Id.* at 2:26-28.

70. Ohe discloses that a problem existed in that a brightness at a location close to the light source edge was different from another location far from the light source edge. *Id.* at 2:20-26.

71. As a solution, Ohe discloses a light reflecting film 7 consisting of a transparent substrate film and a number of light reflecting spots or small places formed on the substrate in a pattern for evenly distributing the quantity of transmitted light from base plate 1 to the light diffusing plate 6 (shown in purple in Fig. F (annotated Fig. 2 of Ohe) below). *Id.* at 3:47-52; *see also* 5:51-55.

Fig. 2

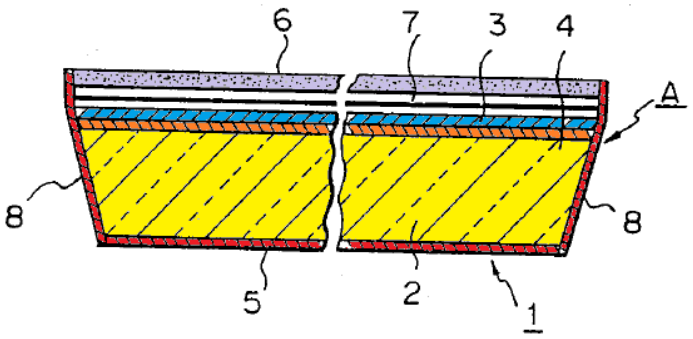
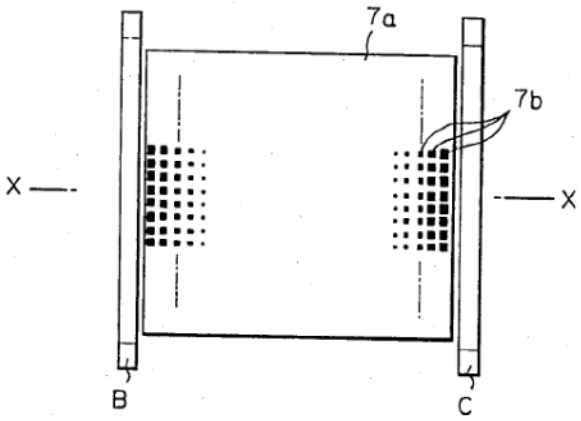


Figure F (annotated Fig. 2 of Ex. 1007, Ohe)

72. Ohe also discloses a film, sheet or substrate, *i.e.*, the light reflecting film 7, overlying the light emitting area. Light reflecting film 7 contains small deformities, light reflecting spots. Figure 4 below depicts light reflecting spots 7b, having a decreasing density with an increased distance from light sources B and C. *Id.* at 6:16-19. The pattern of light reflecting spots is not limited to that shown in Fig. 4 and may vary in size and density. *Id.* at 6:54-61.

Fig. 4



73. As can be seen above in Fig. F, light reflecting film 7 is separated from light

diffusing layer 3 and light diffusing plate 6 by air gaps.

1. Claims 1-4 and 26 are Anticipated by Ohe

a. Claim 1

74. Claim 1 of the '547 Patent recites:

> 1. A backlight assembly comprising
> a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member,
> a separate transparent sheet or film overlying the light emitting area with an air gap therebetween,
> a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film,
> the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss.

75. Ohe discloses a light diffusing device that is a backlight assembly. Ohe discloses that "[t]he present invention relates to a **light diffusing device**. Particularly, the present invention relates to an improved light diffusing device useful for every illuminating a relatively large area at a significantly reduced optical loss." Ex. 1007, Ohe, at 1:6-10 (emphasis added). Accordingly, Ohe discloses "[a] backlight assembly," as required by claim 1 of the '547 Patent.

76. Ohe also discloses a light emitting member, base plate 1, with a light emitting surface. "Referring to FIG. 1, the base plate 1 has a pair of light incident edge faces facing and exposed to light sources (for instance, fluorescent lamps) B and C which are provided with reflectors D and E, respectively." Ex. 1007, Ohe, at 4:4-8.

77. The light emitting area of Ohe also emits light that is internally reflected within the light emitting member. For example, "[r]eferring to FIGS. 1, 2 and 4, when the light sources (fluorescent lamp) B and C are lit, the irradiated light is introduced into the transparent light transmitting layer 2 through the light incident edge face thereof facing the light sources. The introduced light, portions of which are reflected by the light reflecting surface layer 5 and by the light reflecting edge face layer 8 and returned into the transparent light transmitting layer 2, are transmitted to the light diffusing layer 3 through the intermediate layer 4. The light is diffused by the light diffusing layer 3 and is irradiated to the light diffusing plate 6 through the light reflecting film 7." *Id.* at 8:4-15.

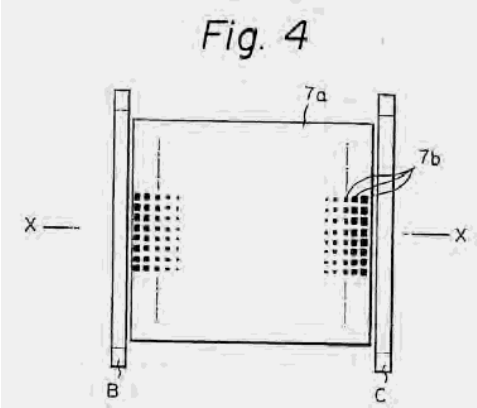
78. Accordingly, Ohe discloses "a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member," as required by claim 1 of the '547 Patent.

79. Ohe also discloses a film, sheet or substrate overlying the light emitting area. In Ohe, this is light reflecting film 7. First, "the base plate 1 **the light reflecting film 7,** and the light diffusing plate 6 have rectangular plane configurations similar in shape and dimensions to each other." Ex. 1007, Ohe, at 3:66-4:2 (emphasis added); *see also* Fig. 1. Second, an air gap also exists between the light refelcting film 7 and base plate 6. Specifically, Ohe discloses that "[t]his light refelcting film 7 consists of a transparent substrate film and a number of light refelcting small spots or small palces formed on the transparent substrate film in a pattern effective for evenly distributing

the quantity of light transmitted from the base plate 1 to the light diffusing plate 6. The light refelcting film 7 is not forced into close contact or adhesion with the light diffusing plate 6 and the light diffusing layer 3 in the base plate 1. That is, the light refelcting film 7 is spaced from the light diffusing plate 6 by a **very thin gap** and from the light diffusing layer 3 also by a **very thin gap**. **These very thin gaps form very thin air layers**." *Id.* at 3:47-59 (emphasis added). Accordingly, Ohe discloses "a separate transparent sheet or film overlying the light emitting area with an air gap therebetween," as required by claim 1 of the '547 Patent.

80. Ohe discloses deformities on an overlying film. According to Ohe, "[a] light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of **light reflecting small spots or small places** formed on the transparent substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6." *Id.* at 3:47-52 (emphasis added).

81. Ohe also discloses that these deformities are small. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." *Id.* at 6:3-9. This can also be seen in Fig. 4 below.



82. Accordingly, Ohe discloses "a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film," as required by claim 1 of the '547 Patent.

83. As discussed above at ¶¶80-81, Ohe discloses deformities varying at different locations on the sheet or film. This can be seen in Fig. 4 of Ohe above.

84. Ohe also discloses the light is emitted for large display systems with reduced optical loss. According to Ohe, "[t]he light diffusing device of the present invention provides a **highly uniform illumination** with evenly scattered light at a **reduced optical loss.** That is, the light diffusing device of the present invention is extremely useful for a **large size display system**." Ex. 1007, Ohe, at 8:31-35 (emphasis added). Also, "[a]nother object of the present invention is to provide a light diffusing device having a **significantly decreased optical loss."** *Id.* at 2:34-36 (emphasis added). One of skill in the art would understand that a large size display system would include an LCD. Also, "reduced optical loss" and "decreased optical loss" are different ways for saying "low loss."

85. Accordingly, Ohe discloses "the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss," as required by claim 1 of the '547 Patent. As explained in detail above, Ohe discloses each and every element of claim 1 in a single embodiment. Therefore, claim 1 is anticipated by Ohe.

b. Claim 2

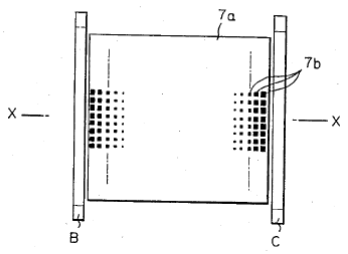
86. Claim 2 of the '547 Patent recites:

> 2. The assembly of claim 1 wherein the deformities vary in size at different locations on the sheet or film to direct the light in different directions.

87. Ohe describes "[t]he assembly of claim 1," as shown above in ¶¶75-85.

88. Ohe discloses deformities varying in size. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." Ex. 1007, Ohe, at 6:3-9; *see also* Fig. 4 below.

Fig. 4



89. Further, "**[t]he size of the light reflecting spots may vary** with the distance from the light source, as shown in FIG. 5. Also, the light reflecting spots having the same size may be distributed at a different distribution density on the transparent film substrate." *Id.* at 4:56-61 (emphasis added).

90. Accordingly, Ohe discloses "the deformities vary in size at different locations on the sheet or film to direct the light in different directions," as required by claim 2 of the '547 Patent.

c. Claim 3

91. Claim 3 of the '547 Patent recites:

> 3. The assembly of claim 1 wherein the deformities vary in shape at different locations on the sheet or film to direct the light in different directions.

92. Ohe describes "[t]he assembly of claim 1," as shown above in ¶¶75-85.

93. Ohe discloses varying deformities on a sheet or film. First, Ohe discloses deformities on a sheet or film overlying a light emitting surface. Ohe discloses "[a] light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of light reflecting small spots or small places formed on the transparent substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6." Ex. 1007, Ohe, at 3:45-52. Second, these light reflecting spots may vary in shape. Ohe recites: "Usually, the light reflecting film comprises a transparent film substrate and a number of light

reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." *Id.* at 6:3-9. One of ordinary skill in the art would understand that a change in configuration of a deformity would be a change in shape.

94. Accordingly, Ohe discloses "the deformities vary in shape at different locations on the sheet or film to direct the light in different directions," as required by claim 3 of the '547 Patent.

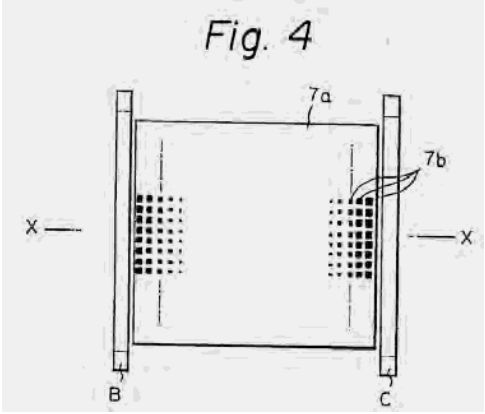
d. Claim 4

95. Claim 4 of the '547 Patent recites:

> 4. The assembly of claim 1 wherein the deformities vary in placement at different locations on the sheet or film to direct the light in different directions.

96. Ohe describes "[t]he assembly of claim 1," as shown above in ¶¶75-85.

97. The limitation of deformities varying in placement at different locations is disclosed by Ohe. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." Ex. 1007, Ohe, at 6:3-9; *see also* Fig. 4 below.



98. Further, "**[t]he size of the light reflecting spots may vary with the distance** from the light source, as shown in FIG. 5. Also, the light reflecting spots having the same size may be distributed at a different distribution density on the transparent film substrate." *Id.* at 4:56-61 (emphasis added).

99. Also, "[r]eferring to FIG. 4, t**he size (area) and the distribution density of the light reflecting spots 7b decreases with an increase in the distance from the light source B or C**. A total area of the spots in the light reflecting film 7 in the above-mentioned end portions thereof increases with decrease in the distance from the light source B or C. In the middle portion of the light reflecting film, the light reflecting spots are not arranged on the transparent film substrate." *Id.* at 6:15-23 (emphasis added). One of skill in the art would understand that a variation in distribution density results in a variation in placement at different locations on the film 7.

100. Accordingly, Ohe discloses "the deformities vary in placement at different locations on the sheet or film to direct the light in different directions," as required by

claim 4 of the '547 Patent.

e. Claim 26

101. Claim 26 of the '547 Patent recites:

> 26. The assembly of claim 1 wherein at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions.

102. Ohe describes "[t]he assembly of claim 1," as shown above in ¶¶75-85.

103. As discussed above, Ohe discloses deformities on film 7 that may vary size, configuration, and distribution density. "The size of the light reflecting spots may vary with the distance from the light source, as shown in FIG. 5. Also, the light reflecting spots having the same size may be distributed at different distribution density on the transparent film substrate." Ex. 1007, Ohe, at 6:56-61. Changes in configuration of the light reflecting spots would result in random or varying changes in shapes on the film 7.

104. Accordingly, Ohe discloses "at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions," as required by claim 26 of the '547 Patent.

B. U.S. Patent No. 5,598,280 ("Nishio")

105. Nishio is directed to an assembly capable of emitting uniform, high-luminance light within a desired angular range without increasing the power consumption. Ex. 1008, Nishio, at 2:40-45. According to Fig. G (annotated Figs. 6 and 8 of Nishio)

below, the light guide plate 1 (red) with a light source 3 (yellow) located adjacent to at least one spot of the terminal portion of the light guide plate 1, has a light reflecting layer 2 (lilac) on one side, and a gap portion 9 (green) and a lens sheet 4 (orange) on the opposite side. *Id.* at 7:5-13. Further, a light source reflector 5 (white) is located near the light source, in addition to a "**housing** (not shown) **containing all the elements** and having a light emitting surface in the form of a window, a power source (not shown), etc." *Id.* at 7:13-17 (emphasis added).

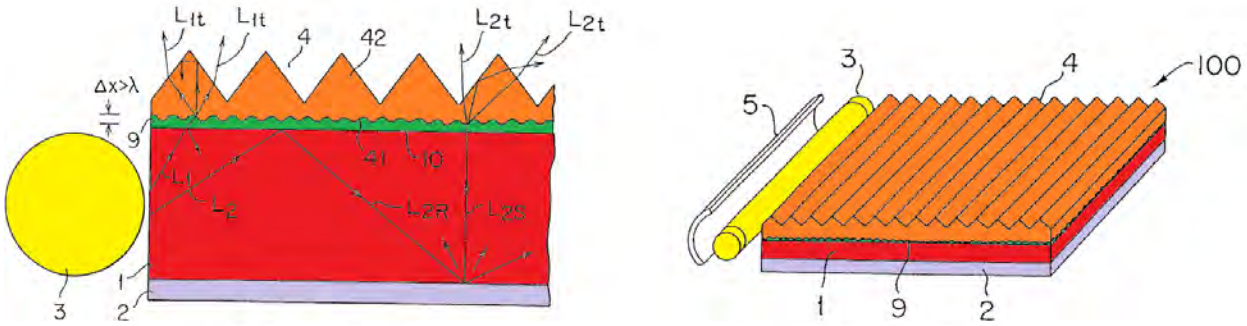


Figure G (annotated Figs. 6 and 8 of Ex. 1008, Nishio)

1. Claims 1, 3, 4, and 16 are Anticipated by Nishio

a. Claim 1

106. Claim 1 of the '547 Patent recites:

> 1. A backlight assembly comprising
> a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member,
> a separate transparent sheet or film overlying the light emitting area with an air gap therebetween,
> a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film,

> the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss.

107. Nishio discloses "a film lens and a surface light source using the same, and more particularly, to a **surface light source** adapted for back-lighting for a display unit, such as a liquid crystal display unit, illuminated advertising display, traffic-control sign, etc." Ex. 1008, Nishio, at 1:7-11 (emphasis added). Accordingly, Nishio describes "[a] backlighting assembly," as required by claim 1 of the '547 Patent.

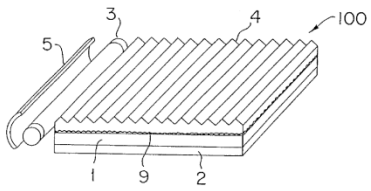


FIG. 8

108. Nishio discloses a light guide plate 1. *Id.* at 7:9, and Figs. 6 and 8 above. As previously discussed, the panel member of the '547 Patent can also be referred to as a light guide. *See supra*, at ¶43.

109. Nishio also discloses the light guide 1 has a light emitting area that emits light that is internally reflected within the light emitting member. Specifically, Nishio discloses that "[t]he projections 41 are designed so that a gap 9 having a width Δx not smaller than the wavelength of the source light is formed at least partially between a smooth surface 10 of a **light guide plate 1** and the lens sheet 4, as shown in FIG. 6. If the gap width Δx is smaller than the wavelength of the source light, as mentioned

later, **satisfactory total reflection of light** on the smooth surface 10 of the plate 1 cannot be enjoyed. If the gap width is greater than 10 μm, on the other hand, the indentations of the projections 41 are improperly conspicuous." Ex. 1008, Nishio, at 6:29-38 (emphasis added). Also, "the projections 41 may have any rugged contour provided that the above object is achieved. Preferably, however, irregular indentations (e.g., sand-grain patterns, pear-skin patterns, etc.) are formed all over the reverse side of the lens sheet 4, as shown in FIGS. 6, 7, 10 and 11, **in order to obtain an angular distribution for uniform luminance within a desired diffusion angle and a uniform luminance distribution within the light source plane**. In this arrangement, the projection group 41 also serves as a light diffusion layer which diffuses light beams L1, L2S, etc. incident upon the reverse side of the lens sheet 4 in an isotropic manner." Ex. 1008, Nishio, at 6:39-50 (emphasis added).

110. Accordingly, Nishio describes "a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member," as required by claim 1 of the '547 Patent.

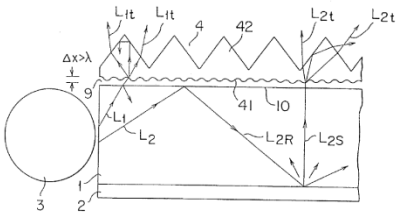


FIG. 6

111. Nishio discloses a lens sheet 4 that is located on one side of the light guide plate 1, and on the opposite side of light reflecting layer 2. *Id.* at 7:11-13, Figs. 6, 8

above.

112. Nishio discloses that the lens sheet 4 has projections 41 on its reverse side. *Id.* at 6:12-13, Fig. 7. Additionally, between projections 41 on lens sheet 4 and light guide plate 1, there is a gap portion 9. *Id.* at 7:53-54, Figs. 6, 8 above. "The projections 41 are designed so that a **gap 9** having a width Δx not smaller than the wavelength of the source light is formed at least partially between a smooth surface 10 of a light guide plate 1 and the lens sheet 4, as shown in FIG. 6." *Id.* at 6:29-33 (emphasis added). "At the **gap portion 9**, the light guide plate 1, usually having the refractive index of about 1.5, and an air (or vacuum) layer with the refractive index of about 1.0 adjoin each other with the surface 10 as an interface, so that total reflection of light occurs in the same manner as in the case of FIG. 1." *Id.* at 9:55-60 (emphasis added).

113. Accordingly, Nishio describes "a separate transparent sheet or film overlying the light emitting area with an air gap therebetween," as required by claim 1 of the '547 Patent.

114. Nishio discloses that lens sheet 4 can include "a group of cylindrical unit lenses 42 (lenticular lenses in a broad sense) adjacently arranged with their respective longitudinal axes (ridges) parallel to one another, as shown in FIG. 7, or of an ommateal lens including a number of protuberant unit lenses 42, e.g., each in the form of a hemispherical projection having an independent circumference, which are arranged in a two-dimensional manner." *Id.* at 4:50-58. The lens elements 42, illustrated as prisms in Figs. 6 and 7, and the protuberant unit lenses 42 have one or

more reflective or refractive surfaces because of their function, as illustrated by annotated Fig. 6 below. The lines show the light rays either being reflected (blue) or refracted (red) by the lenses 42; the blue ray at right shows both phenomena.

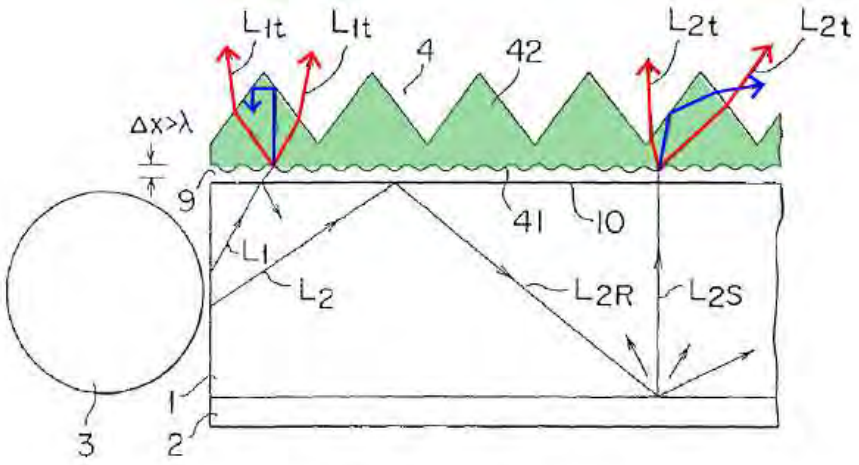


FIG. 6

Figure D (annotated Fig. 6 from Ex. 1008, Nishio)

115. Additionally, Nishio discloses that "[a] group of projections 41 on the reverse side of the lens sheet, having a profile height not smaller than the wavelength of a source light and not greater than 100 μm, may be formed directly on the reverse side of the integrally molded lens sheet 4 by heat-press embossing, sandblasting, etc., as shown in FIG. 7, or obtained by forming a light transmitting material layer having projections on the flat reverse side of the sheet 4, as shown in FIG. 11." *Id.* at 6:12-19. The projections have one or more reflective or refractive surfaces because they are microprisms. *See supra*, at ¶46.

116. Accordingly, Nishio describes "a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and

length of the sheet or film," as required by claim 1 of the '547 Patent.

117. Nishio discloses that "[t]he profile of each unit lens may have the shape of a continuous smooth curve, e.g., circular, elliptic, cardioid, Rankine's-egg-shaped, cycloid, or involute, as shown in FIGS. 13 and 14. Alternatively, the profile may be formed of part or whole of a polygon, such as a triangle or hexagon, as shown in FIG. 7." Ex. 1008, Nishio, at 4:59-64. As previously discussed, deformities can be microlenses. *See supra*, at ¶49. The unit lenses having particular shapes listed qualify as deformities because they are "any change in the shape or geometry of a surface and/or coating or surface treatment that causes a portion of the light to be emitted," as I interpret it. *See supra*, at ¶67. These deformities may also vary at different locations on the sheet or film because they may have any shape and "[t]he projections 41 may have **any rugged contour** . . . ." Ex. 1008, Nishio, at 6:39-50 (emphasis added). One form of projections having a roughed contour would be projections created by surface roughening. As discussed above in Section III, surface roughening creates deformities that vary randomly on the surface, here the film or sheet. Thus, one of skill in the art would understand that projections having a rugged contour on a sheet or film would mean that the deformities or projections, vary at different locations on the sheet or film.

118. Further, Nishio is aimed at "provid[ing] a film lens and a surface light source using the same, capable of **emitting uniform, high-luminance light only within a desired angular range, and free from variation in luminance depending on the**

in-plane position." Ex. 1008, Nishio, at 2:40-45 (emphasis added). For Nishio to emit light as described in this passage, one of skill in the art would understand that the light passes through the LCD with low loss. Accordingly, Nishio describes "the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in different directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss," as required by claim 1 of the '547 Patent. As explained in detail above, Nishio discloses each and every element of claim 1 in a single embodiment. Therefore, claim 1 is anticipated by Nishio.

b. Claim 3

119. Claim 3 of the '547 Patent recites:

> 3. The assembly of claim 1 wherein the deformities vary in shape at different locations on the sheet or film to direct the light in different directions.

120. Nishio discloses "[t]he assembly of claim 1," as shown above in ¶¶107-118. Nishio discloses that "The profile of each unit lens may have the shape of a continuous smooth curve, e.g., **circular, elliptic, cardioid, Rankine's-egg-shaped, cycloid, or involute,** as shown in FIGS. 13 and 14. Alternatively, the profile may be formed of part or whole of a polygon, such as a triangle or hexagon, as shown in FIG. 7." Ex. 1008, Nishio, at 4:59-64 (emphasis added); *see also* 6:12-23, 9:20-24. Nishio clearly discloses several types of deformity profiles. Thus, Nishio inherently discloses combining and varying these types within the same sheet or film. Nishio also

discloses that "[t]he projections 41 may have **any rugged contour** . . . ." *Id.* at 6:39-50 (emphasis added). A person of skill in the art would understand this to mean a random, rough surface that necessarily varies in size, shape, orientation, depth, etc. form one position to another.

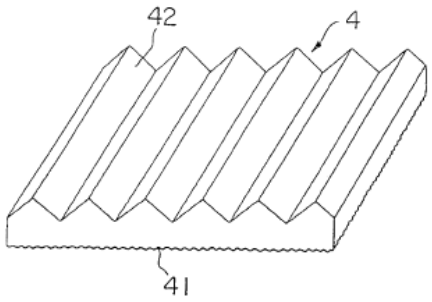


FIG. 7

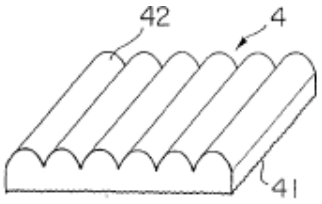


FIG. 13

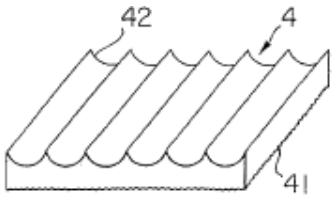


FIG. 14

121. Accordingly, Nishio describes "the deformities vary in shape at different locations on the sheet or film to direct the light in different directions," as required by claim 3 of the '547 Patent.

c. Claim 4

122. Claim 4 of the '547 Patent recites:

> 4. The assembly of claim 1 wherein the deformities vary in placement at different locations on the sheet or film to direct the light in different directions.

123. Nishio discloses "[t]he assembly of claim 1," as shown ¶¶107-118.

124. Further, regarding Fig. 12, Nishio discloses "the projection group 41 may be **composed of spaced dotted patterns, such as mesh patterns, which are distributed within the plate**. Since the patterns 41 arranged in this manner are too conspicuous, however, dispersing the flatting agent in the lens sheet 4 or other

measure is required." Ex. 1008, Nishio, at 6:66-7:4 (emphasis added). Deformities of spotted or mesh patterns that are distributed within the plate would result in arrangement of deformities that vary in placement at different locations. Accordingly, Nishio discloses "the deformities vary in placement at different locations on the sheet or film to direct the light in different directions," as required by claim 4, of the '547 Patent.

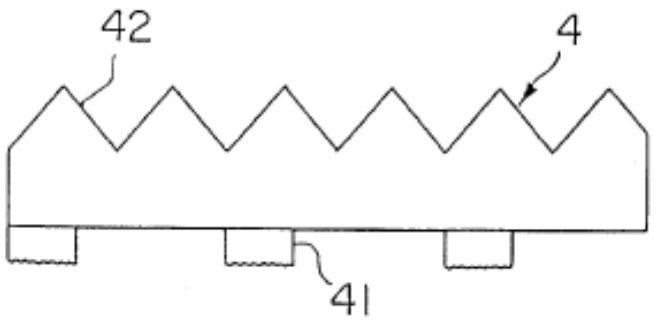


FIG. 12

d. Claim 16

125. Claim 16 of the '547 Patent recites:

> 16. The assembly of claim 1 wherein the deformities are at least one of prisms, prismatic and lenticular.

126. Nishio discloses "[t]he assembly of claim 1," as shown above ¶¶107-118.

127. Nishio discloses deformities as shown above in ¶¶114-116.

128. According to Nishio, the deformities may be lenticular. Nishio discloses that "[t]he profile of each **unit lens** may have the shape of a continuous smooth curve,

e.g., **circular, elliptic, cardioid, Rankine's-egg-shaped, cycloid, or involute**, as shown in FIGS. 13 and 14. Alternatively, the profile may be formed of part or whole of a polygon, such as a triangle or hexagon, as shown in FIG. 7." Ex. 1008, Nishio, at 4:59-64 (emphasis added). It would have been obvious to one of skill in the art to apply the deformities from one side of the sheet to the other side. Accordingly, Nishio discloses "deformities are at least one of prisms, prismatic and lenticular," as required by claim 16 of the '547 Patent.

C. U.S. Patent No. 5,005,108 ("Pristash")

129. Pristash is directed to a thin panel illuminator for more efficient light transmission. This is similar to '547 Patent, which relates to panel assemblies configurations providing better control of light output and more efficient utilization of light. Ex. 1001, the '547 Patent, at 1:21-25. To accomplish this, Pristash discloses a wave guide (similar to a light pipe as discussed above) containing prismatic deformities along its top surface. This can be seen in one of the disclosed embodiments in Fig. 1, as disruptions 16 on wave guide 15. These deformities help produce a desired output distribution. Ex. 1006, Pristash, at 1:30-49.

130. Other embodiments with different deformities can be seen in Fig. 5, with deformities 42 along the top of prism edges 43, and also in Fig. 6, with diffuser surfaces 46 along the top edges 47 of the prismatic surfaces 48. Regarding Fig. 5, these deformities "may be of any desired shape that causes light to be emitted, and may vary in depth and shape along the length of the prism edges 43 to produce a

desired output distribution." *Id.* at 4:49-54.

131. Pristash teaches several different embodiments of the light emitting panel illuminators. A person of ordinary skill in the art would have been motivated to combine elements of a particular embodiment with other elements of other embodiments disclosed in Pristash for several reasons. First, all of the configurations taught by Pristash are aimed to be less expensive and provide for "better control over the light output form the panel," and "more efficient transmission of light from a light source to the light emitting panel." *Id.* at 1:11-16. Second, Pristash specifically acknowledges that "it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon reading and understanding of the specification." *Id.* at 9:3-5. Therefore, it would be obvious to a person of ordinary skill in the art to alter one embodiment with a feature taught in the same patent but from a different embodiment. Finally, Pristash does not limit the combination of any of the elements for the embodiments. Specifically, Pristash does not teach away from any combinations of embodiments presented herein.

1. Claims 1-4, 16, and 26 are Obvious in View of Pristash

a. Claim 1

132. Claim 1 of the '547 Patent recites:

> 1. A backlight assembly comprising
> a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member,
> a separate transparent sheet or film overlying the light emitting area with an air gap therebetween,

> a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film,
> the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss.

133. Pristash discloses a light emitting assembly of claim 1 as can be seen in the Background of the Invention Section. Specifically, the background discloses:

> This invention relates generally, as indicated, to a thin panel illuminator including a solid transparent panel member for conducting light and extractor means for causing light conducted by the panel member to be emitted along the length thereof. Light panel illuminators are generally known. However, the present invention relates to several different panel illuminator configurations which are less expensive to make and/or provide for better control over the light output from the panel. Also, the present invention provides for more efficient transmission of light from a light source to the light emitting panel."

Ex. 1006, Pristash, at 1:5-16. As a result, Pristash teaches "[a] backlight assembly," as required by claim 1 of the '547 Patent.

134. Pristash discloses "**solid transparent prismatic film 51** having a prismatic surface 52 on one side and a back reflector 53 on the other side." *Id.* at 5:6-11 (emphasis added). The solid transparent prismatic film 51 is also referred to as a wave guide 51 ("The second prismatic film 60 may be separated from the first prismatic film or **wave guide 51** by air or an epoxy filled gap 61." *Id.*, at 5:25-27 (emphasis added)). As previously discussed, a light emitting panel member is also known as a

wave guide. *See supra*, at ¶43.

135. Pristash also discloses internally reflected light within the light emitting member. "**Light rays** may be caused to enter the panel 50 perpendicular to the wave guide prism edges 54 from one or both edges 55, 56 of the panel, and **are internally reflected** until they strike a deformity (in this case an edge 54 of panel prismatic surfaces 52) which causes the light rays to be emitted." Ex. 1006, Pristash, at 5:6-16 (emphasis added).

136. Accordingly, Pristash teaches "a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member," as required by claim 1 of the '547 Patent.

137. Pristash discloses "the panel 50 includes a **second prismatic film 60** disposed in close proximity to the panel prismatic surface 52 to shift the angular emission of light toward a particular application." *Id.* at 5:22-25 (emphasis added). This second prismatic film 60 is a separate transparent sheet or film overlying the first prismatic film 51 (*i.e.*, the light emitting area of the light emitting member), separated by a gap 61, as shown in Fig. 7 below. In the panel member of Pristash, "[t]he second prismatic film 60 may be separated from the first prismatic film or wave guide 51 by **air** or an epoxy filled **gap 61**." *Id.* at 5:25-27 (emphasis added). Accordingly, Pristash teaches "a separate transparent sheet or film overlying the light emitting area with an air gap therebetween," as required by claim 1 of the '547 Patent.

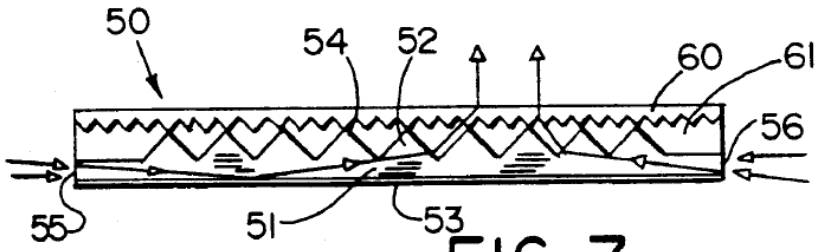


FIG. 7

138. Pristash also discloses a pattern of deformities on one side of the sheet with a small width and length in relation to the width and length of the sheet. As shown in Fig. 5 below, the deformities vary along the length of the panel member along the length of prism edges 43. While "**deformities 42** are shown as being of a generally **triangular shape, they may be of any desired shape that causes light to be emitted**, and **may vary in depth and shape along the length of the prism edges 43** to produce a desired light output distribution." *Id.* at 4:49-54 (emphasis added). As can be seen in Fig. 5, the deformities 42 are quite small in relation to the length and width of the film.

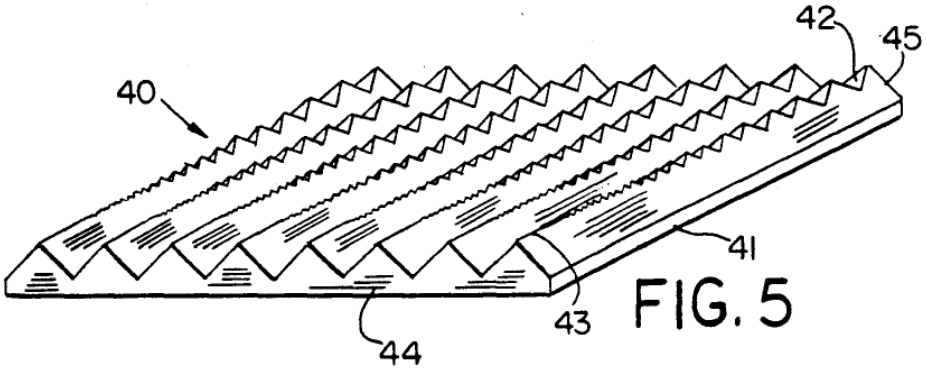


FIG. 5

139. Pristash also discloses that "both of the **light emitting panels 40 and 49** shown in FIGS. 5 and 6 may have **prismatic surfaces on both the top and bottom surfaces rather than on just one surface as shown**, and one or the other of the top

or bottom surface may be provided with a back reflector similar to the back reflector 34 shown in FIG. 4 to redirect emitted light back through the panel toward a particular application." *Id.* at 4:66-5:5 (emphasis added).

140. Pristash discloses a pattern of deformities on the wave guide. Pristash also discloses a second prismatic film overlying the wave guide. It would have been obvious to one of skill in the art to apply the prismatic film styles in Figs. 5 and 6 to any prismatic surface, including the second prismatic film 60.

141. Accordingly, Pristash discloses "a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film," as required by claim 1 of the '547 Patent.

142. Pristahs also discloses deformities varying at different locations. First, as discussed above, Pristash discloses deformities of a different type. In discussing the deformities in Fig. 5 above, Pristash explains that "[a]lthough the **deformities 42** are shown as being of a generally triangular shape, they **may be of any desired shape** that causes light to be emitted, and **may vary in depth and shape** along the length of the prism edges 43 to produce a desired light output distribution." *Id.* at 4:49-54 (emphasis added). Regarding the deformities in Fig. 6 below, Pristash explains that "diffuser surfaces 46 may be formed along the top edges 47 of the prismatic surfaces 48 of a prismatic film light emitting panel 49 as schematically shown in FIG. 6. These **diffuser surfaces 46** may vary in depth and/or width along the length of the panel 49, and **may comprise a roughened surface, a lenticular surface, or a prismatic**

surface or the like that consists of multiple surface deformities. A roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling." *Id.* at 4:57-66 (emphasis added). Also, regarding Fig. 1, Pristash explains that "if the exterior surface 18 is mechanically deformed at decreasingly spaced intervals as the distance from the light source 3 increases, there will be more uniform emission of light from the surface 18 when viewed from a distance. Also, such **disruptions 16 may vary in depth and shape along the length** of the panel 2 to produce a desired light output distribution." *Id.* at 3:42-48 (emphasis added).

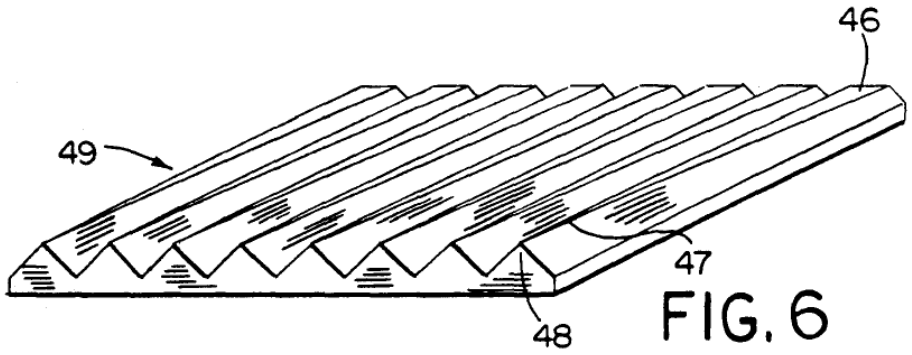


FIG. 6

143. Finally, Pristash discloses that light will pass through the LCD with low loss because the invention provides a more efficient transmission of light from the light source to the panel. Specifically, Pristash discloses that "the present invention relates to several different panel illuminator configurations which are less expensive to make and/or provide for better control over the light output from the panel. Also, the present invention provides for **more efficient transmission** of light from a light source to the light emitting panel." *Id.* at 1:10-16 (emphasis added). A person of

ordinary skill in the art would understand that when there is more efficient light transmission from the light source to the emission surface of the light emitting panel, this means light passes through with low loss.

144. Accordingly, Pristash teaches "the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss," as required by claim 1 of the '547 Patent. As discussed above, Pristash discloses every element of claim 1 of the '547 Patent. Therefore, claim 1 of the '547 Patent is obvious over Pristash.

b. Claim 2

145. Claim 2 of the '547 Patent recites:

> 2. The assembly of claim 1 wherein the deformities vary in size at different locations on the sheet or film to direct the light in different directions.

146. Pristash teaches "[t]he assembly of claim 1," as shown above in ¶¶133-144.

147. The deformities of Pristash may also vary in size. According to Pristash, "such disruptions 16 **may vary in depth** and shape along the length of the panel 2 to produce a desired light output distribution." Ex. 1006, Pristash, at 3:46-48 (emphasis added). Also, "FIG. 5 shows another form of light emitting panel 40 in accordance with this invention comprising a solid transparent prismatic film 41 having deformities 42 cut, molded or otherwise formed along the top of the prism edges 43. Although the **deformities 42 are shown as being of a generally triangular shape,**

they may be of any desired shape that causes light to be emitted, and **may vary in depth and shape along the length of the prism edges 43** to produce a desired light output distribution." *Id.* at 4:45-54 (emphasis added).

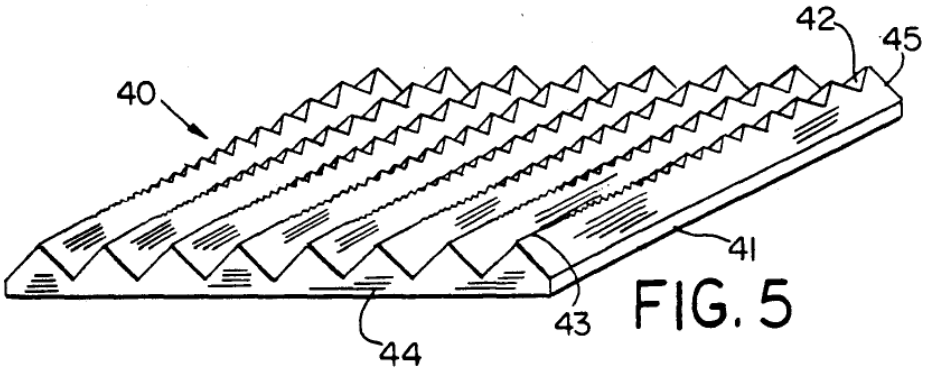


FIG. 5

148. One of skill in the art would understand that one way deformities may vary is size is by varying in depth. As such, Pristash discloses "the deformities vary in size at different locations on the sheet or film to direct the light in different directions," as required by claim 2 of the '547 Patent.

c. Claim 3

149. Claim 3 of the '547 Patent recites:

> 3. The assembly of claim 1 wherein the deformities vary in shape at different locations on the sheet or film to direct the light in different directions.

150. Pristash teaches "[t]he assembly of claim 1," as shown above in ¶¶133-144.

151. The deformities of Pristash may also vary in shape. According to Pristash, "FIG. 5 shows another form of light emitting panel 40 in accordance with this invention comprising a solid transparent prismatic film 41 having deformities 42 cut, molded or otherwise formed along the top of the prism edges 43. Although the

deformities 42 are shown as being of a generally triangular shape, they **may be of any desired shape** that causes light to be emitted, and **may vary in** depth and **shape along the length of the prism edges 43** to produce a desired light output distribution." Ex. 1006, Pristash, at 4:45-54 (emphasis added).

152. Also, "diffuser surfaces 46 may be formed along the top edges 47 of the prismatic surfaces 48 of a prismatic film light emitting panel 49 as schematically shown in FIG. 6. These **diffuser surfaces 46** may vary in depth and/or width along the length of the panel 49, and **may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities**. A roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling." *Id.* at 4:57-66 (emphasis added).

153. Accordingly, Pristash discloses "the deformities vary in shape at different locations on the sheet or film to direct the light in different directions," as required by claim 3 of the '547 Patent.

d. Claim 4

154. Claim 4 of the '547 Patent recites:

> 4. The assembly of claim 1 wherein the deformities vary in placement at different locations on the sheet or film to direct the light in different directions.

155. Pristash teaches "[t]he assembly of claim 1," as shown above in ¶¶133-144.

156. As discussed above, Pristash discloses deformities that vary in density and shape along the length of the film. *See supra*, at ¶147. One of skill in the art would

understand that means the deformities may vary in placement at different locations because variation in density results in variation in placement in the x-direction.

157. Pristash also discloses that the deformities may vary in depth. *See supra*, at ¶148. One of skill in the art would also understand that this means the deformities will vary in placement at different locations on the sheet because variation in depth would results in variation in placement in the y-direction.

158. Accordingly, Pristash discloses "the deformities vary in placement at different locations on the sheet or film to direct the light in different directions," as required by claim 4 of the '547 Patent.

e. Claim 16

159. Claim 16 of the '547 Patent recites:

> 16. The assembly of claim 1 wherein the deformities are at least one of prisms, prismatic and lenticular.

160. Pristash teaches "[t]he assembly of claim 1," as shown above in ¶¶133-144.

161. Pristash also teaches deformities as shown above in ¶¶140-142.

162. The deformities may also be lenticular or prismatic. Pristash discloses that "diffuser surfaces 46 may be formed along the top edges 47 of the prismatic surfaces 48 of a prismatic film light emitting panel 49 as schematically shown in FIG. 6. These **diffuser surfaces** 46 may vary in depth and/or width along the length of the panel 49, and **may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities.** A roughened

surface, for example, may be produced by grinding, sanding, laser cutting or milling." Ex. 1006, Pristash, at 4:57-66 (emphasis added).

163. Accordingly, Pristash discloses "the deformities are at least one of prisms, prismatic and lenticular," as required by claim 16.

f. Claim 26

164. Claim 26 of the '547 Patent recites:

> 26. The assembly of claim 1 wherein at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions.

165. Pristash teaches "[t]he assembly of claim 1," as shown above in ¶¶133-144.

166. Pristash also teaches deformities as shown above in ¶¶140-142.

167. The deformities may also have random or varying changes in shape. First, as discussed above, the deformities may vary in depth and shape along the prism edges. Ex. 1006, Pristash, at 4:45-54; *see also* Fig. 5. Second, Pristash also discloses that the deformities may vary randomly. According to Pristash, "[t]he size, shape and depth of the wave guide deformities 52 may be varied along the length of the panel to produce a desired light output distribution." *Id.* at 5:17-19. Further, "[t]hese diffuser surfaces 46 may vary in depth and/or width along the length of the panel 49, and may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities. A **roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling**." *Id.* at 4:60-66

(emphasis added). Deformities on a roughened surface created by grinding, sanding, and milling must vary randomly, since these methods necessarily produce irregular scratches and indents. *Cf.* Ex. 1020, Takeuchi, at 8:28-33, 15:35-38, Figs. 13 and 22. Accordingly, Pristash discloses "at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions," as requried by claim 26 of the '547 Patent.

D. U.S. Patent No. 5,408,388 ("Kobayashi")

168. Kobayashi discloses a planar illuminating device having "increased illuminance" and an "increased uniformity in surface illumination." Ex. 1009, Kobayashi, at 2:14-16, 2:59-61. This is similar to the '547 Patent, which relates to panel assembly configurations providing better control of light output and more efficient utilization of light. Ex. 1001, the '547 Patent, at 1:23-28.

169. Kobayashi discloses prismatic cuts on the front surface of the light transmitting plate, a reflecting finish comprising an assembly of spot-shaped layers applied to the rear surface of the light transmitting plate, or a satin finish on the rear surface of the light transmitting plate comprising an assembly of spot-shaped layers applied to the satin finish. Ex. 1009, Kobayashi, at 2:28-54.

170. As shown in Fig. H (annotated Figs. 1 and 2 of Kobayashi) below, the front portion of light transmitting plate 2 has prismatic cuts 21. *Id.* at 4:25-26. On the opposite side of light transmitting plate 2, the rear surface, Kobayashi discloses a reflecting finish, for example, an array of spot-shaped light reflecting layers 22. *Id.* at

4:26-29. A prismatic sheet with the same prismatic cuts 21 may be provided between the light diffusing sheet 4 and the light transmitting plate 2.

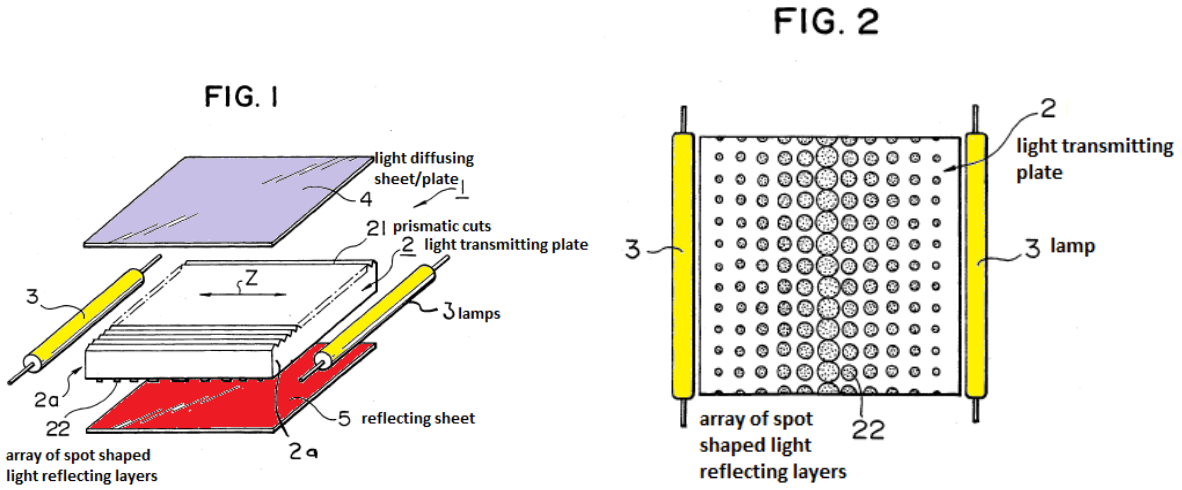


Figure H (annotated Figs. 1 and 2 of Ex. 1009, Kobayashi)

171. This arrangement in Kobayashi achieves the objective of the '547 Patent—better control of light and more efficient light utilization. Specifically, this arrangement "increases both the surface illuminance and the uniformity in the surface illuminance of diffusing sheet 4." *Id.* at 4:30-32.

1. Claims 1-4, 16, and 26 are Obvious Over Kobayashi in View of Ohe

a. Claim 1

172. Claim 1 of the '547 Patent recites:

> 1. A backlight assembly comprising
> a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member,
> a separate transparent sheet or film overlying the light emitting area with an air gap therebetween,
> a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to

> the width and length of the sheet or film,
> the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss.

173. Kobayashi discloses a light emitting panel assembly, which can be seen in Fig. 1 above.

174. Furthermore, Kobayashi "relates to a **planar illuminating device** used as a back light for liquid crystal displays of portable office automation apparatuses such as a word processor or a personal computer." Ex. 1009, Kobayashi, at 1:6-9 (emphasis added). "FIG. 1 shows a **planar illuminating device** according to a first embodiment of the present invention." *Id.* at 4:8-9 (emphasis added). Accordingly, Kobayashi discloses "[a] backlight assembly," as required by claim 1 of the '547 Patent.

175. Kobayashi discloses "[a] planar illuminating device 1 comprises a **rectangular light transmitting plate 2** of a transparent material such as acrylic resin or polycarbonate. . . . " *Id.* at 4:9-21 (emphasis added); *see also* Fig. 1 above. The transmitting plate 2 is a light emitting member. The light is also internally reflected. According to Kobayashi, "[t]he prismatic cuts 21 provide faces constiuting an elevation angle to the travel dirction of rays of light from the sources of light 3 **propogating through the light transmitting plate 2**." *Id.* 5:19-22 (emphasis added). Accordingly, Kobayashi discloses "a light emitting member having at least

one light emitting area that emits light that is internally reflected within the light emitting member," as required by claim 1 of the '547 Patent.

176. Kobayashi also discloses prismatic sheet 6 overlying the light emitting area of transmitting plate 2 with an air gap therebetween. First, Kobayashi discloses "[t]he planar illuminating device 1 according to the third embodiment further provides between the light transmitting plate 2 and the light diffusing 4 a prismatic sheet 6 the front portion of which has substantially the same prismatic cuts as the prismatic cuts 21 but has the axes Y of the prismatic cuts transverse to the axes Z of the prismatic cuts 21." Ex. 1009, Kobayashi, at 6:3-10. Second, Kobayashi discloses "[a] planar illuminating device 1 comprises a rectangular light transmitting plate 2 of a transparent material such as acrylic resin or polycarbonate, a pair of tubular flourescent laps 3, 3 arranged along opposite side edge surfaces 2a, 2a of the light transmitting plate 2, **a light diffusing sheet or plate 4 having the same rectangular front surface size as the light trasnmitting plate 2 and arranged to the front surface of the light transmitting plate 2 with a clearance**, and a reflecting sheet 5 having the same rectangular front surface size as the light transmitting plate 2 and arranged relative to the rear surface of the light transmitting plate 2 with a clearance. **Air fills the clearance regions**." Ex. 1009, at 4:9-22 (emphasis added); *see also* Fig. 1 above. Accordingly, an air gap would also exist between the light emitting area and the prismatic sheet 6. Accordingly, Kobayashi discloses "a separate transparent sheet or film overlying the light emitting area with an air gap therebetween," as required by

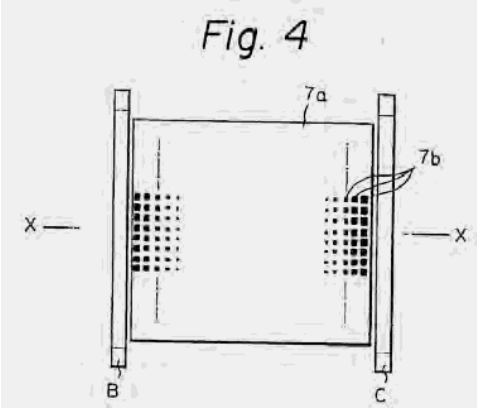
claim 1 of the '547 Patent.

177. Kobayashi discloses deformities on prismatic film 6 that are quite small. Kobayashi discloses "[t]he planar illuminating device 1 according to the third embodiment further provides between the light transmitting plate 2 and the light diffusing sheet 4 a prismatic sheet 6 the front portion of which has substantially the same prismatic cuts as the prismatic cuts 21 but has the axes Y of the prismatic cuts transverse to the axes Z of the prismatic cuts 21. . . . When the prismatic cuts 21 comprise the hairline grooves or cuts 23 as illustrated in the second embodiment, the prismatic cuts of the prismatic sheet 6 likewise comprise the same hairline cuts or grooves." Ex. 1009, Kobayashi, at 6:3-25. One of skill in the art would understand that prismatic cuts are quite small in relation to the length and width of a sheet.

178. To the extent it is found that Kobayashi does not disclose quite small deformties on an overlying film this is disclosed by Ohe. Ohe discloses deformities on an overlying film. According to Ohe, "[a] light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of light reflecting **small spots or small places** formed on the transparent substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6. " *Id.* at 3:45-52 (emphasis added).

179. Ohe also discloses that these deformities are small. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small

spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." Ex. 1007, Ohe, at 6:3-9; *see also* Fig. 4 below.



180. It would have been obvious to one of skill in the art to combine Kobayashi with Ohe. First, both Kobayashi and Ohe relate to backlight assemblies. Second, they both have similar objectives. Kobayashi discloses a planar illuminating device having "increased illuminance" and an "increased uniformity in surface illumination." Ex. 1009, Kobayashi, at 2:14-16, 2:59-61. Ohe discloses a light diffusing device for "highly uniform illumination with evenly scattered light at a reduced optical loss." Ex. 1007, Ohe, at 8:31-33. And third, both disclose using the claimed invention for display devices such as LCDs. *Id.* at 1:15-19; Ex. 1009, Kobayashi, at 1:6-9.

181. Accordingly, Kobayashi with Ohe discloses "a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film," as required by claim 1 of the '547 Patent.

182. Kobayashi discloses prismatic cuts 21 on prismatic sheet 6 that vary at different locations. First, as discussed above, Kobayashi discloses prismatic sheet 6 having prismatic cuts 21: "The planar illuminating device 1 according to the third embodiment further provides between the light transmitting plate 2 and the light diffusing sheet 4 a prismatic sheet 6 the front portion of which has substantially the same prismatic cuts as the prismatic cuts 21 but has the axes Y of the prismatic cuts transverse to the axes Z of the prismatic cuts 21. . . . When the prismatic cuts 21 comprise the hairline grooves or cuts 23 as illustrated in the second embodiment, the prismatic cuts of the prismatic sheet 6 likewise comprise the same hairline cuts or grooves." Ex. 1009, Kobayashi, at 6:3-25. The prismatic cuts on prismatic sheet 6 are labeled as element 21. Second, Kobayashi discloses that the light transmitting plate 2 also has prismatic cuts, also labeled as element 21. Third, Kobayashi discloses these prismatic cuts 21 may vary. "In detail, each of the **prismatic cuts 21** on the front portion of the light transmitting plate 2 has a **triangular cross section** . . . .The **array of spot-shaped reflecting layers 22** is made, e.g., of a white paint such as titanium oxide or dioxide or aluminum oxide, or aluminum vapor deposition. . . . Thus, the **array of reflecting spots 22 increases the reflectance of the central of the rear surface of the light transmitting plate 2** at and near the longitudinal axis of the light transmitting plate 2 more so than the reflectance of part near each of the sources of light 3." *Id.* at 4:33-63 (emphasis added); *see also* 5:1-4. Fourth, the prismatic cuts cause light to be emitted. "The **prismatic cuts 21 provide faces constituting an**

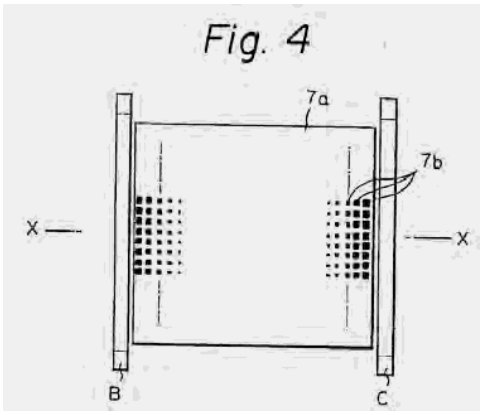
elevation angle to the travel direction of rays of light from the sources of light 3 propagating through the light transmitting plate 2. Since the faces constituting the elevation angle reflect the total rays of light incident upon the faces of the prismatic cuts 21, **rays of light totally reflected by the front portion of the light transmitting plate 2 include more component rays of light traveling across the thickness of the light transmitting plate 2 than rays of light totally reflected by the flat front surface of a prior art light transmitting plate do**. Rays of light reflected by the array of reflecting spots 22 and the reflecting sheet 5 thus include **more component rays of light traveling across the thickness of the light transmitting plate 2,** i.e., in the direction of a viewing of an operator of an office automation apparatus comprising the planar illuminating device 1 than rays of light reflected by a reflecting device attached to the rear surface of the prior art light transmitting plate." *Id.* at 5:19-37 (emphasis added). Therefore, one of skill in the art would understand that prismatic cuts 21 on prismatic sheet 6 may vary at different locations as required by claim 1.

183. Kobayashi also discloses an LCD. "The present invention relates to a planar illuminating device used as a **back light for liquid crystal displays** of portable office automation apparatuses such as a word processor or a personal computer." *Id.* at 1:6-9 (emphasis added).

184. And Kobayashi discloses light to be emitted with low loss. Kobayashi discloses "The arrangement of the light transmitting plate 2 **increases both the surface**

illuminance and the uniformity in the surface illuminance of the diffusing sheet 4." *Id.* at 4:30-32 (emphasis added). And, "a primary object of the present invention is to provide a planar illuminating device having an **increased illuminance**." *Id.* at 2:14-16. One of ordinary skill in the art would understand this to mean that light passes through with low loss. *See supra*, at ¶50.

185. To the extent, Kobayashi is found to not disclose varying deformities at different locations, this is disclosed by Ohe. As discussed above, Ohe discloses deformities on an overlying film. Ohe discloses that they may vary at different locations. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." Ex. 1007, Ohe, at 6:3-9; *see also* Fig. 4 below. As discussed above, it would have been obvious to one of skill in the art to combine Kobayashi with Ohe.



186. Accordingly, Kobayashi with Ohe discloses "the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in different directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss," as required by claim 1 of the '547 Patent. As discussed above, Kobayashi in view of Ohe discloses the elements of claim 1 of the '547 Patent. Therefore, claim 1 of the '547 Patent is obvious in light of Kobayashi in view of Ohe.

b. Claim 2

187. Claim 2 of the '547 Patent recites:

> 2. The assembly of claim 1 wherein the deformities vary in size at different locations on the sheet or film to direct the light in different directions.

188. Kobayashi teaches "[t]he assembly of claim 1," as shown above in ¶¶173-186.

189. As discussed above, it would have been obvious to one of skill in the art to combine Kobayashi with Ohe.

190. Ohe discloses varying deformities on a sheet or film. First, Ohe discloses deformities on a sheet or film overlying a light emitting surface. Ohe discloses "[a] light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of light reflecting small spots or small places formed on the transparent substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6." Ex. 1007, Ohe, at

3:45-52. Second, these light reflecting spots may vary in size. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." *Id.* at 6:3-9.

191. Accordingly, Kobayashi and Ohe disclose "the deformities vary in size at different locations on the sheet or film to direct the light in different directions," as required by claim 2 of the '547 Patent.

c. Claim 3

192. Claim 3 of the '547 Patent recites:

> 3. The assembly of claim 1 wherein the deformities vary in shape at different locations on the sheet or film to direct the light in different directions.

193. Kobayashi teaches "[t]he assembly of claim 1," as shown above in ¶¶173-186.

194. As discussed above, it would have been obvious to one of skill in the art to combine Kobayashi with Ohe.

195. Ohe discloses varying deformities on a sheet or film. First, Ohe discloses deformities on a sheet or film overlying a light emitting surface. Ohe discloses "[a] light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of light reflecting small spots or small places formed on the transparent

substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6." Ex. 1007, Ohe, at 3:45-52. Second, these light reflecting spots may vary in size. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." *Id.* at 6:3-9. One of skill in the art would understand that a change in configuration of a deformity would be a change in shape.

196. Accordingly, Kobayashi and Ohe disclose "the deformities vary in shape at different locations on the sheet or film to direct the light in different directions," as required by claim 3 of the '547 Patent.

d. Claim 4

197. Claim 4 of the '547 Patent recites:

> 4. The assembly of claim 1 wherein the deformities vary in placement at different locations on the sheet or film to direct the light in different directions.

198. Kobayashi teaches "[t]he assembly of claim 1," as shown above in ¶¶173-186.

199. As discussed above, it would have been obvious to one of skill in the art to combine Kobayashi with Ohe.

200. Ohe discloses varying deformities on a sheet or film. First, Ohe discloses deformities on a sheet or film overlying a light emitting surface. Ohe discloses "[a]

light reflecting film 7 is interposed between the light diffusing plate 6 and the light diffusing layer 3. This light reflecting film 7 consists of a transparent substrate film and a number of light reflecting small spots or small places formed on the transparent substrate film in a pattern effective for evenly distributing the quantity of light transmitted from the base plate 1 to the light diffusing plate 6." Ex. 1007, Ohe, at 3:45-52. Second, these light reflecting spots may vary in size. "Usually, the light reflecting film comprises a transparent film substrate and a number of light reflecting small spots or small places formed on the film substrate. The size, configuration, and distribution density of the light reflecting spots are designed so that they cause the distribution of light transmitted through the light reflecting film to be uniform." *Id.* at 6:3-9.

201. Accordingly, Kobayashi and Ohe disclose "the deformities vary in placement at different locations on the sheet or film to direct the light in different directions," as required by claim 4 of the '547 Patent.

e. Claim 16

202. Claim 16 of the '547 Patent recites:

> 16. The assembly of claim 1 wherein the deformities are at least one of prisms, prismatic and lenticular.

203. Kobayashi teaches "[t]he assembly of claim 1," as shown above ¶¶173-186.

204. Kobayashi discloses deformities as shown above in ¶177.

205. According to Kobayashi, the deformities may be prismatic. Kobayashi

discloses that "[t]he planar illuminating device 1 according to the third embodiment further provides between the light transmitting plate 2 and the light diffusing sheet 4 a **prismatic sheet 6** the front portion of which has substantially the same **prismatic cuts** as the prismatic cuts 21 but has the axes Y of the prismatic cuts transverse to the axes Z of the prismatic cuts 21. . . . When the prismatic cuts 21 comprise the hairline grooves or cuts 23 as illustrated in the second embodiment, the prismatic cuts of the prismatic sheet 6 likewise comprise the same hairline cuts or grooves." Ex. 1009, Kobayashi, at 6:3-25 (emphasis added). Accordingly, Kobayashi discloses "deformities are at least one of prisms, prismatic and lenticular," as required by claim 16 of the '547 Patent.

f. Claim 26

206. Claim 26 of the '547 Patent recites:

> 26. The assembly of claim 1 wherein at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions.

207. Kobayashi teaches "[t]he assembly of claim 1," as shown above in ¶¶173-186.

208. As discussed above, Ohe discloses deformities on film 7 that may vary size, configuration, and distribution density. "The size of the light reflecting spots may vary with the distance from the light source, as shown in FIG. 5. Also, the light reflecting spots having the same size may be distributed at a different distribution density on the transparent film substrate." Ex. 1007, Ohe, at 6:57-61. As explained

above, it would have been obvious to combine Ohe with Kobayashi.

209. Accordingly, Kobayashi and Ohe discloses "at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions," as required by claim 26 of the '547 Patent.

E. U.S. Patent No. 5,386,347 ("Matsumoto")

210. Matsumoto discloses an illuminating apparatus within which an edge light conductor is used. Ex. 1010, Matsumoto, at Title.

211. According to Matsumoto, prior art illuminating apparatuses failed to use the light from the light sources effectively and to achieve uniformity in illuminating intensity over the illuminating plane of the apparatus. *Id.* at 2:18-30

212. To solve this problem, Matsumoto discloses diffusing plane 8, which may be formed on upper or lower surfaces of acrylic plate A. *Id.* at 5:47-49, 7:55-56. By way of Figs. 4 and 5, Matsumoto discloses that diffusing plane 8 has deformities that are quite small in relation to the length and width of the plane and they vary in shape, size, and placement at different locations on the diffusing plane 8. *See id.* at 6:32-42, 7:24-35, 8:30-33.

1. Claims 1-4 and 26 are Obvious Over Pristash in View of Matsumoto

a. Claim 1

213. Claim 1 of the '547 Patent recites:

> 1. A backlight assembly comprising
> a light emitting member having at least one light emitting area that emits light that is internally reflected within the

> light emitting member,
> a separate transparent sheet or film overlying the light emitting area with an air gap therebetween,
> a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film,
> the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss.

214. Pristash discloses a light emitting assembly of claim 1 as can be seen in the Background of the Invention Section. Specifically, the background discloses:

> This invention relates generally, as indicated, to a thin panel illuminator including a solid transparent panel member for conducting light and extractor means for causing light conducted by the panel member to be emitted along the length thereof. Light panel illuminators are generally known. However, the present invention relates to several different panel illuminator configurations which are less expensive to make and/or provide for better control over the light output from the panel. Also, the present invention provides for more efficient transmission of light from a light source to the light emitting panel."

Ex. 1006, Pristash, at 1:5-16. As a result, Pristash teaches "[a] backlight assembly," as required by claim 1 of the '547 Patent.

215. Pristash discloses "**solid transparent prismatic film 51** having a prismatic surface 52 on one side and a back reflector 53 on the other side." *Id.* at 5:6-11 (emphasis added). The solid transparent prismatic film 51 is also referred to as a wave guide 51 ("The second prismatic film 60 may be separated from the first prismatic film or **wave guide 51** by air or an epoxy filled gap 61." *Id.* at 5:25-27 (emphasis

added)). As previously discussed, a light emitting panel member is also known as a wave guide. *See supra*, at ¶43.

216. Pristash also discloses internally reflected light within the light emitting member. "**Light rays** may be caused to enter the panel 50 perpendicular to the wave guide prism edges 54 from one or both edges 55, 56 of the panel, and **are internally reflected** until they strike a deformity (in this case an edge 54 of panel prismatic surfaces 52) which causes the light rays to be emitted." Ex. 1006, Pristash, at 5:11-16 (emphasis added).

217. Accordingly, Pristash teaches "a light emitting member having at least one light emitting area that emits light that is internally reflected within the light emitting member," as required by claim 1 of the '547 Patent.

218. Pristash discloses "the panel 50 includes a **second prismatic film 60** disposed in close proximity to the panel prismatic surface 52 to shift the angular emission of light toward a particular application." *Id.* at 5:22-25 (emphasis added). This second prismatic film 60 is a separate transparent sheet or film overlying the first prismatic film 51 (*i.e.*, the light emitting area of the light emitting member), separated by a gap 61, as shown in Fig. 7 below. In the panel member of Pristash, "[t]he second prismatic film 60 may be separated from the first prismatic film or wave guide 51 by **air** or an epoxy filled **gap 61**." *Id.* at 5:25-27 (emphasis added). Accordingly, Pristash teaches "a separate transparent sheet or film overlying the light emitting area with an air gap therebetween," as required by claim 1 of the '547 Patent.

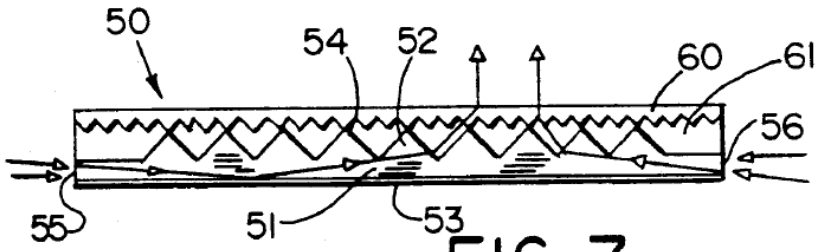


FIG. 7

219. Pristash also discloses a pattern of deformities with a small width and length in relation to the width and length of the sheet. As shown in Fig. 5 below, the deformities vary along the length of the panel member along the length of prism edges 43. While "**deformities 42** are shown as being of a generally **triangular shape, they may be of any desired shape that causes light to be emitted**, and **may vary in depth and shape along the length of the prism edges 43** to produce a desired light output distribution." *Id.* at 4:49-54 (emphasis added). As can be seen in Fig. 5, the deformities 42 are quite small in relation to the length and width.

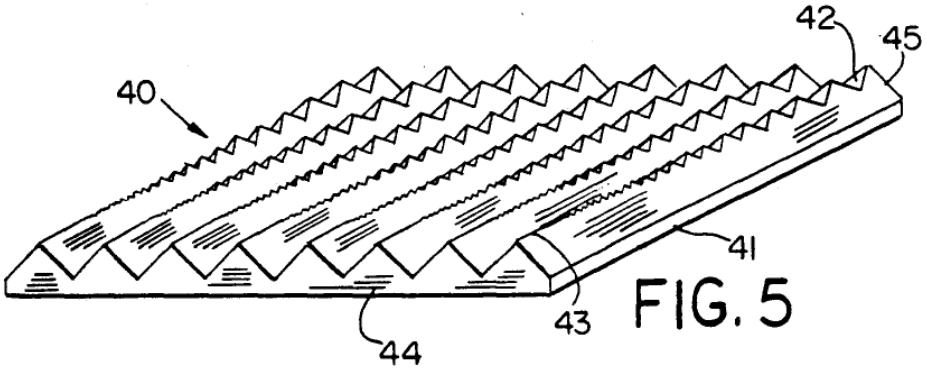


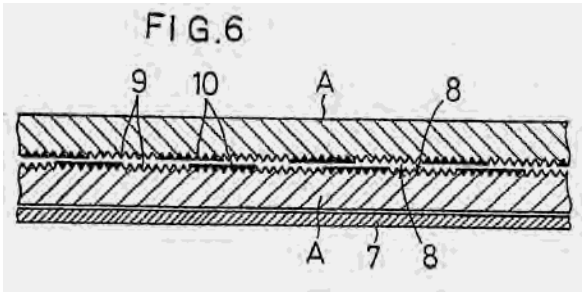
FIG. 5

220. Pristash also discloses that "both of the **light emitting panels 40 and 49** shown in FIGS. 5 and 6 may have **prismatic surfaces on both the top and bottom surfaces rather than on just one surface as shown**, and one or the other of the top or bottom surface may be provided with a back reflector similar to the back reflector

34 shown in FIG. 4 to redirect emitted light back through the panel toward a particular application." *Id.* at 4:66-5:5 (emphasis added).

221. Pristash discloses a pattern of deformities on the wave guide. Pristash also discloses a second prismatic film overlying the wave guide. It would have been obvious to one of skill in the art to apply the prismatic film styles in Figs. 5 and 6 to any prismatic surface, including the second prismatic film 60.

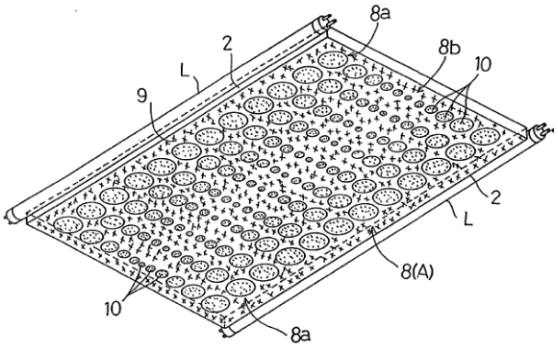
222. Matsumoto also discloses a film overlying the panel member with a pattern deformities that are quite small in relation to the width and length of the film. Matsumoto discloses that "[t]he diffusing plane 8 may be formed on each of the **upper and lower surfaces** of the acrylic plate A." Ex. 1010, Matsumoto, at 7:55-56 (emphasis added). Also, "[t]he light box may include a plurality of acrylic plates A as shown in FIGS. 6, 7 and 8." *Id.* at 7:57-58; *see also* Figs. 6-8. Thus, Matsumoto discloses a film overlying the panel member or plate A. It may also be transparent. Matsumoto discloses that "[t]he **plate of transparent** or semitransparent optical medium is not limited to the **acrylic plate A**. Glass or various plastics (e.g. polyethylene, polyester and epoxy resin) may be employed instead." *Id.* at 8:34-37 (emphasis added).



223. Further, Matsumoto discloses a the pattern deformities may be on one side of the sheet or film. Specifically, Matsumoto discloses that "**[o]ne of the upper and lower surfaces** of the acrylic plate A is used to define the diffusing plane 8. First, as shown in FIG. 3 (A), **a rugged surface is formed over the entire diffusing plane 8** by sand blasting. This rugged surface has a **degree of roughness adjustable** by selecting size, blasting intensity, blasting time and the like of an abrasive used in the sand blasting. In fact, what is known as a diffuser plate or diffuser sheet having such a rugged surface already formed is commercially available also. Such a product may be used instead." *Id.* at 6:32-42 (emphasis added).

224. According to Matsumoto, "FIGS. 4 and 5 show reflector regions formed of **dot patterns**. The **diffusing plane 8** shown in FIG. 4 includes **irregular reflector regions 9** formed of a plurality of dots having different sizes. These dots are the **smaller towards the end surfaces 2** and the larger away therefrom." *Id.* at 7:24-29 (emphasis added); *see also* Figs. 4 and 5. Thus, Matsumoto discloses that the overlying film may have a pattern of deformities that are quite small in relation to the length and width. This can be seen in Fig. 5 below.

FIG.5



225. It would have been obvious to combine Matsumoto with Pristash because like Pristash, Matsumoto also discloses an illumination apparatus and both disclose the same objectives of uniform illumination and more efficient transmission of light. Ex. 1006, Pristash, at 1:10-16; Ex. 1010, Matsumoto, at 3:11-14, 3:63-66. It would have been obvious to one of skill in the art to substitute the overlying diffusing plane 8 of Matsumoto with the overlying prismatic film 60 of Pristash because sheets are employed for the purpose of altering the transmission of light out of the light emitting member. Ex. 1006, Pristash at 5:22-33, Fig. 7; Ex. 1010, Matsumoto, at 3:6-10.

226. Accordingly, Pristash with Matsumoto discloses "a pattern of deformities on one side of the sheet or film having a width and length that is quite small in relation to the width and length of the sheet or film," as required by claim 1 of the '547 Patent.

227. Pristash also discloses deformities varying at different locations. First, as discussed above, Pristash discloses deformities of a different type. In discussing the deformities in Fig. 5 above, Pristash explains that "[a]lthough the **deformities 42** are shown as being of a generally triangular shape, they **may be of any desired shape** that causes light to be emitted, and **may vary in depth and shape** along the length of the prism edges 43 to produce a desired light output distribution." Ex. 1006, Pristash, at 4:49-54 (emphasis added). Regarding the deformities in Fig. 6 below, Pristash explains that "diffuser surfaces 46 may be formed along the top edges 47 of the prismatic surfaces 48 of a prismatic film light emitting panel 49 as schematically shown in FIG. 6. These **diffuser surfaces 46** may vary in depth and/or width along

the length of the panel 49, and **may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities**. A roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling." *Id.* at 4:57-66 (emphasis added). Also, regarding Fig. 1, Pristash explains that "if the exterior surface 18 is mechanically deformed at decreasingly spaced intervals as the distance from the light source 3 increases, there will be more uniform emission of light from the surface 18 when viewed from a distance. Also, such **disruptions 16 may vary in depth and shape along the length** of the panel 2 to produce a desired light output distribution." *Id.* at 3:42-48 (emphasis added).

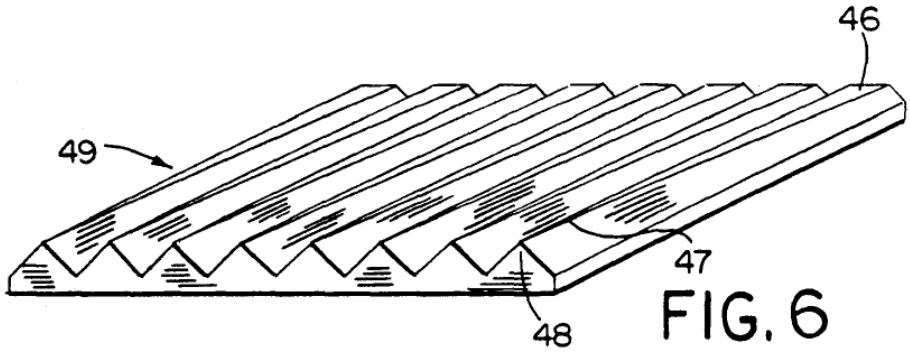


FIG. 6

228. Finally, Pristash discloses that light will pass through the LCD with low loss because the invention provides a more efficient transmission of light from the light source to the panel. Specifically, Pristash discloses that "the present invention relates to several different panel illuminator configurations which are less expensive to make and/or provide for better control over the light output from the panel. Also, the

present invention provides for **more efficient transmission** of light from a light source to the light emitting panel." *Id.* at 1:10-16 (emphasis added). A person of ordinary skill in the art would understand that when there is more efficient light transmission from the light source to the emission surface of the light emitting panel, this means light passes through with low loss.

229. Matsumoto discloses deformities on an overlying film vary at different locations. According to Matsumoto, "[t]he diffusing plane 8 shown in FIG. 5 includes **a plurality of dots having different sizes and formed in portions** other than the irregular reflector regions 9. These dots provide the modified irregular reflector regions 10, which are the larger toward the end surfaces 2 and the smaller away therefrom." Ex. 1010, Matsumoto, at 7:30-35 (emphasis added); *see also* FIGS. 4 and 5. Forming a plurality of dots in different portions means the deformities vary at different locations on the overlying sheet.

230. As with Pristash, Matsumoto discloses that light will pass through an LCD with low loss. Matsumoto discloses that "[t]he illuminating apparatus is not limited to the ultra-thin light box, but may comprise a **backlight apparatus for a display device or for a liquid crystal display** of an office automation product, for example." *Id.* at 7:67-8:2 (emphasis added). Matsumoto also discloses high efficiency of light. Specifically, Matsumoto discloses that "the present invention provides a method of easily and quickly manufacturing an edge light conductor having a **high efficiency** of irregular reflection and assuring bright edge light." *Id.* at 3:63-66 (emphasis added).

As with Pristash, a person of ordinary skill in the art would understand that when there is more efficient light transmission from the light source to the light emitting surface, this means light passes through with low loss.

231. As discussed above, it would have been obvious to combine Matsumoto with Pristash. *See supra*, at ¶225.

232. Accordingly, Pristash with Matsumoto discloses "the deformities varying at different locations on the sheet or film to direct the light that is emitted by the, light emitting member in different directions to produce a desired light output distribution such that the light will pass through a liquid crystal display with low loss," as required by claim 1 of the '547 Patent. As discussed above, Pristash in view of Matsumoto teach the elements of claim 1 of the '547 Patent. Therefore, claim 1 of the '547 Patent is obvious over Pristash in view of Matsumoto.

b. Claim 2

233. Claim 2 of the '547 Patent recites:

> 2. The assembly of claim 1 wherein the deformities vary in size at different locations on the sheet or film to direct the light in different directions.

234. Pristash and Matsumoto teach "[t]he assembly of claim 1," as shown above in ¶¶214-232.

235. The deformities of Pristash may also vary in size. According to Pristash, "such disruptions 16 **may vary in depth** and shape along the length of the panel 2 to produce a desired light output distribution." Ex. 1006, Pristash, at 3:46-48 (emphasis

added). Also, "FIG. 5 shows another form of light emitting panel 40 in accordance with this invention comprising a solid transparent prismatic film 41 having deformities 42 cut, molded or otherwise formed along the top of the prism edges 43. Although the **deformities 42 are shown as being of a generally triangular shape,** they may be of any desired shape that causes light to be emitted, and **may vary in depth and shape along the length of the prism edges 43**." *Id.* at 4:45-54 (emphasis added).

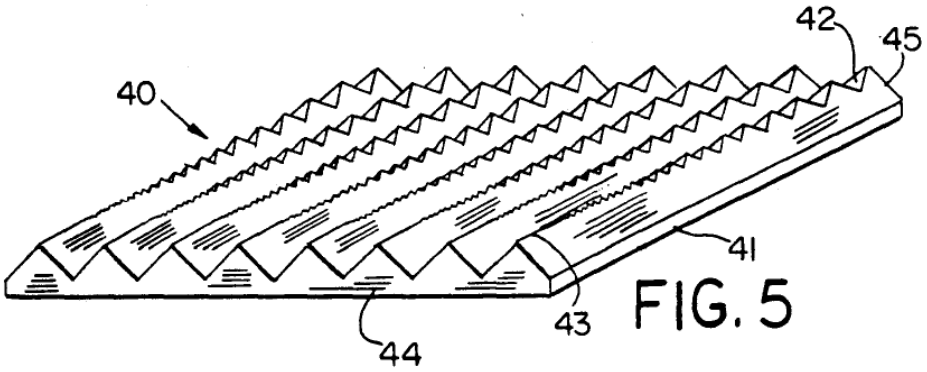


FIG. 5

236. One of skill in the art would understand that one way deformities may vary in size is by varying in depth.

237. Matsumoto also discloses deformities varying in size on an overlying film. Specifically, Matsumoto discloses that "FIGS. 4 and 5 show reflector regions formed of dot patterns. The diffusing plane 8 shown in FIG. 4 includes irregular reflector regions 9 formed of a **plurality of dots having different sizes**. These dots are the **smaller towards the end surfaces 2 and the larger away therefrom**." Ex. 1010, Matsumoto, at 7:24-29 (emphasis added). Additionally, Matsumoto explains that "[t]he diffusing plan 8 shown in FIG. 5 includes **a plurality of dots having different**

sizes and formed in portions other than the irregular reflector regions 9. These dots provide the modified irregular reflector regions 10, which are the larger toward the end surfaces 2 and the smaller away therefrom." *Id.* at 7:30-35 (emphasis added); *see also* FIGS. 4 and 5.

238. As discussed above, it would have been obvious to combine Matsumoto with Pristash. *See supra*, at ¶225.

239. Accordingly, Pristash with Matsumoto discloses "the deformities vary in size at different locations on the sheet or film to direct the light in different directions," as required by claim 2 of the '547 Patent.

c. Claim 3

240. Claim 3 of the '547 Patent recites:

> 3. The assembly of claim 1 wherein the deformities vary in shape at different locations on the sheet or film to direct the light in different directions.

241. Pristash and Matsumoto teach "[t]he assembly of claim 1," as shown above in ¶¶214-232.

242. The deformities of Pristash may also vary in shape. According to Pristash, "FIG. 5 shows another form of light emitting panel 40 in accordance with this invention comprising a solid transparent prismatic film 41 having deformities 42 cut, molded or otherwise formed along the top of the prism edges 43. Although the **deformities 42 are shown as being of a generally triangular shape,** they **may be of any desired shape** that causes light to be emitted, and **may vary in** depth and

shape along the length of the prism edges 43." Ex. 1006, Pristash, at 4:45-54 (emphasis added).

243. Also, "diffuser surfaces 46 may be formed along the top edges 47 of the prismatic surfaces 48 of a prismatic film light emitting panel 49 as schematically shown in FIG. 6. These **diffuser surfaces 46** may vary in depth and/or width along the length of the panel 49, and **may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities**. A roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling." *Id.* at 4:57-66 (emphasis added).

244. Matsumoto discloses that deformities on an overlying film may vary in shape. According to Matsumoto, "the irregular reflector regions 9 are **not limited to the ship-shape patterns, but may be in the form of triangles, groups of lines, or dots**." Ex. 1010, Matsumoto, at 8:30-33 (emphasis added); *see also* FIGS. 4 and 5. Additionally, in Matsumoto, [t]he modified irregular reflector regions 10 may be **formed in only certain of the parts** of the diffusing plane 8 where the irregular reflector regions 9 are not formed. The quantity of irregular reflection from the modified irregular reflector regions 10 **need not be uniform** through the diffusing plane 8. **Plural types of modified irregular reflector regions 10** providing varied quantities of irregular reflection may be distributed over the diffusing plane 8." *Id.* at 7:46-54. Thus, Matsumoto discloses deformities varying in shape at different locations on diffusing plane 8.

245. As discussed above, it would have been obvious to combine Matsumoto with Pristash.

246. Accordingly, Pristash with Matsumoto discloses "the deformities vary in shape at different locations on the sheet or film to direct the light in different directions," as required by claim 3 of the '547 Patent.

d. Claim 4

247. Claim 4 of the '547 Patent recites:

> 4. The assembly of claim 1 wherein the deformities vary in placement at different locations on the sheet or film to direct the light in different directions.

248. Pristash and Matsumoto teach "[t]he assembly of claim 1," as shown above in ¶¶214-232.

249. As discussed above, Pristash discloses deformities that vary in density and shape along the length of the film. *See supra*, at ¶147. One of skill in the art would understand that means the deformities may vary in placement at different locations because variation in density results in variation in placement in the x-direction.

250. Pristash also discloses that the deformities may vary in depth. *See supra*, at ¶148. One of skill in the art would also understand that this means the deformities will vary in placement at different locations on the sheet because variation in depth would results in variation in placement in the y-direction.

251. Matsumoto discloses that deformities on an overlying film vary in placement at different locations. The deformities vary in placement depending on the proximity to

one of the end surfaces. According to Matsumoto, "FIGS. 4 and 5 show reflector regions formed of dot patterns. The diffusing plane 8 shown in FIG. 4 includes irregular reflector regions 9 formed of a plurality of dots having different sizes. These dots are the **smaller towards the end surfaces 2 and the larger away therefrom**." Ex. 1010, Matsumoto, at 7:24-29 (emphasis added). Deformities also vary in placement depending on if they are being formed in regions 9. Matsumoto discloses that "[t]he diffusing plan 8 shown in FIG. 5 includes **a plurality of dots having different sizes and formed in portions other than the irregular reflector regions 9.** These dots provide the modified irregular reflector regions 10, which are the larger toward the end surfaces 2 and the smaller away therefrom." *Id.* at 7:30-35 (emphasis added); *see also* FIGS. 4 and 5. Additionally, "[t]he modified irregular reflector regions 10 may be **formed in only certain of the parts** of the diffusing plane 8 where the irregular reflector regions 9 are not formed. The quantity of irregular reflection from the modified irregular reflector regions 10 **need not be uniform** through the diffusing plane 8. Plural types of modified irregular reflector regions 10 providing **varied quantities of irregular reflection may be distributed over the diffusing plane 8**." *Id.* at 7:46-54 (emphasis added). Thus, Matsumoto discloses that deformities on the overlying film may vary in placement at different locations.

252. As discussed above, it would have been obvious to combine Matsumoto with Pristash. *See supra*, at ¶225.

253. Accordingly, Pristash with Matsumoto discloses "the deformities vary in

placement at different locations on the sheet or film to direct the light in different directions," as required by claim 4 of the '547 Patent.

e. Claim 26

254. Claim 26 of the '547 Patent recites:

> 26. The assembly of claim 1 wherein at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions.

255. Pristash and Matsumoto teach "[t]he assembly of claim 1," as shown above in ¶¶214-232.

256. Pristash also teaches deformities as shown above in ¶¶219-221.

257. The deformities may also have random or varying changes in shape. First, as discussed above, the deformities may vary in depth and shape along the prism edges. Ex. 1006, Pristash, at 4:45-54; *see also* Fig. 5. Second, Pristash also discloses that the deformities may vary randomly. According to Pristash, "[t]he size, shape and depth of the wave guide deformities 52 may be varied along the length of the panel to produce a desired light output distribution." *Id.* at 5:17-19. Further, "[t]hese diffuser surfaces 46 may vary in depth and/or width along the length of the panel 49, and may comprise a roughened surface, a lenticular surface, or a prismatic surface or the like that consists of multiple surface deformities. A **roughened surface, for example, may be produced by grinding, sanding, laser cutting or milling**." *Id.* at 4:60-66 (emphasis added). Deformities on a roughened surface created by grinding, sanding,

and milling must vary randomly, since these methods necessarily produce irregular scratches and indents. *Cf.* Ex. 1020, Takeuchi, at 8:28-33, 15:35-38, Figs. 13 and 22.

258. Matsumoto discloses deformities having random or varying changes in shape on an overlying film. Accordingly to Matsumoto, "the irregular reflector regions 9 are **not limited to the ship-shape patterns, but may be in the form of triangles, groups of lines, or dots**." Ex. 1010, Matsumoto, at 8:30-33 (emphasis added); *see also* FIGS. 4 and 5. Thus, the deformities of Matsumoto may vary in shape or geometry. Matsumoto also discloses that "[t]he quantity of irregular reflection from the modified irregular reflector regions 10 need **not be uniform** through the diffusing plane 8. Plural types of modified irregular reflector regions 10 providing varied quantities of irregular reflection may be distributed over the diffusing plane 8." *Id.* at 7:49-54 (emphasis added). Thus, the deformities of Matsumoto need not be uniform through the diffusing plane 8 and therefore, they may be random.

259. As discussed above, it would have been obvious to combine Matsumoto with Pristash. *See supra*, at ¶225.

260. Accordingly, Pristash with Matsumoto discloses "at least some of the deformities have random or varying changes in shape or geometry on the sheet or film to direct the light in different directions," as requried by claim 26 of the '547 Patent.

VI. SUPPLEMENTATION

261. This declaration, along with the attached appendices, is based on my present

assessment of material and information currently available to me.

262. I hereby declare that all statements made herein of my own knowledge are true and that all statements made herein on information and belief are believed to be true. Further, these statements were made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-identified patent.

Dated: 3 Dec 2014

Respectfully submitted,

By: _____
Michael J. Escuti, Ph.D.

APPENDIX A

MICHAEL JAMES ESCUTI

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Professional Preparation

2002 PhD in Electrical Engineering, Brown University
Dissertation: "Structured Liquid Crystal/Polymer Composites as Photonic Crystal Switches and LCD Innovations" – *Advisor*: Dr. Gregory P. Crawford
1999 MSc in Electrical Engineering, Brown University
1997 BS (magna cum laude) in Electrical & Computer Engineering, Drexel University

Professional Experience

2010-present Associate Professor, Dept. Electrical & Computer Engineering, NC State Univ
2005-present Chief Science Officer, ImagineOptix Corporation
2004-2010 Assistant Professor, Dept. Electrical & Computer Engineering, NC State Univ
2002-2004 Post-Doc, Dept. Functional Polymers, Eindhoven Univ of Tech (Netherlands)

Honors and Awards

2011 Presidential Early Career Award for Scientists and Engineers (PECASE)
2011 Alcoa Foundation Engineering Research Achievement Award, NC State Univ
2010 Faculty Early Career Development (CAREER) Award, National Science Foundation
2004 Glenn Brown Award for Outstanding PhD Dissertation, International Liquid Crystal Soc
2003 First Prize – Art & Liquid Crystals Competition, European Conf. Liquid Crystals
2002 OSA/New Focus Student Award, Top Winner, CLEO/QELS Conference
2001 Graduate Student Silver Award, Materials Research Soc. Fall Meeting
2001 Sigma Xi Outstanding Graduate Student Research Award, Brown University
2000 Citation of Excellence in Science Education, RI House of Representatives
1999 Best Student Paper Award, Society for Information Display, International Symposium
1997 Citation of Excellence in Engineering Design, Drexel University

Publications and Patents Summary

Inventor on 11 issued US patents and 19 US patent applications, and 40 foreign patents and patent applications. Authored 39 journal articles, 64 refereed conference proceedings, 29 invited research presentations, and 1 book contribution. As of June 2014 per ISI Web of Knowledge™ (across journal papers): Accumulated Citations 756, and h-index 15

External and Internal Sponsored Research Activities

External Funding: ~ $ 8M (overall), ~ $ 6.8M (to NCSU), ~ $ 6.5M (as PI/co-PI)
Prime Sponsors (Gov't): Natl Science Foundation, NASA, US Air Force Research Lab, DARPA
Industry Partners, Sponsors: Raytheon, SAIC, Boulder Nonlinear Sys, ImagineOptix, Teledyne

Expert Witness Experience

Closed 2014: Patent dispute, before Dist Court of Delaware (Civil Action No. 12-cv-214-LPS)
Technology: LCD system technologies
Supporting: Vizio et al (Defendants) v Graphics Properties Holdings
Firm: Thomas Whitelaw
Role: Supported infringement analysis; settlement prior to expert reports

MICHAEL JAMES ESCUTI

Closed 2013: Inter Partes Review, US Patent & Trademark Office (IPR2013-00066 & -00068)
Technology: LCD system, active-matrix/TFT substrate
Supporting: Semiconductor Energy Lab Co Ltd (Patent Owner) v Chimei Innolux
Firm: Steptoe & Johnson
Role: Written declarations, deposition; settlement prior to hearing

Closed 2013: Patent dispute, before District Court of New Jersey (Civil Action No. 12-952)
Technology: Optical Data Storage, CD/DVD/Blueray-Disc, Holograms
Supporting: Samsung et al (Defendants) v Voxpath RS LLC
Firm: Greenberg Traurig
Role: Conducting lab testing

Closed 2012: Patent dispute, before US International Trade Commission (ITC No. 337-TA-836)
Technology: LCD system technologies
Supporting: LG Electronics et al (Respondents) v Graphics Properties Holdings
Firm: Greenberg Traurig
Role: Expert reports, witness statements, extensive lab testing, deposition; settlement prior to hearing

Closed 2012: Patent dispute, before US International Trade Commission (ITC No. 337-TA-805)
Technology: LCD backlights
Supporting: LG Display, LG Electronics et al (Respondents) v Ind Tech Res Instr
Firm: Steptoe & Johnson
Role: Expert reports, witness statements, deposition, extensive lab testing, testified at hearing

Closed 2011: Patent dispute, before US International Trade Commission (ITC No. 337-TA-749)
Technology: LCD optics, viewing angle compensation
Supporting: Thomson (Complainants) v Chimei Innolux, AU Optronics, et al
Firm: Kirkland & Ellis
Role: Expert reports, witness statements, deposition, tutorial, testified at hearing

Advisory Board Memberships

2013-present Member, Board of Directors, ImagineOptix Corporation
2008-present Member, Laser & Photonics Technology Advisory Board, Central Carolina Community College

Teaching and Mentoring Experience

I have previously graduated 5 PhD and 3 MST students as Chair, and currently advise 3 PhD and 0 MST students. I have directed 17 undergraduate researchers, and mentor 2 Post-Docs. Classes Taught: ECE-200 (Intro to Electrical Circuits, Signals, Sys), ECE-303 (Electromagnetic Fields), ECE-492K (Optical Comm), ECE-592S (LCDs & Organic Electronics), E-304 (Intro to Nano-Science & Tech)

Professional Memberships

SPIE – International Society for Optical Engineering (2000-present), IEEE – Institute of Electrical and Electronics Engineers (1996-present), ILCS – International Liquid Crystal Society (2002-present), SID – Society for Information Display (1999-2002, 2006-present), OSA – Optical Society of America (2000-present), MRS – Materials Research Society (2001-2005)

Invited Book Chapter

1. G.P. Crawford and M.J. Escuti, "Liquid Crystal Display Technology", in *Encyclopedia of Imaging Science and Technology*, ed. J.P. Hornak, (John Wiley & Sons, Inc., 2002).

MICHAEL JAMES ESCUTI

Journal Publications (peer-reviewed)

1) Y. Liu, M. Miskiewicz, M.J. Escuti, J. Genzer, and M.D. Dickey, "Three-dimensional folding of pre-strained polymer sheets via absorption of laser light", *Journal of Applied Physics*, **vol. 115**, no. 20, num. 204911, 2014.
2) M.N. Miskiewicz and M.J. Escuti, "Direct-Writing of Complex Liquid Crystal Patterns," *Optics Express*, **vol. 22**, no. 10, pp. 12691-12706, 2014.
3) M.W. Kudenov, M.N. Miskiewicz , M.J. Escuti, and J. Coward, "Polarization Spatial Heterodyne Interferometer: Model and Calibration", *Optical Engineering*, **vol. 53**, no. 4, num. 044104, 2014.
4) B. Gökce, Y. Li, M.J. Escuti, and K. Gundogdu, "Femtosecond pulse shaping using the geometric phase", *Optics Letters*, **vol. 39**, no. 6, pp. 1521-1524, 2014.
5) M.N. Miskiewicz, S. Schmidt, and M.J. Escuti, "A 2D FDTD Algorithm for Whole-Hemisphere Incidence on Periodic Media", *IEEE Transactions on Antennas and Propagation*, **vol. 62**, no. 3, pp. 1348-1353, 2014.
6) A. Dudley, Y. Li, T. Mhlanga, M.J. Escuti, and A. Forbes, "Generating and measuring nondiffracting vector Bessel beams", *Optics Letters*, **vol. 38**, no. 17, pp. 3429-3432, 2013.
7) R.K. Komanduri, K.F. Lawler, and M.J. Escuti, " Multi-twist retarders: broadband retardation control using self-aligning reactive liquid crystal layers", *Optics Express*, **vol. 21**, no. 1, pp. 404-420, 2013.
8) Y. Li, J. Kim, M.J. Escuti, "Orbital angular momentum generation and mode transformation with high efficiency using forked polarization gratings," *Applied Optics*, **vol. 51**, no. 34, pp. 8236-8245, 2012.
9) M.W. Kudenov, M.N. Miskiewicz, M.J. Escuti, and E. Dereniak, "Spatial heterodyne interferometry with polarization gratings", *Optics Letters*, **vol. 37**, no. 21, pp. 4413-4415, 2012.
10) J. Kim, R.K. Komanduri, K.F. Lawler, D.J. Kekas, and M.J. Escuti, "Efficient and monolithic polarization conversion system based on a polarization grating", *Applied Optics*, **vol. 51**, no. 20, pp. 4852-4857, 2012.
11) M. Kudenov, M.J. Escuti, N. Hagen, E. Dereniak, and K. Oka, "Snapshot imaging Mueller matrix polarimeter using polarization gratings," *Optics Letters*, **vol. 37**, no. 8, pp. 1367-1369, 2012.
12) J. Kim, C. Oh, S. Serati, and M.J. Escuti, "Wide-angle, nonmechanical beam steering with high throughput utilizing polarization gratings," *Applied Optics* **50**, no. 17, pp. 2636-2639, 2011.
13) M. Kudenov, M.J. Escuti, E. Dereniak, and K. Oka, "White light channeled imaging polarimeter using broadband polarization gratings" *Applied Optics* **50**, no. 15, 2283-2293, 2011.
14) E. Nicolescu, C. Mao, A. Fardad, and M.J. Escuti, "Polarization-independent variable optical attenuator using liquid crystal polarization gratings," *IEEE Journal of Lightwave Technology*, **vol. 28**, no. 21, pp. 3121-3127, 2010.
15) E. Nicolescu and M.J. Escuti, "Polarization-independent tunable optical filters using bilayer polarization gratings," *Applied Optics*, **vol. 49**, no. 20, pp. 3900-3904, 2010.
16) C. Packham, M. Escuti, J. Ginn, C. Oh, I. Quijano, and G. Boreman, "Polarization Gratings: A Novel Polarimetric Component for Astronomical Instruments," *Publications of the Astronomical Society of the Pacific*, **vol. 122**, no. 898, pp. 1471-1482, 2010.
17) C. Oh, J. Kim, J.F. Muth, S. Serati, and M.J. Escuti, "High-Throughput, Continuous Beam Steering Using Rotating Polarization Gratings", *IEEE Photonics Technology Letters*, **vol. 22**, no. 4, pp. 200-202, 2010.
18) R.K. Komanduri and M.J. Escuti, "Highly Efficient Reflective Liquid Crystal Polarization Gratings," *Applied Physics Letters*, **vol. 95**, art. num. 091106, 2009.
19) P.F. McManamon, P.J. Bos, M.J. Escuti, J. Heikenfeld, S. Serati, H. Xie, and E.A. Watson, "A Review of Phased Array Steering for Narrowband Electro-Optical Systems," *Proceedings of the IEEE*, **vol. 97**, no. 6, pp. 1078-1096, 2009.

MICHAEL JAMES ESCUTI

20) C Oh and MJ Escuti, "Achromatic diffraction from polarization gratings with high efficiency," *Optics Letters*, **vol. 33**, pp. 2287-2289, 2008.
21) C. Sanchez, F. Verbakel, M.J. Escuti, C.W.M. Bastiaansen, and D.J. Broer, "Printing of Monolithic Polymeric Micro-Structures using Reactive Mesogens," *Advanced Materials*, **vol. 20**, no. 1, pp. 74-78, 2008.
22) C. Oh and M.J. Escuti, "Numerical Analysis of Polarization Gratings Using the Finite-Difference Time-Domain Method," *Physical Review A*, **vol. 76**, no. 4, num. 043815, 2007.
23) R.K. Komanduri and M.J. Escuti, "Elastic Continuum Analysis of the Liquid Crystal Polarization Grating," *Physical Review E*, **vol. 76**, no. 2, num. 021701, 2007.
24) R.K. Komanduri, W.M. Jones, C. Oh, and M.J. Escuti, "Polarization-Independent Modulation for Projection Displays Using Small-Period LC Polarization Gratings," *Journal of the Society for Information Display*, **vol. 15**, no. 8, pp. 589-594, 2007.
25) C. Oh and M.J. Escuti, "Time-domain analysis of periodic anisotropic media at oblique incidence: an efficient FDTD implementation," *Optics Express*, **vol. 14**, no. 24, pp. 11870-11884, 2006.
26) B.-J. de Gans, C. Sánchez, D. Kozodaev, M.J. Escuti, C. Bastiaansen, D.J. Broer, and U.S. Schubert, "Optimizing photo-embossed gratings: A gradient library approach," *Journal of Combinatorial Chemistry*, **vol. 8**, no. 2, pp. 228-236, 2006.
27) C. Sanchez, M.J. Escuti, C. van Heesch, C. Bastiaansen, and D.J. Broer, "TiO_2 nanoparticle-photopolymer composites for volume holographic recording," *Advanced Functional Materials*, **vol. 15**, no. 10, pp. 1623-1629, 2005.
28) C. Sanchez, M.J. Escuti, C. van Heesch, C. Bastiaansen, and D.J. Broer, "An efficient illumination system for LCDs incorporating an anisotropic hologram," *Applied Physics Letters*, **vol. 87**, no. 9, art. no. 094101, 2005.
29) C. Sánchez, B.-J. de Gans, D. Kozodaev, A. Alexeev, M.J. Escuti, C. van Heesch, T. Bel, U.S. Schubert, C. Bastiaansen, and D.J. Broer, "Photoembossing of periodic relief structures using polymerization induced diffusion: A combinatorial study," *Advanced Materials*, **vol. 17**, no. 21, pp. 2567-2571, 2005.
30) M.J. Escuti and G.P. Crawford, "Holographic Photonic Crystals," *Optical Engineering*, **vol. 43**, no. 9, pp. 1973-1987, 2004.
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Invited Research Presentations

1) 2014 *Lorentz Center Workshop* at Leiden (Netherlands), "Creating Arbitrary Optical Axis Patterns Via Direct-Write Lithography for Geometric Phase Holograms and Patterned Retarders", at the international workshop on Polarimetric Techniques & Technology
2) 2014 *Merck Chemical Ltd* at Chilworth (England), "Geometric Phase Holograms & Multi-Twist Retarders", at the Advanced Technologies R&D Group

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3) 2014 *University of Toronto* at Toronto (Canada), "Geometric Phase Holograms and Multi-Twist Retarders," at the Dunlap Institute for Astronomy & Astrophysics
4) 2013 *American Chemical Society* at New Orleans (LA), "On patterning liquid crystal monomers into perfect geometric phase holograms," in Liquid Crystals and Polymers Session
5) 2012 *OSA Frontiers in Optics* at Rochester (NY), "Geometric Phase Holograms - Fabricating Generalized Polarization Gratings Enabling Arbitrary Wavefront Control with Perfect Efficiency," in Optical Design and Unconventional Polarization Session
6) 2012 *Microsoft Research* at Redmond (WA), "Polarization gratings & multi-twist retarders: 'perfect' wavefront manipulation & 'fully' tailorable broadband retardation control"
7) 2012 *Eindhoven University of Technology* at Eindhoven (Netherlands), "Polarization Gratings and Other Liquid Crystal Devices", in the Chemical Engineering Department
8) 2012 *Leiden University* at Leiden (Netherlands), "Geometric Phase Holograms & Multi-Twist Retarders", in the Astronomy Department
9) 2012 *European Patent Office* in Munich (Germany), "Innovation and Success in University/Industry Partnership: the technology and story of commercialization of functional polymer optics"
10) 2012 *St. Petersburg State University, Invited Research Seminar,* in St. Petersburg (Russia), "Liquid Crystal Polarization Gratings as 'perfect' diffractive elements via the geometric phase: fundamental insights, novel photonic devices, and commercialization", Physics Department
11) 2012 *NCSU, Physics Department Colloquium* in Raleigh (NC), "Polarization gratings and beyond: how liquid crystals + holography = 'perfect' wavefront manipulation"
12) 2012 *US Air Force Research Laboratory (AFRL)* at Dayton (OH), "Liquid Crystal Polarization Gratings – review and prospects of their use in visible thru infrared applications".
13) 2012 *SPIE Photonics West* at San Diego (CA), "Liquid Crystals in Diffraction Gratings Review," in Liquid Crystals Session
14) 2011 *SPIE Defense, Security, & Sensing* at Orlando (FL), "A liquid crystal shutter for unpolarized broadband light," Acquisition, Tracking, Pointing, and Laser Systems Technologies Session
15) 2011 *SPIE Defense, Security, & Sensing* at Orlando (FL), "LC polarization gratings: performance review and prospects for visible through longwave infrared applications," Acquisition, Tracking, Pointing, and Laser Systems Technologies Session
16) 2010 *University of Arizona Invited Research Seminar* at Tucson (AZ), "Polarization Gratings – Novel Efficient Optical Elements," College of Optical Sciences
17) 2010 *SPIE Optics & Photonics* at San Diego (CA), "Liquid Crystal Polarization Gratings With Large Diffraction Angles - Efficiency and Polarization Trends and Compensation," Liquid Crystal Switches, Modulators, Lasers Session
18) 2008 *SPIE Optics & Photonics* at San Diego (CA), "Polarization Freedom For Liquid Crystal Devices," Liquid Crystal Switches, Modulators, Lasers Session
19) 2007 *SPIE Optics & Photonics* at San Diego (CA), "DAZLE: A New Approach to Adaptive Imaging", Atmospheric and Space Optical Systems Session
20) 2006 *BASF Invited Research Seminar* at Ludwigshafen (Germany), "Switchable and Polymer Polarization Gratings for Displays and Other Systems"
21) 2006 *International Liquid Crystal Conference* at Keystone (CO), "Polarization-Independent Modulation and Simplified Spectropolarimetry Using LC Polarization Gratings", Novel Devices and Applications Session

22) 2006 OSA/SPIE *Optics in the Southeast Conference* at Charlotte (NC), "Anisotropic Gratings for Polarization-Independent Modulation & Simplified Spectropolarimetry", Micro- and Nano-Optics Section
23) 2006 *Brown University Invited Seminar* at Providence (RI), "Polarization-Independent Modulation and Other Tricks with LC Polarization Gratings"
24) 2006 *Kent State University, Liquid Crystal Institute Invited Seminar* at Kent (OH), "Reactive and Switchable LC Polarization Gratings"
25) 2005 *North Carolina Photonics Consortium* at Raleigh (NC), "Polarization Gratings in Photonics: the Hidden uncovered by the Asymmetric"
26) 2004 *International Liquid Crystal Conference* at Ljubljana (Slovenia), Invited ILCS Award Talk: "Structured LC/Polymer Composites as Tunable Photonic Crystals"
27) 2002 *American Chemical Society Annual Meeting* at Boston (MA), "Switchable Photonic Lattices with Polymer Dispersions of Liquid Crystals"
28) 2002 *Josef Stefan Institute Invited Seminar, Univ of Ljubljana* (Slovenia), "Holographic-PDLCs and Novel Structures from Reactive Mesogens"
29) 2000 *Brownbag Research Seminar*, *NASA Glenn Research Center* at Cleveland (OH), "Investigations into Bulk and Polymer Dispersed Liquid Crystals in Microgravity"

US Patents Issued

1) *US Patent No.* 8,610,853
2) *US Patent No.* 8,537,310
3) *US Patent No.* 8,530,740
4) *US Patent No.* 8,520,170
5) *US Patent No.* 8,475,033
6) *US Patent No.* 8,358,400
7) *US Patent No.* 8,339,566
8) *US Patent No.* 8,305,523
9) *US Patent No.* 8,064,035
10) *US Patent No.* 7,692,759
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US Patent Applications

1) *US Patent Application No.* 20140078298
2) *US Patent Application No.* 20130335683
3) *US Patent Application No.* 20130130156
4) *US Patent Application No.* 20130077040
5) *US Patent Application No.* 20130027656
6) *US Patent Application No.* 20120188467
7) *US Patent Application No.* 20120086903
8) *US Patent Application No.* 20110242461
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14) *US Patent Application No.* 20090074356
15) *US Patent Application No.* 20090044861
16) *US Patent Application No.* 20090027872
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Foreign Patents and Applications

1) EP 2388625
2) CN 102246089
3) ES 2367445
4) EP 2350736
5) CN 101846811
6) CN 101840077
7) WO WO/2010/042089
8) CN 101688937
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APPENDIX B

Information Considered

Description
U.S. Patent No. 7,300,194
Prosecution History of U.S. Patent No. 7,300,194
U.S. Patent No. 7,434,974
Prosecution History of U.S. Patent No. 7,434,974
U.S. Patent No. 7,404,660
Prosecution History of U.S. Patent No. 7,404,660
U.S. Patent No. 7,537,370
Prosecution History of U.S. Patent No. 7,537,370
U.S. Patent No. 8,215,816
Prosecution History of U.S. Patent No. 8,215,816
U.S. Patent No. 5,461,547 ("Ciupke")
U.S. Patent No. 5,005,108 ("Pristash")
U.S. Patent No. 5,619,351 ("Funamoto")
JP H06-273756 ("Gyoko") (English)
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JP H06-273756 ("Gyoko") (Certification)
U.S. Patent No. 5,408,388 ("Kobayashi")
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U.S. Patent No. 6,108,060 ("the '060 Patent") and corresponding file history
U.S. Patent No. 5,160,195 ("Miller")
J. A. Castellano, *Handbook of Display Technology,* Academic Press Inc., San Diego, 1992, at pp. 9-13 and Ch. 8
U.S. Patent No. 5,384,658 ("Ohtake")
U.S. Patent No. 5,303,322 ("Winston")
U.S. Patent No. 5,050,946 ("Hathaway")
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