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UNITED STATES PATENT APPLICATION

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FOR

LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

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LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

FIELD OF THE INVENTION

[0001] The invention relates generally to liquid crystal displays and, more specifically, to liquid crystal displays having enhanced lighting uniformity.

BACKGROUND OF THE INVENTION

[0002] Traditional display panels, such as cathode ray tube (CRT) displays are being replaced by more advanced alternatives, such as liquid crystal displays (LCDs) and plasma displays. These newer display technologies offer various advantages over traditional CRT technology, including reduced weight; thinner profile; superior color, contrast and brightness in the resulting display; and reduced power consumption.

[0003] LCDs typically include an array of pixels arranged in front of a light source, lighting panel, or reflector. Each pixel includes a layer of liquid crystal material, and two filters, with one filter serving to polarize light horizontally and the other filter serving to polarize light vertically. A reflective LCD has a reflective layer (such as a mirror) behind the pixels and is lit by either a frontlight or by ambient light. A transmissive LCD is lit by a backlight, in an arrangement where the pixels are arranged in front of a light source and light from the light source is transmitted through the pixels to the front of the LCD or the viewing area, resulting in a "lit" pixel. Light sources for backlighting may include electroluminescent panels/foils (ELs), cold cathode fluorescent lamps (CCFLs), hot cathode fluorescent lamps (HCFLs) External Electrode Fluorescent Lamps (EEFLs), traditional incandescent light bulbs, or light emitting diodes (LEDs). High intensity discharge lamps (HIDs) may also be used in certain backlighting applications.

[0004] When LEDs are utilized as light sources for transmissive LCD backlighting, they may be traditional or side view LEDs. Side view LEDs are also known as "side emitting LEDs" or "side looker LEDs." A side view LED is a packaged LED that emits light parallel to the plane of the surface to which the package is mounted. Compared to traditional LED packages, side view LED packages are thinner and typically less expensive to manufacture. A typical side view LED package has dimensions of about 1.5

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mm by about 0.5-0.7 mm, but such dimensions may vary. Owing at least in part to their small size, side view LED packages have limited current handling capabilities, thus limiting their emissions. As a result, a single side view LED package typically has less output capability than a traditional LED package. Whether accidentally or deliberately, practitioners often "overcurrent" side view LEDs to achieve greater output, which can lead to overheating and failure of a device incorporating such LEDs.

[0005] Current LED lighting techniques for transmissive LCDs include either direct backlighting or backlighting by edge illumination. While a backlight will light the pixels from the backside, that light may come from directly behind the center of the pixels (direct backlighting) or from behind the sides of the pixels (backlighting by edge illumination). While both techniques are recognized as backlighting, direct backlighting refers to illumination directed axially (centrally) through the backside of pixels. In contrast, edge illumination refers to an arrangement where the light source is located along an edge of a LCD system and lights the pixels from the side. Edge illumination may occur along the side edges of the LCD, the top edge, or the bottom edge. Backlighting of transmissive LCDs may utilize a waveguide to spread the light to an entire LCD panel, with such waveguide having a single entry for light and transmitting the light by internal reflection to be spread over a desired area.

[0006] A traditionally LED backlit LCD may include a layered system that includes an array of red, green and blue LEDs positioned on a panel or array of tiles. The panel or tiles include a reflective surface or layer arranged so that light is reflected in the desired direction toward aa diffusion layer that diffuses the light provided from the LED backlight and reflects some of the light back toward the reflective surface or layer, thereby functioning to mix the light and improve the light uniformity ("recycling effect"). A brightness enhancement film and/or collimating layer over the reflective layer or surface and the diffusion layer provides light to the LCD panel layers in a more optimal fashion and also acts with the reflective layer or surface and the diffusion layer to enhance the recycling effect Depending on the embodiment, additional or less layers can be utilized as is understood by one of skill in the art. Such a backlight system may also include thermal layers below the LEDs for thermal management. As such, as is

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understood by one of skill in the art, the LED backlight system provides uniform white light to the LCD panels, which typically include a shutter layer and red, green and blue color filters.

[0007] The above-described traditionally lit screens have several inherent limitations. In the context of direct backlighting with a LED, a traditional LED package emits light directly at (i.e., through) a LCD screen. In order to light the entire screen, the LED must operate at high power and be very thick if utilized without a waveguide. Accordingly, the thickness of the resulting LCD system (television, monitor, etc.) is also increased. Modern consumers, however, desire thinner profile systems with thicknesses as small as a few inches. Accordingly, thick LCD systems are not commercially desirable. Additionally, use of high powered traditional LED package without a waveguide may create a "headlight effect" also known as a "hot spot" on the panel, causing a detrimental lack of light uniformity.

[0008] With regard to edge illumination, in which a waveguide is used to spread the light emission of a side view LED package disposed on an edge of the LCD, the resulting screen size is limited. As indicated previously, light emission characteristics of side view LED packages are reduced in comparison to traditional LED packages, with such limitation due to their size and current handling capabilities. As a result of the lower light emission, and the single entry for light in the waveguide, one or more portions (*i.e.*, typically the center) of a side view LED-lighted LCD screen may not be lit if the screen is relatively large in size. LCD screens illuminated with side view LED packages and having acceptably uniform illumination characteristics are currently limited to screens of about 12 to 14 inches (diagonal) in size.

[0009] Accordingly, a need exists in the art for backlit LCD displays and display systems that are light in weight, have a thin profile, that enable use of large screens, and that are uniformly lit over the entire display with superior color and contrast. These and other needs are addressed with devices and systems according to embodiments of the present invention.

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SUMMARY OF THE INVENTION

[0010] The present invention provides improved liquid crystal display systems and methods of using the same.

[0011] In one aspect, the invention provides a liquid crystal display (LCD) system comprising a LCD panel, at least one waveguide element comprising a plurality of light entry regions, a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions, and at least a second light-emitting source positioned to emit light into the at least one waveguide element at at least a second light entry region of the plurality of light entry regions.

[0012] In another aspect, a liquid crystal display (LCD) system comprises a LCD panel with a viewable surface having a diagonal measurement of at least about 12 inches, at least one waveguide element comprising a plurality of light entry regions, a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions, and at least a second light-emitting source positioned to emit light into the at least one waveguide element at at least a second light entry region of the plurality of light entry regions; wherein each of the first light-emitting source and the at least second light-emitting source comprises a plurality of LEDs arranged in at least one strip.

[0013] In another aspect, the invention provides a liquid crystal display (LCD) system comprising a LCD panel, at least one waveguide element comprising at least one light entry region, a first light-emitting source positioned to emit light into the at least one waveguide element at a light entry region, and at least a second light-emitting source positioned to emit direct backlight onto the LCD panel.

[0014] In still another aspect, the invention provides a method utilizing a LCD panel; at least one waveguide element having a first and at least a second light entry region; a first light-emitting source; and at least a second light-emitting source positioned to emit light into the at least one waveguide element; and comprises multiple steps including: (1)

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optically coupling the first light-emitting source to the at least one waveguide element at the first light entry region; (2) optically coupling the at least a second light-emitting source to the at least one waveguide element at the at least a second light entry region; and (3) positioning the at least one waveguide element to backlight the LCD panel.

[0015] In another aspect, the invention provides a waveguide system comprising a first waveguide element comprising at least one light entry region; a first light-emitting source positioned to emit light into the first waveguide element at the first light entry region; at least a second waveguide element comprising at least one light entry region; and at least a second light-emitting source positioned to emit light into the at least a second waveguide element at the first light entry region. Embodiments of the invention also provide LCD systems utilizing waveguide systems as described herein.

[0016] In a further aspect, any of the foregoing aspects may be combined for additional advantage.

[0017] These aspects and other aspects and advantages of the invention will be apparent to one skilled in the art upon review of the ensuing disclosure and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1A is a schematic front view illustration of at least a portion of an exemplary LCD system including a waveguide element with edge illumination from two side edges, utilizing a plurality of LEDs arranged in strips as light sources according to one embodiment of the invention.

[0019] FIG. 1B is a schematic perspective view illustration of the exemplary LCD system of FIG. 1A.

[0020] FIG. 1C is a schematic perspective view of the multi-LED strip light source of FIG. 1A and 1B, disposed adjacent to a waveguide.

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[0021] FIG. 2 is a schematic perspective view illustration of at least a portion of an exemplary LCD system including a waveguide element with angled extensions to receive light from a plurality of LEDs arranged in strips, according to one embodiment of the invention.

[0022] FIG. 3 is a schematic view illustration of at least a portion of an exemplary LCD system including a waveguide element with multiple extensions curved toward a principal plane of the waveguide element according to one embodiment of the invention.

[0023] FIG. 4 is a schematic perspective view illustration of an exemplary LCD system including a waveguide element subject to both backlighting by a plurality of LEDs arranged in strips behind the LCD screen, and side backlighting by a plurality of LEDs arranged in strips along at least one side edge of the system according to one embodiment of the invention.

[0024] FIG. 5 is a schematic illustration of a plurality of LEDs arranged in a strip for use in a light-emitting source in a LCD system according to one embodiment of the invention.

[0025] FIG. 6A is a schematic front view illustration of a lit LCD screen, lighted by a waveguide system containing two waveguides, according to one embodiment of the invention.

[0026] FIG. 6B is a cross-sectional view illustration of the LCD screen of FIG. 6A and at least a portion of an associated waveguide system arranged to light the LCD screen.

[0027] FIG. 7A is a schematic front view illustration of a lit LCD screen, lighted by a waveguide system containing three waveguides, according to one embodiment of the invention.

[0028] FIG. 7B is a cross-sectional view illustration of the LCD screen of FIG. 7A and at least a portion of an associated waveguide system arranged to light the LCD screen according to one embodiment of the invention.

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[0029] FIG. 8A is a schematic front view illustration of a lit LCD screen, lighted by a waveguide system containing four waveguides, according to one embodiment of the invention.

[0030] FIGS. 8B and 8C are cross-sectional view illustrations of LCD screen of FIG. 8A and at least a portion of an associated waveguide system arranged to light the LCD screen, according to one embodiment of the invention.

[0031] FIG. 9A is a schematic front view illustration of a lit LCD screen, lighted by a waveguide system containing four waveguides, according to one embodiment of the invention.

[0032] FIG. 9B is a cross-sectional view illustration of the LCD screen of FIG. 9A and at least a portion of an associated waveguide system arranged to light the LCD screen according to one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0033] The present invention relates in various aspects to improved LCD systems. In one embodiment, a LCD system comprises a LCD panel or screen, at least one waveguide with multiple entry regions for light, and at least two light-emitting sources positioned to emit light into the at least one waveguide. When the light emitted by the light-emitting sources is optically coupled into the waveguide, the waveguide transmits light sufficient to light the entire LCD panel or screen of the system. Alternatively, multiple waveguides may be employed, each with at least one entry region for light and at least one associated light-emitting source positioned to emit light into the waveguides. With multiple waveguides, each waveguide may be positioned to light a portion of the LCD panel.

[0034] A conventional LCD system generally includes a LCD panel and a light source such as a LED optionally coupled to a single waveguide element having a single light entry point. Side view LED packages are desirable for use in LCD systems, due to their low current usage and small size. Due to concerns of overheating, however, the current

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that can be supplied to side view LED packages is limited, thus limiting their emissions. Consequently, the amount of light that can be emitted from a single side view LED package into a conventional waveguide is also limited. Therefore, side view LED packages coupled to single-input waveguides are not well-suited for use in backlighting LCD panels having viewable diagonal measurements larger than approximately 12-14 inches.

[0035] Embodiments of the present invention are not so limited, as they provide for uniform backlighting of panels of any desirable size, including panels having viewable diagonal measurements larger than about 12 inches, without problems such as overheating and creation of "hot spots." LCD systems embodied in the present invention may include, but are not limited to televisions and computer monitors.

[0036] Embodiments of the present invention include single waveguides having multiple light entry regions for receiving light from locations other than, and/or in addition to, a single edge of the waveguide. The provision of light into at least one waveguide from multiple entry regions permits low current side view LED packages, whether alone or with other types of light sources, to uniformly light a LCD panel or screen, even if the LCD panel or screen has a viewable surface with a diagonal measurement greater than approximately 12-14 inches.

[0037] Embodiments of the present invention also include waveguide systems comprising multiple waveguides each waveguide having at least a single light entry region. Such a waveguide system may be utilized in a LCD system, where each waveguide has a transmissive surface that lights a portion of the LCD panel. The provision of light to multiple waveguides permits use of low current side view LED packages, whether alone or with other types of light sources, to uniformly light the LCD panel.

[0038] A LCD system according to the present invention may include any suitable type of conventional LCD panel or screen. Generally, a LCD panel includes LCD pixels arranged in front of a light source or reflective surface to illuminate the pixels.

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Furthermore, the LCD may include an LCD shutter panel and/or color filters, such as RGB color filters, as are known to those of skill in the art.

[0039] In one embodiment, a LCD system according to the present invention includes a transmissive LCD, such that the light is provided to the LCD panel or screen from behind via at least one waveguide element. Preferably the at least one waveguide element disperses the light in an even and complete manner, such that the entire panel is lit consistently and at a consistent intensity. A single waveguide element may be utilized, or multiple waveguide elements may be utilized with a single LCD panel. A waveguide element is a device utilized to guide optical waves from a light entry region to a transmissive surface or exit region of the waveguide element. A waveguide element may comprise a hollow structure with a reflective internal surface; alternatively, a waveguide may be substantially solid in nature. Glass, quartz, plexiglass, and other optically transmissive materials may be employable in the fabrication of transmissive portions of waveguides, with reflective materials such as metals further employed to fabricate reflective portions. Other materials such as glass and plastic may be employed to fabricate additional portions of the waveguide. To minimize loss of light from the waveguide element from an area other than the transmissive surface or exit region, the waveguide element may also be surrounded in whole or in part by a material such as plastic to reflect any light back into the element. In one embodiment, the waveguide includes a prism. At least a portion of a waveguide may be substantially planar or tubular in shape, or of any other configuration known to those of skill in the art. Total internal reflection is desirable, such that all of the light supplied to the waveguide element from associated light source(s) is transmitted out of the waveguide element via the transmissive surface. Internal reflection guides the optical waves to a transmissive surface of the waveguide element, which is optically coupled to provide light to the LCD screen or panel, such that the LCD panel or screen may be lit by the transmitted light. A waveguide is generally utilized in an arrangement where the LCD panel or screen is located between the waveguide element and a viewer.

[0040] When a single waveguide element is used, the waveguide preferably has multiple light entry regions. Additionally, the transmissive surface of the waveguide element and

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the viewable surface of the LCD panel or screen are preferably of substantially the same size. Optionally, the waveguide may contain gaps or holes to allow light from a direct backlight to the LCD panel or screen.

[0041] Waveguides utilized in LCD systems according to the invention may be utilized in combination, and when multiple waveguides are employed in a waveguide system, each may have one or more light entry regions. Light enters the one or more light entry regions of a waveguide and is transmitted to the transmissive surface thereof. A transmissive surface is preferably substantially flat to conform to a LCD panel. This transmissive surface provides backlight to the LCD panel, and is capable of lighting the viewable surface of the LCD panel or screen. In a LCD system of the invention, one or more waveguides may be utilized in lighting the LCD panel or screen.

[0042] When multiple waveguide elements are used, each waveguide preferably has at least one light entry region. The combined transmissive surface area of the waveguide elements is preferably substantially the same as that of the viewable surface area of the LCD panel or screen. Each waveguide of the group may light a different portion of the LCD panel, or the combined transmission may light substantially all of the LCD panel. In another embodiment, when multiple waveguides are utilized, the waveguides may be spaced sufficiently to allow light from a direct backlight to the LCD screen or panel or any of the individual waveguides of the group may contain gaps or holes to allow light from a direct backlight to the LCD panel or screen. When multiple waveguides are employed, they may abut one another laterally, or at least portions thereof may be disposed in a front-to-back or layered relationship if desired. In one embodiment, multiple upstream waveguides may be optically coupled to a downstream waveguide to promote easy fabrication and/or enhance uniformity of light distribution.

[0043] A light entry region of a waveguide element according to the invention may be adapted to receive light from one or more light sources. Light entry regions may be arranged along any convenient portion of a waveguide element. If a front portion of a waveguide is optically coupled to transmit light to a LCD panel or screen, then light entry

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regions may be disposed along any of a top edge, a first side edge, a second side edge, a bottom edge, and a back side of the waveguide element.

[0044] A waveguide element of the invention may be also adapted for use with a direct backlight source. As described above, a traditionally backlit LCD system includes a layered system which may include a direct backlight and, optionally, thermal layers under the light source, reflective layer(s), diffusion layer(s), brightness enhancement film(s) and/or collimating layer(s). In one embodiment of the invention the waveguide element of the invention is adapted for use with a direct backlight source, such that the waveguide element is included within or in addition to the layered backlight system. Where direct backlighting is provided in the LCD system of the invention, inclusion and orientation of such layers, films and elements, including one or more waveguide elements, is provided to optimize the direct backlight transmitted to the LCD panel or screen. In one embodiment a waveguide element is provided between the direct backlight source and the diffusion layer. In another embodiment, the waveguide element serves as a diffusion layer.

[0045] Multiple waveguides may form a "waveguide system" such that in one embodiment, light transmitted from each of the waveguides is coupled to provide light to the LCD panel or screen of a LCD system. A waveguide system in another embodiment may include two or more waveguides arranged in a layered configuration, where each waveguide provides light to a different portion of a LCD panel, such that the entire panel is substantially illuminated by the waveguide system. Each individual waveguide within the waveguide system includes one or more light entry regions, to which one or more light sources are optically coupled. Each waveguide also includes a transmissive surface or an exit region, where light exits the waveguide. A transmissive surface may comprise glass, quartz, or other optically transmissive materials, and may be referred to as a "prismatic" section of the waveguide. Portions of the waveguide not comprising a transmissive surface may comprise materials without prismatic or transmissive properties. The waveguide may also comprise a material or be surface treated such that a light shined directly at the waveguide will enter the waveguide or pass through the

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waveguide. Optionally, layered waveguides may be alternated with layers of diffusers and/or "light shaping" components.

[0046] In an exemplary LCD system according to one embodiment of the invention, a waveguide system including two layered waveguides is used, where the first waveguide may light a central or interior region of the LCD screen and the second waveguide may light a peripheral or outer region of the LCD screen. FIG. 6A illustrates a LCD screen **42** lit by a two layer waveguide system according to one embodiment of the invention. On the lighted screen **42**, a first waveguide (not shown) is arranged to provide lighting to a central portion **45** of the LCD screen **42** and a second waveguide (not shown) is arranged to provide lighting to a peripheral or outer section **46** of the LCD screen **42**. Each waveguide of the waveguide system preferably receives light from at least one different light source (not shown). FIG. 6B provides a cross-sectional view of an exemplary waveguide system **41** used to light a LCD screen **42** such as illustrated in FIG. 6A, taken along section lines B-B of FIG. 6A. As can be seen in FIG. 6B, in the exemplary two waveguide system **41**, the waveguide layers **44A, 44B** may be of similar size to one another. The waveguides **44A**, **44B** are positioned in a layered configuration, such that one waveguide **44A** is positioned between the second waveguide **44B** and the LCD screen **42**. Each waveguide **44A, 44B** has a transmissive or prismatic portion **49A**, **49B** on a major surface that emits light toward the LCD screen **42**. Each waveguide **44A**, **44B** lights a portion of the LCD screen **42**, such that the LCD screen **42** is substantially lit. A waveguide system may optionally be backed by a mirror or white light diffuser **40**, and/or may contain additional diffusers or light shaping components (not shown) between the waveguide layers **44A**, **44B**.

[0047] In one embodiment according to the present invention, a waveguide system includes three layered waveguides, with a first waveguide lighting a central or interior region of the LCD screen, a second waveguide lighting a first portion of a peripheral or exterior region of the LCD screen, and a third waveguide lighting a second (e.g., remaining) portion of the peripheral or exterior region of the LCD screen. FIG. 7A illustrates an exemplary lit LCD screen **52** utilizing a three layer waveguide system **51**. On the lighted screen **52**, a first waveguide (not shown) is arranged to provide lighting to

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a first portion **55** along the center of the LCD screen **52**, a second waveguide (not shown) is arranged to provide lighting to a second portion **56** along the exterior of the LCD screen **52** and a third waveguide (not shown) is arranged to provide lighting to a third portion **57** along a remaining exterior portion of the LCD screen **52**. Each waveguide **54A-54C** of the waveguide system preferably receives light from at least one different light source (not shown). FIG. 7B provides a cross-sectional view of an exemplary waveguide system **51** used to light LCD screen **52** as illustrated in FIG. 7A, taken along section lines B-B of FIG. 7A. As can be seen in FIG. 7B, each waveguide layer **54A-54C** of the exemplary three waveguide system **51** may be of similar size. The waveguides **54A-54C** are positioned in a layered configuration, such that one waveguide **54A** is positioned closest to the LCD screen **52** and the third waveguide **54C** is positioned furthest from the LCD screen **52**, with the second waveguide **54B** positioned between the first and third waveguides **54A, 54C**. Each waveguide **54A-54C** has a transmissive or prismatic portion **59A-59C** on a major surface thereof that emits light toward the LCD screen **52**. Each waveguide **54A-54C** lights a portion of the LCD screen **52**, such that the entire LCD screen **52** is substantially lit. The waveguide system **51** may optionally be backed by a mirror or white light diffuser **50**, and/or may contain additional diffusers or light shaping components (not shown) between the waveguide layers **54A-54C**.

[0048] In another embodiment according to the present invention, four layered waveguides are provided. In such an arrangement, the waveguides may each provide light to a different portion (e.g., quadrants) of a LCD screen.

[0049] FIG. 8A illustrates such an exemplary LCD screen **62** lit by a four layer waveguide system. On the exemplary lit screen **62**, a first waveguide (not shown) is arranged to provide lighting to a first portion **65** corresponding to an upper left quadrant of the LCD screen **62**, a second waveguide (not shown) is arranged to provide lighting to a second portion **66** corresponding to a lower left quadrant of the LCD screen **62**, a third waveguide (not shown) is arranged to provide lighting to a third portion **67** corresponding to an upper right quadrant of the LCD screen **62**, and a fourth waveguide (not shown) is arranged to provide lighting to a fourth portion **68** corresponding to a lower right

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quadrant of the LCD screen **62**. Each waveguide of the waveguide system preferably receives light from at least one different light source (not shown). FIG. 8B provides a first cross-sectional view of a waveguide system **61** useable to light the LCD screen **62** of FIG. 8A, taken along section lines B-B of FIG. 8A. FIG. 8C provides an alternative cross-sectional view of a first waveguide system useable to light the LCD screen **62** of FIG. 8A, taken along section lines C-C. As can be seen in FIGS. 8B and 8C, in the exemplary four waveguide system **61**, the waveguide layers **64A-64D** are of similar size to one another. The waveguides **64A-64D** are positioned in a layered configuration, such that a first waveguide **64A** is positioned closest to the LCD screen **61** and a fourth waveguide **64D** is positioned furthest from the LCD screen **61**, with a second waveguide **64B** and a third waveguide **64C** positioned between the first and fourth waveguides **64A, 64D**. Each waveguide **64A-64D** has a transmissive or prismatic portion **69A-69D** on its surface that emits light toward the LCD screen **62**. Each waveguide **64A-64D** lights a portion of the LCD screen **62**, such that the entire LCD screen **62** is substantially lit. The waveguide system **61** is optionally backed by a mirror or white light diffuser (not shown) and may contain additional diffusers or light shaping components (not shown) between the waveguide layers **64A-64D**.

[0050] FIG. 9A illustrates an exemplary LCD screen **72** lit by another four layer waveguide system. On the exemplary lit screen **72**, a first waveguide lights a first portion **75** of the LCD screen **72**, a second waveguide lights a second portion **76** of the LCD screen **72**, a third waveguide lights a third portion **77** of the LCD screen **72**, and a fourth waveguide lights a fourth portion **78** of the LCD screen **72**. Each waveguide **74A-74D** of the waveguide system preferably receives light from at least one different light source (not shown). FIG. 9B provides a cross-sectional view of a waveguide system **71** useable to light the LCD screen **72** of FIG. 9A, taken along section lines B-B of FIG. 9A. As can be seen in FIG. 9B, in the exemplary four waveguide system **71**, the waveguide layers **74A-74D** are of similar size to one another. The waveguides **74A-74D** are positioned in a layered configuration, such that a first waveguide **74A** is positioned closest to the LCD screen **72** and a fourth waveguide **74D** is positioned furthest from the LCD screen **72**, with a second waveguide **74B** and a third waveguide **74C** positioned between the first and fourth waveguides **74A, 74D**. Each waveguide **74A-74D** has a transmissive or

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prismatic portion **79A-79D** on its surface that emits light toward the LCD screen **72**. Each waveguide **74A-74D** lights a portion of the LCD screen **72**, such that the entire LCD screen **72** is substantially lit. The waveguide system **71** is optionally backed by a mirror or white light diffuser (not shown) and may contain additional diffusers or light shaping components (not shown) between the waveguide layers**74A-74D**.

[0051] It is to be understood that the exemplary waveguide systems described above are not limited to the particular transmission configurations provided herein. Any number of waveguides may be arranged in any configuration such that the transmissive sections of the waveguides illuminate various sections of a LCD screen. Transmission by the waveguides in any particular configuration does not have to be evenly distributed among individual waveguides. The exemplary waveguide systems set forth above include waveguides of approximately similar size; however, the waveguides of a waveguide system may be of any size, as long as the resulting transmissive sections of those waveguides illuminate substantially all of the LCD screen.

[0052] As described hereinabove, one or more light sources are optically coupled to a waveguide element in various embodiments of the invention. Any number of light sources may be employed to achieve uniform lighting of a LCD panel. While the light sources are optically coupled to emit light into the light entry regions of the waveguide element, the number of light entry regions does not limit the number of light sources. In one embodiment, at least one waveguide element is utilized, including a first light-emitting source positioned to emit light into a first entry region of the at least one waveguide element and a second light-emitting source positioned to emit light into a second entry region of the at least one waveguide element. Additional light-emitting sources and light entry regions may be employed.

[0053] A light-emitting source may be positioned anywhere within a LCD system that allows optical coupling of the light emitted into a light entry region. Accordingly, light-emitting sources may be located in or along a side region, a top region, a bottom region and/or a rear region of the LCD system. Light-emitting sources may be spaced apart from corresponding light entry regions, may be adjacent to corresponding light entry

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regions, and/or may be physically coupled to the corresponding light entry regions. In one embodiment, the light-emitting sources include side view LED packages, the light-emitting sources are arranged to not simultaneously and solely emit light into a top edge and a bottom edge of the waveguide. In such an embodiment, light sources may be arranged in locations other than both the top and bottom edges of the waveguide, or light sources arranged along both the top and bottom edge of a waveguide are supplemented with at least one additional light source arranged to emit light into the waveguide from at least one other location.

[0054] Optical coupling between a light source and waveguide element may include any of: directing light to one or more recesses defined a waveguide element, embedding a light source in a waveguide element, and directing light to at least one edge or surface of a waveguide element. The waveguide element does not need to be uniform in shape and, optionally, may contain one or more extensions oriented in any suitable direction, such that the light source may be optically coupled to the waveguide element via the one or more extensions.

[0055] As thinner profile LCD systems may be desirable, where waveguide extensions are utilized, they may be optionally oriented in a manner such that they are angled, bent, or curved toward a primary plane of the waveguide element itself and, correspondingly, toward the LCD panel, to achieve a thinner profile system.

[0056] In one embodiment, a LCD system may further comprise a light source that is not optically coupled to emit light into the waveguide. An exemplary system includes a light source that directly backlights a LCD panel, supplemented by waveguide-directed light. Light emitted by such a backlight may pass through or around a waveguide or waveguide system disposed between the backlight and the LCD panel, in order to transmit light from the backlight to the LCD panel. In such an embodiment, the backlight provides light to the LCD panel or screen, which light is supplemented in one or more locations by light transmitted by the waveguide or waveguide system.

[0057] In another embodiment, a LCD system may further comprise a direct backlight source that is optically coupled into the waveguide as understood by one of skill in the

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art. An exemplary system includes a light source that provides light optically coupled into the waveguide, where the light source is positioned directly behind the LCD panel. Such direct backlighting may be coupled into the waveguide by any means known to those of skill in the art. In one embodiment the LED is provided at the end of a waveguide extension. Such a waveguide extension may be oriented in any manner as more fully described above. Preferably such an extension is short and the backlight is flush with the extension. In another embodiment the waveguide comprises such a material or is surface-treated such that a direct backlight shined on the waveguide will enter the waveguide through the surface and will be optically coupled to light provided to the waveguide through additional light entry sources. In a still further embodiment, the waveguide contains a light entry source in the form of a notch, or groove or other indentation in the surface of the waveguide, allowing for placement of a direct backlight directly against the waveguide. Light emitted from the direct backlight can therefore be optically coupled directly into the waveguide.

[0058] Light sources useful in lighting a LCD panel can include any of: a cold cathode fluorescent lamp (CCFL), a hot cathode fluorescent lamp (HCFL), an electroluminescent panel (ELP), an incandescent light bulb, a light emitting diode (LED), an organic light emitting diode (OLED), a high intensity discharge (HID) lamp, and any combination of the foregoing sources arranged to provide light in additive or spatially discrete arrangement.

[0059] Where LEDs are utilized as light sources in embodiments of the present invention, such LEDs are preferably embodied in LED packages. Such packages may include packaged traditional LEDs that emit light from a side opposite the electrode from which they receive current, and/or may be packaged side view LEDs (also known as "side emitting LEDs" or "sidelooker LEDs") that emit light substantially parallel to a plane of the surface on which the package is mounted. A "LED package," as used herein, preferably includes a substrate, an electrode, a LED chip mounted on or over the substrate and an encapsulant disposed on or over the LED chip. A LED package may also include any of: a diffuser, a reflector, a lens, an electrostatic discharge diode, and/or thermal conduction elements.

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[0060] A light source in a LCD system of the invention may include a LED that emits any of white light, blue light, red light, green light, or light of any desirable wavelength. In one embodiment, a light source includes one or more clusters of red-green-blue (RGB) LEDs. Such clusters may be independently controlled. In another embodiment, a light source includes a blue LED coated or otherwise covered with phosphors to upconvert blue light to white light.

[0061] Exemplary combinations of light sources of the invention may include: (1) direct backlighting utilizing one or more side view LEDs, supplemented with edge backlighting utilizing one or more side view LEDs; (2) direct backlighting utilizing one or more traditional LEDs, supplemented with edge backlighting utilizing one or more side view LEDs; (3) direct backlighting utilizing one or more side view LEDs, supplemented with edge backlighting utilizing one or more traditional LEDs; (4) direct backlighting utilizing one or more traditional LEDs, supplemented with edge backlighting utilizing one or more traditional LEDs; and (5) edge backlighting from more than one edge, utilizing one or more side view LEDs or traditional LEDs, or any combinations thereof. Such combinations may include, but are not limited to, single light sources including both traditional and side view LEDs. The foregoing combinations represent mere examples of possible configurations; other configurations may be employed within the scope of the present invention.

[0062] A single light source may comprise a plurality of LEDs. The LEDs of such a plurality of LEDs may be arranged in any suitable configuration, whether to enable convenient manufacture, to maximize light emitted into the light entry regions of the at least one waveguide element, or both. Exemplary arrangements include multiple LED packages arranged in a strip, or a single LED package containing multiple LEDs arranged in a strip. Such a strip may contain two or more LEDs or LED packages. Individual LEDs or LED packages within a single strip may be characteristically the same as, or different from, other LEDs or LED packages in the same strip. LEDs or LED packages in a single strip may be adapted to emit substantially the same wavelength, or may be adapted to emit different wavelengths. Additionally, multiple strips may be connected to one another in any suitable orientation, such as in an end-to-end orientation, or in a side-

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to-side orientation, in order to yield a single composite light source to emit light into the waveguide element. Where multiple strips are utilized, each strip may be adapted to emit light of substantially the same wavelength as other strips, or may be adapted to emit light of wavelengths different from light other strips.

[0063] A light source including a strip of LEDs or LED packages may include a circuit board or other common structural support, such that the LEDs may be electrically connected to one another. The LEDs may be further electrically connected to components adapted to provide uniform performance of the plurality of LEDs. Such components may include one or more common control circuits (e.g., integrated circuits or processors) to regulate, for example, power to the LEDs, intensity of the emitted light, wavelength of the emitted light, and/or other parameters. Additionally, a strip of LEDs may include or be connected to one or more common electrostatic discharge (ESD) diodes, providing protection from voltage spikes to multiple LEDs within the strip. Moreover, multiple strips may be subject to control from a single master control circuit or CPU.

[0064] FIG. 5 illustrates of an exemplary light source for use in a LCD system, including a plurality of LED packages arranged in a strip **100**. In a preferred embodiment, the strip **100** has dimensions of 20 mm x 2.5 mm and contains five or more LED packages **101A-101E**, which may be disposed in series. Optionally, such a strip **100** comprises a circuit board **105** including a 2.5 mil thickness FR4 substrate and 1 oz. copper, electroless Nickel Immersion Gold plating, and does not contain soldermask on the back surface. The strip **100** includes a common ESD diode **102** in electrical communication with the LEDs **101A-101E**. Contacts 103, 104 may be provided to serve as common electrical inputs for the strip 100.

[0065] It is understood that when a single light source comprises a plurality of LED packages, any desirable number of LED packages may be provided. Factors affecting the makeup of a single light source may include: the size of the panel being lit, the desired viewing angle, the entry angle of the light into the light entry region of the waveguide element, the spacing of the individual LED packages, the brightness of the individual

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LED packages, and the size of the LED packages. In combination, plural light sources coupled to at least one waveguide utilized in a system as described herein are adapted to uniformly light a LCD panel of any desired size.

[0066] FIG. 1A is a schematic front view illustration of at least a portion of an exemplary LCD system **1** including a LCD panel **2** and multiple light sources **3A**, **3B**. FIG. 1B is a schematic side view illustration of the system of FIG. 1A, depicting the LCD panel **2**, light sources **3A**, **3B** and waveguide element **4**. FIG. 1C is a schematic side view illustration of an exemplary light source **3B**, comprising a plurality of side view LED packages, **6A-6E** arranged as a strip on base **7** and emitting light **8**, parallel to the plane of base **7**, into waveguide **4**.

[0067] FIG. 2 is a schematic perspective view illustration of at least a portion of an exemplary LCD system **11** according to an embodiment of the present invention, including a LCD panel **12**, waveguide element **14**, first light source **13**, and additional light sources **15A-15D**, each coupled to the waveguide element **14** at the end of waveguide extensions **16A-16D**, respectively. In FIG. 2, the first light source 13 provides light to a light entry region located along a lateral edge of the waveguide element **14** and additional strips of LED packages **15A-15D** are optically coupled to the waveguide element **14** along light entry regions on extensions **16A-16D** of the waveguide element **14**.

[0068] FIG. 3 is a schematic perspective view illustration of at least a portion of an exemplary LCD system **21** according to one embodiment of the invention, the system including a LCD panel **22,** waveguide element **24**, and light sources **23**, **25A**, **25B** coupled to the waveguide element **24** along an edge **27** of a primary waveguide surface and at the ends of waveguide extensions **26A**, **26B**, respectively. Additional light sources (not shown) are contemplated to be coupled to the waveguide element **24** at the end of waveguide extensions **26C** and **26D**, and along edge **28**. Waveguide extensions **26A-26D** are curved toward a primary plane of the waveguide element **24**, such that the side profile of the resulting system **21** is thinner than it would otherwise be if the extensions **26A-26D** were straight.

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[0069] FIG. 4 is a schematic perspective view illustration view of an exemplary LCD system **31** according to one embodiment of the invention. The system **31** includes a LCD panel **32**, a waveguide element **34**, a first light source **33** optically coupled to an edge **37** of the waveguide element **34**, and additional light sources **34A-34I** optically coupled to the back side **35** of the waveguide element **34**.

[0070] Various embodiments of the invention also provide methods of lighting a LCD panel utilizing light sources as described above. A LED panel may be lit by any combination of light sources that provides complete and uniform illumination of the panel. Light may be provided to the panel from light sources located along edge or back regions of the waveguide element, by direct backlighting, or use of any combination of light sources arranged to emit light directly to a LED panel and/or to emit light into one or more interposing waveguide elements.

[0071] Although the invention has been described with reference to the above embodiments, it will be understood that modifications and variations are encompassed within the spirit and scope of the invention. Accordingly, the invention is limited only by the following claims.

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What is claimed is:

1. A liquid crystal display (LCD) system comprising:
   a) a LCD panel;
   b) at least one waveguide element comprising a plurality of light entry regions;
   c) a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions; and
   d) at least a second light-emitting source positioned to emit light into the at least one waveguide element at at least a second light entry region of the plurality of light entry regions.

2. The LCD system of claim 1, wherein the LCD panel has a viewable surface, the at least one waveguide element has a transmissive surface, and the transmissive surface is approximately the same size as the viewable surface.

3. The LCD system of claim 2, wherein the viewable surface has a diagonal measurement of at least about 12 inches.

4. The LCD system of claim 1, wherein each of the first light entry region and the at least a second light entry region is disposed at a different location on the at least one waveguide element selected from: a top edge of the at least one waveguide element, a bottom edge of the at least one waveguide element, a first side edge of the at least one waveguide element, a second side edge of the at least one waveguide element, and a back side of the at least one waveguide element.

5. The LCD system of claim 1, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a LED adapted to emit any of white light and single color light.

6. The LCD system of claim 5, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a direct LED.

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7. The LCD system of claim 5, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a side view LED.

8. The LCD system of claim 1, wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs.

9. The LCD system of claim 8, wherein each of the first plurality of LEDs and the second plurality of LEDs comprises LEDs adapted to emit different wavelengths.

10. The LCD system of claim 8, wherein each LED of the first plurality of LEDs and second plurality of LEDs is adapted to output substantially the same wavelength.

11. The LCD system of claim 8, wherein the first plurality of LEDs is adapted to emit a first wavelength and the second plurality of LEDs is adapted to emit a second wavelength.

12. The LCD system of claim 8, wherein the first plurality of LEDs and the second plurality of LEDs are arranged in at least one strip.

13. The LCD system of claim 12, wherein the at least one strip comprises a common control circuit in electrical communication with the plurality of LEDs arranged in the at least one strip.

14. The LCD system of claim 12, wherein the at least one strip comprises a common electrostatic discharge diode in electrical communication with the plurality of LEDs arranged in the at least one strip.

15. The LCD system of claim 12, wherein the LEDs arranged in the at least one strip are linearly arranged.

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16. The LCD system of claim 8, wherein the at least one strip comprises a first strip and a second strip, with the first plurality of LEDs being arranged in the first strip and the second plurality of LEDs being arranged in the second strip.

17. The LCD system of claim 16, further comprising a common control circuit in electrical communication any of the first plurality of LEDs and the second plurality of LEDs.

18. The LCD system of claim 16, wherein further comprising an electrostatic discharge diode in electrical communication with any of the first plurality of LEDs and the second plurality of LEDs.

19. The LCD system of claim 16, wherein each of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.

20. The LCD system of claim 1, wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to the at least one waveguide element.

21. The LCD system of claim 20, wherein any of the first light-emitting source and the at least a second light-emitting source is coupled to extensions of the at least one waveguide element surface.

22. The LCD system of claim 20, wherein the extensions are bent toward a principal plane of the at least one waveguide element.

23. The LCD system of claim 20, wherein any of the first light-emitting source and the at least a second light-emitting source is embedded within a surface of the at least one waveguide element.

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24. The LCD system of claim 20, wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to at least one recess defined in a surface of the at least one waveguide element.

25. The LCD system of claim 20, wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to a back portion of the at least one waveguide element.

26. The LCD system of claim 20, wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to an edge of the at least one waveguide element.

27. The LCD system of claim 1, wherein the at least one waveguide element comprises a first waveguide element and a second waveguide element.

28. The LCD system of claim 27, wherein the first light emitting source is optically coupled to the first waveguide element and the at least a second light-emitting source is optically coupled to the second waveguide element.

29. The LCD system of claim 28, wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs.

30. The LCD system of claim 29, wherein the first plurality of LEDs and the second plurality of LEDs are arranged in a common strip.

31. The LCD system of claim 29, wherein first plurality of LEDs and the second plurality of LEDs are arranged in a plurality of strips.

32. The LCD system of claim 1, wherein any of the first light emitting source and the at least a second light-emitting source is disposed along an edge region of the

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LCD system, and positioned to emit light into an edge of the at least one waveguide element.

33. The LCD system of claim 1, wherein any of the first light emitting source and the at least a second light-emitting source is disposed along a center region of the LCD system behind the LCD panel, and is positioned to emit light into a back side of the at least one waveguide element.

34. The LCD system of claim 1, wherein any of the first light emitting source and the at least a second light-emitting source is disposed at a location selected from: 1) along an edge region of the LCD system, positioned to emit light into an edge of the at least one waveguide element, and 2) along a center region of the LCD system behind the LCD panel, positioned to emit light into a back side of the at least one waveguide element.

35. The LCD system of claim 1, wherein the at least one waveguide element comprises a prism.

36. The LCD system of claim 1, further comprising at least a third light-emitting source, positioned to emit direct backlight onto the LCD panel.

37. The LCD system of claim 1, embodied in a television.

38. The LCD system of claim 1, embodied in a computer monitor.

39. A liquid crystal display (LCD) system comprising:
    a) a LCD panel with a viewable surface having a diagonal measurement of at least about 12 inches;
    b) at least one waveguide element comprising a plurality of light entry regions;

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c) a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions; and

d) at least a second light-emitting source positioned to emit light into the at least one waveguide element at at least a second light entry region of the plurality of light entry regions;

wherein each of the first light-emitting source and the at least second light-emitting source comprises a plurality of LEDs arranged in at least one strip.

40. The LCD system of claim 39, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a direct LED.

41. The LCD system of claim 39, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a side view LED.

42. The LCD system of claim 39, wherein each strip of the at least one strip comprises a common control circuit in electrical communication with the plurality of LEDs arranged in the at least one strip.

43. The LCD system of claim 39, further comprising an electrostatic discharge diode in electrical communication with the at least one strip.

44. A liquid crystal display (LCD) system comprising:

a) a LCD panel;

b) at least one waveguide element comprising at least one light entry region;

c) a first light-emitting source positioned to emit light into the at least one waveguide element at a light entry region; and

d) at least a second light-emitting source positioned to emit direct backlight onto the LCD panel.

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45. A method utilizing a) a LCD panel; b) at least one waveguide element having a first and at least a second light entry region; c) a first light-emitting source; and d) at least a second light-emitting source positioned to emit light into the at least one waveguide element, the method comprising:

optically coupling the first light-emitting source to the at least one waveguide element at the first light entry region;

optically coupling the at least a second light-emitting source to the at least one waveguide element at the at least a second light entry region; and

positioning the at least one waveguide element to backlight the LCD panel.

46. The method of claim 45, further comprising illuminating the LCD panel with the first light emitting source and the least a second light-emitting source.

47. A waveguide system comprising:

a) a first waveguide element comprising at least one light entry region;

b) a first light-emitting source positioned to emit light into the first waveguide element at the first light entry region;

c) at least a second waveguide element comprising at least one light entry region; and

d) at least a second light-emitting source positioned to emit light into the at least a second waveguide element at the first light entry region.

48. A liquid crystal display (LCD) system comprising:

a) a LCD panel; and

b) the waveguide system of claim 47.

49. The LCD system of claim 48, wherein the LCD panel has a viewable surface area, the first waveguide element has a first transmissive surface area, the at least a second waveguide element has a second transmissive surface area and the sum of the first transmissive surface area and the second transmissive surface area is approximately the same size as the viewable surface area.

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50. The LCD system of claim 48, further comprising at least a third light-emitting source, positioned to emit direct backlight onto the LCD panel.

51 A liquid crystal display (LCD) system comprising:

a) a LCD panel;

b) at least one waveguide element comprising an outer light entry region at an edge of said at least one waveguide element and an inner light entry region spaced from said edge of said at least one waveguide element;

c) a first light-emitting diode source positioned to emit light into said outer entry region; and

d) at least a second light-emitting diode source positioned to emit light into said inner light entry region.

52. A liquid crystal display (LCD) system comprising:

a) a LCD panel having a peripheral region and an inner region;

b) at least one waveguide element comprising a light entry region at an edge of said LCD panel;

c) a first light-emitting diode source positioned to emit light into said light entry region; and

d) at least a second light-emitting diode source positioned to emit light into an inner region of said LCD panel.

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ABSTRACT OF THE INVENTION

A LCD system including multiple light sources optically coupled through different light entry regions to at least one waveguide element positioned to backlight a LCD panel. A LCD system including multiple light sources coupled to light entry regions of two or more waveguides comprising a waveguide system positioned to backlight a LCD panel. Waveguides of various configurations and promoting even lighting of associated LCD panels are provided. Resulting LCD systems enable uniformly lit panels having diagonal measurements in excess of 12 to 14 inches, but the invention is not limited to panels of any particular size.

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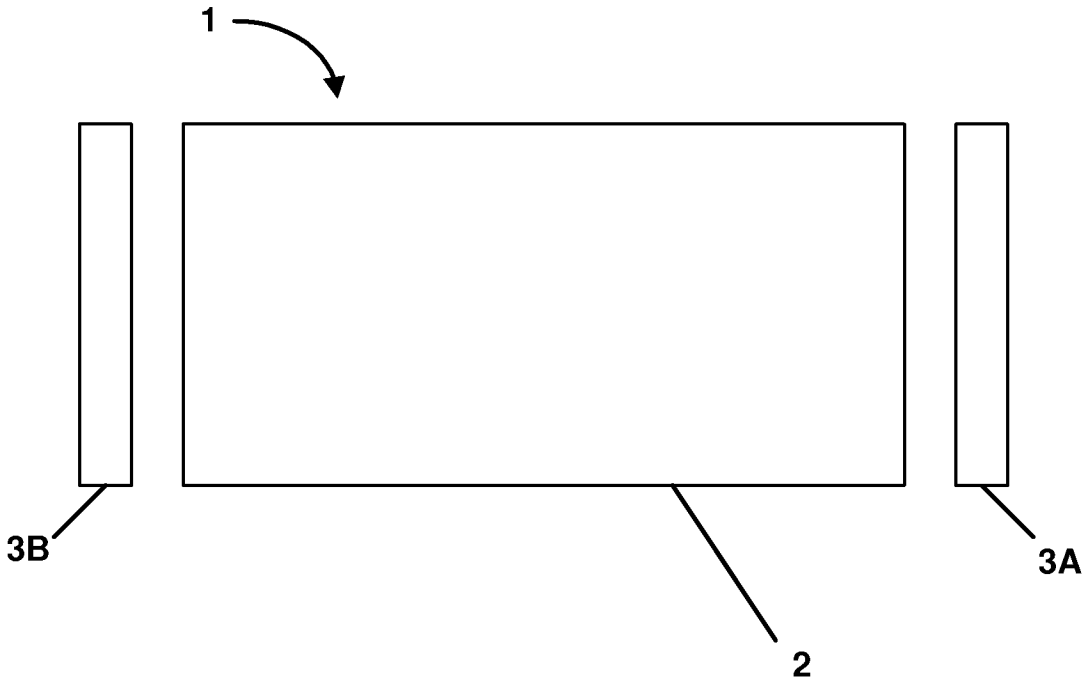

FIG. 1A

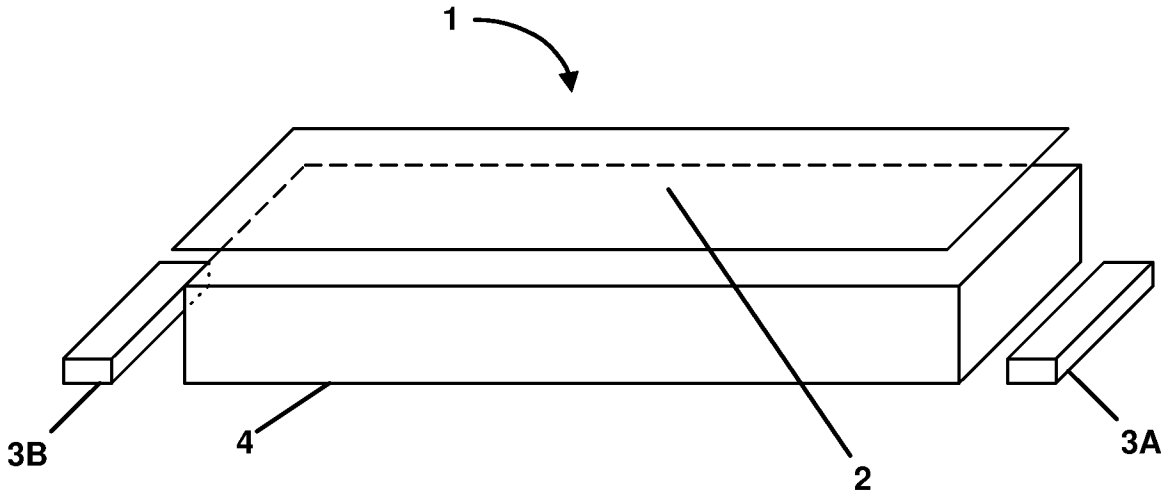

FIG. 1B

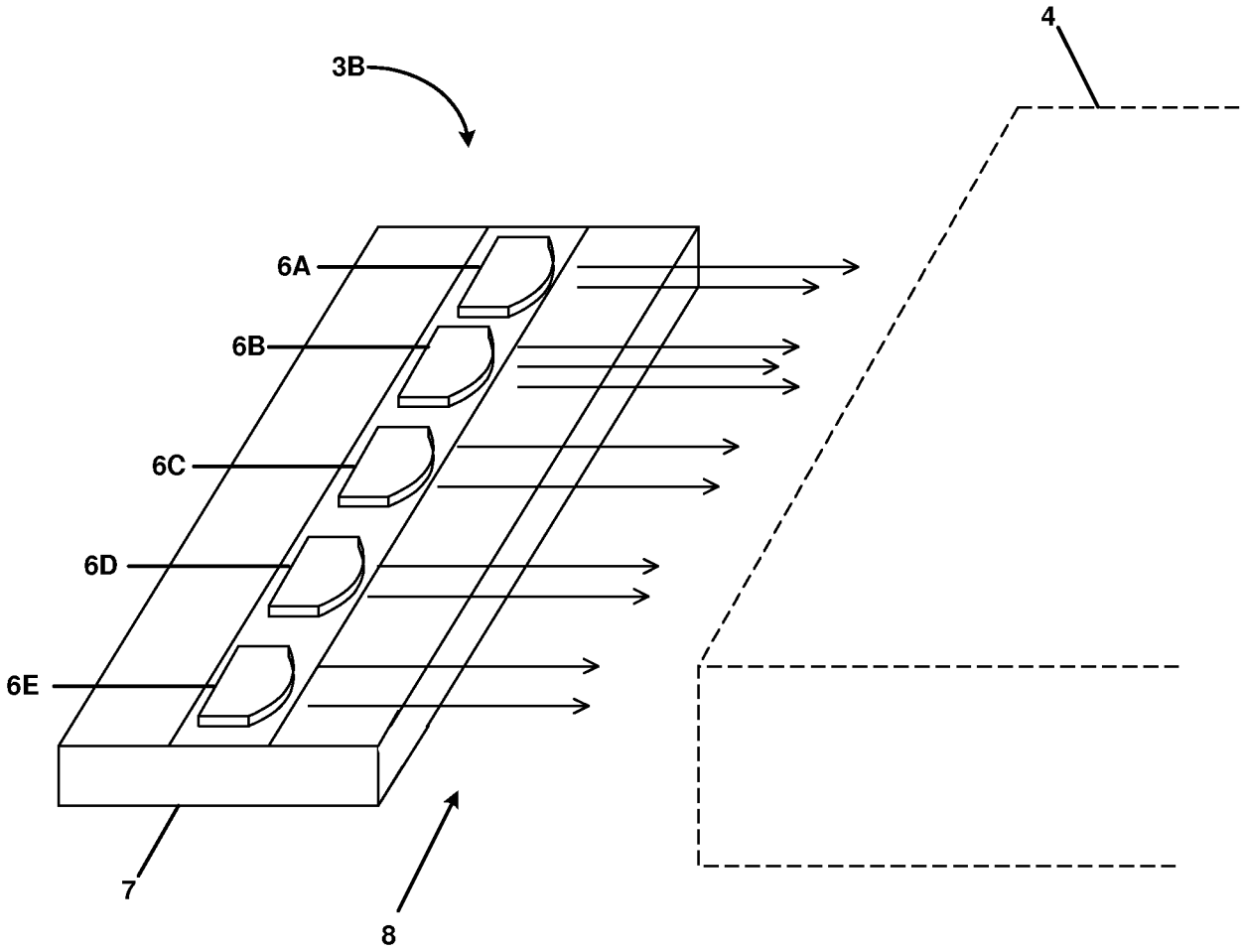

FIG. 1C

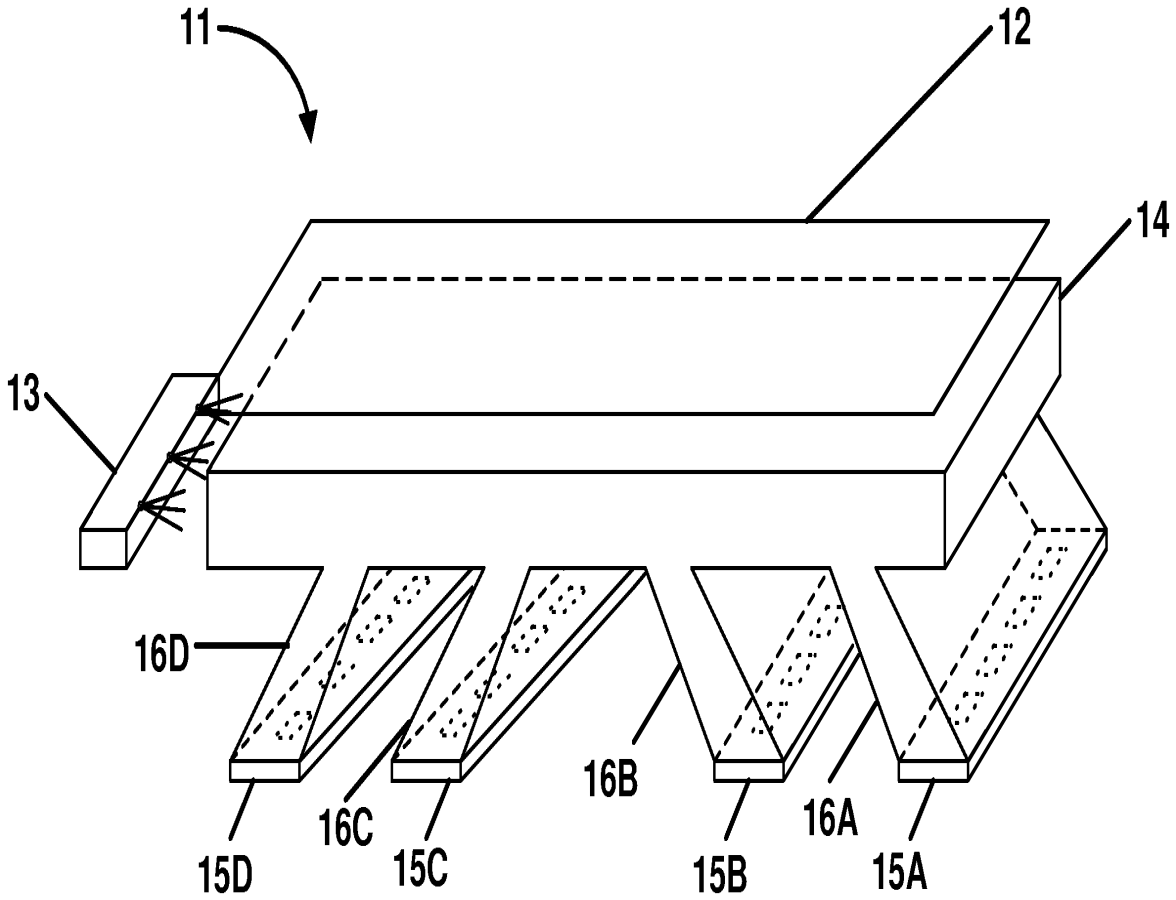

FIG. 2

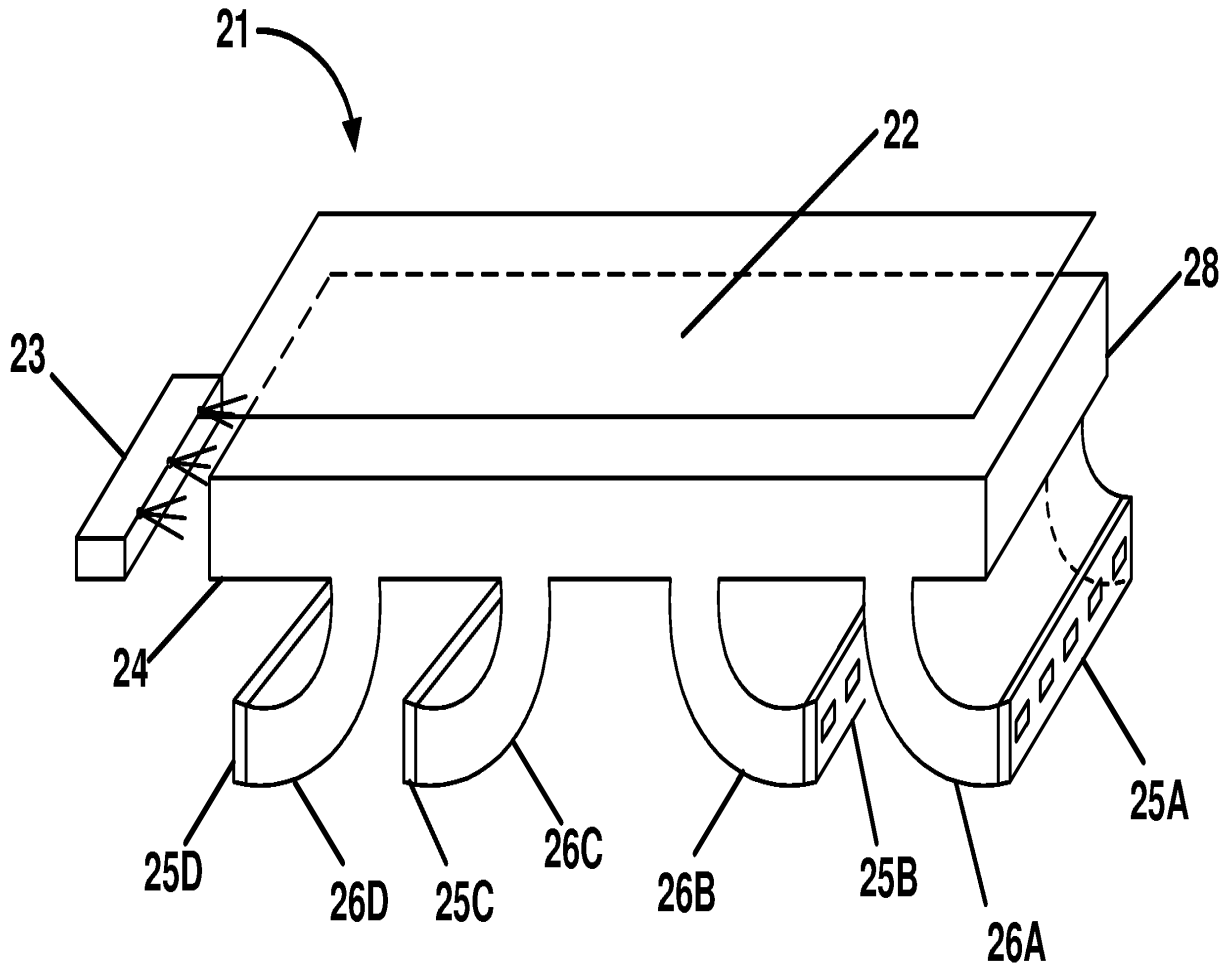

FIG. 3

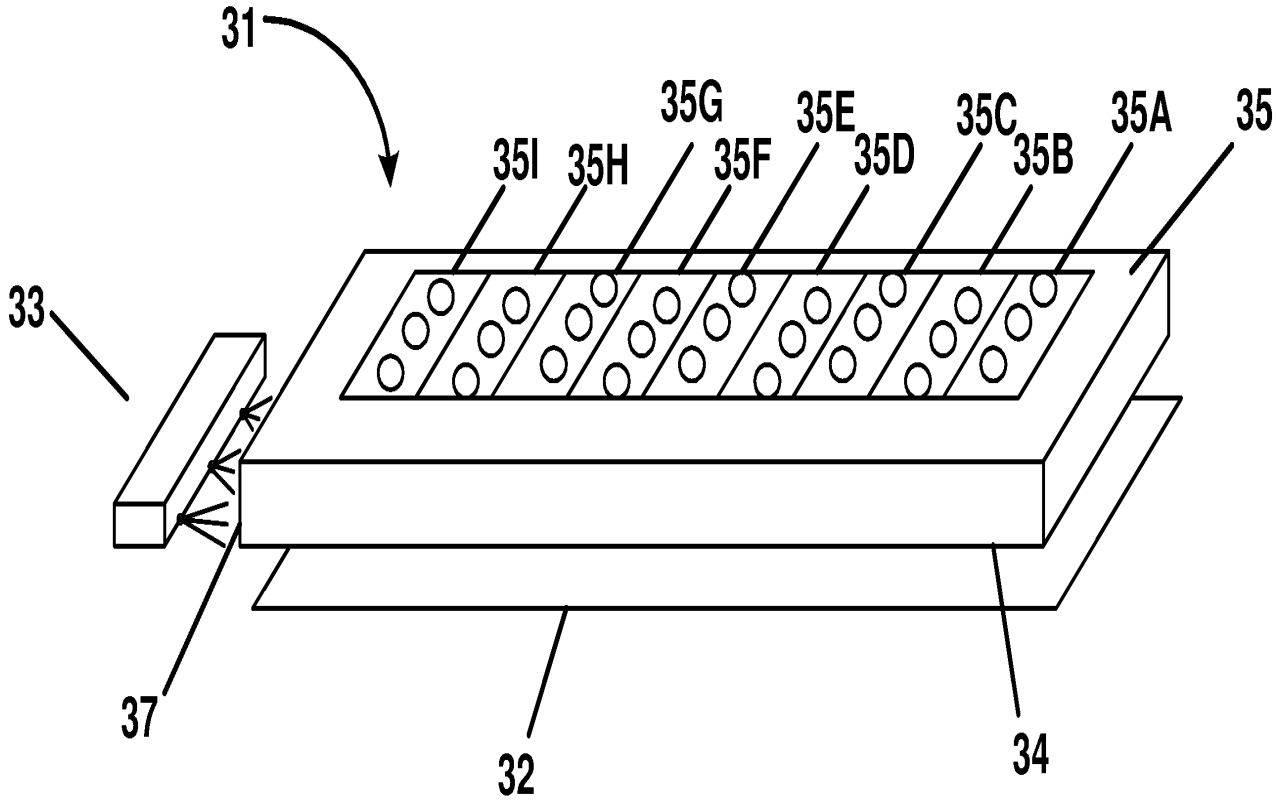

FIG. 4

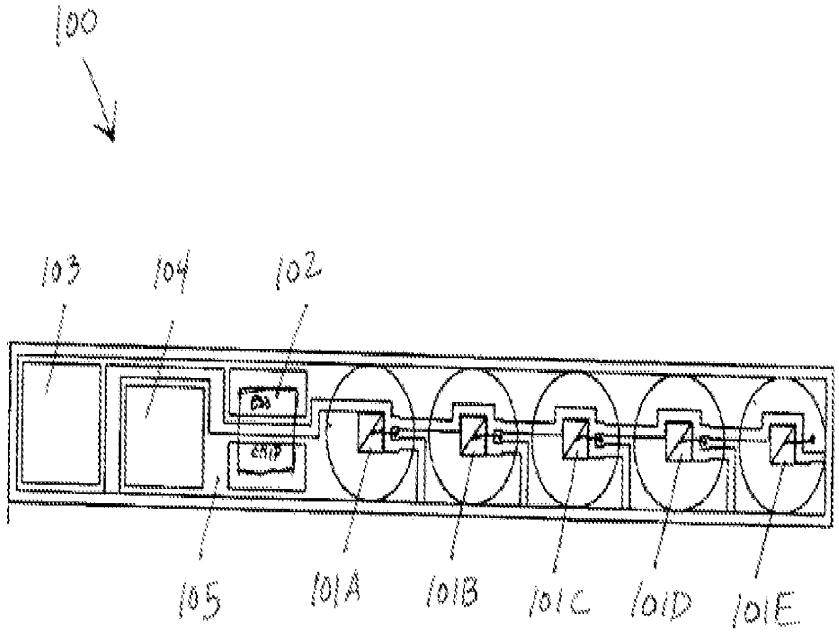

FIG. 5

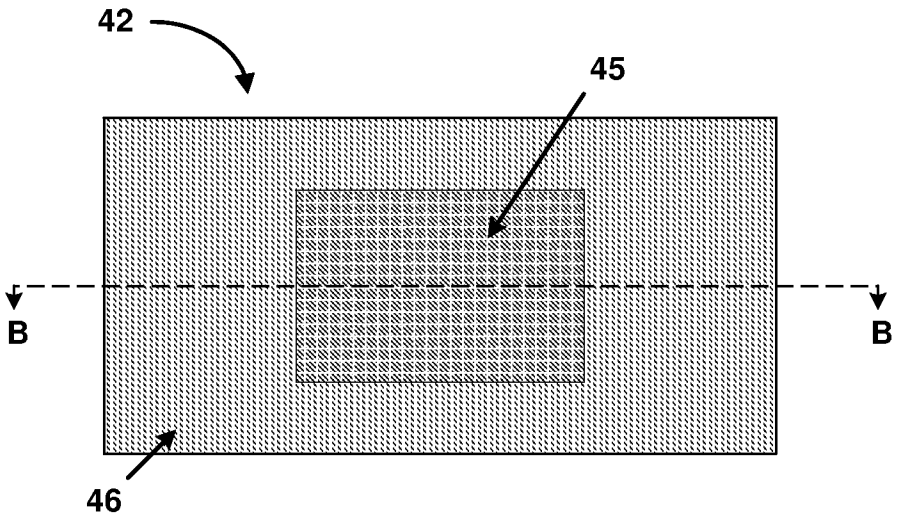

FIG. 6A

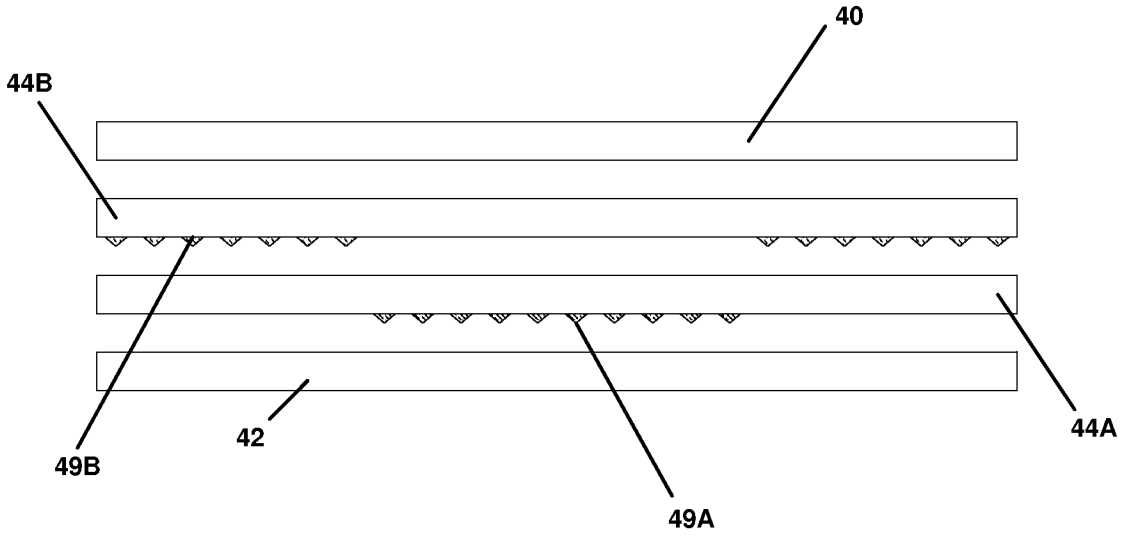

FIG. 6B

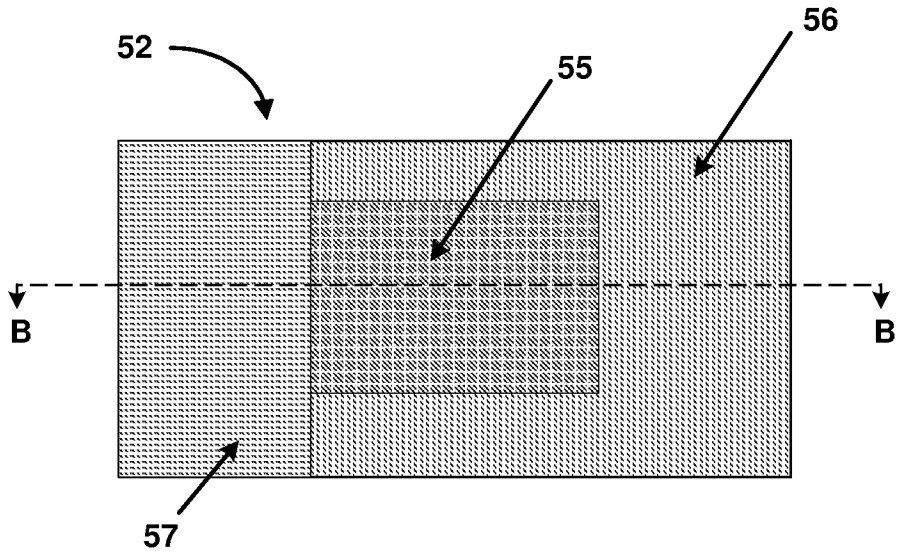

FIG. 7A

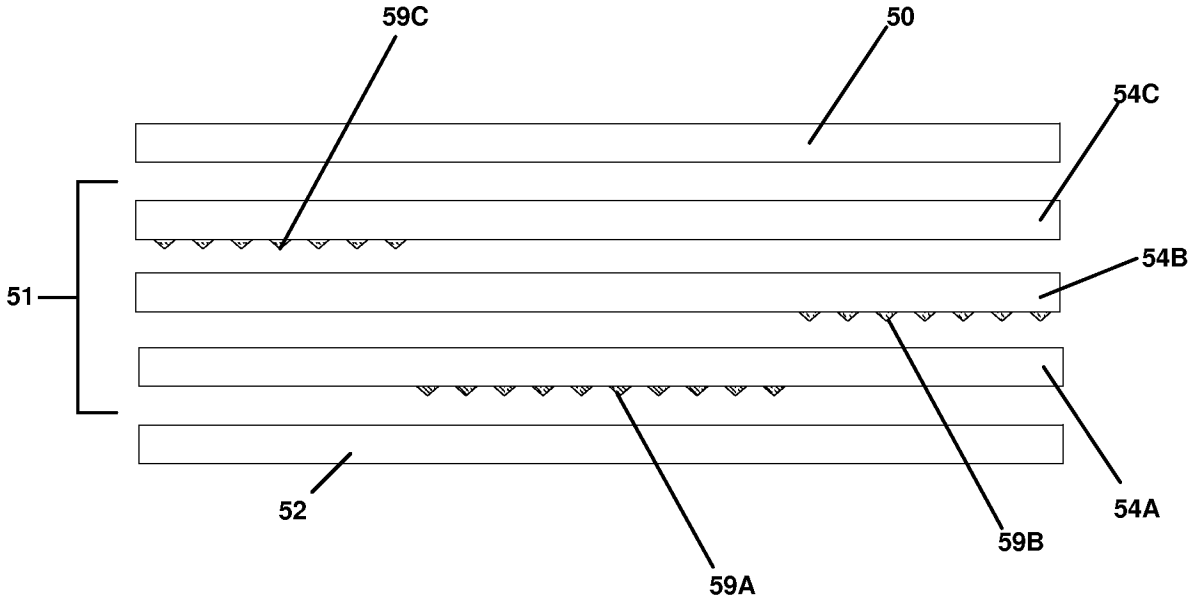

FIG. 7B

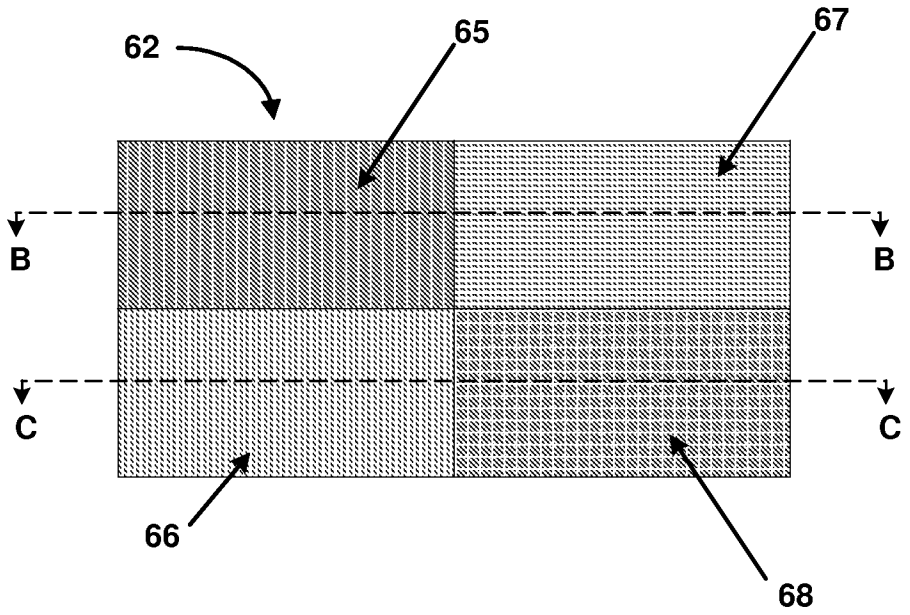

FIG. 8A

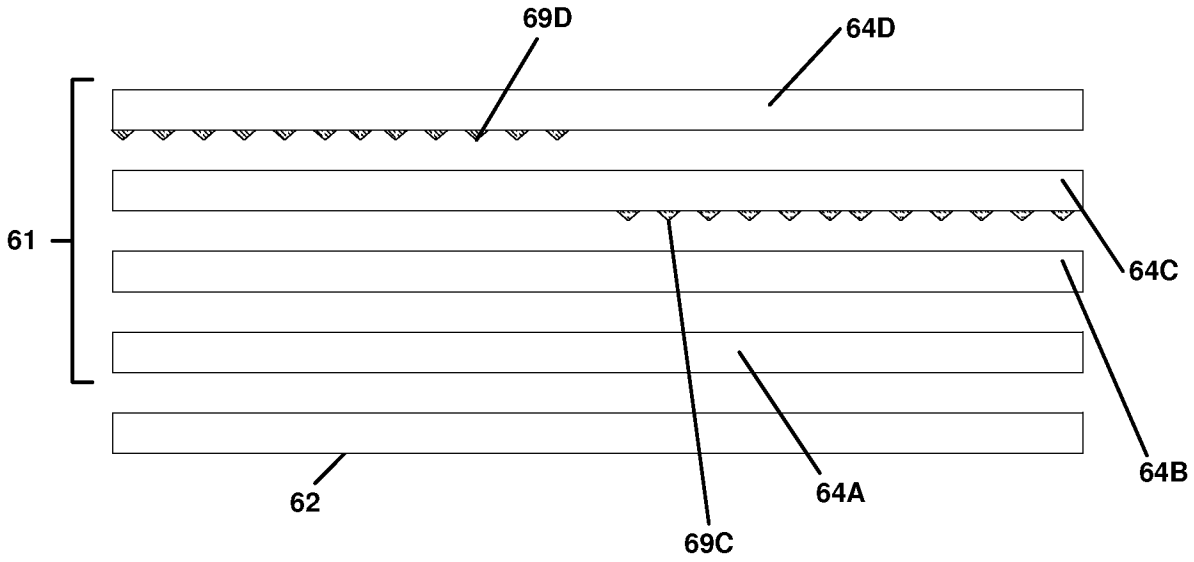

FIG. 8B

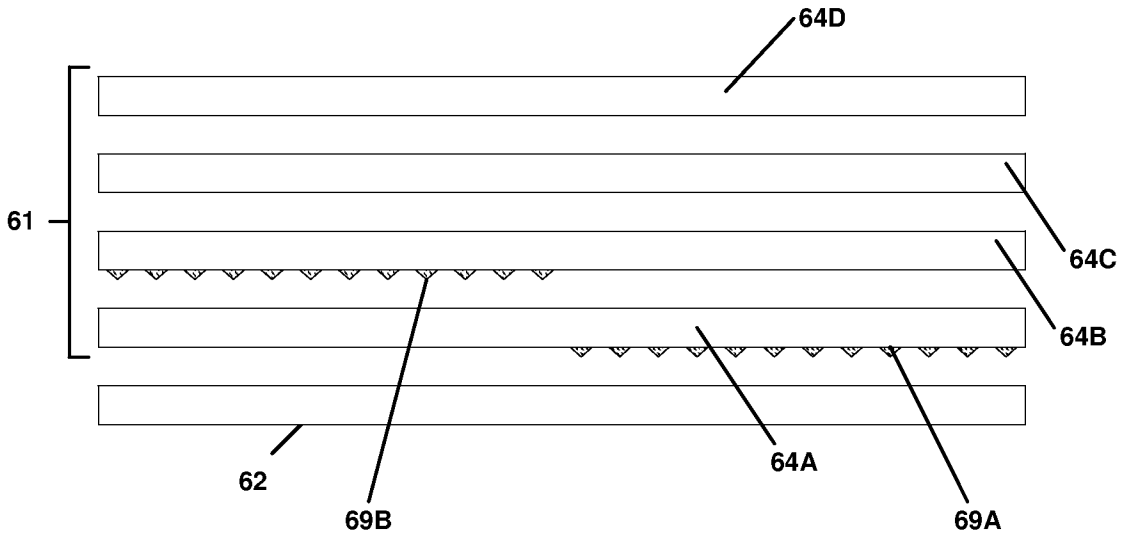

FIG. 8C

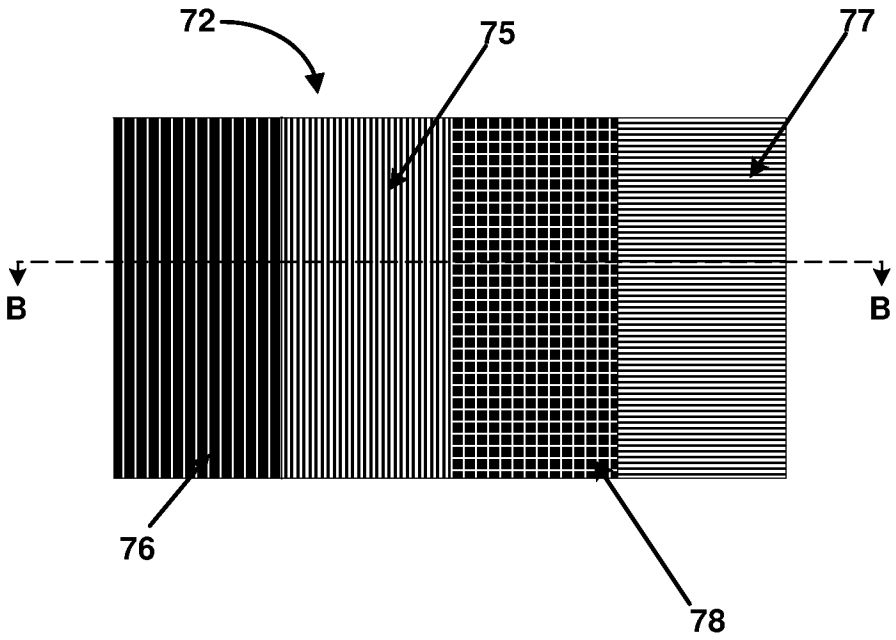

FIG. 9A

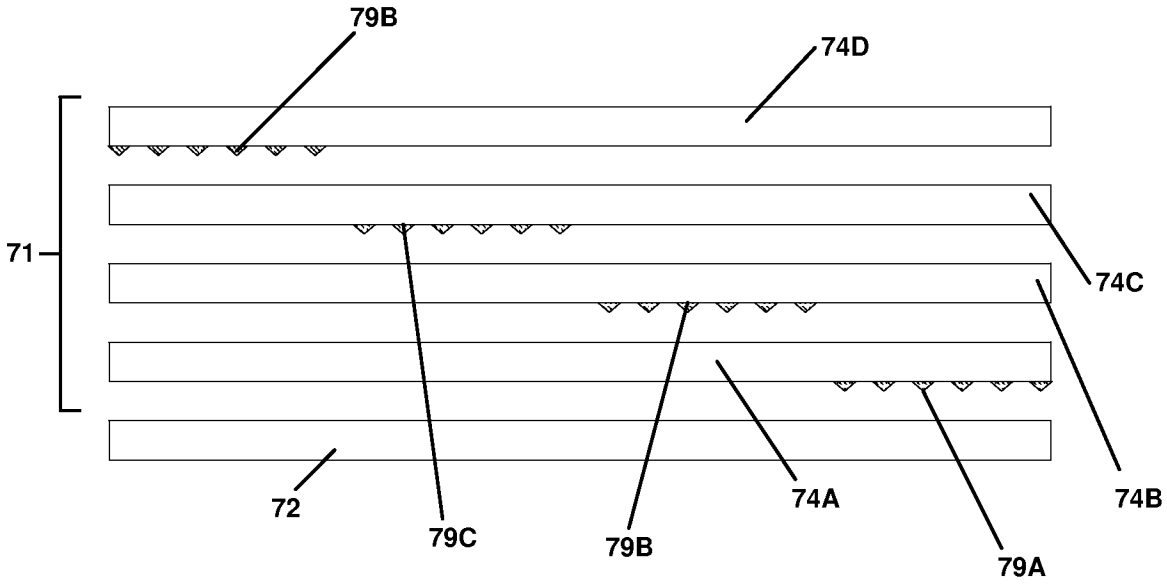

FIG. 9B

CERTIFICATE OF EFS FILING

I hereby certify that this patent application is being filed via EFS in the United States Patent and Trademark Office on July 29, 2007.
/steven j. hultquist/

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	4241-696
First Inventor	Medendorp, Jr., et al.
Title	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (e.g., PTO/SB/17) *(Submit an original and a duplicate for fee processing)*
2. ☐ **Applicant claims small entity status.** See 37 CFR 1.27.
3. ☒ **Specification** [*Total Pages* 31] Both the claims and abstract must start on a new page *(For information on the preferred arrangement, see MPEP 608.01(a))*
4. ☐ **Drawing(s)** *(35 U.S.C. 113)* [*Total Sheets* 11
5. **Oath or Declaration** [*Total Sheets*]
   a. ☐ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63 (d)) *(for continuation/divisional with Box 18 completed)*
      i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☒ **Application Data Sheet**. See 37 CFR 1.76
7. ☐ **CD-ROM or CD-R** in duplicate, large table or Computer Program *(Appendix)*
   ☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. Computer Readable Form (CRF)
      i. ☐ Computer Readable Form (CRF)
      ii. ☐ Transfer Request (37 CFR 1.821(e))
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

ACCOMPANYING APPLICATION PARTS

9. ☐ **Assignment Papers** (cover sheet & document(s))
   Name of Assignee _____
10. ☐ **37 CFR 3.73(b) Statement** *(when there is an assignee)* ☐ **Power of Attorney**
11. ☐ **English Translation Document** *(if applicable)*
12. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of foreign patent documents, publications, & other information
13. ☐ **Preliminary Amendment**
14. ☐ **Return Receipt Postcard** (MPEP 503) (*Should be specifically itemized*)
15. ☐ **Certified Copy of Priority Document(s)** *(if foreign priority is claimed)*
16. ☐ **Nonpublication Request** under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
17. ☐ Other: _____

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:*
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____
Prior application information: Examiner _____ *Art Unit:* _____

19. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: **23448** ***OR*** ☐ Correspondence address below

Name	Intellectual Property/Technology Law				
Address					
City		State		Zip Code	
Country		Telephone		Email Address	vgustafson@iptl.com

Signature	/steven j. hultquist/	Date	July 29, 2007	
Name (Print/type)	Steven J. Hultquist	Registration No. (Attorney/Agent)	28021	

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4241-696
	Application Number	
Title of Invention	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Nicholas	W.	Medendorp, Jr.	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Raleigh	State/Province	NC	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i] US

Mailing Address of Applicant:

Address 1	1129 Devlin Court		
Address 2			
City	Raleigh	State/Province	NC
Postal Code	27614	Country[i]	US

Applicant 2 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Norbert		Hiller	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Chapel Hill	State/Province	NC	Country of Residence[i]	US

Citizenship under 37 CFR 1.41(b)[i] DE

Mailing Address of Applicant:

Address 1	407A Hillsborough Street		
Address 2			
City	Chapel Hill	State/Province	NC
Postal Code	27514	Country[i]	US

Applicant 3 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Russell		Villard	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City		State/Province		Country of Residence[i]	US

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 44 of 482

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4241-696
	Application Number	
Title of Invention	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS	

Citizenship under 37 CFR 1.41(b) i	US		
Mailing Address of Applicant:			
Address 1			
Address 2			
City		**State/Province**	
Postal Code		**Country**i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23448		
Email Address	hultquist@iptl.com	Add Email	Remove Email

Application Information:

Title of the Invention	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS		
Attorney Docket Number	4241-696	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application has not been and will not be the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ US Representative (37 CFR 11.9)

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 45 of 482

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4241-696
	Application Number	
Title of Invention	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS	

Customer Number	23448

Domestic Priority Information:

This section allows for the applicant to claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c). Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

Additional Domestic Priority Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
			◉ Yes ○ No

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Assignee Information:

Providing this information in the application data sheet does not substitute for compliance with any requirement of part 3 of Title 37 of the CFR to have an assignment recorded in the Office.

Assignee 1 Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information:

Address 1			
Address 2			
City		**State/Province**	
Country [i]		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee Data may be generated within this form by selecting the **Add** button. Add

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 46 of 482

PTO/SB/14 (06-07)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	4241-696
	Application Number	
Title of Invention	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS	

Signature	/steven j. hultquist/			Date (YYYY-MM-DD)	2007-07-29
First Name	Steven	Last Name	Hultquist	Registration Number	46182

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	NICHOLAS W. MEDENDORP, JR.
Filer:	Steven John Hultquist
Attorney Docket Number:	4241-696

Filed as Large Entity

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	300	300
Utility Search Fee	1111	1	500	500
Utility Examination Fee	1311	1	200	200
Pages:				
Claims:				
Claims in excess of 20	1202	32	50	1600
Independent claims in excess of 3	1201	4	200	800
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3400**

Electronic Acknowledgement Receipt

EFS ID:	2022434
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	NICHOLAS W. MEDENDORP, JR.
Customer Number:	23448
Filer:	Steven John Hultquist
Filer Authorized By:	
Attorney Docket Number:	4241-696
Receipt Date:	29-JUL-2007
Filing Date:	
Time Stamp:	09:31:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$3400
RAM confirmation Number	3472
Deposit Account	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1		696Application.pdf	237499 360390b2d5c4c65219287d4c0698fdc940169602	yes	42

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	22
Claims	23	30
Abstract	31	31
Drawings	32	42

Warnings:					
Information:					
2	Transmittal of New Application	696Transmittal.pdf	41325 4127fcf34dfe41e91ea8150ebb819abf29415585	no	1
Warnings:					
Information:					
3	Application Data Sheet	696DataSheet.pdf	1085035 64c2f6c78cd3d5542c40bab37d2d0212a7a0e577	no	5
Warnings:					
Information:					
4	Fee Worksheet (PTO-06)	fee-info.pdf	8557 12c3ef4dec77f8b4fd024d9f5849a1367a799fe6	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			1372416		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

07/29/07

PTO/SB/06 (12-04)

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PATENT APPLICATION FEE DETERMINATION RECORD
Substitute for Form PTO-875

Application or Docket Number: 11,829,912

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	500
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	200
2 (37 CFR 1.16(i))	52 minus 20 =	* 32	X 25=		OR	X 50=	1600
INDEPENDENT CLAIMS (37 CFR 1.16(h))	7 minus 3 =	* 4	X 100=			X 200=	800
APPLICATION SIZE FEE (37 CFR 1.16(s))							
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))			N/A			N/A	
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL				3400

APPLICATION AS AMENDED – PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)	OR	RATE ($)	ADDITIONAL FEE ($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	X =		OR	X =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X =		OR	X =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					N/A		OR	N/A	
						TOTAL ADD'T FEE		OR	TOTAL ADD'T FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
11/829,912	07/29/2007		3400	4241-696	52	7

CONFIRMATION NO. 2008

23448
INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC27709

FILING RECEIPT

Date Mailed: 08/13/2007

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Nicholas W. Medendorp JR., Raleigh, NC;
Norbert Hiller, Chapel Hill, NC;
Russell Villard, Residence Not Provided;

Power of Attorney: None

Domestic Priority data as claimed by applicant

Foreign Applications

If Required, Foreign Filing License Granted: 08/10/2007

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US11/829,912**

Projected Publication Date: To Be Determined - pending completion of Missing Parts

Non-Publication Request: No

Early Publication Request: No

Title

LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of

Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696

CONFIRMATION NO. 2008

23448
INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

FORMALITIES LETTER

Date Mailed: 08/13/2007

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.*
  Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings have a line quality that is too light to be reproduced (weight of all lines and letters must be heavy enough to permit adequate reproduction) or text that is illegible (reference characters, sheet numbers, and view numbers must be plain and legible) see 37 CFR 1.84(l) and (p)(1)); See Figure(s) 5.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee, or oath or declaration) as set forth in 37 CFR 1.16(f) of $130 for a non-small entity, must be submitted with the missing items identified in this notice.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$130** for a non-small entity

- **$130** Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199
PART 3 - OFFICE COPY

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**		
Date Filed:	**July 29, 2007**		
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

CERTIFICATE OF EFS FILING

I hereby certify that this document is being filed via EFS in the United States Patent and Trademark Office on September 20, 2007.
/vincent k. gustafson/

RESPONSE TO AUGUST 13, 2007 NOTICE TO FILE MISSING PARTS IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

In response to the August 13, 2007 Notice to File Missing Parts in the above-identified U.S. patent application, enclosed and submitted herewith is a Declaration and Power of Attorney executed by the inventors, and replacement drawing sheets 1-9, together with the delayed filing fee of **$130.00**. Payment of such fee is being submitted online via credit card with this Response.

Respectfully submitted,

/vincent k. gustafson/
Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

Enclosures:
Declaration and Power of Attorney [4 pgs.]
Replacement Drawings [9 pgs]
Return Copy of Notice to File Missing Parts [2 pgs.]

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 61 of 482

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696

CONFIRMATION NO. 2008

23448
INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

FORMALITIES LETTER

Date Mailed: 08/13/2007

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The oath or declaration is missing. *A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.*
  Note: If a petition under 37 CFR 1.47 is being filed, an oath or declaration in compliance with 37 CFR 1.63 signed by all available joint inventors, or if no inventor is available by a party with sufficient proprietary interest, is required.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
  - The drawings have a line quality that is too light to be reproduced (weight of all lines and letters must be heavy enough to permit adequate reproduction) or text that is illegible (reference characters, sheet numbers, and view numbers must be plain and legible) see 37 CFR 1.84(l) and (p)(1)); See Figure(s) 5.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee, or oath or declaration) as set forth in 37 CFR 1.16(f) of $130 for a non-small entity, must be submitted with the missing items identified in this notice.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is $**130** for a non-small entity

- $**130** Surcharge.

Replies should be mailed to: Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
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Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199
PART 2 - COPY TO BE RETURNED WITH RESPONSE

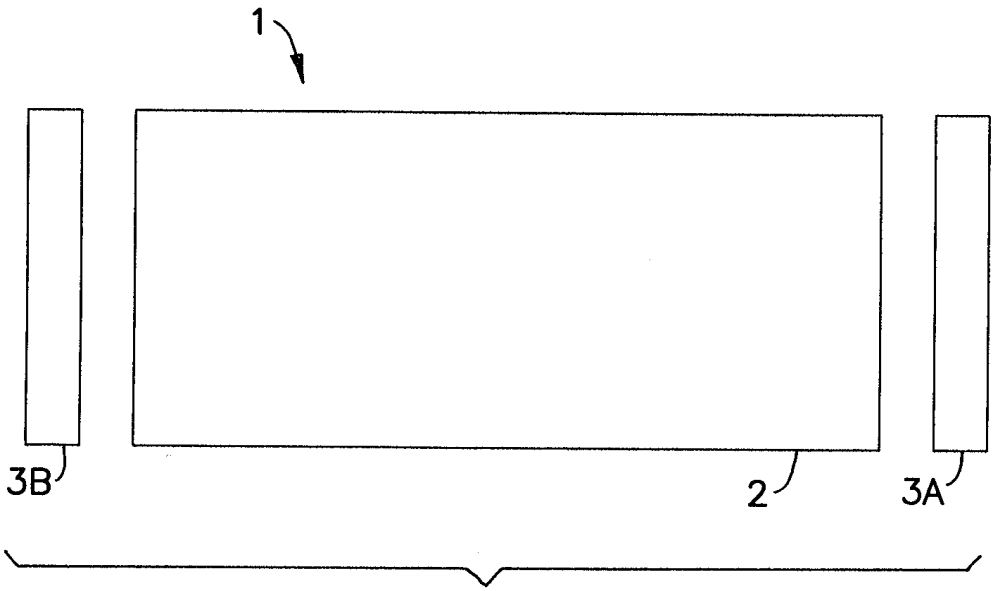


FIG. 1A

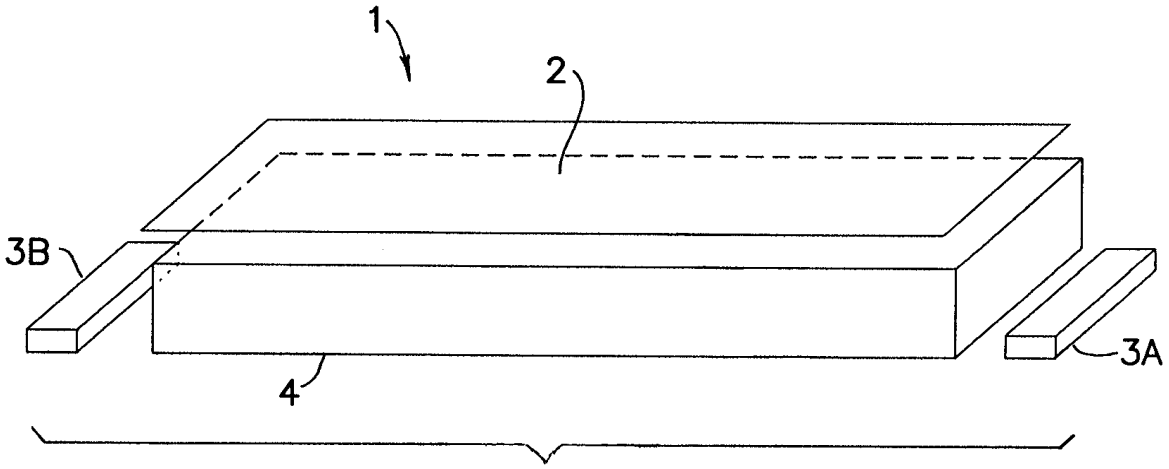


FIG. 1B

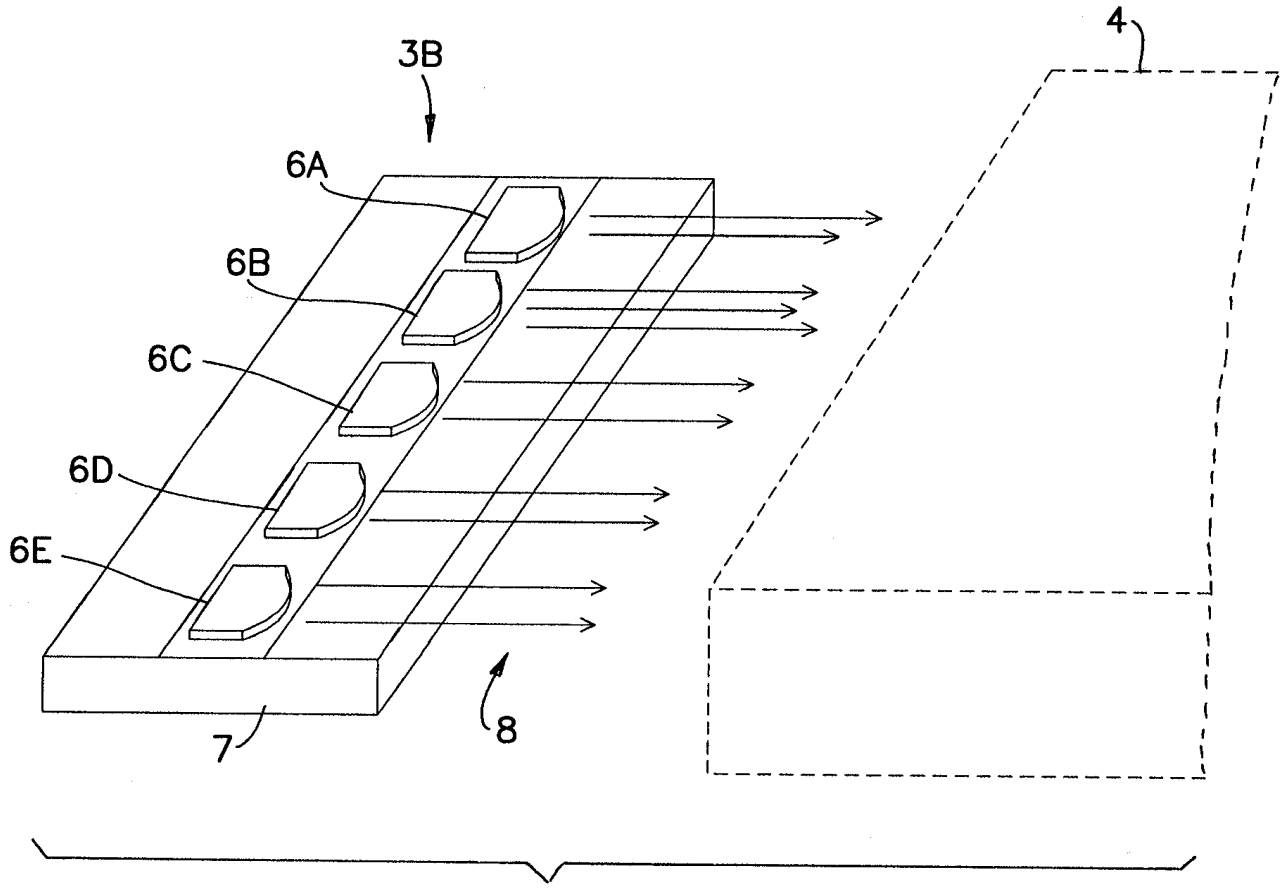


FIG. 1C

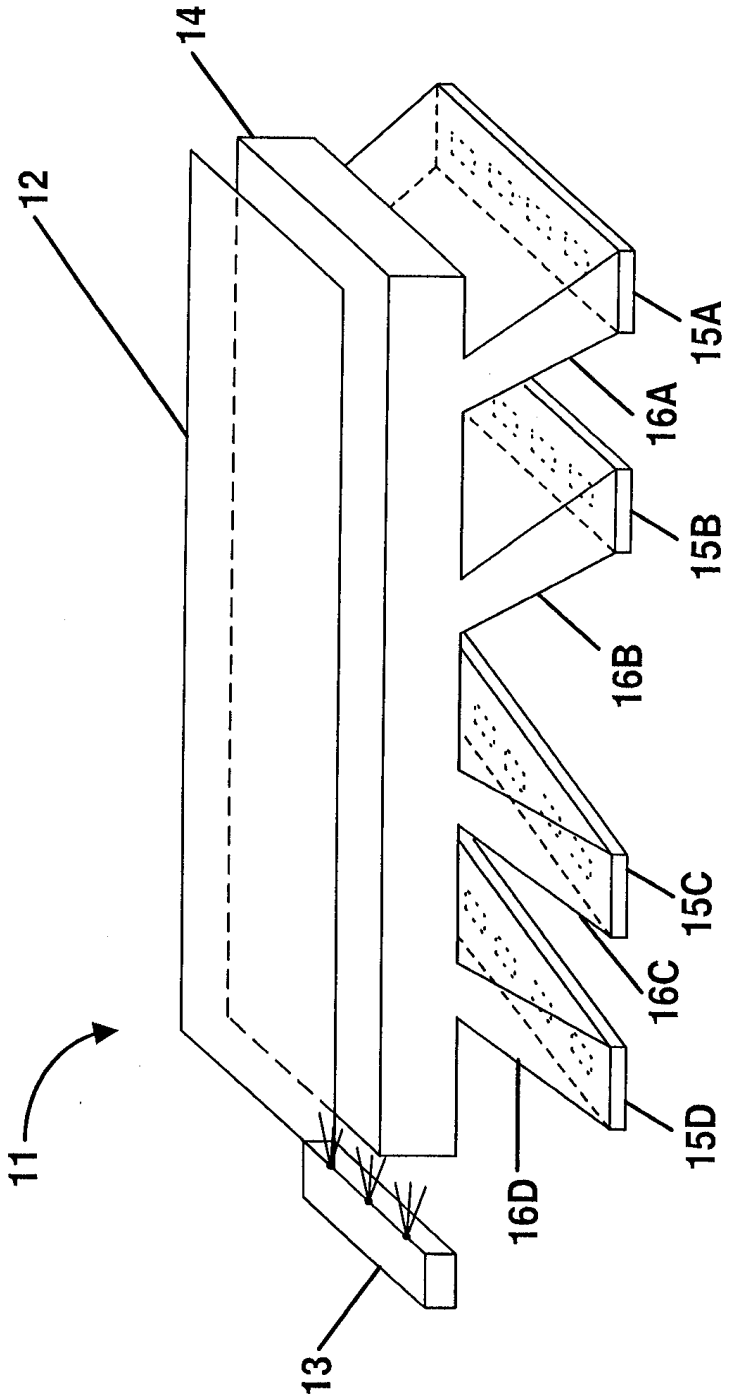


FIG.2

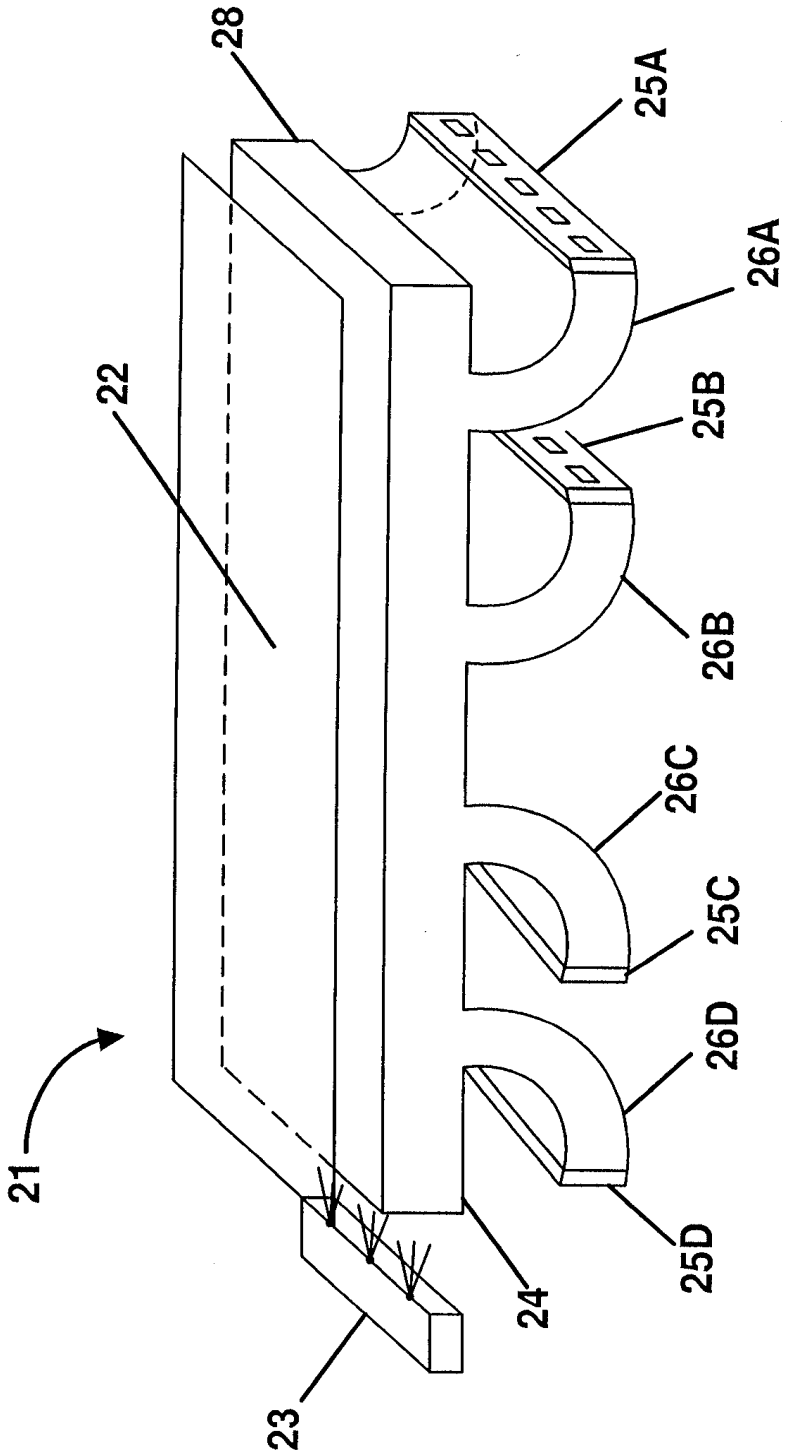


FIG.3

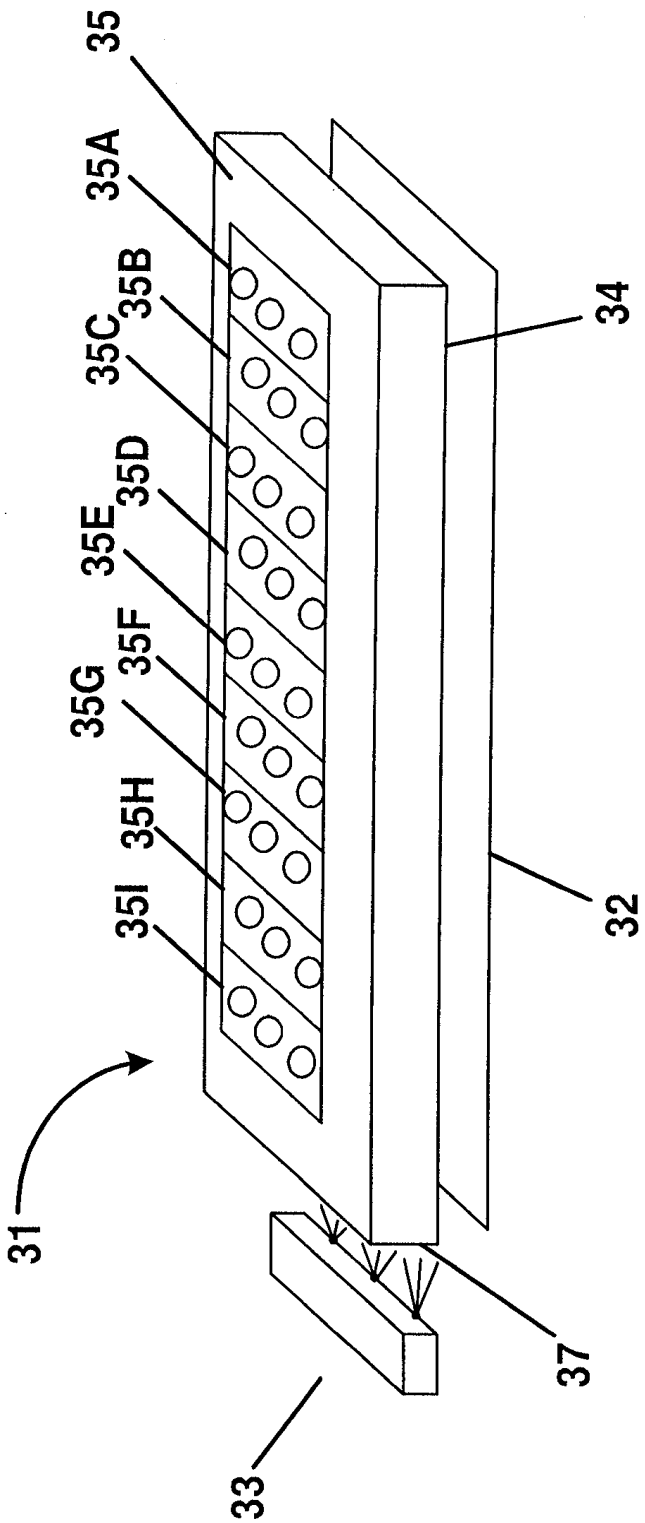


FIG.4

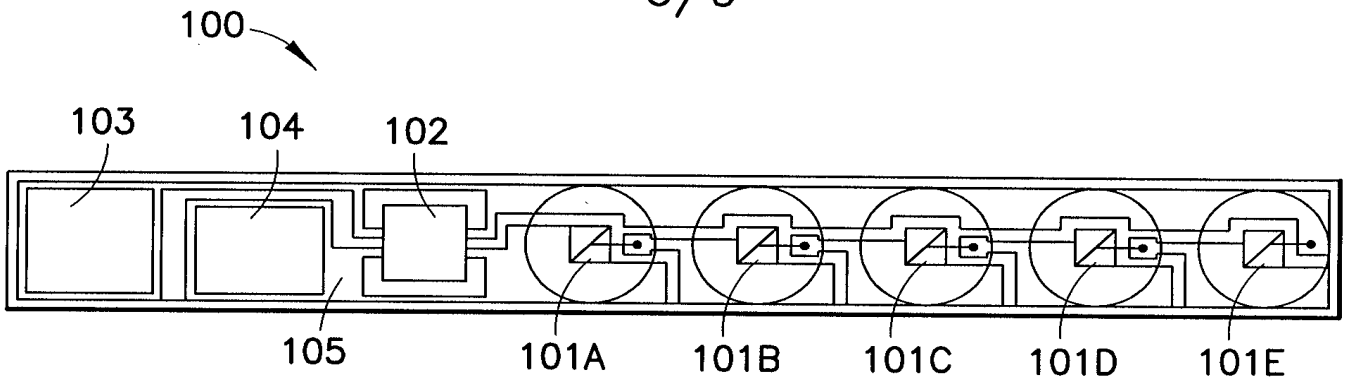


FIG.5

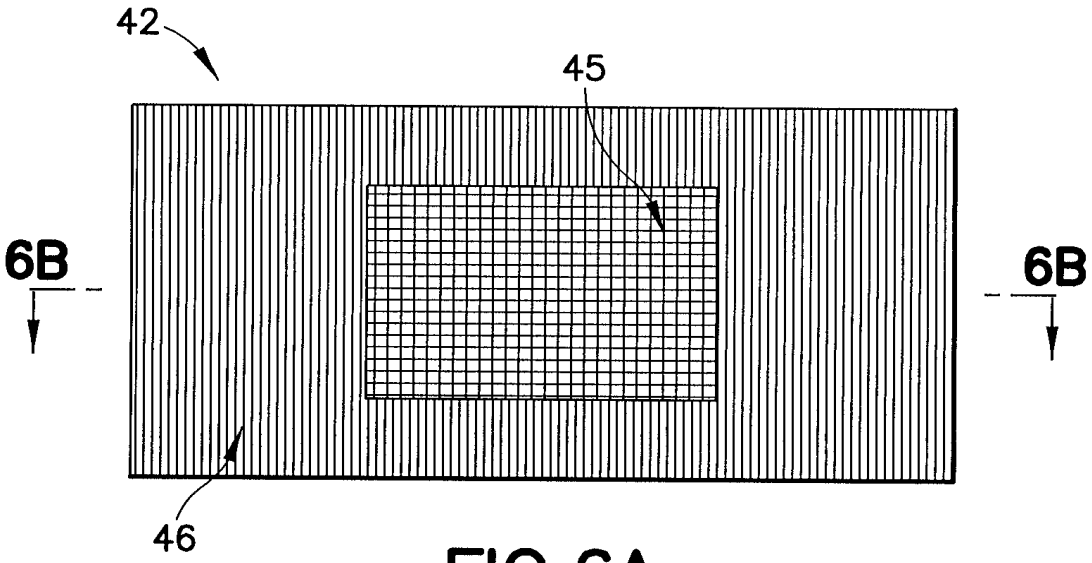


FIG.6A

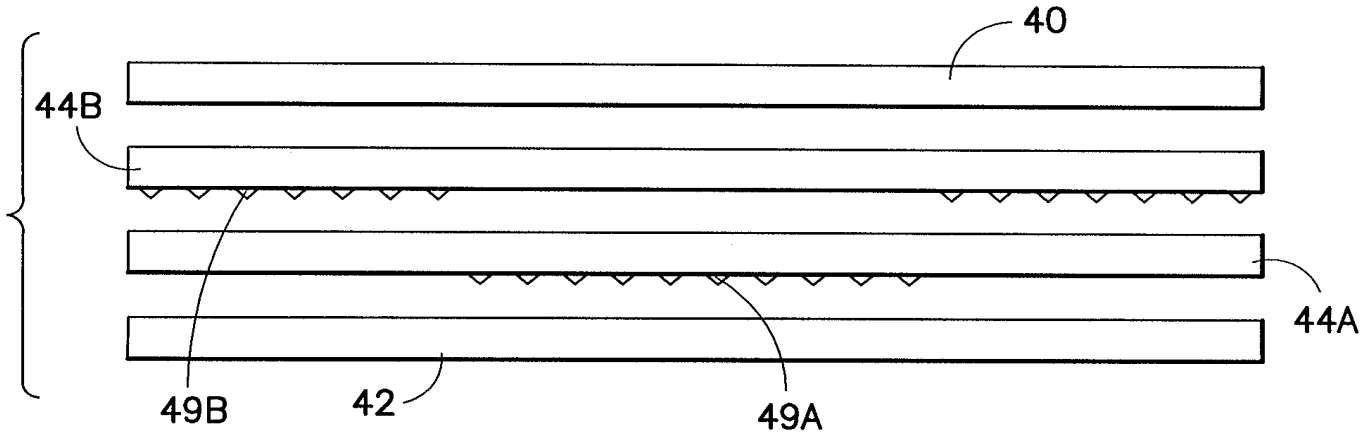


FIG.6B

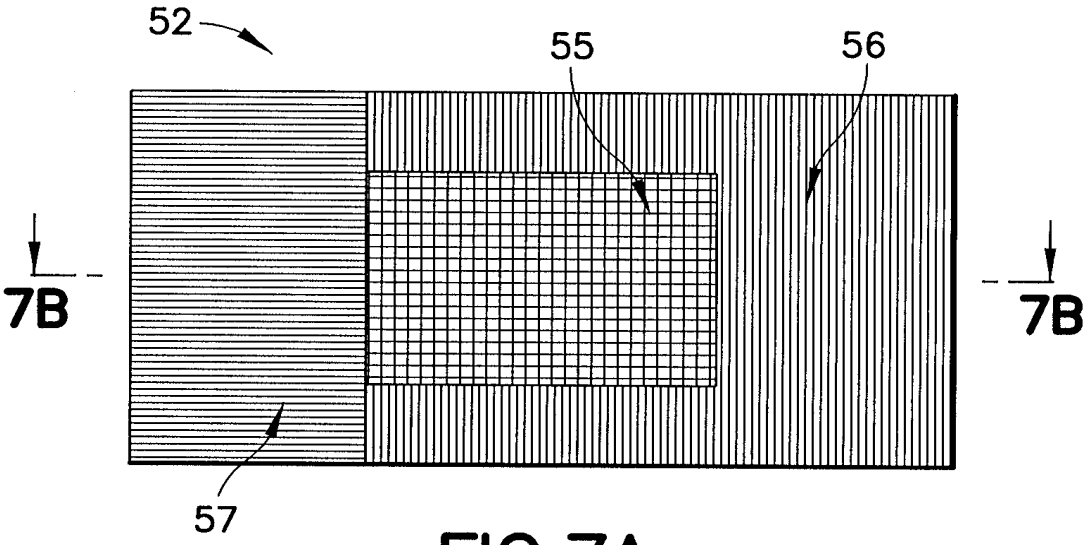


FIG.7A

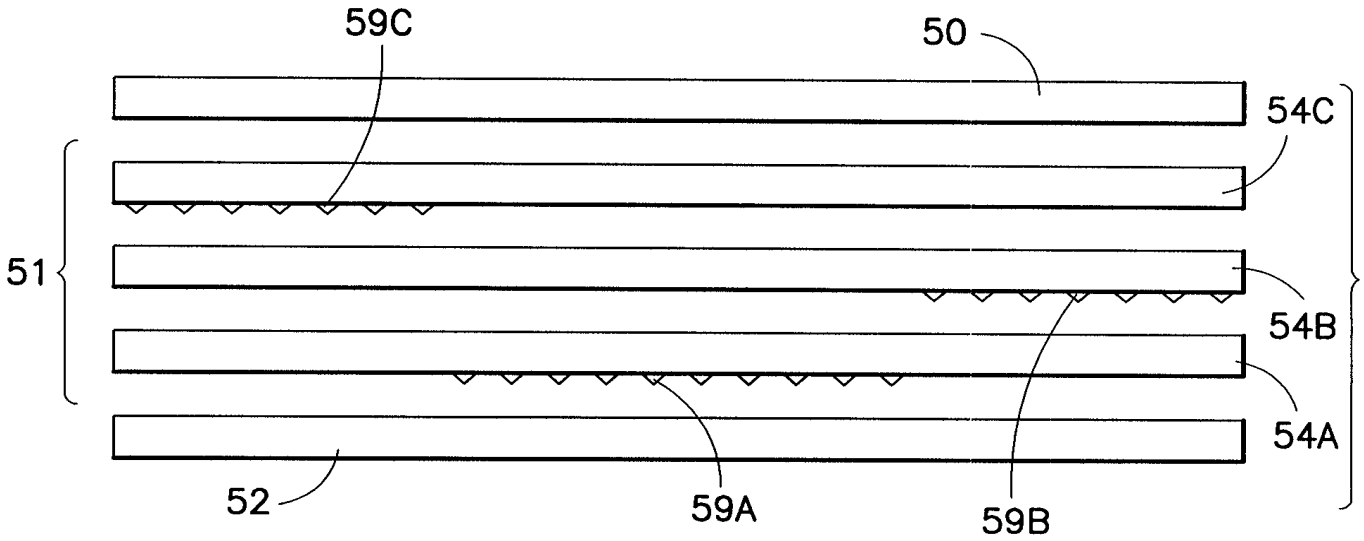


FIG.7B

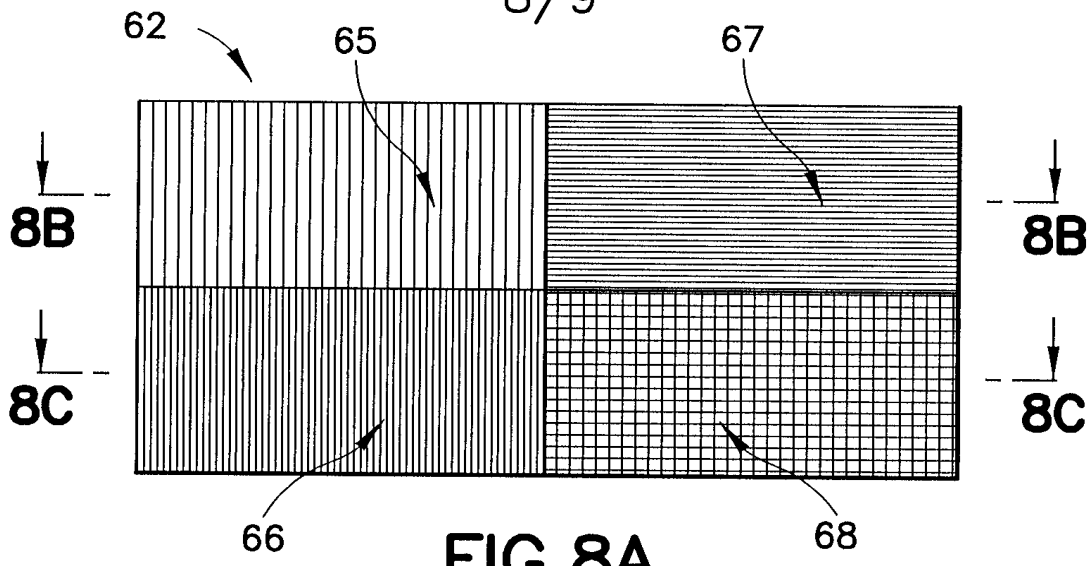


FIG.8A

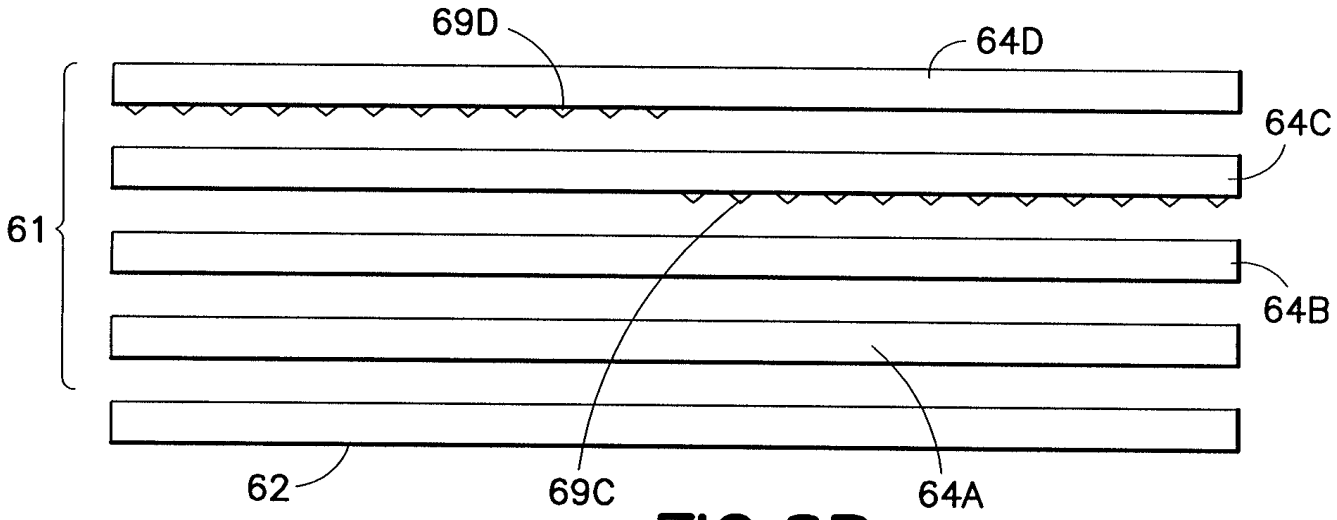


FIG.8B

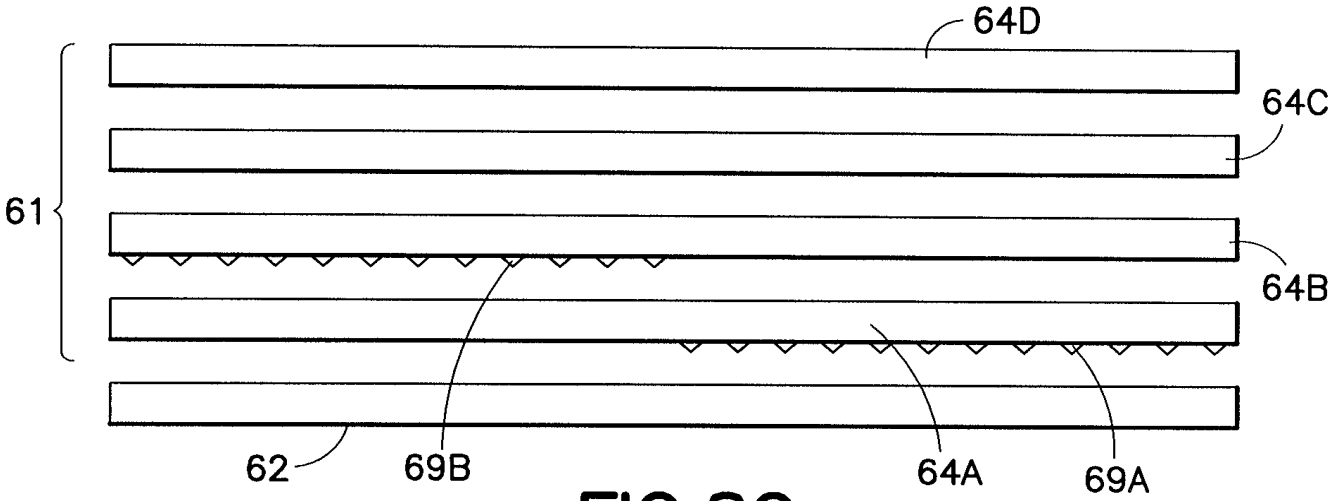


FIG.8C

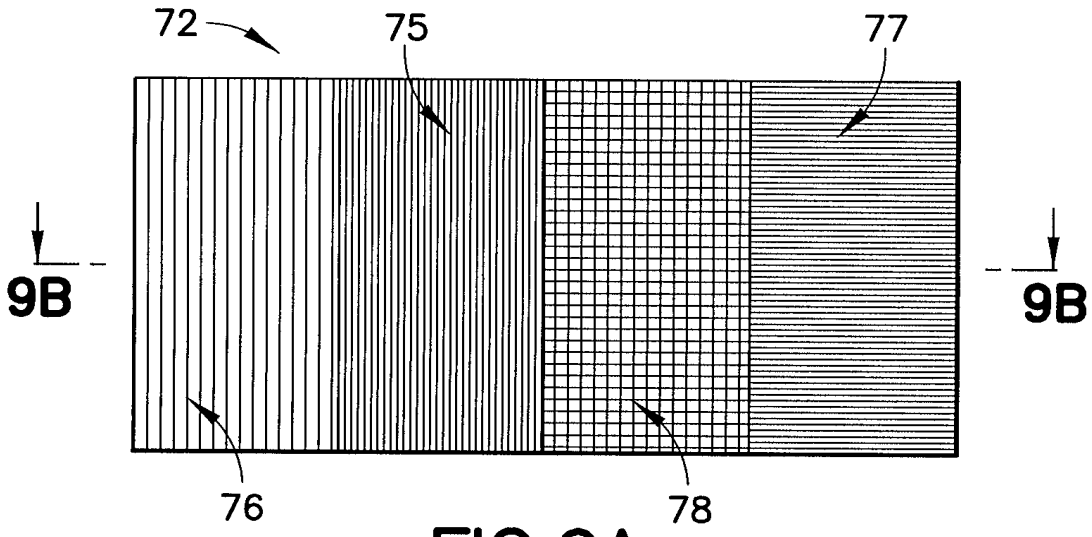


FIG.9A

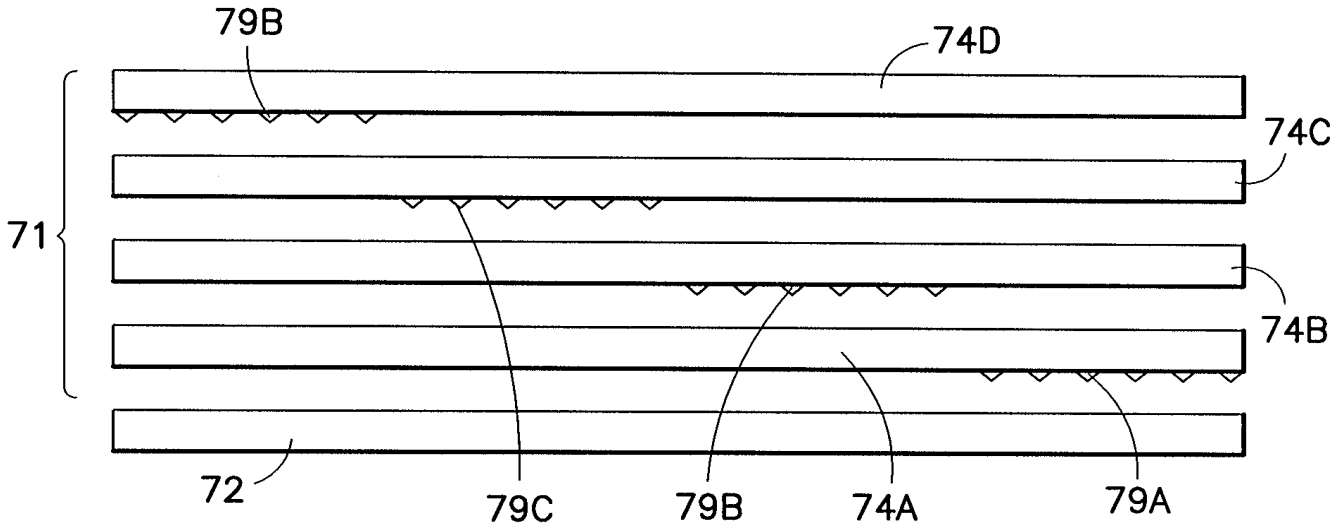


FIG.9B

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As the below-named inventors, we hereby declare that our residences, post office addresses, and citizenships are as stated below next to our names.

We believe that we are the original, first and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled **"LED BACKLIGHT SYSTEM FOR LCD DISPLAYS,"** the specification of which was filed July 29, 2007 as U.S. Patent Application No. 11/829,912.

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims. We acknowledge the duty to disclose information that is material to the patentability and examination of the present application in accordance with Title 37, Code of Federal Regulations, §1.56 (a).

We hereby appoint all of the registered practitioners associated with customer number

23448

to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

We further appoint to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith the following additional registered practitioners of Cree, Inc., 4600 Silicon Drive, Durham, NC 27703:

JULIO GARCERAN, REG. NO. 45,735
ROBERT PYLES, REG. NO. 57,495

All correspondence in connection with this application should be sent to the address associated with customer number

23448

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine and/or imprisonment under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent hereafter issued that is based on or claims priority to or the benefit of the present application.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 73 of 482

Full Name of First or Sole Inventor: **NICHOLAS W. MEDENDORP, JR.**

Inventor's Signature _____ Date 8/28/07

Residence Address: 1129 Devlin Court, Raleigh, NC 27614, US

Citizenship: US

Mailing Address: same as above

State of North Carolina)
County of Durham)

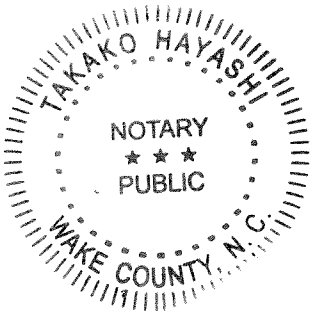
Before me personally appeared said *Nicholas W. Medendorp, Jr.* and acknowledged the foregoing instrument to be his free act and deed this 28th day of August, 2007.

Takako Hayashi

Notary Public: Takako Hayashi

My commission expires: May 11, 2008

SEAL



Petitioner Hisense USA Corporation
Exhibit 1002 - Page 74 of 482

Full Name of Second Inventor: **NORBERT HILLER**

Inventor's Signature _____ Date 8/29/17

Residence Address: 407A Hillsborough Street, Chapel Hill, NC 27514

Citizenship: DE

Mailing Address: same as above

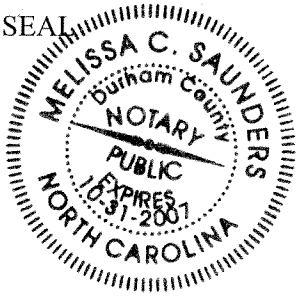
State of North Carolina)
County of Durham)

Before me personally appeared said *Norbert Hiller* and acknowledged the foregoing instrument to be his free act and deed this 29th day of August, 2017.

Melissa C. Saunders
Notary Public: Melissa C. Saunders

My commission expires: October 31, 2007

SEAL



Petitioner Hisense USA Corporation
Exhibit 1002 - Page 75 of 482

Full Name of Third Inventor: **RUSSELL G. VILLARD**

Inventor's Signature _____ Date 9/5/07

Residence Address: 303 Village Loop Drive, Apex, NC 27502

Citizenship: US

Mailing Address: same as above

State of North Carolina)
County of Durham)

Before me personally appeared said *Russell G. Villard* and acknowledged the foregoing instrument to be his free act and deed this 5th day of September, 2007.

Melissa C. Saunders
Notary Public: Melissa C. Saunders

My commission expires: October 31, 2007

SEAL

MELISSA C. SAUNDERS
Durham County
NOTARY PUBLIC
EXPIRES 10-31-2007
NORTH CAROLINA

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 76 of 482

Electronic Patent Application Fee Transmittal

Application Number:	11829912
Filing Date:	29-Jul-2007
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Filer:	Steven John Hultquist/Vincent Gustafson
Attorney Docket Number:	4241-696

Filed as Large Entity

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Late filing fee for oath or declaration	1051	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**130**

Electronic Acknowledgement Receipt

EFS ID:	2219994
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Steven John Hultquist/Vincent Gustafson
Filer Authorized By:	Steven John Hultquist
Attorney Docket Number:	4241-696
Receipt Date:	20-SEP-2007
Filing Date:	29-JUL-2007
Time Stamp:	13:58:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment was successfully received in RAM	$130
RAM confirmation Number	9259
Deposit Account	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)

1	Miscellaneous Incoming Letter	696_Response_to_Notice_Missing_Parts.pdf	22700 965b83b7c3c824a62181b6443a698e4873dd27fc	no	2
Warnings:					
Information:					
2	Miscellaneous Incoming Letter	696_PTO_Notice_Missing_Parts.pdf	129052 185c242699218b226542d7b2b6afaf0350196827	no	2
Warnings:					
Information:					
3	Drawings	696_Formal_Drawings.pdf	418903 d8e5444c577afc54ffb27a5484936d8d61232cf7	no	9
Warnings:					
Information:					
4	Oath or Declaration filed	696_Declaration_Power_of_Attorney.pdf	200932 bd80bb59be2270f9f1944414087a7613e58589eb	no	4
Warnings:					
Information:					
5	Fee Worksheet (PTO-06)	fee-info.pdf	8176 cb2b446d08123c1192cc99d6ba15f318e66c6b0c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	779763		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
11/829,912	07/29/2007	2871	3530	4241-696	52	7

CONFIRMATION NO. 2008

UPDATED FILING RECEIPT

23448
INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC27709

Date Mailed: 09/28/2007

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Nicholas W. Medendorp JR., Raleigh, NC;
Norbert Hiller, Chapel Hill, NC;
Russell G. Villard, Apex, NC;

Power of Attorney: The patent practitioners associated with Customer Number 23448

Domestic Priority data as claimed by applicant

Foreign Applications

If Required, Foreign Filing License Granted: 08/10/2007

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US11/829,912**

Projected Publication Date: 01/29/2009

Non-Publication Request: No

Early Publication Request: No

Title

LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PTO/SB/08a (05-07)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	
Examiner Name	
Attorney Docket Number	4241-696

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6964497	B2	2005-11-15	Greiner, Horst	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070019129	A1	2007-01-25	Negley, Gerald H.	
	2	20070115670	A1	2007-05-24	Roberts, John K., et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	4241-696

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	YU, MICHAEL, "Backlight Technology Overview", "http://www.densitron.com/uploadedFiles/Displays/Products/whitepaper17.pdf", February 16, 2006, Page(s) 1-18, Publisher: Densitron Technologies, plc.	☐

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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	4241-696

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/vincent k. gustafson/	Date (YYYY-MM-DD)	2007-11-14
Name/Print	Gustafson, Vincent K.	Registration Number	46182

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Electronic Acknowledgement Receipt

EFS ID:	2469462
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Steven John Hultquist/Vincent Gustafson
Filer Authorized By:	Steven John Hultquist
Attorney Docket Number:	4241-696
Receipt Date:	14-NOV-2007
Filing Date:	29-JUL-2007
Time Stamp:	18:53:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed	696_IDS.pdf	788991 17b2f54484af068d02c42bac79f5f3452b0b920a	no	4

Warnings:	
Information:	

2	NPL Documents	Yu_2006.PDF	1356296 28644e62659e96db3ead36166420ded9ac7eb411	no	18

Warnings:	
Information:	
Total Files Size (in bytes):	2145287

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696

CONFIRMATION NO. 2008

23448
INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

PUBLICATION NOTICE

OC00000034275770

Title:LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

Publication No.US-2009-0027588-A1
Publication Date:01/29/2009

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7195364	B2	2007-03-27	Hahm, H. et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2005001892	WO	A2	2005-01-06	McCollum, T. et al.		☐
	2	2007061758	WO	A1	2007-05-31	Negley, G. et al.		☐
	3	2004068909	WO	A1	2004-08-12	Setmoto, T. et al.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	KIANNI, KAVEH C.
	Attorney Docket Number	4241-696

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	KIANNI, KAVEH C.
	Attorney Docket Number	4241-696

CERTIFICATION STATEMENT

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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/vincent k. gustafson/	Date (YYYY-MM-DD)	2009-03-09
Name/Print	Gustafson, Vincent K.	Registration Number	46182

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	4929792
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
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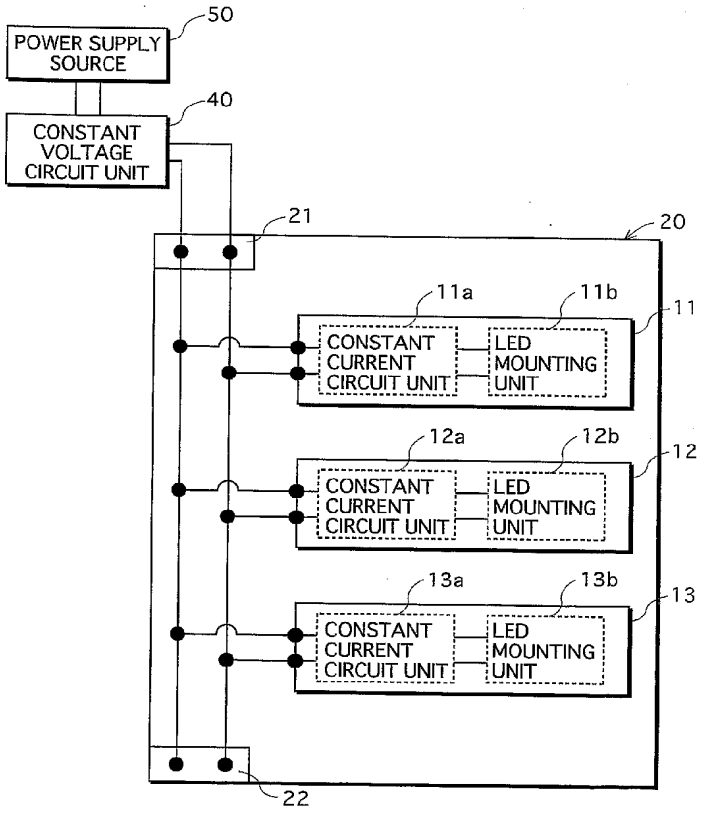
(54) Title: MULTICHIP LED LIGHTING DEVICE



(57) Abstract: In a module socket, a connecter and a connector are connected by wiring, and three LED modules are connected in parallel with respect to a constant voltage circuit unit via the wiring. Each module has a constant current circuit unit and an LED mounting unit. The constant current circuit unit includes one resistor and two transistors mounted on a surface of a sub-substrate on which a conductive land is formed. The sub-substrate is bonded to a main substrate.

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Description

MULTICHIP LED LIGHTING DEVICE

Technical Field

The present invention relates to a lighting device, and in particular to a lighting device in which light emitting diodes are used as a light source.

Background Art

In recent years lighting devices that use light emitting diodes (hereinafter referred to as "LED(s)") have been under development, and some are being put into practical use.

One example of a lighting device that uses LEDs (hereinafter referred to as an "LED lighting device") is one in which LED bare chips are mounted on a substrate (this arrangement is called an "LED module"), and the LED bare chips are made to emit light according to power from a power supply source. A plurality of LED bare chips are generally mounted on the substrate because sufficient light to produce a lighting device is not provided by only one LED bare chip. The LED bare chips are mounted densely in order to produce a more compact lighting device.

In an LED lighting device with such a structure, the LED bare chips exhibit premature deterioration due to the heat generated by the LED bare chips themselves during operation. For this reason, consideration is being given to using metal base substrates due to their high thermal conductivity compared to resin substrates. A metal base substrate has a layered structure that includes a metal layer and an insulative layer (resin), and

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has a thermal conductivity of approximately 1 W/mK to 10 W/mK.

Furthermore, in order to stabilize the luminous intensity of the LED bare chips during operation in an LED lighting device, power from a power supply source is controlled so as to have a constant current (see Japanese Patent Application Publication No. 2001-215913).

When an LED module has reached the end of its life expectancy, it is necessary to replace the LED module. However, a problem arises that the specifications of the replacement LED module differ from those of the original LED module.

Specifically, LEDs have a significantly longer life expectancy than conventional incandescent lamps, and with rapid progress in the development of LEDs, it is unlikely that the specifications (for example the Vf of the LED bare chips) of LED modules at the time of replacement will be the same as the specifications when the lighting device was designed.

In terms of a device that uses the circuit described in the aforementioned patent document, the circuit structure of the device is such that the LED module and the circuit are separate, and the circuit is composed of a converter circuit and a constant current circuit.

With this circuit, when a number of LED modules are provided in parallel, there is only one converter circuit feedback signal. Even if the number of LED modules is increased, there is still only one main LED module used as a reference.

In other words, the control depends strongly on the LED module connected to extract the feedback signal, and control of other LED modules becomes dependant on the main LED module. This

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is not ideal for the LED modules. For this reason, when replacing the LED module in this device, it is preferable to use an LED module that has the same properties (specifications) as the original LED modules.

If a unit made up of a most current LED module is used to replace the main LED module, the capability of the dependant LED modules will be reduced. In the same way, if a dependant LED module is replaced, the capability of the replacement dependant module will suffer.

In this way, according to the aforementioned patent document, it is difficult to obtain maximum performance from each LED module because it is not possible to compensate for differences in LED performance of the LED modules.

For this reason, in order to maintain LED module performance in such devices, it is necessary to either recommence manufacturing of LED modules with the specifications at the time of design, or to keep a stock of such LED modules. Furthermore, an LED module cannot be replaced with the most current LED module that is superior in aspects such as Vf of the LED bare chip.

Disclosure of the Invention

In view of the stated problems, the object of the present invention is to provide a lighting device in which stability of luminous intensity of an LED bare chip in an LED module is improved, and in which the LED module can be easily replaced or expanded in number with an LED module of differing specifications.

In order to achieve the stated object, the present invention is a lighting device including an LED module, the LED module being

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composed of a main substrate, a light emitting diode bare chip provided on a main surface of the main substrate, a power supply terminal for receiving power from a power supply source, and a luminous intensity stabilization circuit provided between and electrically connected to the power supply terminal and the light emitting diode bare chip.

In this lighting device, an illumination stabilizing circuit such as a constant current circuit is provided in the power supply path for supplying power to the LED bare chip of the LED module. Therefore, luminous intensity of the LED bare chip during operation can be stabilized.

Furthermore, since the luminous intensity stabilizing circuit is provided in the LED module, the LED bare chip can emit light with a stable luminous intensity without providing a luminous intensity stabilizing circuit such as a constant current circuit on the power supply side of the LED module.

Furthermore, if the LED module is made to be detachable, even when the LED module is replaced, if the new LED module includes a luminous intensity stabilizing circuit that is compatible with the LED bare chip mounted on the new LED module, the LED bare chip can also be made to emit light with stable luminous intensity.

In addition, in the lighting device of the present invention the number of LED modules can be easily expanded. Note that if the main substrate is a metal base substrate that is composed of a metal layer and an insulative layer, premature deterioration of the LED bare chip due to the heat generated by the LED bare chip during operation can be prevented.

Consequently, in the lighting device of the present

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invention, luminous intensity of the LED bare chip in the LED module can be stabilized, and if, for example, the LED module is detachable, the LED module can be easily replaced or expanded in number with an LED module having different specifications.

Furthermore, use of a constant current circuit as the luminous intensity stabilizing circuit is preferable in terms of stability of luminous intensity of the LED bare chip, since power with a constant current can be supplied to the LED bare chip. In particular, if power with constant voltage is supplied by the power supply source to the constant current circuit of the LED module, the luminous intensity of the LED bare chip can be stabilized with high precision.

When a constant current circuit is provided in the lighting device, the constant current circuit can be formed on a main substrate (the metal base substrate) with a die bonding method using silver paste, or by attaching a sub-substrate on which the constant current circuit has been pre-formed to the main substrate. The method of using a sub-substrate is particularly favorable as the constant current circuit can be formed on the main substrate without a steep rise in the cost of manufacturing.

Since the LED bare chip is ordinarily mounted to the conductive land on the insulative layer of the metal base substrate using a method such as FCB (flip chip bonding) according to ultrasonic bonding, it is necessary to keep the surface of the substrate clean before mounting the LED bare chips, and a reflow method cannot be used to mount the components of the constant current circuit.

In contrast, if the constant current circuit is provided

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on a sub-substrate, a reflow method can be used to mount the components on the sub-substrate.

The sub-substrate may be made of resin/ceramic or Si.

The lighting device may have the single LED module or a plurality of LED modules. In the case of a plurality of LED modules, if the LED modules are connected in parallel with respect to the power supply source, the LED modules can be added to easily. In other words, in the present invention the number of LED modules is easily expandable.

Note that as long as each LED module has its own constant current circuit, it is not necessary for other structural aspects, such as the number of mounted LED bare chips, to be the same.

Furthermore, it is preferable for each LED module to be detachable from the socket that is connected to the power supply source, to enable each LED module to be easily replaced when it has reached the end of its life, and to improve workability when replacing the LED modules.

Furthermore, a so-called metal base substrate that has a layered structure of an insulative layer and a metal layer is used as the main substrate in the LED module in the lighting device. Compared to a substrate made of resin only, this metal base substrate efficiently expels heat generated by the LED bare chips during operation, and is effective in controlling deterioration of the LED bare chips by heat.

Furthermore, by providing a thermal element (such as a thermistor) in a vicinity of the LED bare chips in the LED module, and connecting the thermal element to the luminous intensity stabilization circuit, current supply to the LED bare chip can

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be reduced when the temperature of the LED bare chip rises to be equal to or greater than a pre-set temperature.

Adjusting current supply in this way according to the temperature of LED bare chips is favorable in that it lengthens the life span of the LED bare chips.

Furthermore, the LED module may further include an abnormality detection unit that is provided in a vicinity of the light emitting diode bare chip and that detects an abnormality in the light emitting diode bare chip, and the constant voltage circuit may include a control unit that reduces or stops provision of current to the LED module when the abnormality detection unit detects an abnormality in the light emitting diode bare chip. Alternatively, the light emitting diode bare chip may be one of a plurality included in the LED module that are divided into groups of light emitting diodes that are connected in series, the groups being connected in parallel with each other, and each group having a current detection unit connected thereto, and the constant voltage circuit may include a control unit that reduces or stops supply of current to the LED module when one of the current detection units detects an abnormality in an amount of current in the light emitting diode bare chips. Such structures prevents light emission continuing when an abnormality occurs in the LED bare chips, and is favorable in terms of safety.

Furthermore, it is preferable that the LED module further includes a Zener diode connected to the luminous intensity stabilization circuit, in parallel with the light emitting diode bare chip. This structure is favorable in terms of protecting the LED bare chip from static electricity.

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Brief Description of the Drawings

FIG. 1 is a perspective drawing of relevant parts of an LED lighting device 1 of an embodiment of the present invention;

FIG. 2 is a cross sectional drawing showing a portion indicated by A-A in the LED lighting device 1 of FIG. 1;

FIG. 3 is a block drawing showing circuits of the LED lighting device 1 of FIG. 1;

FIG. 4 is a perspective drawing (partially transparent view) showing an LED module 13 that is a compositional element of the LED lighting device 1 of FIG. 1;

FIG. 5 is a circuit diagram of the LED module 13 of FIG. 4;

FIG. 6 is a process diagram showing a method of forming the LED module 13 of FIG. 4;

FIG. 7 is a circuit diagram of the LED module 14 of a first modification;

FIG. 8 is a circuit diagram of an LED module 15 of a second modification;

FIG. 9 is a circuit diagram of an LED module 16 of a third modification;

FIG. 10 is a perspective diagram (partially transparent view) showing an LED module 17 of a fourth modification;

FIG. 11 is a block diagram showing circuits of an LED lighting device 101 of a fifth modification;

FIG. 12 is a circuit diagram of an LED module 18 of a first example of the fifth modification;

FIG. 13 shows the circuit structure of a constant voltage

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circuit unit 140 of the first example of the fifth modification; and

FIG. 14 is a circuit diagram of an LED module 21 of a second example of the fifth modification 5.

Best Mode for Carrying Out the Invention

Overall Structure

The following describes the overall structure of the LED lighting device 1 of the preferred embodiment of the present invention with use of FIGs. 1, 2 and 3. FIG. 1 is a perspective drawing of relevant parts of the LED lighting device 1, FIG. 2 is a cross sectional drawing of part of the LED lighting device 1, and FIG. 3 is a block diagram showing the circuit structure.

As shown in FIG. 1, the LED lighting device 1 has three LED modules 11, 12 and 13, a module socket 20 into which the LED modules 11, 12 and 13 are loaded, and a heat radiating plate 30 that is attached to the back side of the module socket 20.

In addition, although not illustrated in FIG. 1, the LED lighting device 1 has a constant voltage circuit unit that is connected to a power supply source, and a lead 41 that extends from the constant voltage circuit unit to be connected to a connector 42. The connector 42 is inserted in a male connector 21 provided in the module socket 20.

The LED modules 11, 12 and 13 are connected to wiring 23 and 24 (not shown in FIG. 1) in the module socket 20, via respective connection terminals (terminals 136 and 137 in the case of the LED module 13).

The module socket 20 is composed of a metal frame which

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is made of stainless steel or the like, and includes magazine units 20a, 20b and 20c into which the LED modules 11, 12 and 13 are loaded.

Furthermore, the module socket 20 has two connectors 21 and 22. The connector 42 to which the lead 41 is connected from the constant voltage circuit unit as described is mountable in the connector 21. The connectors 21 and 22 are connected to each other by the wiring 23 and 24 (not shown in FIG. 1) inside the module socket 20.

The other connector 22 is for use when expanding the number of LED modules. In other words, module sockets can be added in the LED lighting device 1 via the connector 22.

In order to load the LED modules 11, 12 and 13 in the magazine units 20a, 20b and 20c, respectively, the LED modules 11, 12 and 13 are slid into the respective magazine units 20a, 20b and 20c in a direction towards the bottom left of the drawing, with both side parts fitted into the side channels of respective the magazine units 20a, 20b and 20c.

When loaded completely, as the LED modules 11 and 12 are shown loaded into the magazine units 20a and 20b with the connection terminals of the LED modules 11 and 12 not externally exposed in FIG. 1, the connection terminals of the LED modules 11 and 12 are in a state of connection with the terminals provided inside the module socket.

Specifically, as shown in FIG. 2, when the LED module 12 is loaded in the magazine unit 20b, a connection terminal 127 of the LED module 12 and a terminal 25 of the module socket 20 contact each other, thereby being in a state of electrical

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connection.

The terminal 25 is bent in part to connect terminal, thus pushing against the connection terminal 127 when the LED module 12 is loaded. Accordingly, the LED module 12 cannot be removed easily from the module socket 20 due to self weight and the like.

Note that while FIG. 2 shows the connection between the terminal 25, the wiring 24 and the connection terminal 127 of the LED module 12, the other connection terminal of the LED module 12, and the connection terminals of the LED modules 11 and 13 are also connected to respective terminals in the magazine units 20a and 20b in the module socket 20 (not illustrated in FIG. 2).

Returning to FIG. 1, the heat radiating plate 30 is for releasing heat generated by the LED bare chips of the LED modules 11, 12 and 13 during operation, and is attached to the back side of the module socket 20 by, for example, screws 31, 32, 33 and 34.

The following describes the circuit structure of the LED lighting device 1 with use of FIG. 3.

As shown in FIG. 3, a constant voltage circuit unit 40 connected to a power supply source 50, which is a commercial power supply or the like, is connected to the module socket 20 via the connector 42. Furthermore, in the module socket 20, the three LED modules 11, 12 and 13 are connected in parallel with respect to the constant voltage circuit unit 40.

The LED modules 11, 12 and 13 are composed of constant current circuit units 11a, 12a and 13a and LED mounting units 11b, 12b and 13b, respectively.

Note that since the LED modules 11, 12 and 13 are connected

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in parallel and have respective constant current circuit units 11a, 12a and 13a, it is not necessary for al three of the LED modules 11, 12 and 13 to be mounted on the module socket 20. Instead, it is sufficient for only one or two of the LED modules 11, 12 and 13 to be mounted in order for the device to operate. Furthermore, as described earlier, the LED modules may be added to using the connector 22.

Structure of the LED modules

The following describes the structure of the LED modules 11, 12 and 13 with use of FIGs. 4 and 5. FIG. 4 is a perspective drawing (partially transparent view) of the LED module 13, and FIG. 5 is a circuit diagram of the LED module 13.

As shown in FIG. 4, the LED module 13 includes a main substrate 130 on which the constant current circuit unit 13a and the LED mounting unit 13b are formed. Furthermore, connection terminals 136 and 137 are provided on the of the main substrate 130 that appears in the bottom left of the drawing.

The main substrate 130 has a multi-layered structure, composed of an insulative layer 130a of resin or the like formed on a metal layer 130b of Al or the like. The insulative layer 130a and the metal layer 130b are thermally bonded, and therefore the main substrate 130 has a favorable thermal conductivity rate of 1 WmK to 10 WmK.

For this reason, the main substrate 130 is superior in terms of thermal conductivity to, for example, a substrate made of resin only. In other words, the main substrate 130 is ideal as a substrate for use in a lighting device or the like in which LED bare chips are densely mounted. A conductive land (not

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illustrated) of a desired pattern is formed on the insulative layer 130a.

The insulative layer 130a is formed from a compound material that includes an inorganic filler (such as Al_2O_3, MgO, BN, SiO_2, SiC, Si_3N_4, or AlN) and a resin component.

Although not illustrated, in the LED mounting unit 13b a total of 64 LED bare chips are mounted on the conductive land of the main substrate 130 using FCB (flip chip bonding) according to an ultrasonic bonding method. A reflective plate and phosphor resin are disposed on this arrangement, which is then sealed with resin. When sealing, hemispherical shaped lenses are formed in places corresponding to the LED bare chips.

Furthermore, parts of the conductive land extend from one side of the sealing resin of the LED mounting unit 13, and function as terminals 13b1 and 13b2 for connecting to the constant current circuit unit 13a described below.

As shown in FIG. 4, the constant current circuit unit 13a is provided in the area on the main substrate 130 between the LED mounting unit 13b and the connection terminals 136 and 137.

Specifically, the constant current circuit unit 13a is composed of a sub-substrate 131 on which a conductive land 132 is formed in a desired pattern, and one resistor 133 and two transistors 134 and 135 mounted in advance on the sub-substrate 131 using a reflow method.

The sub-substrate 131 on which the constant current circuit has been formed as described is then attached to the aforementioned area of the main substrate 130 using a resin material or the like.

Bonding wire 138 made of Au or the like is used to connect

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the constant current circuit unit 13a with the terminals 13b1 and 13b2 of the LED mounting unit 13b and with the terminals 136 and 137.

Furthermore, although the circuit structure on the sub-substrate 131 is shown in FIG. 4 in a manner that aids comprehension, the sub-substrate 131, including the connection portions, on which the circuit is formed is actually sealed with resin (resin sealing unit 139) that is shown with broken lines in FIG. 4.

The following describes the circuit structure of the LED module 13 in which the constant current circuit unit 13a and the LED mounting unit 13b are connected as shown in FIG. 3 in more detail with use of FIG. 5.

As shown in FIG. 5, the LED mounting unit 13b has a structure in which a total of 64 LED bare chips 13L are arranged in eight lines and eight rows.

Furthermore, the constant current circuit unit 13a has a general constant current circuit composed of one resistor 133 and two NPN transistors 134 and 135. Specifically, the resistor 133 is inserted between the emitter and the base of the transistor 134, and the base of the transistor 134 is connected to the emitter of the other transistor 135. The collector of the transistor 134 is connected to the base of the transistor 135.

The base of the transistor 135 is connected to the input connection terminal 136 and one terminal 13b1 of the LED mounting unit 13b, while the collector is connected to the other terminal 13b2 of the LED mounting unit 13b.

The emitter of the transistor 134 is connected to the output

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connection terminal 137.

In this way, the constant current circuit 13a, which is inserted in the power supply path in the LED module 13, controls so that power supplied by the constant voltage circuit unit 40 has constant current, and supplies the resulting power to the LED mounting unit 13b. In other words, during operation of the LED module 13, the constant current circuit unit 13a functions to stabilize luminous intensity of the LED bare chips.

Note that the LED modules 11 and 12 have the same structure as the LED module 13.

Formation of the constant current circuit unit 13a

The following describes the method used to form the constant current circuit unit 13a when forming the LED module 13, with use of FIGs. 6A and 6B.

The resistor 133 and the transistors 134 and 135 are mounted, using a reflow method, on the conductive land 132 which is on the main surface of the resin sub-substrate 131 as shown in FIG. 6A. The sub-substrate 131 on which the constant current circuit is composed according to the components is attached using resin to the main substrate 130 on which the LED mounting unit 13b has been formed in advance.

Next, part of the conductive land on the sub-substrate 131 is connected with terminals 13b1 and 13b2 and with the connection terminals 136 and 137 using the bonding wire 138 which is made of Au.

Finally, the whole of the constant current circuit unit 13a, including the bonding portion, is sealed with resin, thereby completing the formation of the constant current circuit unit

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13a in the LED module 13.

Advantages of the LED lighting device 1

In the LED lighting device 1 having the described structure, each of the three LED modules 11, 12 and 13 has a constant current circuit such as the constant current circuit 13a, as shown in FIG. 3, and the LED modules 11, 12 and 13 are connected in parallel. This means that the number of LED modules can be expanded.

In other words, if the number is to be expanded so that the LED lighting device 1 has four or more LED modules, this can be done using another module socket 20 having the same structure shown in FIG. 1. Even when the number of LED modules is increased, constant current control is performed in each LED module, and therefore stabilization of the luminous intensity of the LED bare chips is improved.

Furthermore, even if the LED bare chips mounted on the LED module differ in terms of current rating, operation can be performed with stable luminous intensity by providing individual constant current circuit units 13a for each LED module according to the specifications of the mounted LED bare chips.

In other words, when replacing an LED module in the LED lighting apparatus 1, it is possible to use a replacement LED module whose LED bare chip specifications differ to those at the time the LED lighting device 1 was designed.

Furthermore, since metal base substrates are used as the main substrate 130 in each of the LED modules 11, 12 and 13, heat generated by the LED bare chips 13L can be efficiently transferred to the heat radiating plate 30. In other words, when the substrate of the LED module is a resin substrate as in a light source device

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disclosed in Japanese Patent Application Publication No. 2002-304902, different types of circuits can be provided easily on the same substrate, but the LED bare chips cannot be mounted densely because of problems such as emission processing emission of heat generated by the LED bare chips. Consequently, it is difficult for such a device to be put into practical use as a lighting device.

In contrast, with LED modules 11, 12 and 13 in which a metal base substrate is used as the main substrate 130 as in the present embodiment, deterioration of the LED bare chips 13L according to heat can be controlled, even if a total of 64 LED bare chips 13L are mounted densely.

In addition, since the constant current circuit units 11a, 12a and 13a are formed in the LED modules 11, 12 and 13 by first mounting the electronic components 133 to 135 etc. on the sub-substrate in advance using a reflow method, and then the sub-substrate 131 is attached to the main substrate 130 as shown in FIGs. 6A and 6B, the LED bare chips 13L are not subject to damage due to heat in the reflowing when forming the circuit. This is advantageous is terms of cost.

Note that the sub-substrate 131 may be attached to the main substrate 130 after the formation of the LED mounting unit 13b as shown in FIGs. 6A and 6B, or before forming the LED mounting unit 13b.

In particular, if the sub-substrate 131 is attached before the LED mounting unit 13b is formed, the resin lens parts of the LED mounting unit 13b can be formed when sealing the LED bare chips 13L with resin, as part of the same process, thereby improving

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work efficiency.

Accordingly, the LED lighting device 1 of the present embodiment improves stability of luminous intensity of LED bare chips 13L mounted densely on the main substrate 130, and makes the LED modules 11, 12 and 13 easily expandable in number and replaceable. Furthermore, when expanding or replacing the LED modules 11, 12 and 13, it is not necessary to use an LED module having the same specifications.

<First Modification>

The following describes the LED lighting device of a first modification with use of FIG. 7. FIG. 7 shows the circuit structure of an LED module 14, which differs to the preferred embodiment of the invention.

As shown in FIG. 7, the LED module 14 of the present modification has an LED mounting unit 14b composed of 64 LED bare chips 14L in the same way as the preferred embodiment.

A constant current circuit unit 14a differs from the preferred embodiment in that it is composed of one resistor 143 and one transistor 144.

Specifically, the input connection terminal is connected to one of the terminals of the LED mounting unit 14b and the base of the transistor 144. The output connection terminal is connected to one end of the resistor 143, and the other end of the resistor 143 is connected to the emitter and the base of the transistor 144.

The other end of the LED mounting unit 14b is connected to the collector of the transistor 144.

The LED module 14 having the constant current circuit unit

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14a with the described structure is able to supply power with a constant current to the LED bare chips 14L with a simpler circuit structure than the LED module 13 of FIG. 5.

Consequently, the LED lighting device having the LED module 14 is able to stabilize the luminous intensity of the LED bare chips 14L densely mounted on the main substrate 130, for less cost than the LED lighting device 1 described earlier. In addition, in the same way as the LED lighting device 1, the LED lighting device having the LED module enables easy expansion and replacement of LED modules 11, 12 and 13.

Furthermore, the LED module 13 is superior in terms of stabilization of luminous intensity.

Note that the LED lighting device described here is the same as the LED lighting device 1 in respects other than the circuit structure of the constant current circuit unit 14a.

<Second Modification>

The following describes an LED module 15 of the second modification with use of FIG. 8.

As shown in FIG. 8, in the LED module 15 of the present modification a constant current circuit unit 15a differs partly in terms of structure from the preferred embodiment, and has a thermistor 15T.

Specifically, in the LED module 15, the thermistor 15T is inserted between the collector of a transistor 154 and the base of a transistor 155 in the constant current circuit unit 15a. Although not illustrated, the thermistor 15T is fixed to the surface of the insulative layer of the main substrate by silicone resin or the like.

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In the LED module 15 having such a structure, the heat generated by the LED bare chips 15L during operation can be monitored in substantially real time by the thermistor 15T, and the current to the LED mounting unit 15b controlled accordingly.

Although the thermistor 15T is described here as being provided on the surface of the insulative layer, it is able to sense the heat from the LED bare chips 15L in substantially real time because of the favorable thermal conductivity of the metal base substrate.

Consequently, a LED lighting device having the LED module 15 of the present modification is able to maintain the life expectancy of the LED bare chips 15L, in addition to the same advantages as the LED lighting device 1.

Note that the thermistor 15T is not limited to being positioned on the surface of the insulative layer. The same effects can be obtained wherever the thermistor 15T is positioned on the substrate, due to the metal base having superior heat conductivity. For instance, a recess may be provided in the insulative layer that is sufficient in size and depth for the thermistor 15T to be embedded in and reach the metal layer, and the thermistor 15T inserted therein.

<Third Modification>

The following describes an LED module 16 of a third modification with use of FIG. 9.

As shown in FIG. 9, the circuit of the LED module 16 differs from that of the LED module 13 of the preferred embodiment, in that a constant voltage diode (hereinafter called a "Zener diode") 16Z is inserted parallel to the LED mounting unit 16b. Other

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than this, the circuit structure and the structure of the LED module are the same as those in the preferred embodiment.

In the LED module 16 that includes the Zener diode as described, the LED bare chips 16L, the wiring, and the like are protected from static electricity.

Consequently, in an LED lighting device containing the LED module 16, in addition to the advantages of the LED lighting device 1, the LED bare chips 16L are protected from static electricity, and therefore the device is highly reliable.

<Fourth Modification>

The following describes an LED module 17 of a fourth modification with use of FIG. 10.

As shown in FIG. 10, in the LED module 17 of the present modification, chip components for the constant current circuit 17a are disposed directly on the conductive land 172 on the surface of the insulative layer of the main substrate 17.

In other words, instead of using a sub-substrate as described in the preferred embodiment, in the LED module 17 a resistor 173 and transistors 174 and 175 are mounted by in the necessary positions according die bonding using Ag paste or the like.

These circuit components 173, 174, and 175 are mounted around the time of the ultrasonic mounting of the LED bare chips, and lastly the area including the conductive land 172 is sealed with resin.

Note that the circuit structure of the LED module 17 is the same as that shown in FIG. 5, and the conductive land 172 is formed together with the connection terminals 176 and 177,

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the terminals 17b1, 17b2, through to 17b9 of the LED mounting unit 17b by etching of the metal layer on the insulative layer.

The LED module 17 with such a structure is superior in terms of weight and cost compared to the LED module 13 of the preferred embodiment, due to the lack of a sub-substrate such as the sub-substrate 131 in the LED module 13. Furthermore, a LED lighting device having the LED module 17 also has the same advantages as the LED lighting device 1.

<Fifth Modification>

The lighting device of the fifth modification is characterized in reducing the power supply to the LED module when an excessive rise in temperature occurs due to an abnormality, such as a short circuit, in the LED bare chips mounted on the LED module.

Specifically, the characteristics of the present modification are that the LED module includes an abnormality detection unit that detects abnormalities in the LED bare chips, and the constant voltage circuit unit includes a control unit that reduces power supply to the module socket (the LED modules) when the abnormality detection unit detects an abnormality in the LED bare chips.

The following describes the structure of two specific examples. Note that here "reducing the power supply" includes stopping the power supply.

1. First Example

The following describes, as the LED bare chip abnormality, the LED module exhibiting an excessive rise in temperature, with use of FIGs. 11 to 13.

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As shown in FIG. 11, a lighting device 101 of the fifth modification includes a module socket 120 that has three detachable LED modules 18, 19 and 20, and a constant voltage circuit unit 140 that provides a constant voltage to the LED modules 18, 19 and 20. Note that the constant voltage circuit unit 140 and the module socket 120 are connected by three leads.

Each of the LED modules 18, 19 and 20 has substantially the same structure, and the following describes the structure of the LED module 18.

As shown in FIGs. 11 and 12, the LED module 18 has a constant current circuit unit 18a, an LED mounting unit 18b, and a thermal element 18c. Note that since the constant current circuit unit 18a and the LED mounting unit 18b are as described in the preferred embodiment, a description thereof is omitted here.

The thermal element 18c is for detecting heat abnormalities in the LED mounting unit 18b (in other words, the thermal element 18c is the abnormality detection unit of the present invention). As one example, as shown in FIG. 12, the thermal element 18c includes a thermistor 186, a resistor 187 and a comparator 188, and is connected in parallel with respect to the constant current circuit unit 18a.

Note that in FIG. 12 for convenience the thermistor 186 is shown as being some distance from the LED mounting unit 18b, but in reality it is positioned near the LED mounting unit 18b, and is able to detect a temperature abnormality in the LED bare chips 18L immediately.

Specifically, when the temperature of the LED mounting unit 18b is a temperature when a short of the like is not occurring

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(this case is referred to as "normal operation"), an H signal, for instance, is output by the comparator 188.

On the other hand, when the temperature of the LED mounting unit 18b rises exceedingly above the temperature during normal operation (this case is referred to as "abnormal operation"), the voltage input into the comparator 188 exceeds a reference voltage (corresponding to "Ref" in FIG. 12), and an L signal, for instance, is output by the comparator 188 (shown by "SM1" in FIG. 12).

The module socket 120 is basically the same as described in the preferred embodiment and the first to fourth modifications. However, as shown in FIG. 11, the module socket 120 includes a logical circuit unit 120a, and, for example, an AND gate, for outputting an L signal (shown as "SM2" in FIG. 13) to the constant voltage circuit unit 140 if an L signal is included in the signals SM1 output by the thermal element units 18c, 19c and 20c of the three LED modules 18, 19 and 20. The signal is output to the constant voltage circuit unit 140 via a lead connected to the connecter 121.

Note that in addition to the three LED modules 18, 19 and 20, a connector 122 is also connected to the logical circuit unit 120a. This is so that if the number of LED modules is expanded as described in the preferred embodiment, abnormalities can be detected in LED modules loaded in another module socket.

The constant voltage circuit unit 140 includes as its main compositional elements a recitfier 141, capacitor C1, an output trans T, transistors Q1 and Q2, and an IC, as shown in FIG. 13.

The rectifier 141 rectifies alternating current output from

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a commercial alternating power source 50. The capacitor C1 is connected between output ends O1 and O2 of the rectifier 141, and smoothes power rectified by the rectifier 141.

The output trans T has a primary winding T1 that is an input, and a secondary winding T2 and a tertiary winding T3 that are outputs. An input end I1 of the primary winding T1 is connected to the output end O1 of the rectifier 141, and an input end I2 of the primary winding T1 is connected to the connector C of the transistor Q1. Output ends O3 and O4 of the secondary winding T2 are connected to the module socket 120.

An output end O5 of the tertiary winding T3 is connected to an S3 terminal of the IC via a diode D1, and an output end O6 of the tertiary winding T3 is connected to the output end O2 of the rectifier 141. Furthermore, a capacitor C2 is connected between an output of the diode D1 and the output end O6 of the tertiary winding T3.

Note that an emitter E of the transistor Q1 is connected to the output end O6 of the tertiary winding T3, and a base B of the transistor Q1 is connected to an S2 terminal of the IC.

The transistor Q1 is either on (substantially a state of conduction between the collector and the emitter) or off (a state of non-conduction), based on a pulse signal from a signal output terminal S2 of the IC. This switches direct current voltage applied to the primary winding T1 by the output trans T, and has a constant voltage corresponding to the turns ratio output to the secondary winding T2 and the tertiary winding T3.

Furthermore, a control circuit 142 (the control unit of the present invention) is provided between the condenser C1 and

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the output trans T. The control circuit reduces the supply of power to the module socket 120 when an abnormality occurs in the LED bare chips of the LED module 18, 19 or 20.

When the output signal SM2 from the module socket 120 is an L signal, the control circuit 142 stops (reduces) power supply to the module socket 120 by stopping the switching of the transistor Q1.

The control circuit 142 includes an IC and an transistor Q2.

The IC is a commonly-known PWM switching power control IC, and controls switching operations of the transistor Q1. Here, S1 of the IC is a signal input terminal, S2 is a signal output terminal, S3 is a power input terminal, and S4 is connected to the output end O2 of the rectifier 141 by a ground terminal.

A power input terminal S3 of the IC is connected via a resistor R4 to the output end O1 of the rectifier 141, and is also connected via the diode D1 to the output end O5 of the tertiary winding T3 of the output trans T.

A signal input terminal S1 is connected to the collector C of the transistor Q2, and via a resistor R3 to the power input terminal S3. An emitter E of the transistor Q2 is connected to the output end O2 of the rectifier 141, and a base B of the transistor Q2 is connected to the module socket 120 (the logical circuit unit 120a).

With this structure, the constant voltage circuit unit 140 operates as follows.

<Normal Operation>

First, the constant voltage circuit unit 140 is connected

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to the power supply source 50, and the module socket 120 is connected via a lead to the constant voltage circuit unit 140. Power is supplied by the power supply source 50 via the constant voltage circuit unit 140 to the LED modules 18, 19 and 20.

Each of the LED modules 18, 19 and 20 receives the supply of power from the constant voltage circuit unit 140, and the LED bare chips (18L) in the LED mounting units 18b, 19b and 20b are illuminated.

Here, if the temperatures of the LED mounting units 18b, 19b and 20b in the LED modules 18, 19 and 20 are normal operation temperatures, the comparator 188 of each of the thermal elements 18c, 19c and 20c outputs an H signal (SM1) to the logical circuit unit 120a.

If all of the input signals SM1 from the comparators 188 are H signals, the logical circuit unit 120a outputs an H signal (SM2) to the constant voltage circuit unit 140.

Meanwhile, in the constant voltage circuit unit 140, the input alternating current power is rectified by the rectifier 141, and the resulting direct current voltage is applied via the resistor R4 to the power input terminal S3 of the IC. Charging of the capacitor C2 commences simultaneously. Here, the resistor R4 has a high resistance value in order to protect the IC, and when the capacitor C2 is fully charged, voltage to the IC reaches the IC operational voltage and the IC commences operation.

Furthermore, when there is no abnormality in the LED modules 18, 19 and 20, an H signal voltage is applied to the base B of the transistor Q2, Q2 is turned on (the collector and emitter are substantially in a state of conduction), and the IC signal

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input terminal S1 is substantially grounded (L level).

When an operation voltage is applied to the power input terminal S3 and the signal input terminal S1 is grounded, in other words at the L level, the IC outputs a pulse signal with a predetermined cycle and a predetermined duty ratio from the signal output terminal S2, thereby switching (turning on/off) the transistor Q1.

Accordingly, a voltage having a substantially rectangular waveform is applied to the primary winding T1 of the output trans T, and a voltage correspond to the winding ratio is output from the secondary winding T2 and the tertiary winding T3.

The LED bare chips in the LED modules 18, 19 and 20 are illuminated according this output from the secondary winding T2.

Note that the output from the tertiary winding T3, which also has a rectangular waveform, is rectified and smoothed by the diode D1 and the condenser C2, and applied to the power input terminal S3. That is to say that after commencement of switching by the transistor Q2, the output from the tertiary winding T3 becomes supply source of the operation voltage of the IC.

<Temperature Abnormality>

On the other hand, when a short circuit or the like occurs in one of the LED modules 18, 19 and 20, the temperature of the LED mounting units 18a, 18b and 18c in which the short circuit has occurred rises abnormally.

This rise in temperature lowers the resistance of the thermal elements 18c, 19c and 20c provided in the LED modules 18, 19 and 20, and when a voltage of at least a reference voltage is input into the comparator 188, the comparator 188 outputs an

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L signal (SM1) to the logical circuit unit 120a. The logical circuit unit 120a receives the L signal, and outputs an L signal (SM2) to the constant voltage circuit unit 140.

Since an output signal SM2 from the module socket 120 is an L signal, the transistor Q2 switches to off, and an output voltage of the output end O5 of the tertiary winding T3 of the output trans T is applied via the diode D1 and the resistor R3 to the IC signal input terminal S1 (hereinafter this stated is referred to as "H level").

When the signal input terminal S1 is at the H level, the IC stops output of the pulse signal from the signal output terminal S2, and stops the switching operation of the transistor Q1 (puts the transistor Q1 into an off state).

Accordingly, current no longer flows to the primary winding T1 of the output trans T, and the output of the secondary winding T2 and the tertiary wiring T3 are substantially zero. Consequently, the LED bare chips in the LED modules 18, 19 and 20 are extinguished.

Note that power supplied to the LED modules 18, 19 and 20 can be reduced by, for example, lengthening the off state of the on/off switching operations of the transistor Q1.

2. Second Example

The following describes with use of FIG. 14 a case in which the amount of current in the LED bare chips increases excessively, as an example of an abnormality in the LED bare chips. Note that the module socket and constant voltage circuit unit of the present example are the same as those in the first example, and therefore descriptions thereof are omitted. Furthermore, since each of

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the LED modules in the present example has the same structure, the following describes an LED module 21.

The LED module 21 includes a constant current circuit unit 21a, an LED mounting unit 21b and a current detection unit 21c, as shown in FIG. 14. Note that the constant current circuit unit 21a and the LED mounting unit 21b are as described in the preferred embodiment, and therefore not described here.

The current detection unit 21c is for detecting current abnormalities in the LED mounting unit 18b (the current detection unit is the abnormality detection unit of the present invention), and includes, for example, resistors 216a and comparators 216b, as shown in FIG. 14. The current detection unit 21c is connected in series on the upstream side of the series groups of eight LED bare chips 21L connected in series. An output signal SM3 from each comparator 216b is output to the logical circuit unit 217.

Specifically, when there is no broken wire or the like in the LED bare chips 21L in the eight lines of series groups (this state corresponds to "normal operation" in the first example), each comparator 216b outputs, for example, an H signal as described in the first example. Conversely, when there is a broken wire or the like in the LED bare chips 21L and the current amount in one of the series groups increases (this state corresponds to "abnormal operation" in the first example), the voltage input into the respective comparator 216b becomes equal to or higher than a reference voltage, and the comparator 216b outputs, for example, an L signal ("SM3" in FIG. 14).

The signal SM3 from the comparator 216b of each series is output to the logical circuit unit 217. If all the input signals

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SM3 from the comparators 216b are H signals, the logical circuit unit 217 outputs an H signal (SM4) to the constant voltage circuit unit, and if an L signal is included in the input signals SM3 from the comparators 216b, the logical circuit unit 217 outputs an L signal (SM4) to the constant voltage circuit unit.

3. Conclusion

In the described first and second examples, an abnormality that occurs in one of the LED mounting units 18b, 19b, 20b and 21b is detected by the abnormality detection unit (the thermal element unit in the first example and the current detection unit in the second example), and the supply of power to the module socket is stopped.

This, for example, prevents heat caused by an excessive rise in temperature in one of the LED mounting units in the plurality of LED modules from being conducted by the heat radiating plate 30 (see FIGs. 1 and 2) and causing the other modules to rise in temperature. Note that if heat is transferred to other LED modules causes the LED modules to rise in temperature, the lifespan of the LED bare chips is shortened.

4. Other

a. Regarding the lighting device

In the lighting device in the fifth modification the module socket and the constant voltage circuit unit are separate components, however they may be formed as one. This construction also enables power supply to the LED bare chips to be reduced when an abnormality occurs in an LED mounting unit, therefore prevents excessive rises in temperature of the LED modules and breakage or mis-operation of the constant voltage circuit unit.

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b. Regarding the constant voltage circuit unit

The fifth example simply indicates one example of the circuit structure of the constant voltage circuit unit. A constant voltage circuit unit having a different structure, such as one that includes an op-amp, may be used.

c. Regarding the LED modules

The LED modules are not limited to being detachable as described in the fifth modification. In other words, the feature of the present modification is the structure by which power supply to the LED bare chips of the LED mounting unit is reduced when an abnormality occurs in the LED mounting unit.

Consequently, it is sufficient for the lighting device to include one or a plurality of LED bare chips; an illumination circuit for illuminating the LED bare chip or chips; and abnormality detection means for detecting an abnormality, such as a temperature rise or an increase in current, in the LED bare chip or chips during illumination; and for the illumination circuit to include a control circuit for reducing power supply to the LED bare chip or chips when the abnormality detection means detects and abnormality in the LED bare chip or chips.

The illumination circuit may, for example, include a rectifying/smoothing circuit that rectifies and smoothes power from the power supply source, a switching element that switches the output from the rectifying/smoothing circuit, and an output trans whose primary side is connected (in series for example) to the switching element with respect to the rectifier (141). The control circuit may, for example, control the operations of the switching element of the illuminating circuit, and reduce

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(here, reducing includes stopping) the output of the output trans.

Other Remarks

The preferred embodiment and first to fifth modifications of the present invention are examples given to describe the structure and effects of the present invention, and the present invention is not limited to these examples. For example, instead of using the resin sub-substrate 131 to mount the structural components of the constant current circuit, a ceramic substrate or an Si substrate may be used. Use of an Si substrate is particularly advantageous in obtaining a compact, low-cost current circuit unit because the transistor area and the resistance area can be formed by diffusion.

Furthermore, the circuit structure of the constant current circuit unit is not limited to the examples given in the preferred embodiment and the modifications. For example, the constant current circuit may include an op-amp.

Furthermore, although an example of a constant current circuit being used as the circuit to stabilize luminous intensity of the LED bare chips is given in the preferred embodiment, a constant voltage circuit may be used instead. However, generally it is desirable to use constant current control for LED control.

Furthermore, although the LED modules 11, 12 and 13 in FIG. 1 are fixed in the module socket 20, if the magazine units 20a, 20b and 20c of the LED modules 11, 12 and 13 have a movable structure, workability can be improved when replacing the LED modules 11, 12 and 13. For example, if the lighting device is such that the module socket has a hinge mechanism which acts as an axis to enable the magazine unit to be raised from a base portion which is fixed

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to the main body of the lighting device, the LED modules can be replaced without removing the module socket from the lighting device, by simply raising the magazine unit.

Industrial Applicability

The lighting device of the present invention can be used for stabilizing luminous intensity, and allows LED modules to be easily replaced or increased in number with LED modules of differing specifications.

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Claims

1. A lighting device including:

an LED module composed of

a main substrate,

a light emitting diode bare chip provided on a main surface of the main substrate,

a power supply terminal for receiving power from a power supply source, and

a luminous intensity stabilization circuit provided between and electrically connected to the power supply terminal and the light emitting diode bare chip.

2. The lighting device of Claim 1, wherein

the luminous intensity stabilization circuit is a constant current circuit.

3. The lighting device of Claim 2, further including:

a constant voltage circuit that uses the power from the power supply source to supply a constant voltage to the power supply terminal,

wherein, in the LED module, power that has been supplied via the power supply terminal is then controlled by the constant current circuit so as to have a constant current, and the resulting constant current power is supplied to the light emitting diode chip.

4. The lighting device of Claim 2, wherein

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the LED module further includes a sub-substrate that is attached on the main substrate, and that has the constant current circuit formed thereon.

5. The lighting device of Claim 4, wherein

the sub-substrate is made of one of resin, ceramic, and Si.

6. The lighting device of Claim 1, wherein

the LED module is connected to a second LED module in parallel with respect to the power supply source, the second LED module being identical in structure to the LED module.

7. The lighting device of Claim 1, further including:

a socket that is connected to the power supply source, wherein the LED module is detachably loaded in the socket.

8. The lighting device of Claim 7, wherein

the main substrate has a multi-layer structure composed of an insulative layer and a metal layer, the insulative layer being on a top main side of the main substrate, and the metal layer being on a bottom main side of the substrate,

and the socket includes a heatsink that, when the LED module is loaded in the socket and the socket thereby thermally contacts the metal layer of the main substrate, radiates heat generated by the light emitting diode bare chip during light emission from the LED module.

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9. The lighting device of Claim 1, wherein

the LED module further includes a thermal element provided in a vicinity of the light emitting diode bare chip and connected to the luminous intensity stabilization circuit, and

the luminous intensity stabilization circuit reduces current supply to the light emitting diode bare chip when the light emitting diode bare chip rises in temperature to a predetermined temperature or higher.

10. The lighting device of Claim 3, wherein

the LED module further includes an abnormality detection unit that is provided in a vicinity of the light emitting diode bare chip and that detects an abnormality in the light emitting diode bare chip, and

the constant voltage circuit includes a control unit that reduces or stops provision of current to the LED module when the abnormality detection unit detects an abnormality in the light emitting diode bare chip.

11. The lighting device of Claim 10, wherein

the abnormality detection unit is a thermal element that detects a temperature abnormality in the light emitting diode bare chip.

12. The lighting device of Claim 3, wherein

the light emitting diode bare chip is one of a plurality included in the LED module that are divided into groups of light emitting diodes that are connected in series, the groups being

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connected in parallel with each other, and each group having a current detection unit connected thereto, and

the constant voltage circuit includes a control unit that reduces or stops supply of current to the LED module when one of the current detection units detects an abnormality in an amount of current in the light emitting diode bare chips.

13. The lighting device of Claim 1, wherein

the LED module further includes a Zener diode connected to the luminous intensity stabilization circuit, in parallel with the light emitting diode bare chip.

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FIG.1

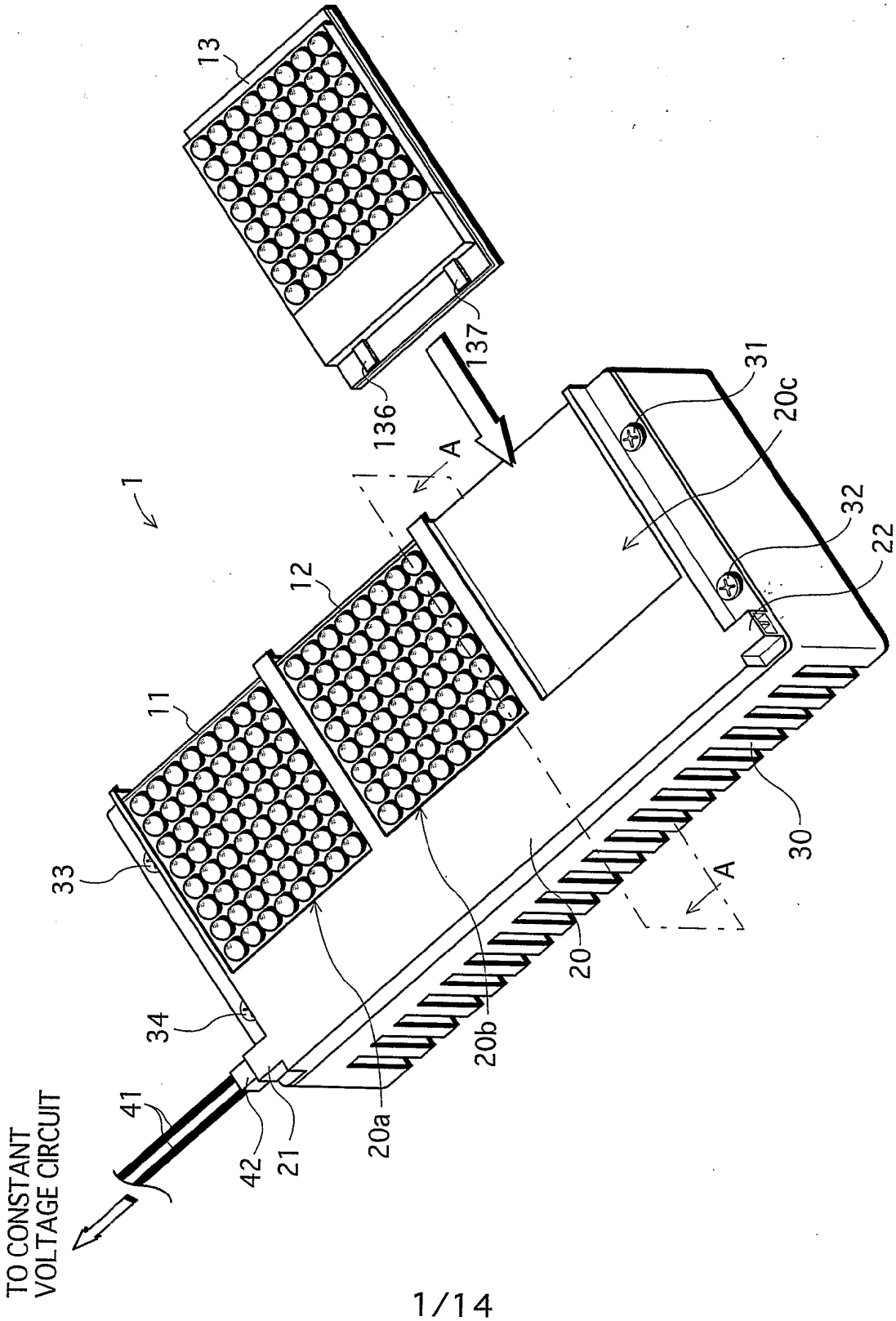

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FIG.2

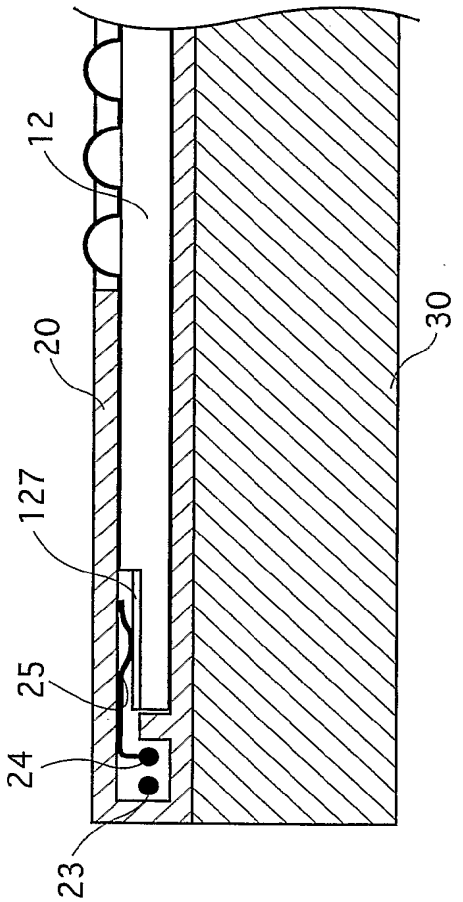

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FIG.3

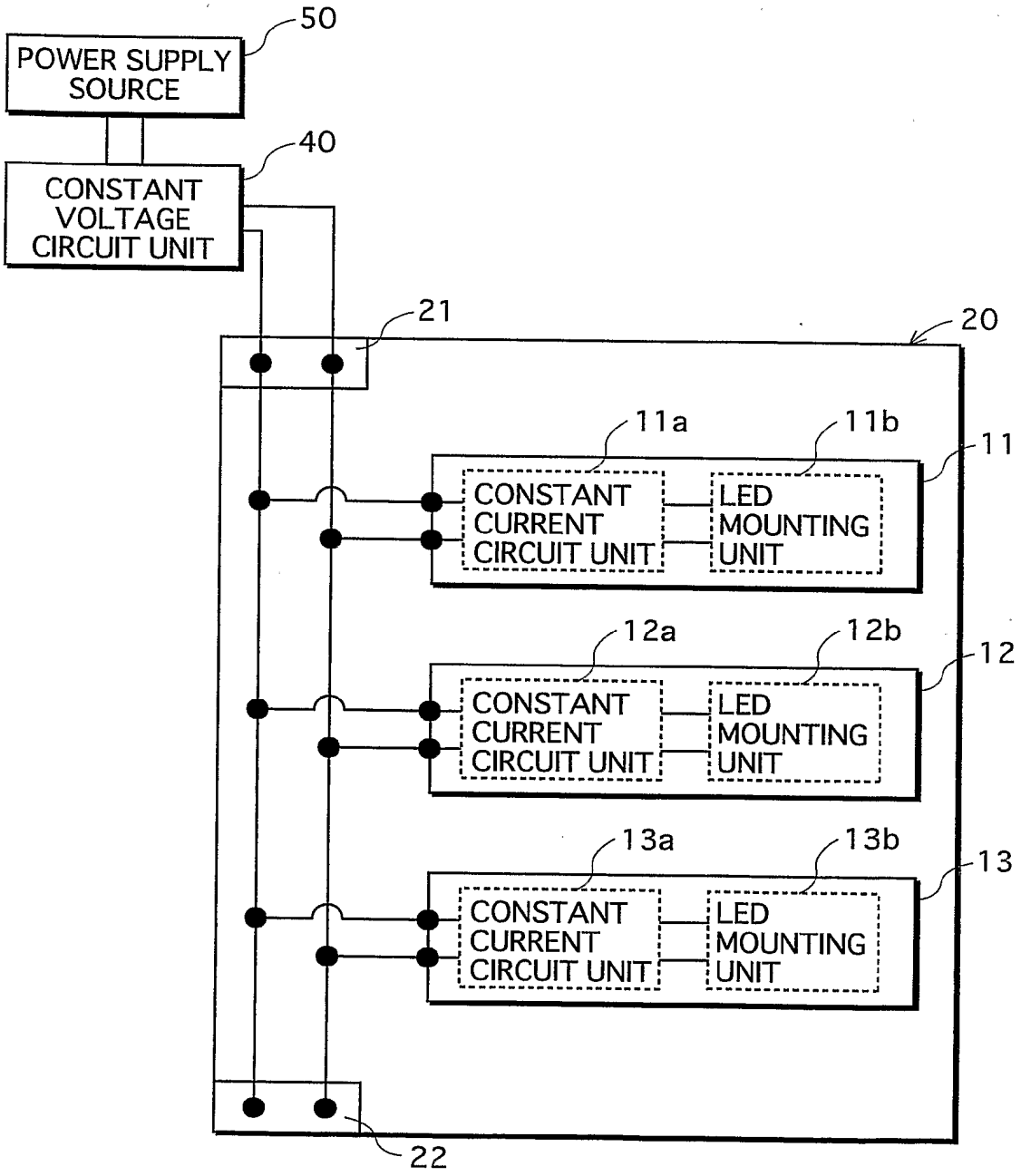

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FIG.4

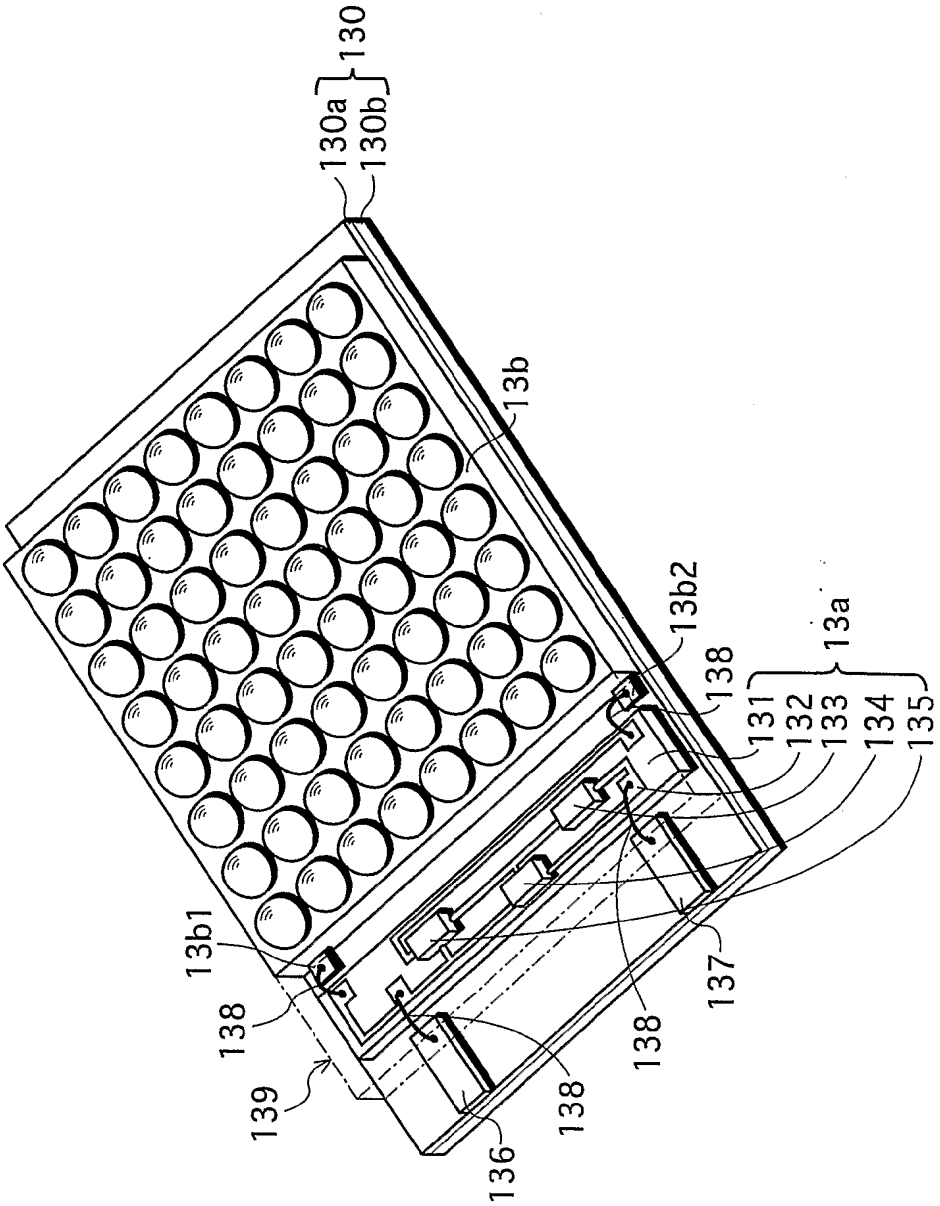

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FIG.5

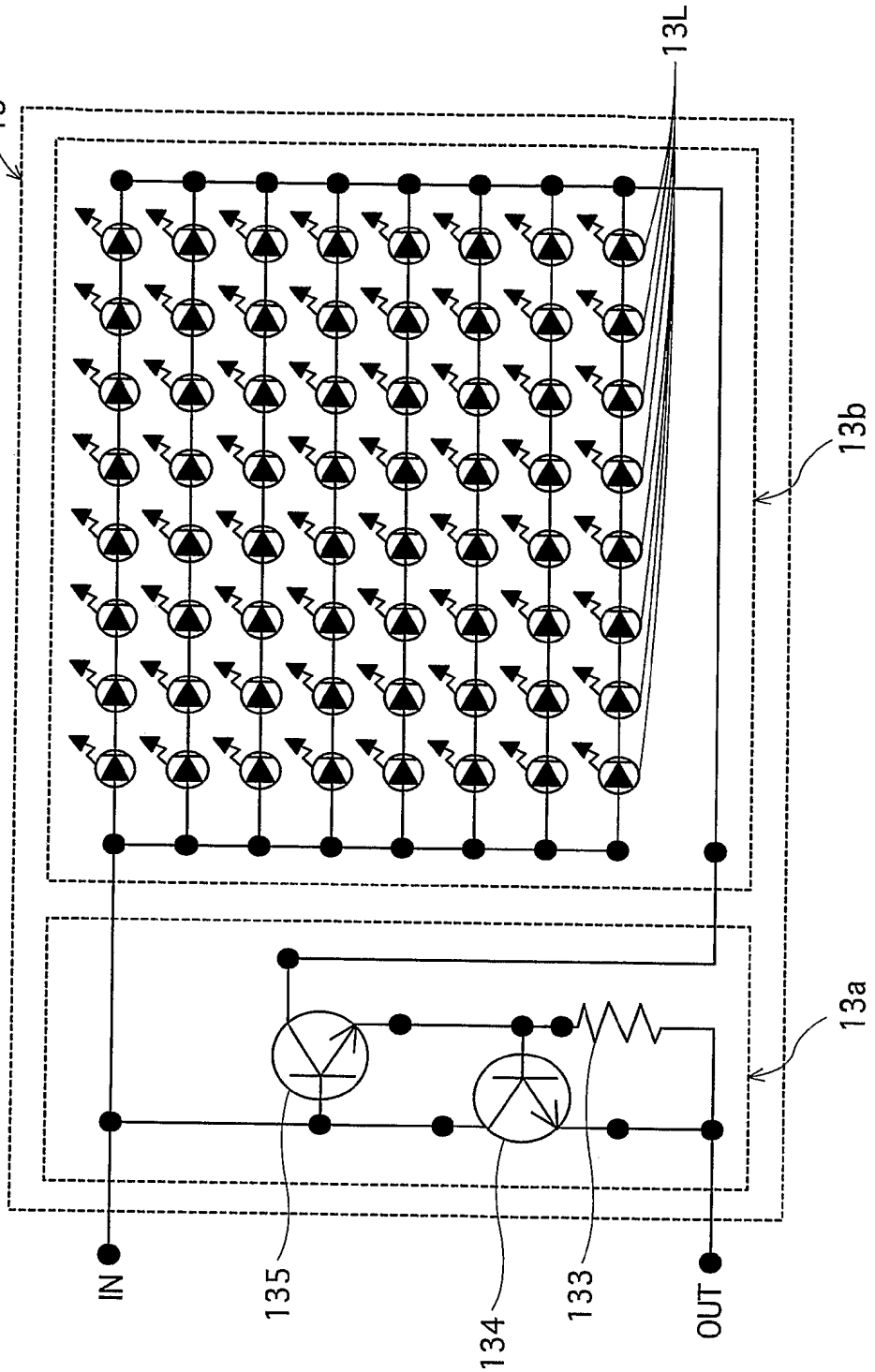

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FIG.6A

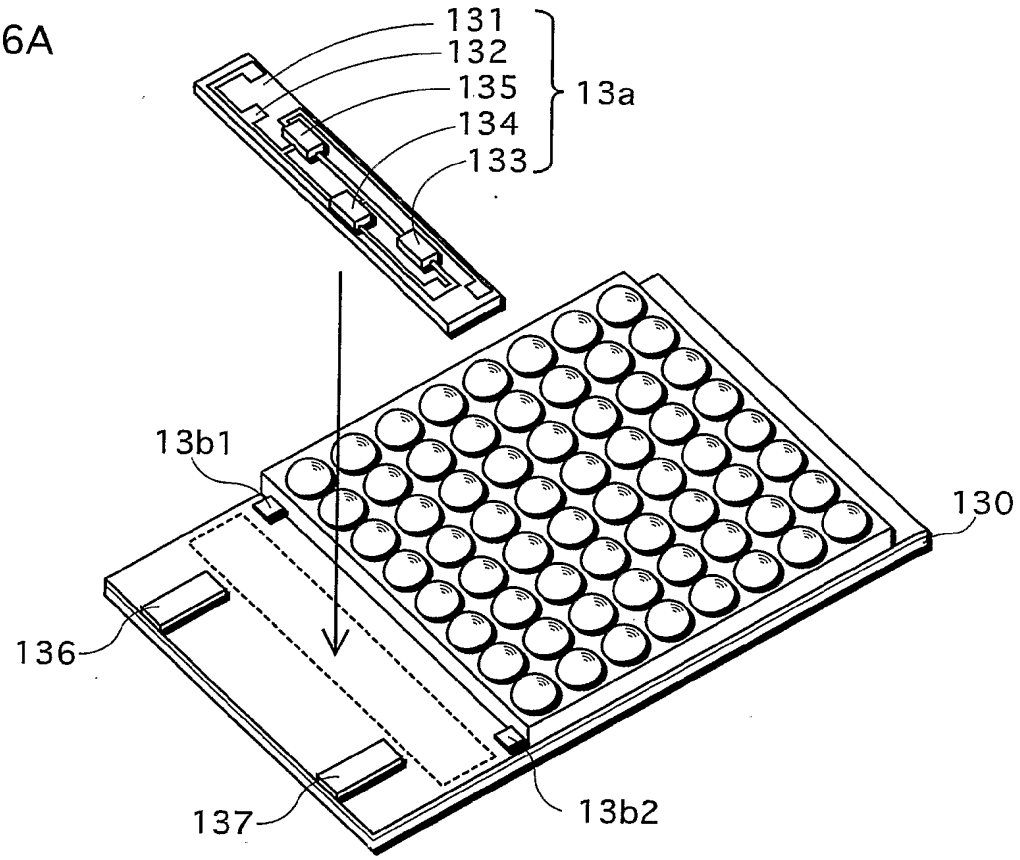

FIG.6B

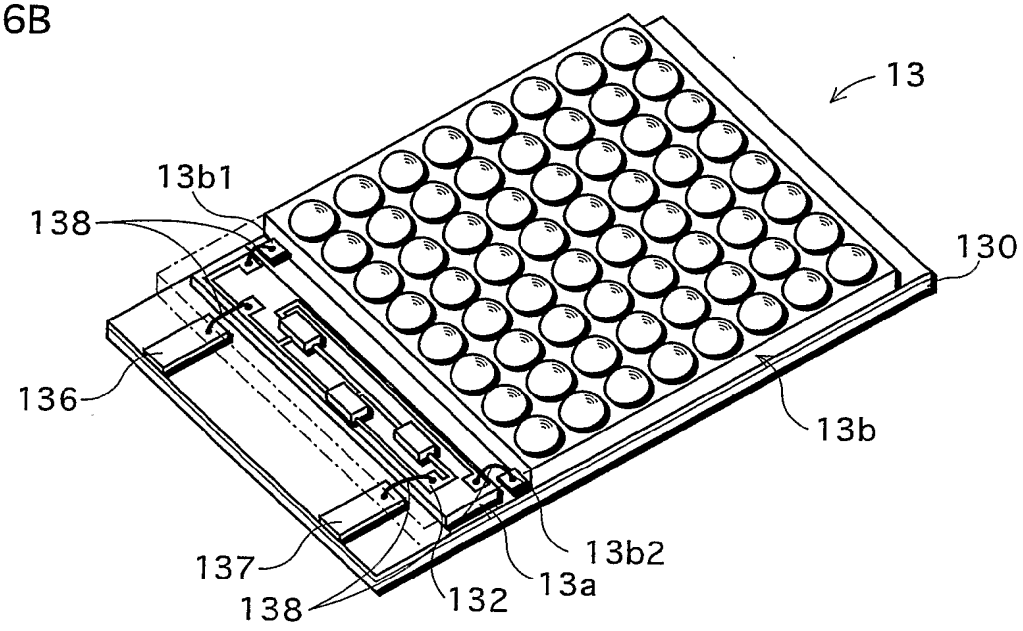

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FIG.7

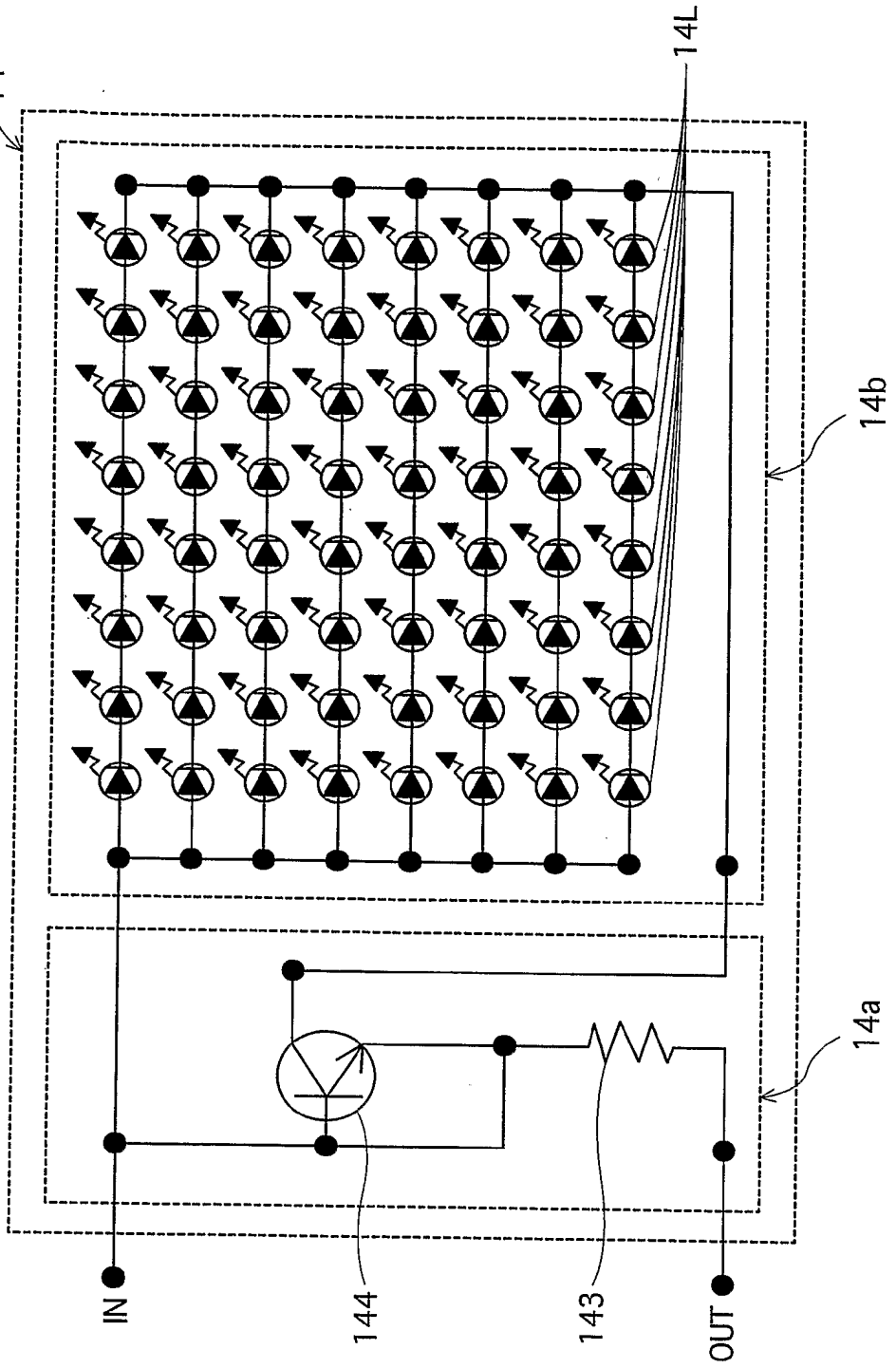

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FIG.8

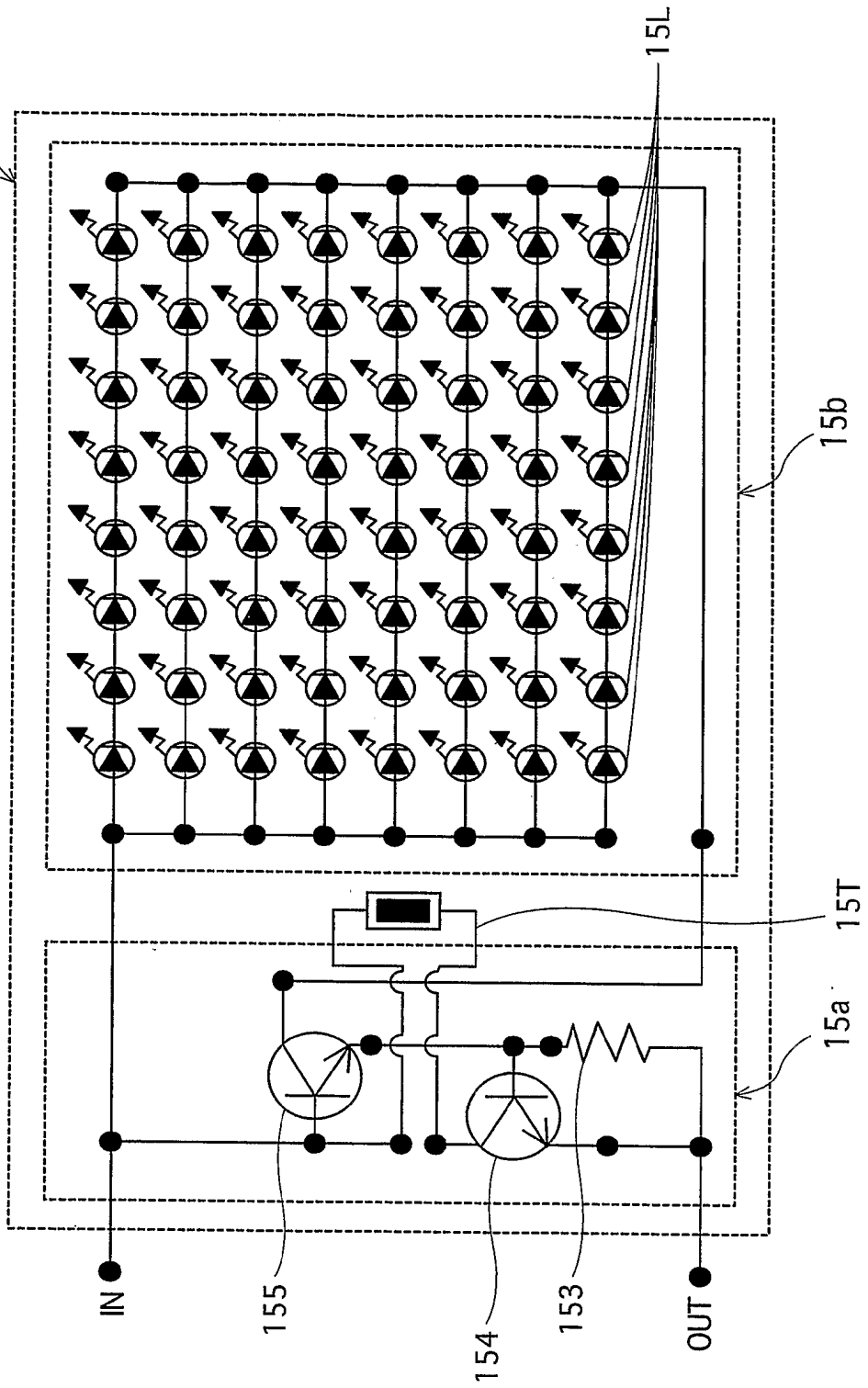

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FIG.9

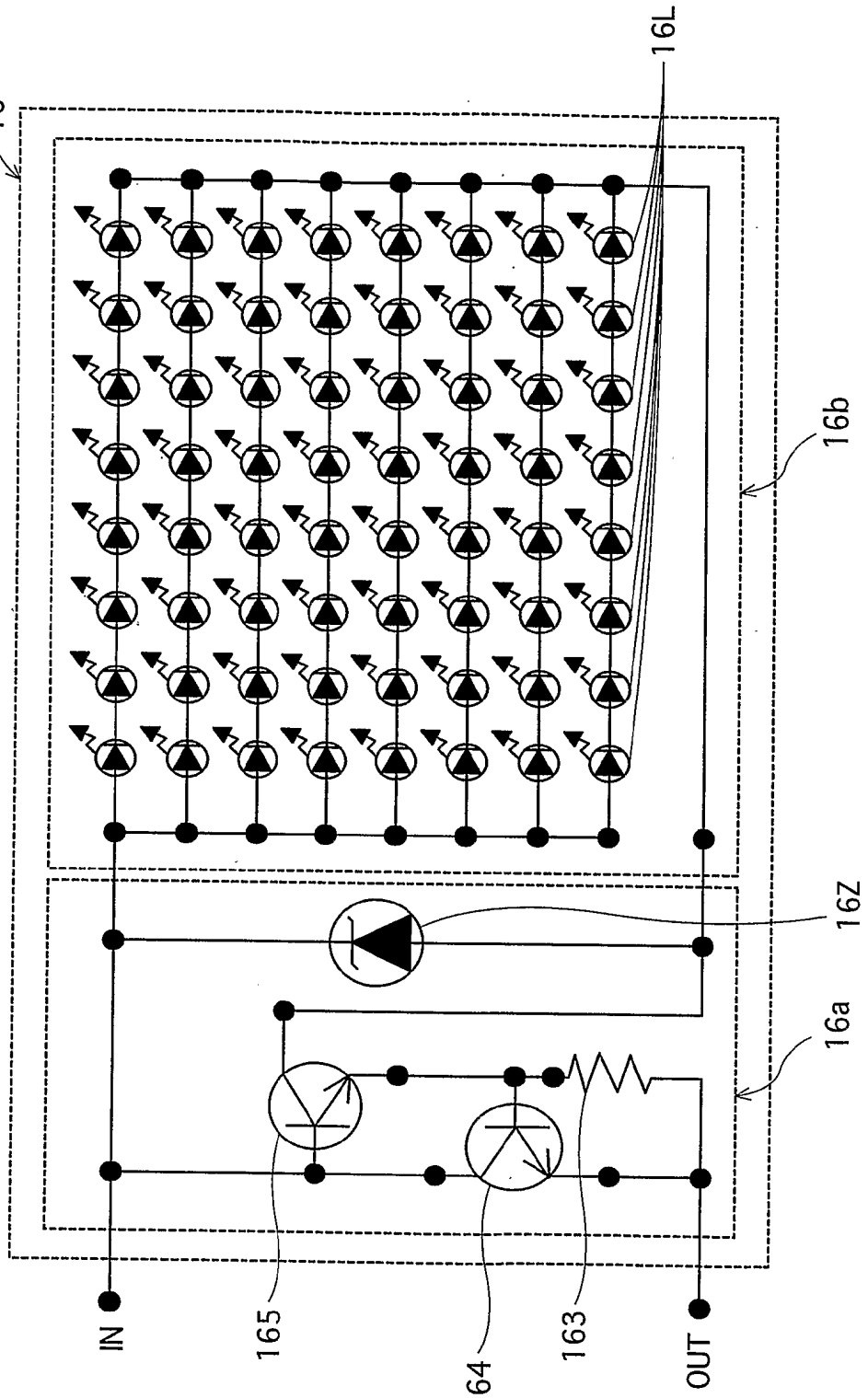

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FIG.10

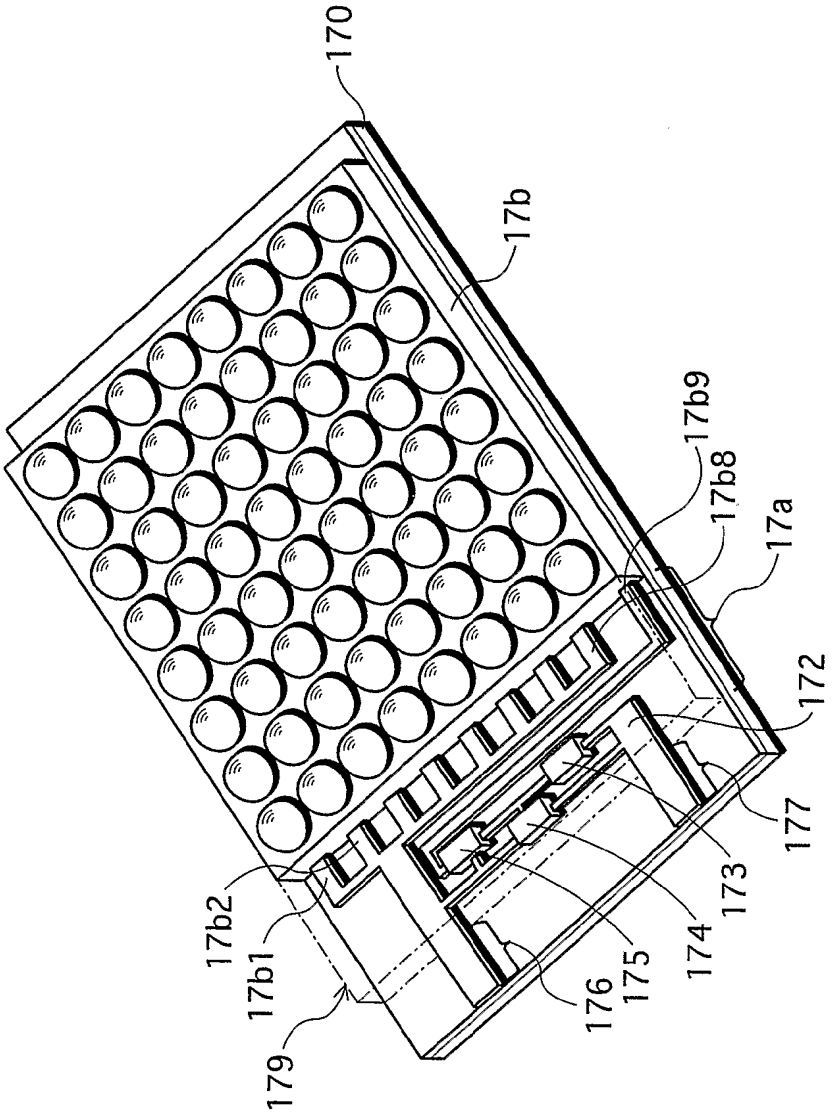

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FIG.11

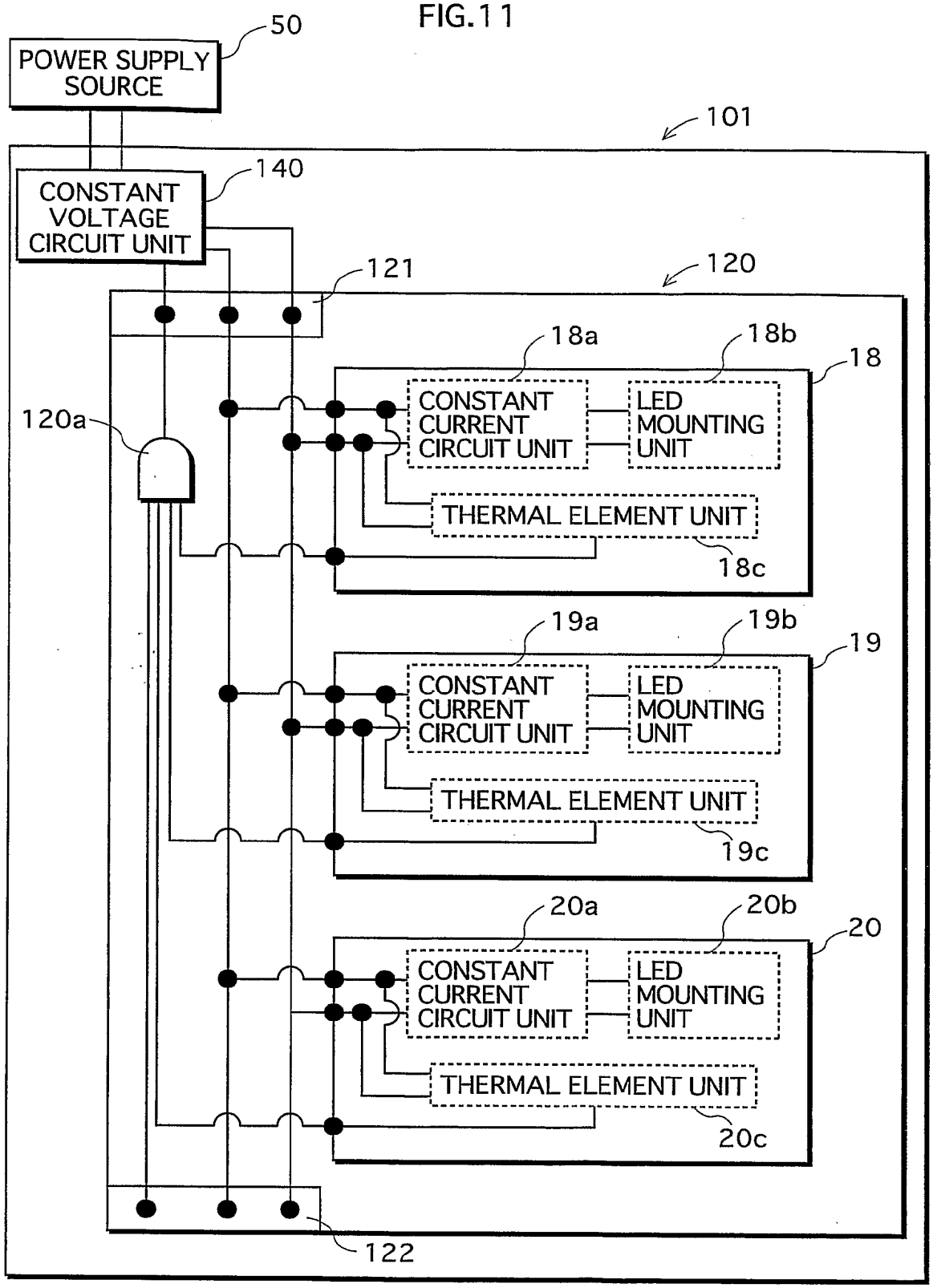

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FIG.12

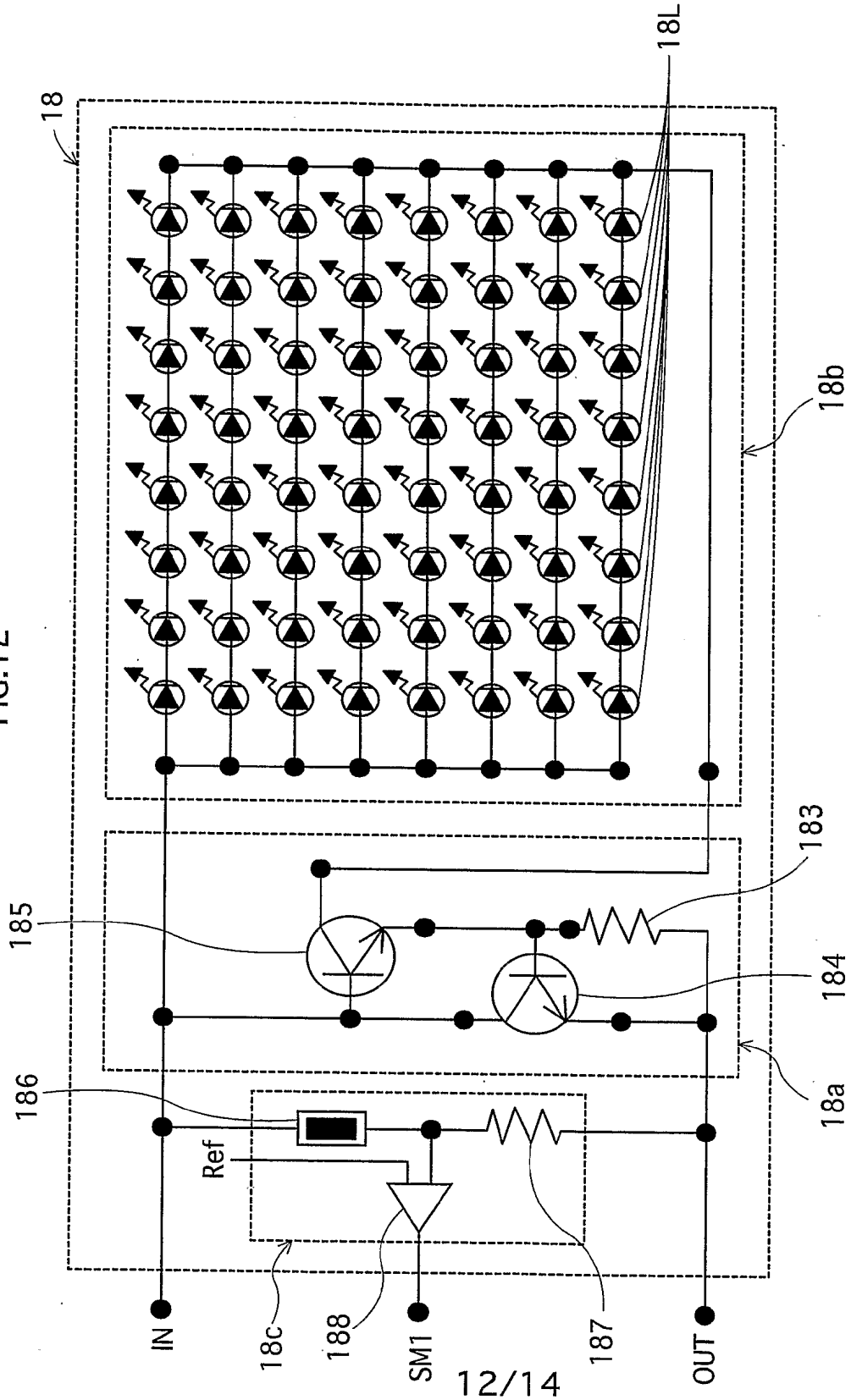

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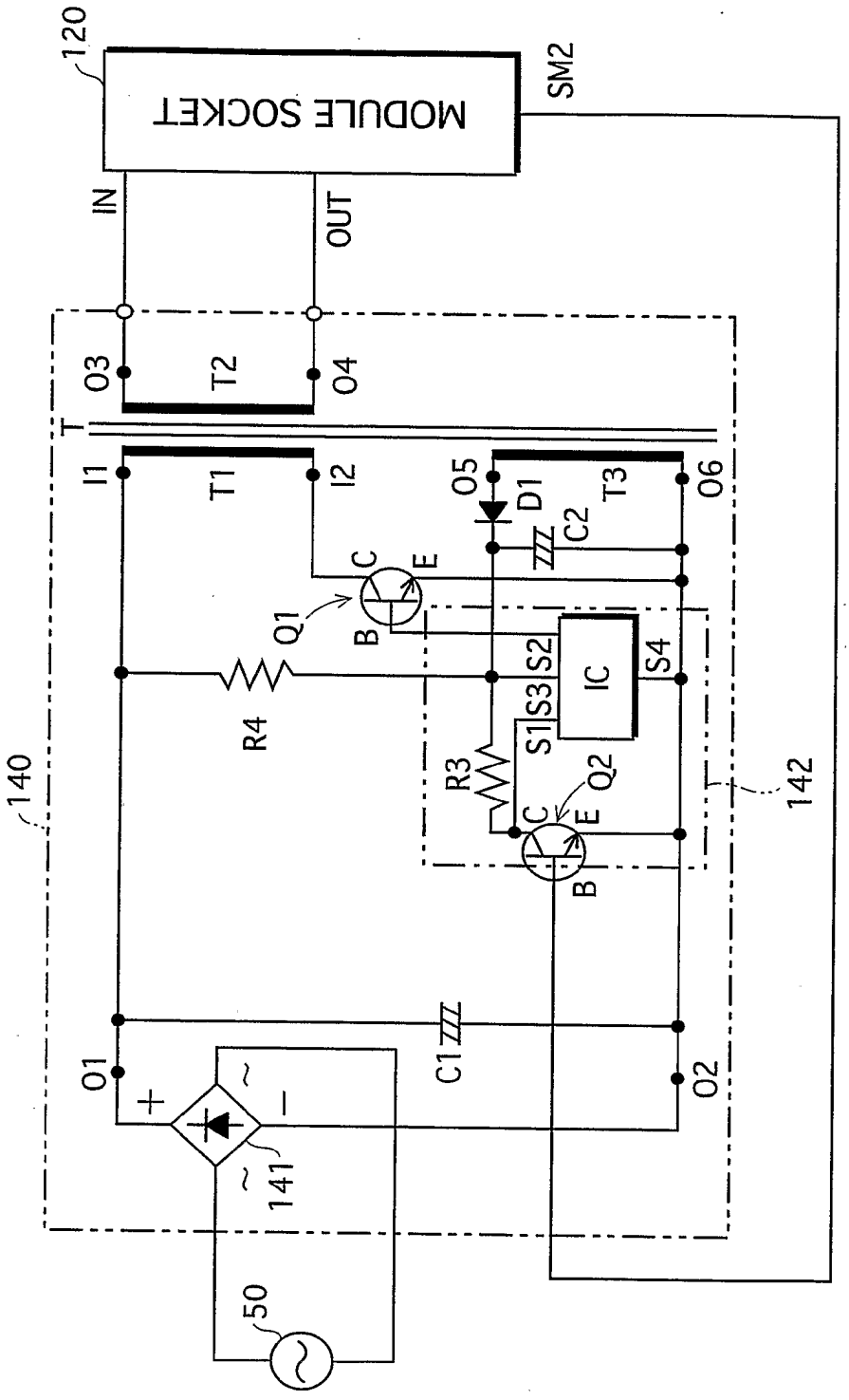
FIG.13



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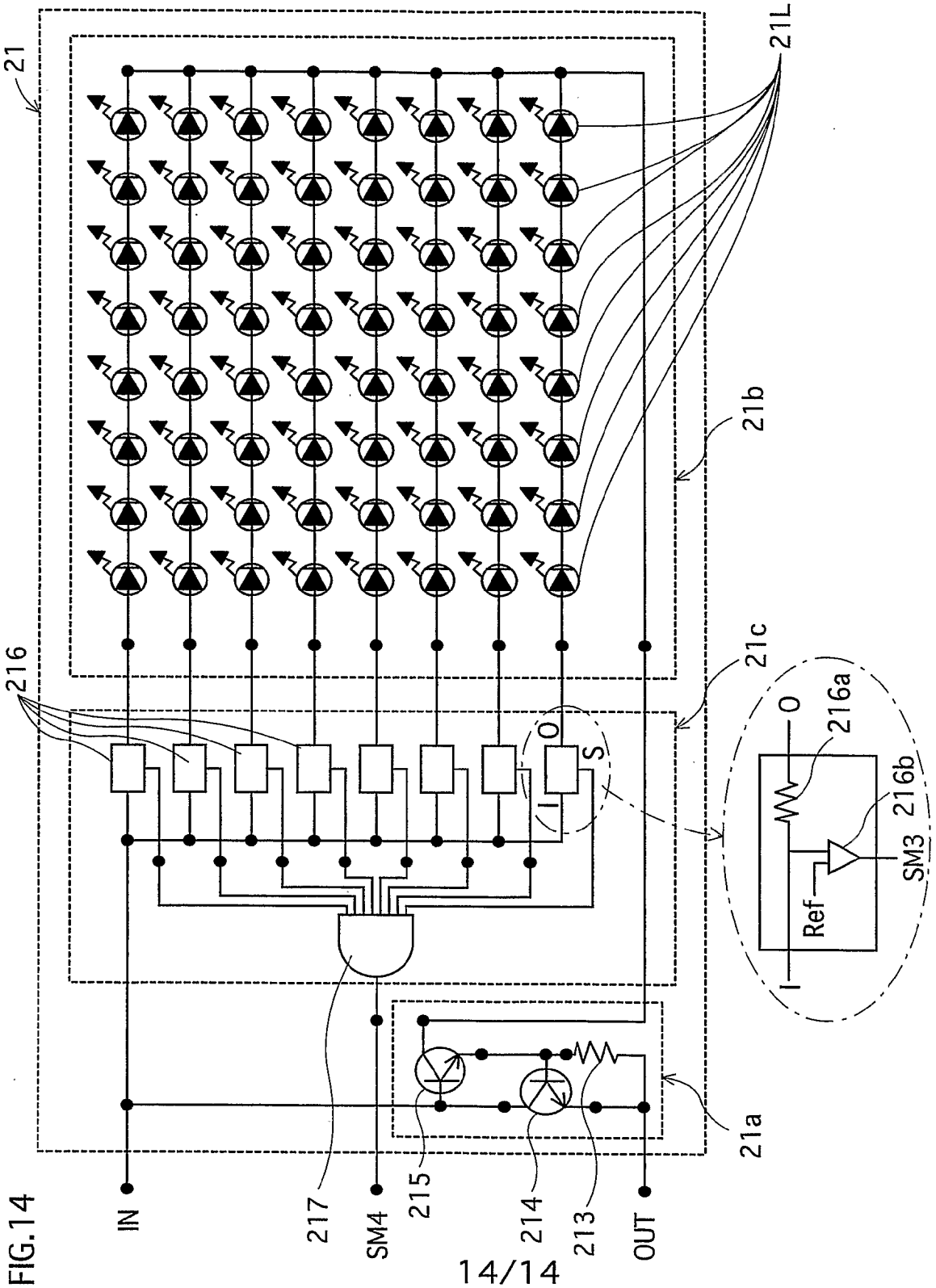

FIG.14

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 03/16428

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H05B33/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2001/032985 A1 (BHAT JEROME C ET AL) 25 October 2001 (2001-10-25) figures	1-6,10, 13 9,11,12
A Y	EP 0 891 120 A (REITTER & SCHEFENACKER GMBH) 13 January 1999 (1999-01-13) figures	6 9,11,12
X	EP 0 980 099 A (ROHM CO LTD) 16 February 2000 (2000-02-16) abstract; figures	1-3
A	PATENT ABSTRACTS OF JAPAN vol. 0130, no. 44 (E-710), 31 January 1989 (1989-01-31) & JP 63 239873 A (HITACHI LTD; others: 01), 5 October 1988 (1988-10-05) abstract	8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 July 2004	26/07/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Maicas, J

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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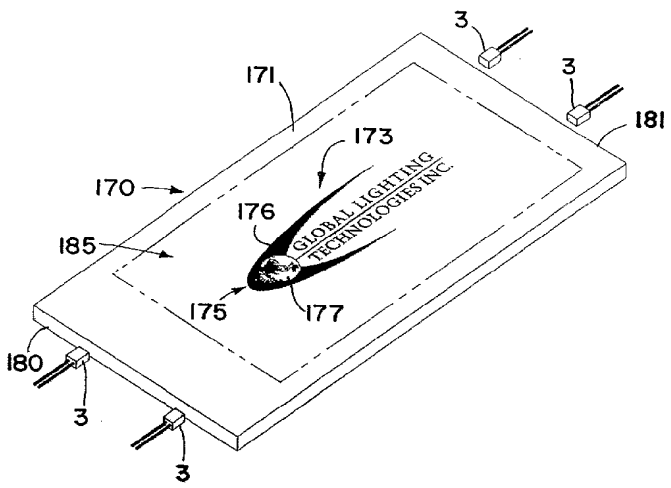
[Continued on next page]

(54) Title: LIGHT EMITTING PANEL ASSEMBLIES



(57) Abstract: Light emitting panel assemblies include one or more light emitting panel members each having at least one pattern of optical deformities that may be varied in size, shape, density, placement, angle, rotation and/or type to obtain at least one light output distribution having a form or shape of at least one of text, graphics, logo or image. At least some of the optical deformities may be shaped or oriented preferentially to cause different colored light propagating through the panel member in different directions to create a multi-colored light output distribution. Also, a plurality of panel members each having a different light output distribution may be placed in overlying relation to one another to produce a composite output distribution when viewed through the panel members or a display overlying the panel members.

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SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

TITLE: LIGHT EMITTING PANEL ASSEMBLIES

BACKGROUND OF THE INVENTION

This invention relates generally, as indicated, to light emitting panel assemblies.

Light emitting panel assemblies are generally known. However, the present invention relates to several different light emitting panel assembly configurations which provide for better control of the light output from the panel assemblies and more efficient utilization of light to suit a particular application.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, the light emitting panel assemblies include a light emitting panel member having a pattern of individual light extracting deformities of well defined shapes on or in one or more surface areas of the light emitting panel member.

In accordance with another aspect of the invention, the pattern of optical deformities may be varied in size, shape, density, placement, angle, rotation and/or type to obtain a desired light output distribution from the panel member to suit a particular application.

In accordance with another aspect of the invention, the pattern of optical deformities may be varied to obtain at least one light output distribution having a form or shape of at least one of text, graphics, logo or image.

In accordance with another aspect of the invention, the at least one light output distribution may be located in another light output distribution of the panel member to create a watermark or other effect in the another output distribution.

In accordance with another aspect of the invention, the optical deformities may be varied to obtain at least one multi-intensity light output distribution from the panel member to suit a particular application.

In accordance with another aspect of the invention, at least some of the optical deformities may be shaped or oriented preferentially to extract light propagating through the panel member in different directions.

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In accordance with another aspect of the invention, at least some of the optical deformities may be shaped or oriented preferentially to cause different colored light propagating through the panel member in different directions to create at least one multi-colored light output distribution.

In accordance with another aspect of the invention, a plurality of panel members each having at least one different light output distribution may be disposed in overlying relation to one another to produce a composite light output distribution when viewed through the panel members or a display overlying the panel members.

In accordance with another aspect of the invention, the intensity of at least one light output distribution of each of the overlying panel members may be different to create a multi-intensity composite output distribution when viewed through the panel members.

In accordance with another aspect of the invention, at least one light redirecting film may be positioned over one or more overlying panel members to allow different light output distributions to be seen when the panel members are viewed through the film or a display overlying the film from different angles.

In accordance with another aspect of the invention, the pattern of optical deformities may be on or in one side of the panel member and additional optical deformities may be on or in the other side of the panel member to allow different output distributions to be seen when the panel member is viewed through the additional optical deformities in the other side.

These and other objects, advantages, features and aspects of the invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but several of the various ways in which the principles of the invention may be employed.

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BRIEF DESCRIPTION OF THE DRAWINGS

In the annexed drawings:

Figs. 1 through 3 are schematic perspective views of three different forms of light emitting panel assemblies in accordance with this invention;

Fig. 4a is an enlarged plan view of a portion of a light output area of a panel assembly showing one form of pattern of light extracting deformities on the light output area;

Figs. 4b, c and d are enlarged schematic perspective views of a portion of a light output area of a panel assembly showing other forms of light extracting deformities formed in or on the light output area;

Fig. 5 is an enlarged transverse section through the light emitting panel assembly of Fig. 3 taken generally on the plane of the line 5-5 thereof;

Fig. 6 is a schematic perspective view of another form of light emitting panel assembly in accordance with this invention;

Fig. 7 is a schematic top plan view of another form of light emitting panel assembly in accordance with this invention;

Fig. 8 is a schematic perspective view of another form of light emitting panel assembly in accordance with this invention;

Fig. 9 is a schematic top plan view of another form of light emitting panel assembly in accordance with this invention;

Fig. 10 is a schematic top plan view of still another form of light emitting panel assembly in accordance with this invention;

Fig. 11 is a side elevation view of the light emitting panel assembly of Fig. 10;

Fig. 11a is a fragmentary side elevation view showing a tapered or rounded end on the panel member in place of the prismatic surface shown in Figs. 10 and 11;

Fig. 12 is a schematic top plan view of another form of light emitting panel assembly in accordance with this invention;

Fig. 13 is a schematic side elevation view of the light emitting panel assembly of Fig. 12;

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Figs. 14 and 15 are schematic perspective views of still other forms of light emitting panel assemblies in accordance with this invention;

Figs. 16 and 17 are enlarged schematic fragmentary plan views of a surface area of a light panel assembly showing still other forms of light extracting deformities in accordance with this invention formed on or in a surface of the panel member;

Figs. 18 and 19 are enlarged longitudinal sections through one of the light extracting deformities of Figs. 16 and 17, respectively;

Figs. 20 and 21 are enlarged schematic longitudinal sections through light extracting deformities similar to Figs. 18 and 19, respectively, except that the deformity end walls are shown extending substantially perpendicular to the panel surface instead of perpendicular to their respective reflective/refractive surfaces as shown in Figs. 18 and 19;

Figs. 22 through 30 are enlarged schematic perspective views of panel surface areas containing various patterns of individual light extracting deformities of other well defined shapes in accordance with this invention;

Fig. 31 is an enlarged schematic longitudinal section through another form of light extracting deformity in accordance with this invention;

Figs. 32 and 33 are enlarged schematic top plan views of panel surface areas containing light extracting deformities similar in shape to those shown in Figs. 28 and 29 arranged in a plurality of straight rows along the length and width of the panel surface area;

Figs. 34 and 35 are enlarged schematic top plan views of panel surface areas containing light extracting deformities also similar in shape to those shown in Figs. 28 and 29 arranged in staggered rows along the length of the panel surface areas;

Figs. 36 and 37 are enlarged schematic top plan views of panel surface areas containing a random or variable pattern of different sized light emitting deformities on the panel surface areas;

Fig. 38 is an enlarged schematic perspective view of a panel surface area showing light extracting deformities in accordance with this invention increasing

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in size as the distance of the deformities from the light source increases or intensity of the light increases along the length of the panel surface area;

Figs. 39 and 40 are schematic perspective views showing different angular orientations of the light extracting deformities along the length and width of a panel surface area;

Figs. 41 and 42 are enlarged perspective views schematically showing how exemplary light rays emitted from a focused light source are reflected or refracted by different individual light extracting deformities of well defined shapes in accordance with this invention;

Fig. 43 is a schematic perspective view showing a light emitting panel assembly similar to Fig. 42 placed on a front face of a display to provide front lighting for the display;

Fig. 44 is a schematic top plan view of another form of light emitting panel assembly in accordance with this invention for use in phototherapy treatment and the like;

Figs. 45 through 47 are schematic side elevation views of still other forms of light emitting panel assemblies in accordance with this invention for use in phototherapy treatment and the like;

Figs. 48 and 49 are schematic perspective views of other forms of light emitting panel assemblies in accordance with this invention having light output distributions in the form or shape of text, graphics, logo and/or image produced by variable patterns of individual optical deformities on or in the panel members;

Fig. 50 is a schematic perspective view of another form of light emitting panel assembly including at least one light output distribution in the form or shape of text, graphics, logo and/or image located in another light output distribution to create a "watermark" or other effect;

Fig. 51 is a schematic perspective view of an optical assembly in accordance with this invention including a screen display that is backlighted for example by the light emitting panel assembly of Fig. 50 with the text, graphics, logo and/or image output distribution of the backlight visible for example in a corner of the display; and

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Fig. 52 is an exploded perspective view of another form of optical assembly in accordance with this invention including two or more light emitting panel assemblies in overlying relation to one another each having different light output distributions that produce one or more parts of a more complex output distribution in the form or shape of text, graphics, logo and/or image that is visible through the panel members and/or an optical film and/or a display overlying the panel members when viewed therethrough.

DETAILED DESCRIPTION OF THE INVENTION

Referring now in detail to the drawings, and initially to Fig. 1, there is schematically shown one form of light emitting panel assembly 1 in accordance with this invention including a transparent light emitting panel 2 and one or more light sources 3 which emit light in a predetermined pattern in a light transition member or area 4 used to make the transition from the light source 3 to the light emitting panel 2, as well known in the art. The light that is transmitted by the light transition area 4 to the transparent light emitting panel 2 may be emitted along the entire length of the panel or from one or more light output areas along the length of the panel as desired to produce a desired light output distribution to fit a particular application.

In Fig. 1 the light transition area 4 is shown as an integral extension of one end of the light emitting panel 2 and as being generally rectangular in shape. However, the light transition area may be of other shapes suitable for embedding, potting, bonding or otherwise mounting the light source. Also, reflective or refractive surfaces may be provided to increase efficiency. Moreover, the light transition area 4 may be a separate piece suitably attached to the light input surface 13 of the panel member if desired. Also, the sides of the light transition area may be curved to more efficiently reflect or refract a portion of the light emitted from the light source through the light emitting panel at an acceptable angle.

Fig. 2 shows another form of light emitting panel assembly 5 in accordance with this invention including a panel light transition area 6 at one end of the light emitting panel 7 with sides 8, 9 around and behind the light source 3

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shaped to more efficiently reflect and/or refract and focus the light emitted from the light source 3 that impinges on these surfaces back through the light transition area 6 at an acceptable angle for entering the light input surface 18 at one end of the light emitting panel 7. Also, a suitable reflective material or coating 10 may be provided on the portions of the sides of the light transition areas of the panel assemblies of Figs. 1 and 2 on which a portion of the light impinges for maximizing the amount of light or otherwise changing the light that is reflected back through the light transition areas and into the light emitting panels.

The panel assemblies shown in Figs. 1 and 2 include a single light source 3, whereas Fig. 3 shows another light emitting panel assembly 11 in accordance with this invention including two light sources 3. Of course, it will be appreciated that the panel assemblies of the present invention may be provided with any number of light sources as desired, depending on the particular application.

The panel assembly 11 of Fig. 3 includes a light transition area 12 at one end of the light emitting panel 14 having reflective and/or refractive surfaces 15 around and behind each light source 3. These surfaces 15 may be appropriately shaped including for example curved, straight and/or faceted surfaces, and if desired, suitable reflective materials or coatings may be provided on portions of these surfaces to more efficiently reflect and/or refract and focus a portion of the light emitted for example from an incandescent light source which emits light in a 360° pattern through the light transition areas 12 into the light input surface 19 of the light emitting panel 14.

The light sources 3 may be mechanically held in any suitable manner in slots, cavities or openings 16 machined, molded or otherwise formed in the light transition areas of the panel assemblies. However, preferably the light sources 3 are embedded, potted or bonded in the light transition areas in order to eliminate any air gaps or air interface surfaces between the light sources and surrounding light transition areas, thereby reducing light loss and increasing the light output emitted by the light emitting panels. Such mounting of the light sources may be accomplished, for example, by bonding the light sources 3 in the slots, cavities or

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openings 16 in the light transition areas using a sufficient quantity of a suitable embedding, potting or bonding material 17. The slots, cavities or openings 16 may be on the top, bottom, sides or back of the light transition areas. Bonding can also be accomplished by a variety of methods that do not incorporate extra material, for example, thermal bonding, heat staking, ultrasonic or plastic welding or the like. Other methods of bonding include insert molding and casting around the light source(s).

A transparent light emitting material of any suitable type, for example acrylic or polycarbonate, may be used for the light emitting panels. Also, the panels may be substantially flat, or curved, may be a single layer or multi-layers, and may have different thicknesses and shapes. Moreover, the panels may be flexible, or rigid, and may be made out of a variety of compounds. Further, the panels may be hollow, filled with liquid, air, or be solid, and may have holes or ridges in the panels.

Each light source 3 may also be of any suitable type including, for example, any of the types disclosed in U.S. Patent Nos. 4,897,771 and 5,005,108, assigned to the same assignee as the present application, the entire disclosures of which are incorporated herein by reference. In particular, the light sources 3 may be an arc lamp, an incandescent bulb which also may be colored, filtered or painted, a lens end bulb, a line light, a halogen lamp, a light emitting diode (LED), a chip from an LED, a neon bulb, a fluorescent tube, a fiber optic light pipe transmitting from a remote source, a laser or laser diode, or any other suitable light source. Additionally, the light sources 3 may be a multiple colored LED, or a combination of multiple colored radiation sources in order to provide a desired colored or white light output distribution. For example, a plurality of colored lights such as LEDs of different colors (red, blue, green) or a single LED with multiple colored chips may be flashed to create white light or any other desired colored light output distribution by varying the intensities of each different colored light or different colored chip.

A pattern of light extracting deformities or disruptions may be provided on one or both sides of the panel members or on one or more selected areas on

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one or both sides of the panel members, as desired. Fig. 4a schematically shows one such light surface area 20 on which a pattern of light extracting deformities or disruptions 21 is provided. As used herein, the term deformities or disruptions are used interchangeably to mean 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. The pattern of light extracting deformities 21 shown in Fig. 4a includes 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 21 are provided or reflected back through the panel and emitted out the other side.

These deformities or disruptions 21 can be produced in a variety of manners, for example, by providing a painted pattern, an etched pattern, a machined pattern, a printed pattern, a hot stamped pattern, or a molded pattern or the like on selected light output areas of the panel members. An ink or printed pattern may be applied for example by pad printing, silk screening, ink jet, heat transfer film process or the like. The deformities may also 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.

By varying the density, opaqueness or translucence, shape, depth, color, area, index of refraction, or type of deformities 21 on an area or areas of the panels, the light output of the panels can be controlled. The deformities or disruptions may be used to control the percent of light emitted from any area of the panels. For example, less and/or smaller size deformities 21 may be placed on panel areas where less light output is wanted. Conversely, a greater percentage of and/or larger deformities may be placed on areas of the panels where greater light output is desired.

Varying the percentages and/or size of deformities in different areas of the panel is necessary in order to provide a uniform light output distribution. For

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example, the amount of light traveling through the panels will ordinarily be greater in areas closer to the light source than in other areas further removed from the light source. A pattern of light extracting deformities 21 may be used to adjust for the light variances within the panel members, for example, by providing a denser concentration of light extracting deformities with increased distance from the light source 3 thereby resulting in a more uniform light output distribution from the light emitting panels.

The deformities 21 may also be used to control the output ray angle distribution of the emitted light to suit a particular application. For example, if the panel assemblies are used to provide a liquid crystal display back light, the light output will be more efficient if the deformities 21 cause the light rays to emit from the panels at predetermined ray angles such that they will pass through the liquid crystal display with low loss.

Additionally, the pattern of light extracting deformities may be used to adjust for light output variances attributed to light extractions of the panel members. The pattern of light extracting deformities 21 may be printed on the light output areas utilizing a wide spectrum of paints, inks, coatings, epoxies, or the like, ranging from glossy to opaque or both, and may employ half-tone separation techniques to vary the deformity 21 coverage. Moreover, the pattern of light extracting deformities 21 may be multiple layers or vary in index of refraction.

Print patterns of light extracting deformities 21 may vary in shapes such as dots, squares, diamonds, ellipses, stars, random shapes, and the like, and are desirably .006 square inch per deformity/element or less. Also, print patterns that are 60 lines per inch or finer are desirably employed, thus making the deformities or shapes 21 in the print patterns nearly invisible to the human eye in a particular application thereby eliminating the detection of gradient or banding lines that are common to light extracting patterns utilizing larger elements. Additionally, the deformities may vary in shape and/or size along the length and/or width of the panel members. Also, a random placement pattern of the deformities may be utilized throughout the length and/or width of the panel members. The

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deformities may have shapes or a pattern with no specific angles to reduce moire or other interference effects. Examples of methods to create these random patterns are printing a pattern of shapes using stochastic print pattern techniques, frequency modulated half tone patterns, or random dot half tones. Moreover, the deformities may be colored in order to effect color correction in the panel members. The color of the deformities may also vary throughout the panel members, for example to provide different colors for the same or different light output areas.

In addition to or in lieu of the patterns of light extracting deformities 21 shown in Fig. 4a, other light extracting deformities including prismatic surfaces, depressions or raised surfaces of various shapes using more complex shapes in a mold pattern may be molded, etched, stamped, thermoformed, hot stamped or the like into or on one or more areas of the panel member. Figs. 4b and 4c show panel areas 22 on which prismatic surfaces 23 or depressions 24 are formed in the panel areas, whereas Fig. 4d shows prismatic or other reflective or refractive surfaces 25 formed on the exterior of the panel area. The prismatic surfaces, depressions or raised surfaces will cause a portion of the light rays contacted thereby to be emitted from the panel member. Also, the angles of the prisms, depressions or other surfaces may be varied to direct the light in different directions to produce a desired light output distribution or effect. Moreover, the reflective or refractive surfaces may have shapes or a pattern with no specific angles to reduce moire or other interference effects.

As best seen in the cross sectional view of Fig. 5, a back reflector (including trans reflectors) 26 may be attached or positioned against one side of the panel member 14 of Fig. 3 using a suitable adhesive 28 or other method in order to improve light output efficiency of the panel assembly 11 by reflecting the light emitted from that side back through the panel for emission through the opposite side. Additionally, a pattern of light extracting deformities 21, 23, 24 and/or 25 may be provided on one or both sides of the panel member in order to change the path of the light so that the internal critical angle is exceeded and a portion of the light is emitted from one or both sides of the panel. Moreover, a

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transparent film, sheet or plate 27 may be attached or positioned against the side or sides of the panel member from which light is emitted using a suitable adhesive 28 or other method in order to produce a desired effect.

The member 27 may be used to further improve the uniformity of the light output distribution. For example, the member 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.

If adhesive 28 is used to adhere the back reflector 26 and/or film 27 to the panel, the adhesive is preferably applied only along the side edges of the panel, and if desired the end edge opposite the light transition areas 12, but not over the entire surface area or areas of the panel because of the difficulty in consistently applying a uniform coating of adhesive to the panel. Also, the adhesive changes the internal critical angle of the light in a less controllable manner than the air gaps 30 (see Fig. 5) which are formed between the respective panel surfaces and the back reflector 26 and/or film 27 when only adhered along the peripheral edges. Additionally, longer panel members are achievable when air gaps 30 are used. If adhesive were to be used over the entire surface, the pattern of deformities could be adjusted to account for the additional attenuation in the light caused by the adhesive.

Referring further to Fig. 2, the panel assembly 5 shown therein also includes molded posts 31 at one or more corners of the panel 7 (four such posts being shown) which may be used to facilitate mounting of the panel assembly and providing structural support for other parts or components, for example, a display panel such as a liquid crystal display panel as desired.

Fig. 6 shows another form of light emitting panel assembly 32 in accordance with this invention including a panel member 33, one or more light sources 3, and one or more light output areas 34. In addition, the panel assembly 32 includes a tray 35 having a cavity or recess 36 in which the panel assembly 32 is received. The tray 35 may act as a back reflector as well as end edge and/or side edge reflectors for the panel 33 and side and/or back reflectors 37 for the light sources 3. Additionally, one or more secondary reflective or refractive surfaces 38 may be provided on the panel member 33 and/or tray 35 to

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reflect a portion of the light around one or more corners or curves in a non-rectangular shaped panel member 33. These secondary reflective/refractive surfaces 38 may be flat, angled, faceted or curved, and may be used to extract a portion of the light away from the panel member in a predetermined pattern. Fig. 6 also shows multiple light output areas 34 on the panel member that emit light from one or more light sources 3.

Fig. 7 is a schematic illustration of still another form of light emitting panel assembly 40 in accordance with this invention including a panel member 41 having one or more light output areas 42 and one or more light transition areas (mixing areas) 43 containing a plurality of light sources 3 at one or both ends of the panel. Each transition area mixes the light from one or more light sources having different colors and/or intensities. In this particular embodiment, each of the light sources 3 desirably employs three colored LEDs (red, blue, green) in each transition mixing area 43 so that the light from the three LEDs can be mixed to produce a desired light output color that will be emitted from the light output area 42. Alternatively, each light source may be a single LED having multiple colored chips bonded to the lead film. Also, two colored LEDs or a single LED having two colored chips may be used for a particular application. By varying the intensities of the individual respective LEDs, virtually any colored light output or white light distribution can be achieved.

Fig. 8 shows yet another form of light emitting panel assembly 45 in accordance with this invention including a light emitting panel member 46 and a light source 3 in a light transition area 48 integral with one end of the panel member. In this particular embodiment, the panel member 46 is three-dimensionally curved, for example, such that light rays may be emitted in a manner that facilitates aesthetic design of a lighted display.

Fig. 9 schematically shows another form of light emitting panel assembly 50 in accordance with this invention, including a panel member 51 having multiple light output areas 52, and mounting posts and/or mounting tabs 53. This particular panel assembly 50 may serve as a structural member to support other parts or components as by providing holes or cavities 54, 55 in the panel

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member 51 which allow for the insertion of modular components or other parts into the panel member. Moreover, a separate cavity or recess 56 may be provided in the panel member 51 for receipt of a correspondingly shaped light transition area 57 having one or more light sources 3 embedded, bonded, cast, insert molded, epoxied, or otherwise mounted or positioned therein and a curved reflective or refractive surface 58 on the transition area 57 and/or wall of the cavity or recess 56 to redirect a portion of the light in a predetermined manner. In this way the light transition area 57 and/or panel member may be in the form of a separate insert which facilitates the easy placement of the light source in a modular manner. A reflector 58 may be placed on the reflective or refractive surface of the cavity or recess 56 or insert 57. Where the reflector 58 is placed on the reflective or refractive surface of the cavity or recess 56, the cavity or recess may act as a mold permitting transparent material from which the transition area 57 is made to be cast around one or more light sources 3.

Figs. 10 and 11 schematically show another form of light emitting panel assembly 60 in accordance with this invention including a panel member 61 having one or more light output areas 62. In this particular embodiment, an off-axis light transition area 63 is provided that is thicker in cross section than the panel member to permit use of one or more light sources 3 embedded or otherwise mounted in the light transition area that are dimensionally thicker than the panel member. Also, a three-dimensional reflective surface 64 (Fig. 11) may be provided on the transition area 63. Moreover, a prism 65 (Fig. 11) or tapered, rounded, or otherwise shaped end 66 (Fig. 11a) may be provided at the end of the panel opposite the light sources 3 to perform the function of an end reflector. The light sources 3 may be oriented at different angles relative to each other and offset to facilitate better mixing of the light rays 67 in the transition area 63 as schematically shown in Fig. 10 and/or to permit a shorter length transition area 63 to be used.

Figs. 12 and 13 schematically show still another form of light emitting panel assembly 70 in accordance with this invention which includes one or more light transition areas 71 at one or both ends of the panel member 72 each containing a single light source 73. The transition area or areas 71 shown in

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Figs. 12 and 13 collect light with multiple or three-dimensional surfaces and/or collect light in more than one plane. For example each transition area 71 shown in Figs. 12 and 13 has elliptical and parabolic shape surfaces 74 and 75 in different planes for directing the light rays 76 into the panel member at a desired angle.

Providing one or more transition areas at one or both ends of the panel member of any desired dimension to accommodate one or more light sources, with reflective and/or refractive surfaces on the transition areas for redirecting the light rays into the panel member at relatively low angles allows the light emitting panel member to be made much longer and thinner than would otherwise be possible. For example the panel members of the present invention may be made very thin, *i.e.*, 0.125 inch thick or less.

Fig. 14 schematically illustrates still another form of light emitting panel assembly 80 in accordance with this invention including a light emitting panel 81 and one or more light sources 3 positioned, embedded, potted, bonded or otherwise mounted in a light transition area 82 that is at an angle relative to the panel member 81 to permit more efficient use of space. An angled or curved reflective or refractive surface 83 is provided at the junction of the panel member 81 with the transition area 82 in order to reflect/refract light from the light source 3 into the body of the panel member 81 for emission of light from one or more light emitting areas 84 along the length of the panel member.

Fig. 15 schematically illustrates still another form of light emitting panel assembly 90 in accordance with this invention including a light transition area 91 at one or both ends of a light emitting panel member 92 containing a slot 93 for sliding receipt of an LED or other suitable light source 3. Preferably the slot 93 extends into the transition area 91 from the back edge 94, whereby the light source 3 may be slid and/or snapped in place in the slot from the back, thus allowing the transition area to be made shorter and/or thinner. The light source 3 may be provided with wings, tabs or other surfaces 95 for engagement in correspondingly shaped recesses or grooves 96 or the like in the transition area 91 for locating and, if desired, securing the light source in place. Also, the light source 3 may be embedded, potted, bonded or otherwise secured within the slot

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93 in the light transition area 91 of the panel member 92. Light from a secondary light source 97 may be projected through the panel member 92 for indication or some other effect.

Fig. 16 through 19 show other light extracting deformities 98 in accordance with this invention which may either be individual projections 99 on the respective panel surface areas 22 or individual depressions 100 in such panel surface areas. In either case, the light extracting deformities 98 differ from the light extracting deformities shown in Figs. 4a, 4b, 4c and 4d in that each of the deformities 98 has a well defined shape including a reflective or refractive surface 101 that intersects the respective panel surface area 22 at one edge 102 and has a uniform slope throughout its length for more precisely controlling the emission of light by each of the deformities. Along a peripheral edge portion 103 of each reflective/refractive surface 101 is an end wall 104 of each deformity 98 that intersects the respective panel surface area at a greater included angle I than the included angle I' between the reflective/refractive surfaces 101 and the panel surface area 22 (see Figs. 18 and 19) to minimize the projected surface area of the end walls on the panel surface area. This allows more deformities 98 to be placed on or in the panel surface areas than would otherwise be possible if the projected surface areas of the end walls 104 were substantially the same as or greater than the projected surface areas of the reflective/refractive surfaces 101.

In Figs. 16 and 17 the peripheral edge portions 103 of the reflective/refractive surfaces 101 and associated end walls 104 are curved in the transverse direction. Also, in Figs. 18 and 19 the end walls 104 of the deformities 98 are shown extending substantially perpendicular to the reflective/refractive surfaces 101 of the deformities. Alternatively, such end walls 104 may extend substantially perpendicular to the panel surface areas 22 as schematically shown in Figs. 20 and 21. This virtually eliminates any projected surface area of the end walls 104 on the panel surface areas 22 whereby the density of the deformities on the panel surface areas may be even further increased.

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The light extracting deformities may also be of other well defined shapes to obtain a desired light output distribution from a panel surface area. Fig. 22 shows individual light extracting deformities 105 on a panel surface area 22 each including a generally planar, rectangular reflective/refractive surface 106 and associated end wall 107 of a uniform slope throughout their length and width and generally planar side walls 108. Alternatively, the deformities 105' may have rounded or curved side walls 109 as schematically shown in Fig. 23.

Fig. 24 shows individual light extracting deformities 110 on a panel surface area 22 each including a planar, sloping triangular shaped reflective/refractive surface 111 and associated planar, generally triangularly shaped side walls or end walls 112. Fig. 25 shows individual light extracting deformities 115 each including a planar sloping reflective/ refractive surface 116 having angled peripheral edge portions 117 and associated angled end and side walls 118 and 119.

Fig. 26 shows individual light extracting deformities 120 which are generally conically shaped, whereas Fig. 27 shows individual light extracting deformities 121 each including a rounded reflective/refractive surface 122 and rounded end wall 123 and rounded or curved side walls 124 all blended together.

Regardless of the particular shape of the reflective/refractive surfaces and end and side walls of the individual deformities, such deformities may also include planar surfaces intersecting the reflective/refractive surfaces and end and/or side walls in parallel spaced relation to the panel surface areas 22. Figs. 28 through 30 show deformities 125, 126 and 127 in the form of individual projections on a panel surface area 22 having representative shapes similar to those shown in Figs. 22, 23 and 26, respectively, except that each deformity is intersected by a planar surface 128 in parallel spaced relation to the panel surface area 22. In like manner, Fig. 31 shows one of a multitude of deformities 129 in the form of individual depressions 130 in a panel surface area 22 each intersected by a planar surface 128 in parallel spaced relation to the general planar surface of the panel surface area 22. Any light rays that impinge on such planar surfaces 128 at internal angles less than the critical angle for emission of light from the panel surface area 22 will be internally reflected by the planar

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surfaces 128, whereas any light rays impinging on such planar surfaces 128 at internal angles greater than the critical angle will be emitted by the planar surfaces with minimal optical discontinuities as schematically shown in Fig. 31.

Where the deformities are projections on the panel surface area 22, the reflective/refractive surfaces extend at an angle away from the panel in a direction generally opposite to that in which the light rays from the light source 3 travel through the panel as schematically shown in Figs. 18 and 20. Where the deformities are depressions in the panel surface area, the reflective/refractive surfaces extend at an angle into the panel in the same general direction in which the light rays from the light source 3 travel through the panel member as schematically shown in Figs. 19 and 21.

Regardless of whether the deformities are projections or depressions on or in the panel surface areas 22, the slopes of the light reflecting/refractive surfaces of the deformities may be varied to cause the light rays impinging thereon to be either refracted out of the light emitting panel or reflected back through the panel and emitted out the opposite side of the panel which may be etched to diffuse the light emitted therefrom or covered by a transparent film, sheet or plate similar to the film 27 shown in Figs. 3 and 5 to produce a desired effect.

Also, the pattern of light extracting deformities on the panel surface areas may be uniform or variable as desired to obtain a desired light output distribution from the panel surface areas. Figs. 32 and 33 show deformities 125 and 126 similar in shape to those shown in Figs. 28 and 29 arranged in a plurality of generally straight uniformly spaced apart rows along the length and width of a panel surface area 22, whereas Figs. 34 and 35 show such deformities 125 and 126 arranged in staggered rows along the length of a panel surface area.

Also, the size, including the width, length and depth or height as well as the angular orientation and position or location of the light extracting deformities may vary along the length and/or width of any given panel surface area to obtain a desired light output distribution from the panel surface area. Figs. 36 and 37 show a random or variable pattern of different sized deformities 105 and 105' similar in shape to those shown in Figs. 22 and 23, respectively, arranged in

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staggered rows on a panel surface area 22, whereas Fig. 38 shows deformities 126 similar in shape to those shown in Fig. 29 increasing in size as the distance of the deformities from the light source increases or intensity of the light decreases along the length and/or width of the panel surface area 22.

Figs. 39 and 40 schematically show different angular orientations of light extracting deformities 135 of any desired shape along the length and width of a panel surface area 22. In Fig. 39 the light extracting deformities 135 are arranged in straight rows 136 along the length of the panel surface area but the deformities in each of the rows are oriented to face the light source 3 so that all of the deformities are substantially in line with the light rays being emitted from the light source. In Fig. 40 the deformities 135 are also oriented to face the light source 3 similar to Fig. 39. In addition, the rows 137 of deformities in Fig. 40 are in substantial radial alignment with the light source.

Figs. 41 and 42 schematically show how exemplary light rays 140 emitted from a focused light source 3 insert molded or cast within a light transition area 6 of a light emitting panel assembly 5 in accordance with this invention are reflected during their travel through the light emitting panel member 7 until they impinge upon individual light extracting deformities 98, 126 of well defined shapes on or in a panel surface area 22 causing more of the light rays to be reflected or refracted out of one side 141 of the panel member than the other side 142. In Fig. 41 the exemplary light rays 140 are shown being reflected by the reflective/refractive surfaces 101 of the deformities 98 in the same general direction out through the same side 141 of the panel member, whereas in Fig. 42 the light rays 140 are shown being scattered in different directions within the panel member 7 by the rounded side walls 109 of the deformities 126 before the light rays are reflected/refracted out of the same side 141 of the panel member. Such a pattern of individual light extracting deformities of well defined shapes in accordance with the present invention can cause 60 to 70% or more of the light received through the input edge 18 of the panel member to be emitted from the same side of the panel member.

Fig. 43 schematically shows the side 141 of the light emitting panel assembly 5 of Fig. 42 from which a majority of the light is emitted placed against

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the front face 143 of a liquid crystal display or other signage 144 for front lighting the display/signage when the ambient light is not sufficient for proper illumination. The portions of the panel member 7 overlying the display/signage 144 are transparent without any back reflector, whereby when the light source 3 is energized, light will be emitted from the side 141 of the panel member 7 contacting the front face 143 of the display/signage 144 and then reflected back out through the panel member 7 including particularly the planar surfaces 128 on the deformities.

By selecting the optical index of refraction of the panel member 7 to closely match the substrate of the display/signage 144, the light reflected by the display/signage will pass through the planar surfaces 128 of the deformities with minimal optical discontinuities for ease of viewing the display/signage. Also, providing a random or variable pattern of light extracting deformities on the panel member insures that the spacing of the light extracting deformities does not match the pixel spacing of the display so as not to produce a headlight effect.

Because the light extracting deformities are of well defined shapes, the size, shape, location and orientation of each light extracting deformity can be individually adjusted or randomly varied at any given surface area of the panel member to spread the light output distribution uniformly across each panel surface area or obtain any other desired light output distribution at each panel surface area. Also, such light extracting deformities may be formed in or on any surface area of the panel member in any desired manner, such as by machining using a milling or laser cutter, or by molding or stamping or the like.

The light source 3 for the panel assemblies shown in Figs. 16, 17 and 39 through 43 may be of any suitable type as previously described. However, preferably such light source is a focused light source such as a lens end bulb, a chip from an LED, or a laser or laser diode. Alternatively such light source may be an LED, incandescent lamp or other light source having an integral collector 145 (see Fig. 16) that collects the light from the light source and focuses the light. In either case the light from the light source is preferably focused in a predetermined pattern on the input surface 146 of the light transition area 6 which directs the light at an acceptable angle for entering the light input edge 18

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of the light emitting panel 7 over a substantial portion of the cross sectional area of the panel.

Fig. 44 schematically illustrates still another form of light emitting panel assembly 150 in accordance with this invention which is particularly adapted to be used for different types of phototherapy treatment by exposing various portions of the skin or eyes of a person to light being emitted from the panel assembly to treat such conditions as neonatal hyperbilirubinemia, insomnia, sleep disorders or tiredness associated with jet lag or shift work, certain types of psychiatric disorders such as seasonal affective disorder (SAD) and depression and so on. To that end, the light emitting panel assembly 150 includes a light emitting panel member 151 which may be in the shape of a pad or blanket. At one or both ends of the panel member 151 are one or more light transition areas 152 containing one or more LEDs or other light sources 3 for uniformly supplying light of any desired wavelength to the panel input edge 154 at one or both ends of the panel member. If desired, the light sources may be different colored LEDs so that the light from the LEDs can be mixed to produce virtually any desired colored light output distribution including white light from the panel member. Also, white LEDs may be used for producing a white light output distribution from the panel member.

On one or more selected panel surface areas on one or both sides of the panel member 151 are a pattern of light extracting deformities or disruptions which are not shown in Fig. 44 but may be of any of the types previously described for producing a desired light output distribution from the panel surface areas. The portion of the body of a person to receive phototherapy treatment may be placed in close association with or directly against the light emitting surface areas of the panel. Alternatively, the panel assembly 150 may be provided with molded portions 155 at strategic locations on the panel member 151 (for example at all four corners) for providing structural support for locating other parts or components such as a diffuser or lens 156 as schematically shown in Fig. 45.

Fig. 46 shows still another form of light emitting panel assembly 160 in accordance with this invention for use in phototherapy treatment or other

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applications in which an array of LEDs or other light sources 3 are mounted on a printed circuit board 162 for directing light through a transparent member 163 which may be a diffuser or lens. The transparent member 163 is maintained in spaced apart relation from the printed circuit board 162 and light sources 3 mounted thereon by a plurality of upstanding supports 164 on a base 165 for the circuit board. Not only does this protect the circuit board 162 and light sources 3 against damage, but also provides an air gap 166 between the light sources 3 and transparent member 163 to facilitate dissipation of any heat that is produced by the light sources.

In Fig. 46 the circuit board 162 and transparent member 163 are shown as being substantially flat. However, it will be appreciated that such circuit board 162 and transparent member 163 may also be curved as schematically shown in Fig. 47 for supporting a body part such as an arm, leg or neck of a person receiving phototherapy treatment.

The various light emitting panel assemblies disclosed herein may be used for a great many different applications including for example liquid crystal display (LCD) or other signage back lighting or lighting in general, decorative and display lighting, automotive lighting, dental lighting, phototherapy or other medical lighting, membrane switch lighting, and sporting goods and apparel lighting or the like. Also the panel assemblies may be made such that the panel members and deformities are transparent without a back reflector. This allows the panel assemblies to be used for example to front light an LCD or other display such that the display is viewed through the transparent panel members in the manner previously described.

The pattern of the various optical deformities disclosed herein may also be varied in size, shape, density, placement, angle, rotation and/or type on or in one or more surface areas of a light emitting panel member to produce a desired light output distribution from the panel member to suit a particular application. By varying the pattern of optical deformities, the light output distribution can be made to be substantially uniform throughout all or a portion of the length of the panel member or variable to increase or decrease the brightness of one or more surface areas of the panel member.

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Also, by varying the pattern of optical deformities, the light output distribution of the panel member can be made to have more complicated features. For example, Figs. 48 and 49 show light emitting panel assemblies 170 of the present invention in which the light output distribution of a specific area or areas of the light emitting panel members 171 may be in the form or shape of text 172, graphics or logo 173 and/or image 174 (hereafter individually or collectively referred to as a design/image 175). The dark and light areas shown in the light emitting regions in Figs. 48 and 49 (as well as those shown in Figs. 50-52) can be interpreted as either the higher light output areas or the lower light output areas. Also, the dark and light areas shown can have either a uniform light output from a given region, or a variable light output throughout the region such as a multi-level output distribution used to create a picture in an output distribution, for example. Moreover, the dark and light regions may have abrupt boundaries or the boundaries may be blended together so that there are no distinct boundaries between regions as desired. Generally any of the dark and light areas of Figs. 48-52 may be interpreted in the above fashion.

The portions 176 of the design/image output distribution 175 that are relatively dark may be formed by surrounding the outline of the relatively dark portions with a suitable pattern of the optical deformities, whereas the portions 177 of the design/image output distribution 175 that are relatively bright (*e.g.*, light) are shaped by placing a suitable pattern of the optical deformities in the shape of such relatively bright portions. Any desired variations in or uniformity of the intensity of the light output distribution of any portion of the design/image 175 may be obtained by varying the size, shape, density, placement, angle, rotation and/or type of the optical deformities.

The panel members may be lighted from one or more ends or sides by optically coupling one or more light sources to one or more input edges of the panel member. Panel members 171 of Figs. 48 and 49 are shown being lighted by two light sources 3 optically coupled to input edges 180 and 181 adjacent each end of the panel members. However, it will be appreciated that any number and type of light sources may be used to light the panel members depending on the particular application.

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The optical deformities may also be shaped or oriented to extract light propagating through the panel members preferentially in one direction over another. This allows different sets of optical deformities to be used to extract light in different preferred directions to construct any desired form or shape of design/image output distribution.

Different colored light sources may also be optically coupled to different input edges of the panel members so that the different sets of optical deformities will cause a preferred color of light to be emitted from the panel members. In this way, multi-colored output distributions can be created to suit a particular application. For example, if different colored light sources are optically coupled to the input edges 180 and 181 at opposite ends of the panel members 171, different sets of optical deformities may be shaped or oriented to extract light propagating through the panel members preferentially in one direction over another for causing the different colored light received by the different input edges to create a design/image output distribution that is multi-colored. In addition, by mixing the different sets of optical deformities within a given area, the light source colors may be mixed to produce colors in the output distribution that are different from the light source colors.

The size of the design/image output distribution in relation to another light output distribution or distributions of the panel members may be varied as desired depending on the particular application. For example, Figs. 48 and 49 show a design/image output distribution 175 that is relatively large in relation to another light output distribution 185 of the panel members, whereas Fig. 50 shows a design/image output distribution 175 that is relatively small in relation to another light output distribution 185 of the panel member.

Making the design/image relatively small will permit the design/image output distribution to be placed wherever desired in another output distribution of the panel member (which may, for example, be uniform) to create a watermark, logo, security marking, label or other effect in the other output distribution. For example, the panel member 171 of Fig. 50 may be used to backlight a display 186 such as a liquid crystal display of an optical assembly 190 as shown in Fig. 51. If the design/image output distribution 175 of the panel member 171 is

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placed in a corner of the panel member as shown in Fig. 50, the design/image will be viewable in a corner of the display 86 as shown in Fig. 51 to create, for example, a "corporate presence" on the display without obscuring images or other data being displayed on the display.

An optical assembly may also be comprised of multiple light emitting panel members overlying one another, each having a different light output distribution or color that produces one or more portions or parts of a more complicated light output distribution or an image with more than one dimension. One such optical assembly 191 is schematically shown in Fig. 52, and includes two (or more) light emitting panel members 171, each having a different light output distribution 192, 193 that produces a portion of the total design/image output distribution 194 that can be seen when viewed through both panel members or through a display 195 overlying the panel members. The term display as used herein may include, for example, one or more liquid crystal displays, optical films, diffusers, touch pads, and/or transparent or semi-transparent overlays or covers and the like.

The intensity of the light output distribution of each of the panel members 171 may be different to create a multi-intensity composite light output distribution when viewed through the panel members or the display. Also, since each of the panel members may have its own light source or light sources 3, different colored light sources may be used for each panel member to produce a different colored light output distribution for each panel member which when viewed through both panel members or a display overlying the panel members will produce a multi-colored composite light output distribution 194.

One or more transparent brightness enhancement films, light management films, diffuser films, color filters or other films 196 may also be attached or positioned in close proximity to the side or sides of the panel members from which the emitted light is viewed to produce a desired effect. For example, the films 196 may be light redirecting films or light management films having optical deformities that redistribute the light passing through the films such that the distribution of light exiting the films is directed more normal to the surface of the films. Also the films 196 may be color filters or diffusers having for example prismatic or lenticular deformities on or in the films that allow different

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light output distributions to be seen when the panel members are viewed through the films (and the display) from different angles. Other optical deformities 197 such as prismatic or lenticular optical deformities may also be provided on the side of the panel member or members 171 opposite the side on which the pattern of optical deformities is provided as further schematically shown in Fig. 52 to allow different light output distributions to be seen when the panel member or members are viewed through the other optical deformities from different angles.

Although the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of the specification. In particular, with regard to the various functions performed by the above-described components, the terms (including any reference to a "means") used to describe such components are intended to correspond, unless otherwise indicated, to any component which performs the specified function of the described component (*e.g.*, that is functionally equivalent), even though not structurally equivalent to the disclosed component which performs the function of the invention. In addition, while a particular feature of the invention may have been disclosed with respect to only one of several embodiments, such feature may be combined with one or more other features of the other embodiments as may be desired and advantageous for any given or particular application.

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WHAT IS CLAIMED IS:

1. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least one light source, and at least one pattern of individual optical deformities on or in at least one surface area of the panel member for producing at least one light output distribution from the panel member, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member, at least some of the deformities having at least one well defined surface, the at least one light output distribution having a form or shape of at least one of text, graphics, logo or image.

2. The assembly of claim 1 wherein the at least one output distribution has the form of at least one of text, graphics, logo or image.

3. The assembly of claim 1 wherein the at least one output distribution has the shape of at least one of text, graphics or logo.

4. The assembly of claim 1 wherein the at least one light output distribution is located in another light output distribution of the panel member to create a watermark, security marking, label or other effect in the another output distribution.

5. The assembly of claim 1 wherein the optical deformities of the at least one pattern are varied in at least one of the following characteristics: size, shape, density, placement, angle, rotation or type.

6. The assembly of claim 5 wherein the optical deformities of the at least one pattern are varied to obtain a substantially uniform intensity of the at least one output distribution.

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7. The assembly of claim 5 wherein the optical deformities of the at least one pattern are varied to obtain at least one multi-intensity output distribution.

8. The assembly of claim 1 wherein the at least one light source is a colored light source to obtain at least one colored output distribution.

9. The assembly of claim 1 wherein the at least one panel member has at least two input edges for receiving light from at least two light sources to obtain the at least one output distribution.

10. The assembly of claim 9 wherein the at least two input edges receive light from different colored light sources, and at least some of the deformities are shaped or oriented preferentially to cause the different colored light received by the different input edges to create at least one multi-colored output distribution.

11. The assembly of claim 1 further comprising another pattern of individual optical deformities on or in another surface area of the at least one panel member for producing another light output distribution from the panel member.

12. The assembly of claim 11 wherein the another output distribution is substantially larger than the one output distribution.

13. The assembly of claim 11 wherein the one output distribution is located on the another output distribution to create a watermark, security marking, label or other effect on the another output distribution.

14. The assembly of claim 11 wherein the deformities on or in the another surface area are varied in at least one of the following characteristics: size, shape, density, placement, angle, rotation or type.

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15. The assembly of claim 14 wherein the deformities on or in the another surface area are varied to obtain the another output distribution that is substantially uniform.

16. The assembly of claim 14 wherein the deformities on or in the another surface area are varied to obtain the another output distribution that is non-uniform.

17. The assembly of claim 11 wherein the intensity of the one output distribution is greater than the intensity of the another output distribution.

18. The assembly of claim 11 wherein the intensity of the one output distribution is less than the intensity of the another output distribution.

19. The assembly of claim 11 wherein the intensity of the one output distribution varies.

20. The assembly of claim 1 wherein a plurality of the panel members are in overlying relation to one another, each of the panel members having at least one different light output distribution that together produce at least one composite output distribution when viewed through the panel members.

21. The assembly of claim 1 further comprising at least one other light emitting panel member having a different light output distribution than the one panel member, the panel members producing at least one composite output distribution when placed in overlying relation to one another and viewed through the panel members.

22. The assembly of claim 20 wherein the other panel member has at least one output distribution in the form or shape of at least one of text, graphics, logo or image.

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23. The assembly of claim 21 wherein each of the panel members receives light from at least one different colored light source to produce at least one multi-colored composite output distribution when viewed through the panel members.

24. The assembly of claim 21 wherein the output distribution of each of the panel members produces one or more parts of a more complex output distribution that is visible through the panel members.

25. The assembly of claim 21 wherein the intensity of at least one output distribution of each of the panel members is different and creates at least one multi-intensity composite output distribution that is visible through the panel members.

26. The assembly of claim 21 further comprising a display overlying the panel members, the output distributions of the panel members being visible through the display.

27. The assembly of claim 26 wherein the display is a liquid crystal display.

28. The assembly of claim 21 further comprising at least one light redirecting film between the display and one of the panel members that allows different light output distributions to be seen when the panel members are viewed through the display from different angles.

29. The assembly of claim 1 further comprising a display overlying the panel member, the at least one output distribution of the panel member being visible through the display.

30. The assembly of claim 29 further comprising at least one light redirecting film between the panel member and the display that allows different

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light output distributions to be seen when the panel member is viewed through the display from different angles.

31. The assembly of claim 1 further comprising at least one light redirecting film in close proximity to the at least one panel member that allows different light output distributions to be seen when the panel member is viewed through the film from different angles.

32. The assembly of claim 31 wherein the at least one film is a prismatic or lenticular brightness enhancing film or light management film.

33. The assembly of claim 1 wherein the optical deformities of the at least one pattern are on or in one side of the at least one panel member, and additional optical deformities are on or in the opposite side of the at least one panel member that allow different output distributions to be seen when the at lest one panel member is viewed from different angles through the opposite side.

34. The assembly of claim 33 wherein the additional optical deformities are prismatic or lenticular optical deformities.

35. The assembly of claim 33 wherein the additional optical deformities allow different output distributions in the form or shape of text, graphics, logo or image to be seen when the panel member is viewed from different angles through the opposite side.

36. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least one light source, and at least one pattern of individual optical deformities on or in at least one surface area of the panel member for producing at least one light output distribution from the panel member, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member, at least some of the deformities having at least one sloping surface that

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intersects the at least one surface area, the at least one light output distribution having a form or shape of at least one of text, graphics, logo or image.

37. The assembly of claim 36 wherein the at least one light output distribution is located in another light output distribution of the panel member to create a watermark, security marking, label or other effect in the another output distribution.

38. The assembly of claim 36 wherein the optical deformities of the at least one pattern are varied in at least one of the following characteristics: size, shape, density, placement, angle, rotation or type.

39. The assembly of claim 36 wherein the at least one sloping surface is planar.

40. The assembly of claim 36 wherein the at least one sloping surface is curved.

41. The assembly of claim 36 wherein the at least one panel member has top and bottom surfaces, and the at least one pattern of individual optical deformities is on or in the top surface of the at least one panel member.

42. The assembly of claim 36 wherein the at least one panel member has top and bottom surfaces, and the at least one pattern of individual optical deformities is on or in the bottom surface of the at least one panel member.

43. The assembly of claim 36 wherein the at least one panel member comprises two or more layers.

44. The assembly of claim 36 wherein the at least one panel member receives light from at least two different colored light sources.

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45. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least two different colored light sources, and at least one pattern of individual optical deformities on or in at least one surface area of the panel member for producing at least one light output distribution from the panel member, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member, the at least one light output distribution having a form or shape of at least one of text, graphics, logo or image.

46. The assembly of claim 45 wherein the different colored light sources are different colored light emitting diodes.

47. The assembly of claim 45 wherein the different colored light sources are light emitting diodes having different colored chips.

48. The assembly of claim 45 wherein the different colored light sources are flashed to produce a desired colored light output distribution.

49. The assembly of claim 45 wherein the at least one panel member has at least two input edges for receiving light from the at least two different colored light sources to obtain the at least one output distribution.

50. The assembly of claim 49 wherein different ones of the deformities are shaped or oriented preferentially to cause the different colored light received by the different input edges to create at least one multi-colored output distribution.

51. The assembly of claim 45 wherein the at least one light output distribution is located in another light output distribution of the panel member to create a watermark, security marking, label or other effect in the another output distribution.

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52. The assembly of claim 45 wherein the optical deformities of the at least one pattern are on or in one side of the panel member, and additional optical deformities are on or in the opposite side of the panel member to allow different output distributions to be seen when viewed through the opposite side from different angles.

53. The assembly of claim 52 wherein the additional optical deformities are prismatic or lenticular optical deformities.

54. The assembly of claim 45 further comprising at least one light redirecting film in close proximity to the at least one panel member to allow different output distributions to be seen when the at least one panel member is viewed through the at least one film from different angles.

55. The assembly of claim 54 wherein the at least one film is a prismatic or lenticular brightness enhancing film or light management film.

56. The assembly of claim 45 further comprising a display overlying the at least one panel member, the at least one output distribution being visible through the display.

57. The assembly of claim 56 wherein the display is a liquid crystal display.

58. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least one light source, at least one pattern of individual optical deformities on or in at least one surface area of the panel member for producing at least one light output distribution from the panel member, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member, the at least one light output distribution having a form or shape of at least one of text, graphics, logo or image, and another pattern of individual optical deformities

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on or in another surface area of the at least one panel member for producing another light output distribution from the panel member.

59. The assembly of claim 58 wherein the another output distribution is substantially larger than the one output distribution.

60. The assembly of claim 58 wherein the one output distribution is located on the another output distribution to create a watermark, security marking, label or other effect on the another output distribution.

61. The assembly of claim 58 wherein the deformities on or in the another surface area are varied in at least one of the following characteristics: size, shape, density, placement, angle, rotation or type.

62. The assembly of claim 61 wherein the deformities on or in the another surface area are varied to obtain the another output distribution that is substantially uniform.

63. The assembly of claim 61 wherein the deformities on or in the another surface area are varied to obtain the another output distribution that is non-uniform.

64. The assembly of claim 58 wherein the intensity of the one output distribution is greater than the intensity of the another output distribution.

65. The assembly of claim 58 wherein the intensity of the one output distribution is less than the intensity of the another output distribution.

66. The assembly of claim 58 wherein the intensity of the one output distribution varies.

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67. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least one light source, at least one pattern of individual optical deformities on or in at least one surface area of the panel member for producing at least one light output distribution from the panel member, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member, the at least one light output distribution having a form or shape of at least one of text, graphics, logo or image, and at least one other light emitting panel member having at least one light output distribution, the panel members producing at least one composite output distribution when placed in overlying relation to one another and viewed through the panel members.

68. The assembly of claim 67 wherein the output distribution of each of the panel members is different.

69. The assembly of claim 67 wherein the at least one output distribution of the other panel member is in the form or shape of at least one of text, graphics, logo or image.

70. The assembly of claim 67 wherein each of the panel members receives light from at least one different colored light source to produce at least one multi-colored composite output distribution when viewed through the panel members.

71. The assembly of claim 67 wherein the output distribution of each of the panel members produces one or more parts of a more complex output distribution that is visible through the panel members.

72. The assembly of claim 67 wherein the intensity of at least one output distribution of each of the panel members is different and creates at least one multi-intensity composite output distribution that is visible through the panel members.

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73. The assembly of claim 67 further comprising a display overlying the panel members, the output distributions of the panel members being visible through the display.

74. The assembly of claim 73 wherein the display is a liquid crystal display.

75. The assembly of claim 73 further comprising at least one light redirecting film between the display and one of the panel members that allows different light output distributions to be seen when the panel members are viewed through the display from different angles.

76. An optical assembly comprising at least one light emitting panel member having at least one input edge for receiving light from at least one light source, at least one pattern of individual optical deformities on or in one side of the panel member for producing at least one light output distribution from the panel member having a form or shape of at least one of text, graphics, logo or image, and another pattern of individual optical deformities on or in the opposite side of the at least one panel member for producing another light output distribution from the panel member having another form or shape of at least one of text, graphics, logo or image, each of the deformities having a length and width that is quite small in relation to the length and width of the panel member.

77. The assembly of claim 76 wherein the one output distribution and the another output distribution produce at least one composite light output distribution when viewed through the panel member.

78. The assembly of claim 76 wherein the one output distribution and the another output distribution produce two separate and distinct output distributions when viewed through the panel member.

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79. The assembly of claim 76 wherein the one output distribution and the another output distribution are separately viewable through the panel member from different angles.

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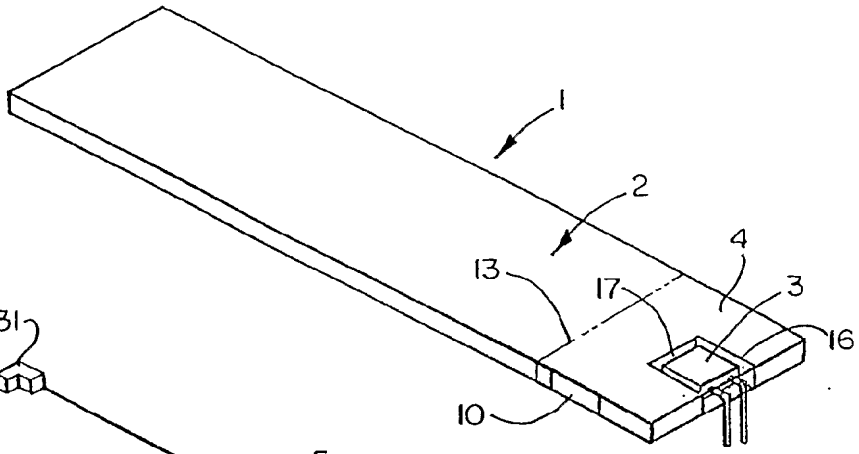


FIG. 1

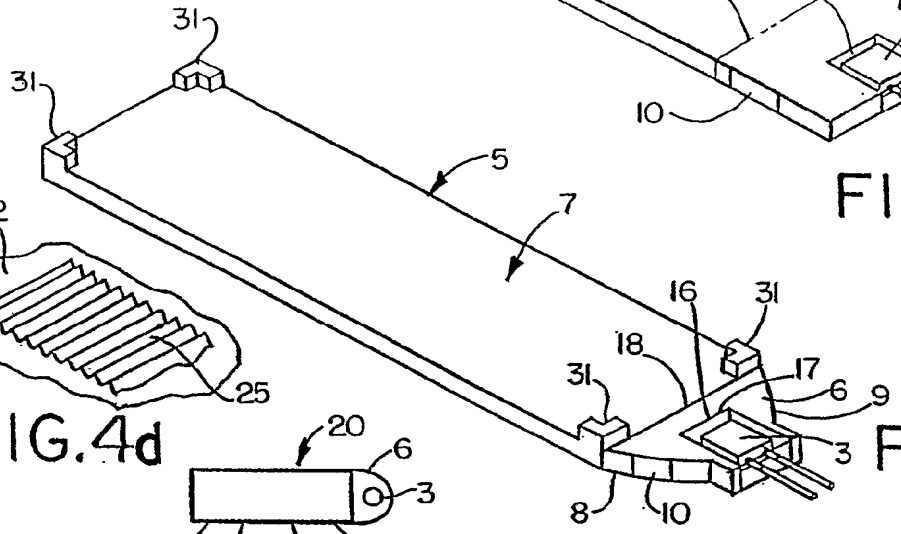


FIG. 2

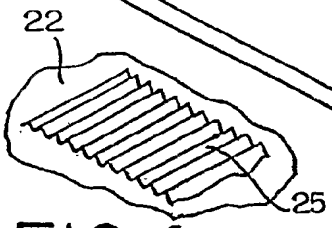


FIG.4d

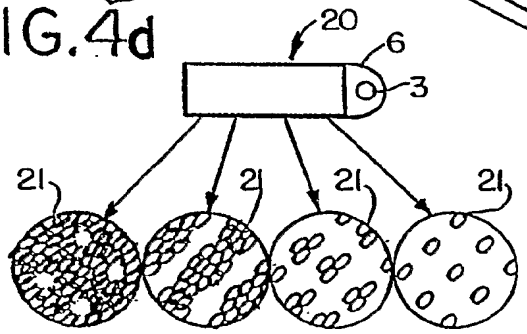


FIG. 4a

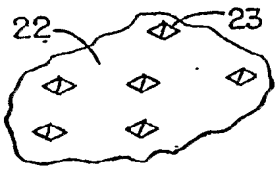


FIG. 4b

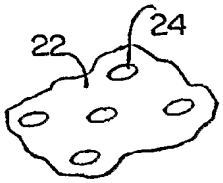


FIG. 4c

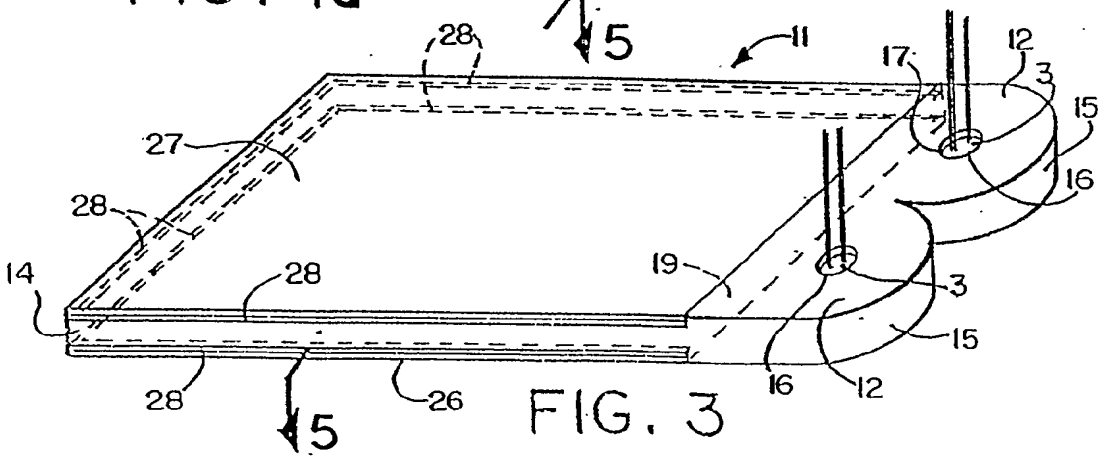


FIG. 3

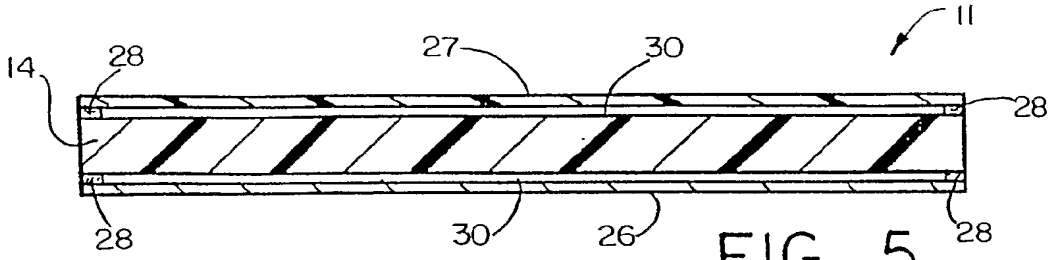


FIG. 5

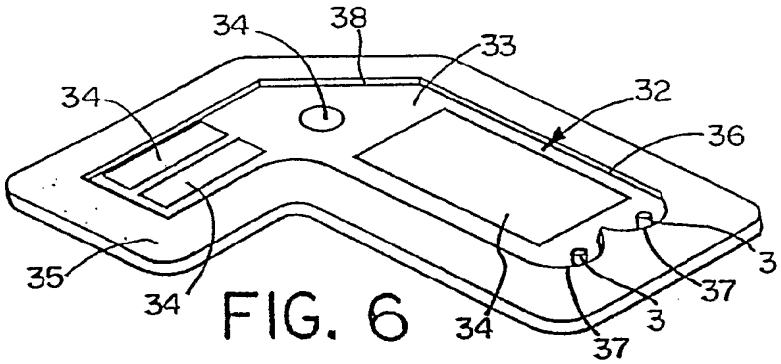


FIG. 6

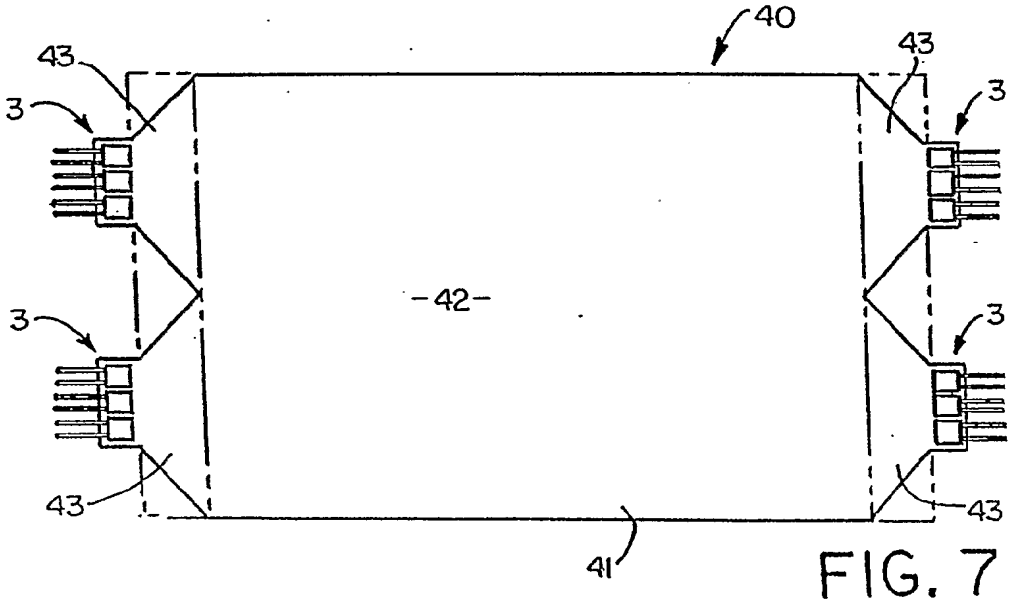


FIG. 7

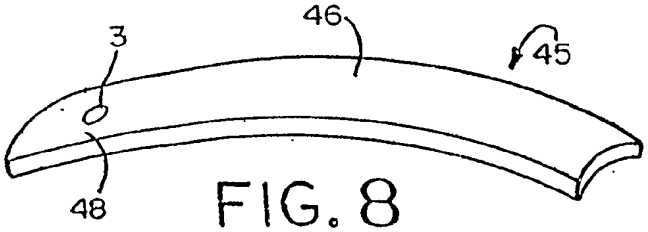


FIG. 8

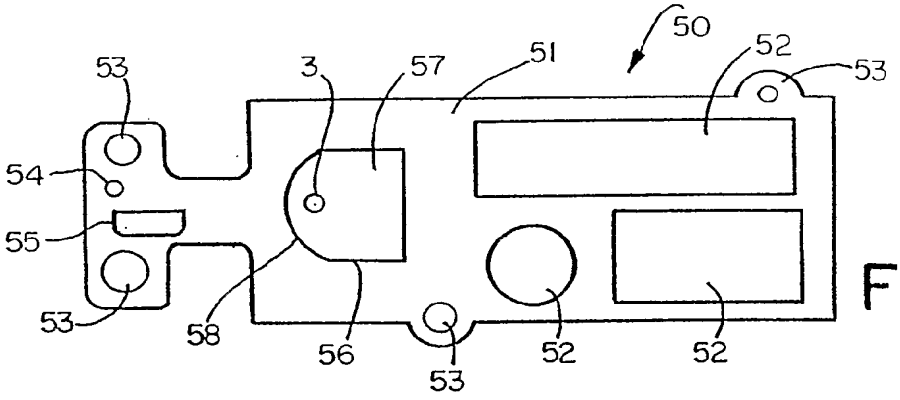


FIG. 9

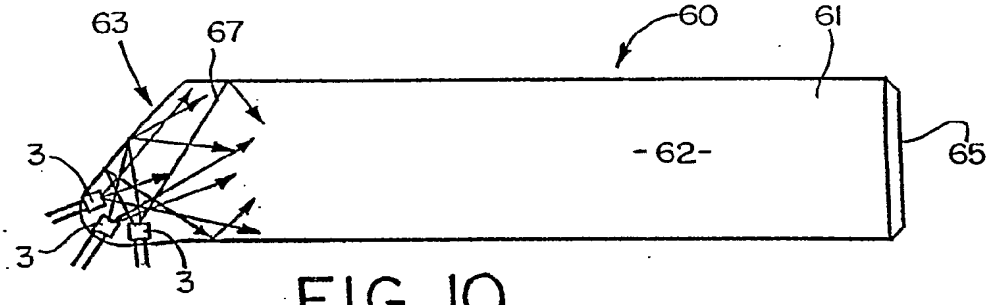


FIG. 10

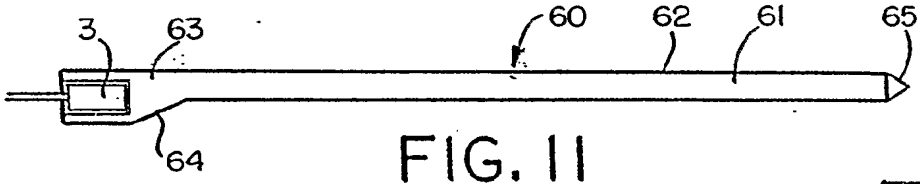


FIG. 11

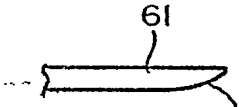


FIG. 11a

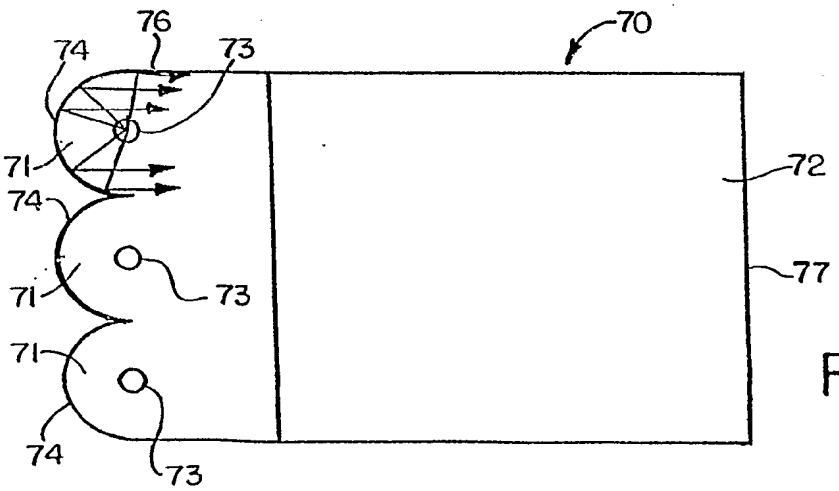


FIG. 12

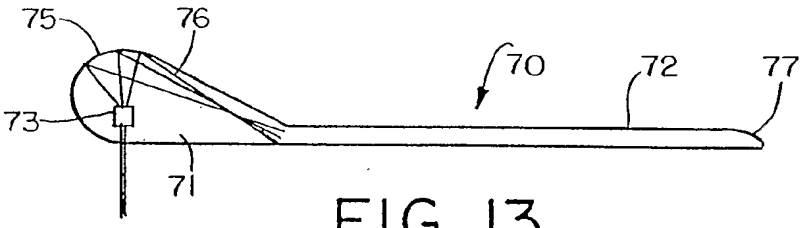


FIG. 13

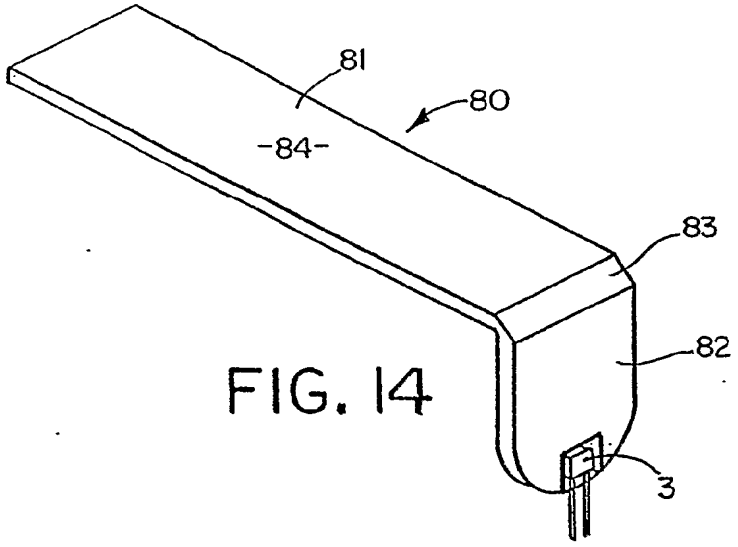


FIG. 14

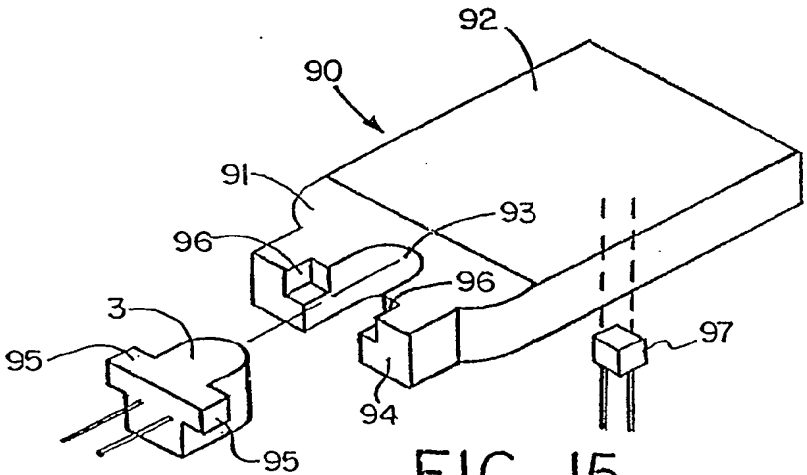


FIG. 15

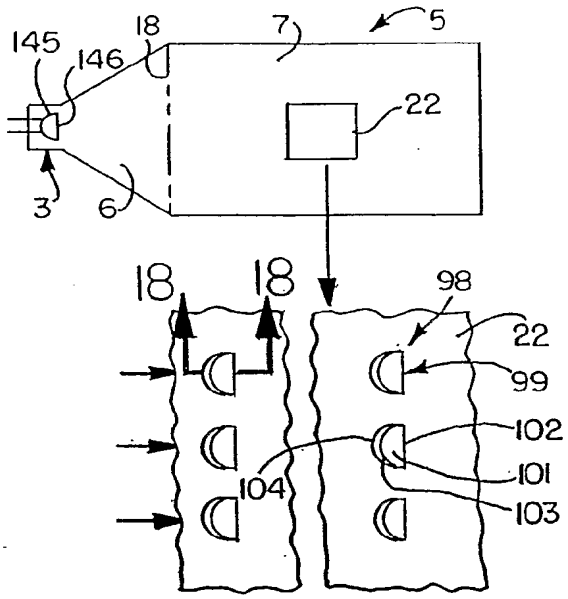


FIG. 16

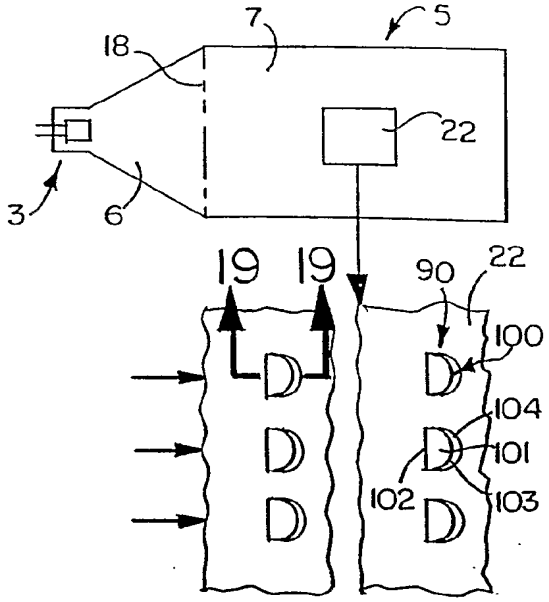


FIG. 17

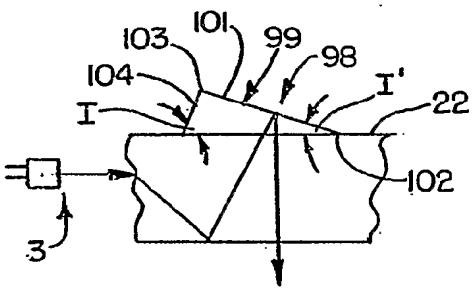


FIG. 18

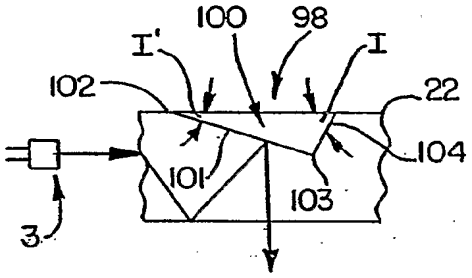


FIG. 19

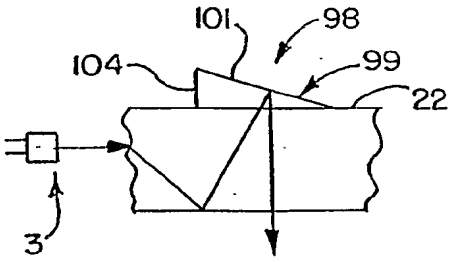


FIG. 20

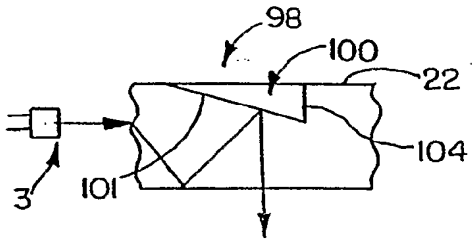


FIG. 21

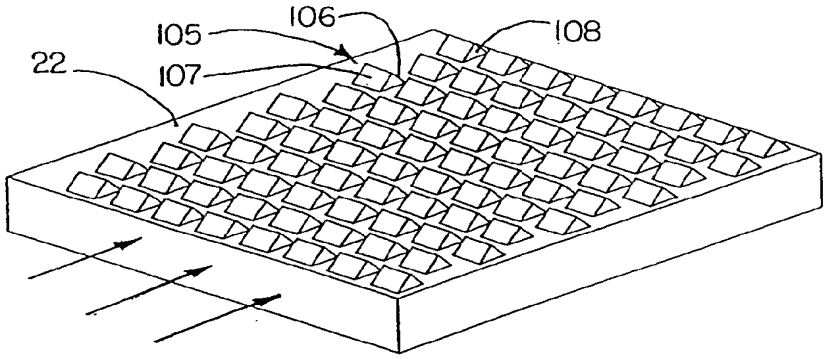


FIG. 22

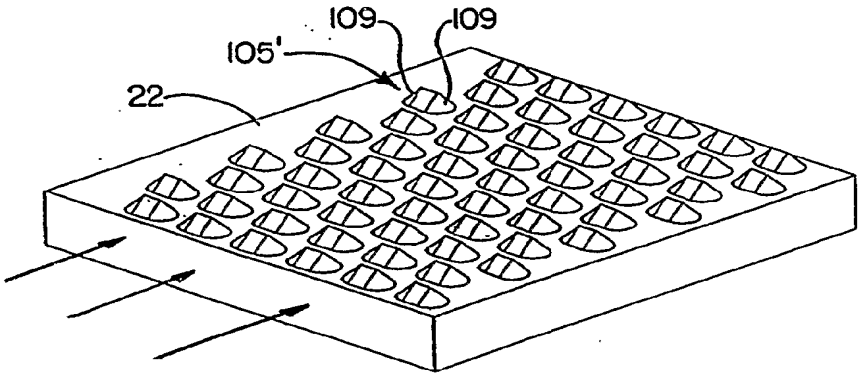


FIG. 23

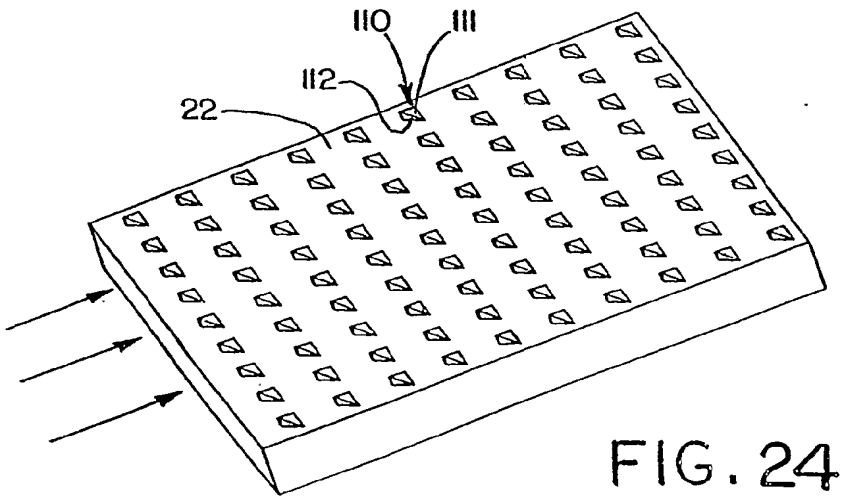


FIG. 24

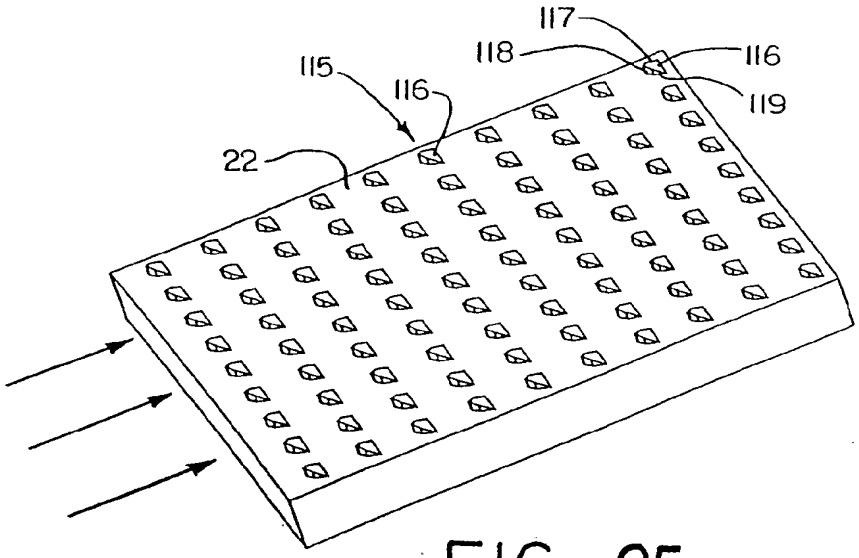


FIG. 25

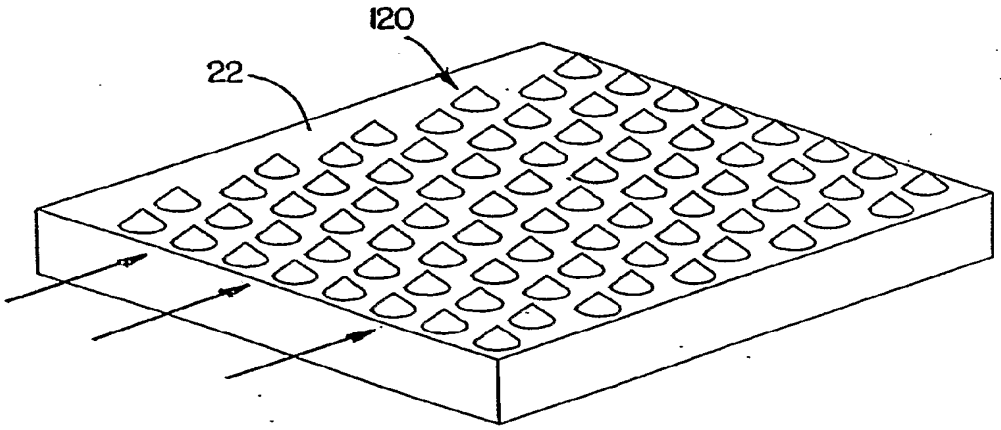


FIG. 26

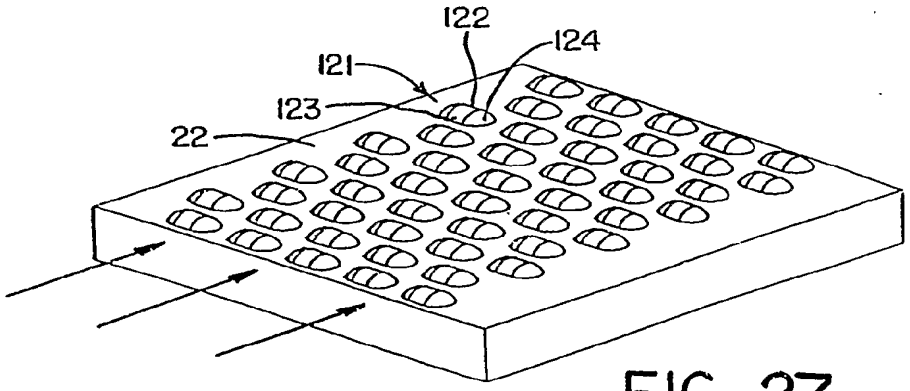


FIG. 27

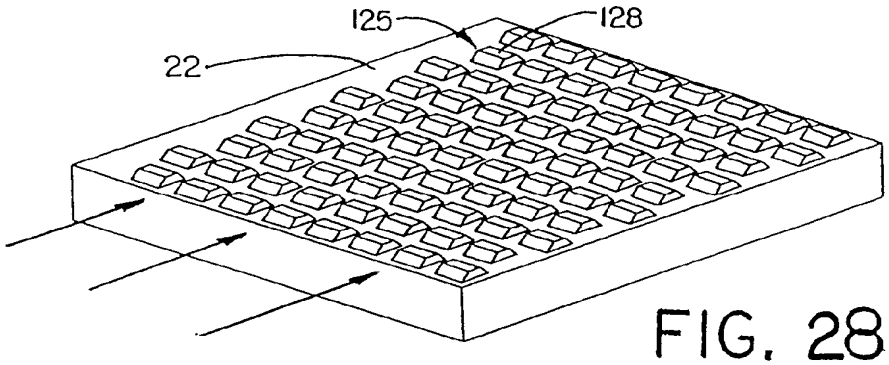


FIG. 28

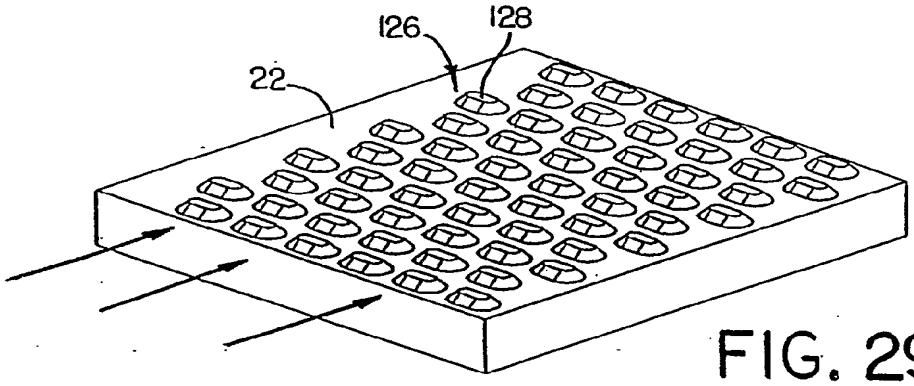


FIG. 29

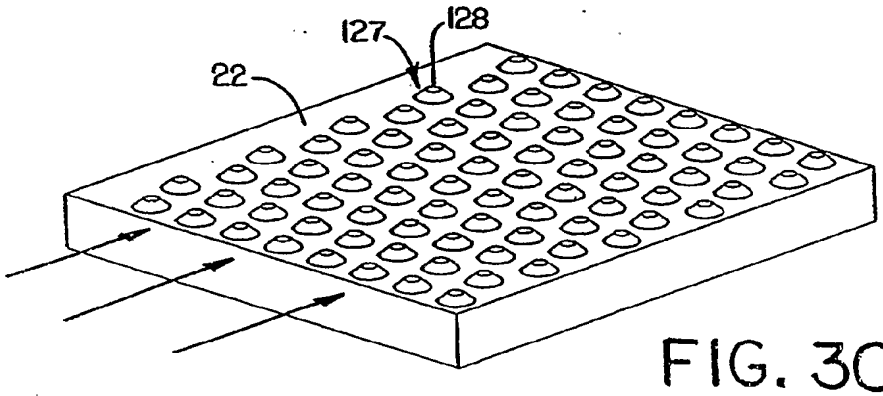


FIG. 30

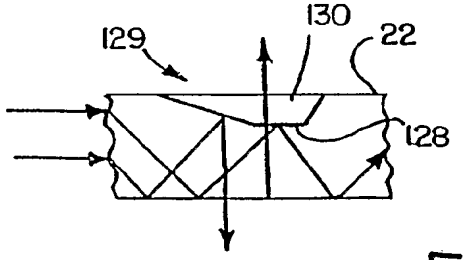


FIG. 31

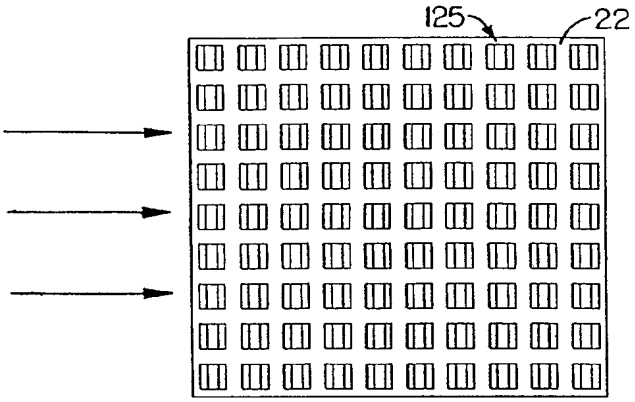


FIG. 32

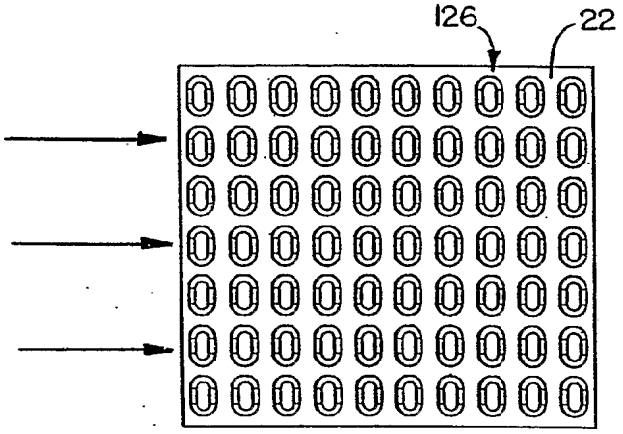


FIG. 33

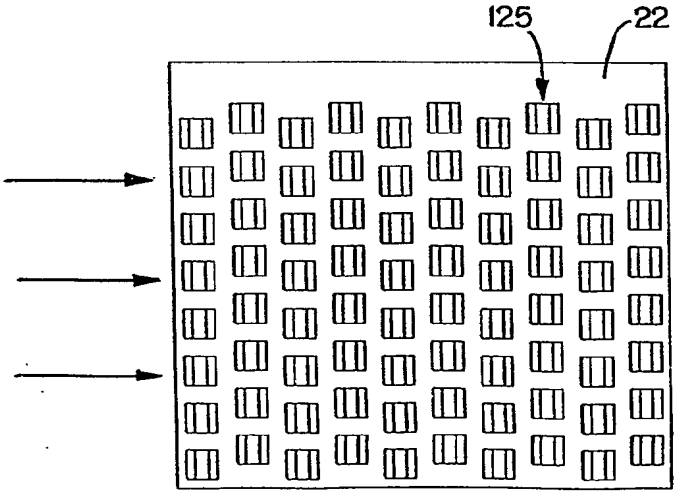
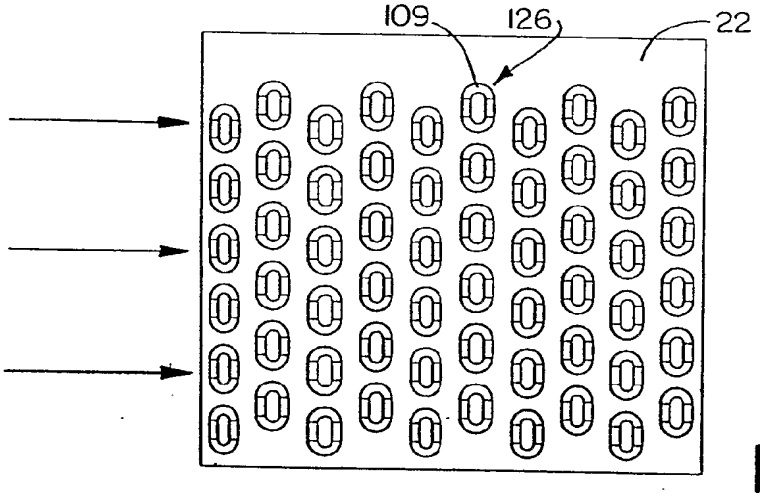


FIG. 34



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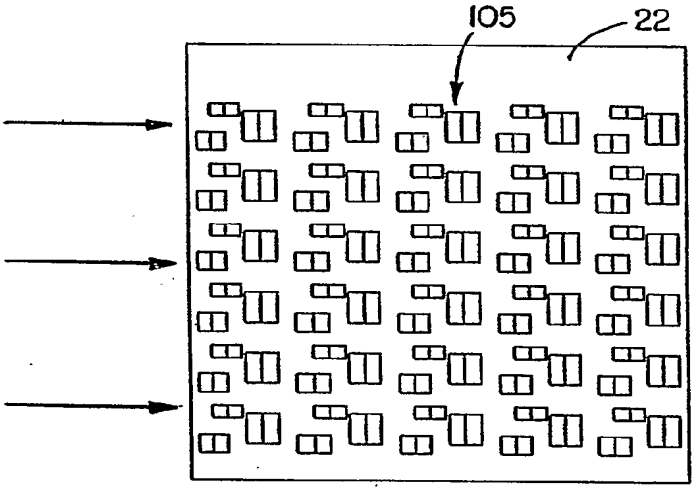
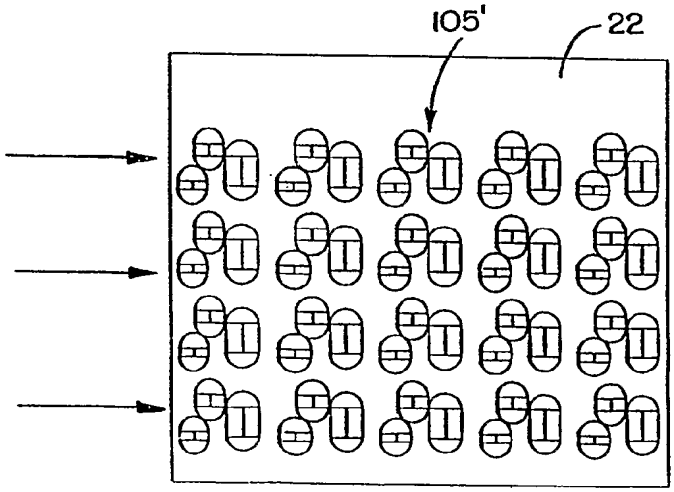


FIG. 36



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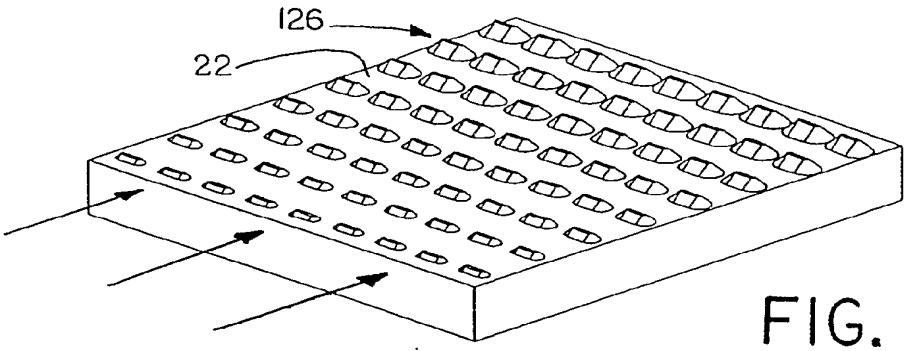

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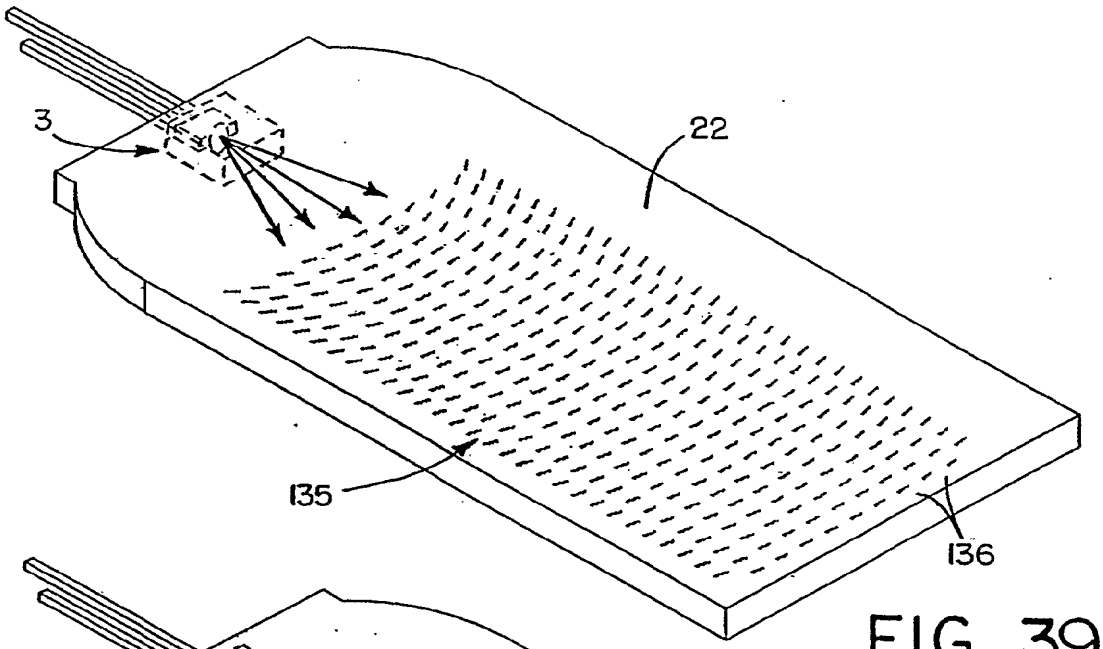


FIG. 39

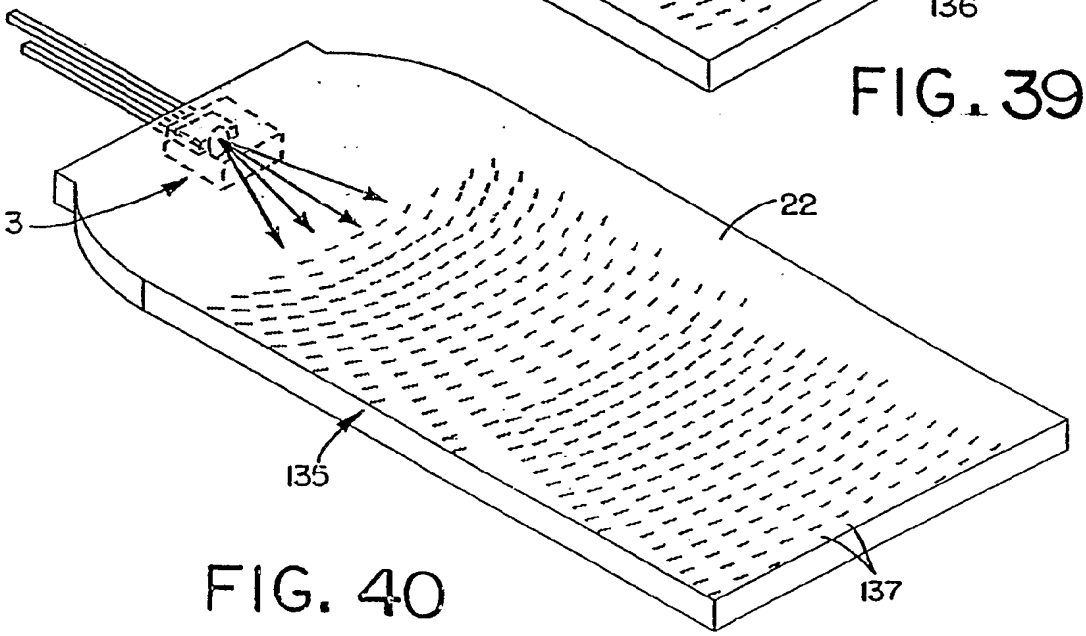


FIG. 40

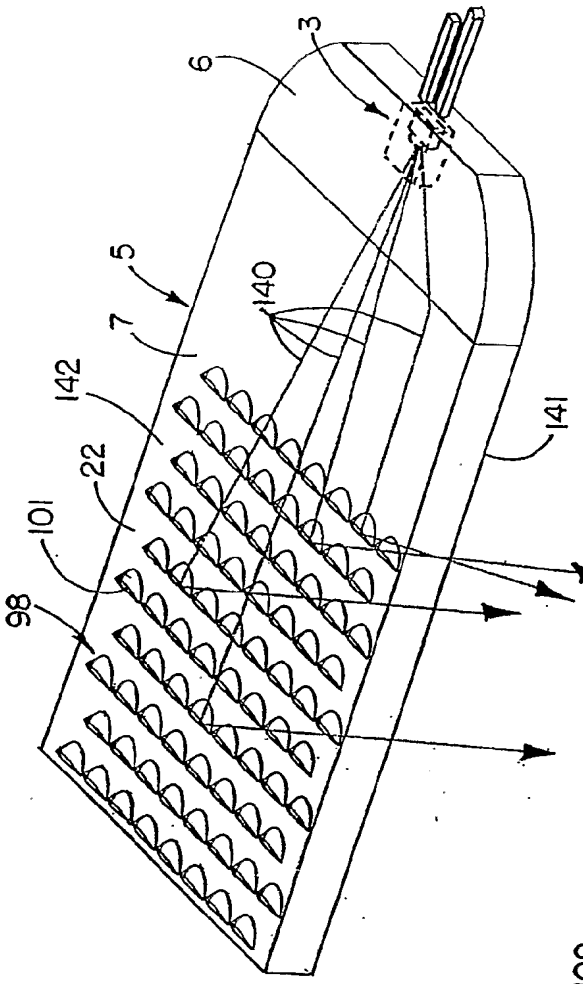
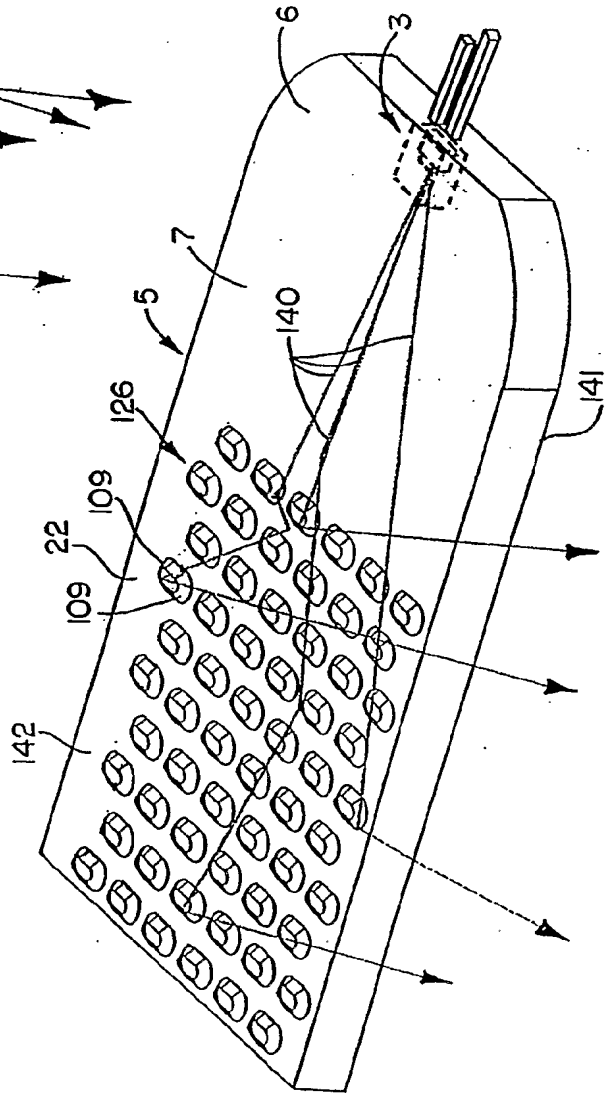


FIG. 41



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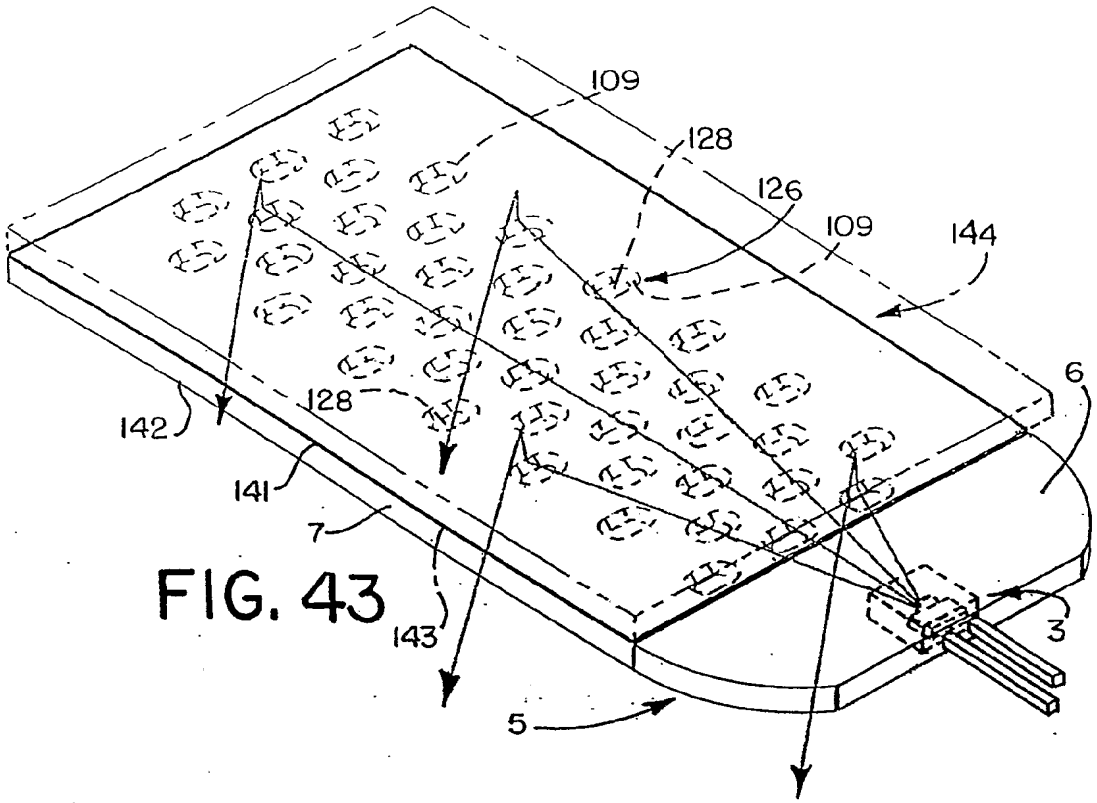

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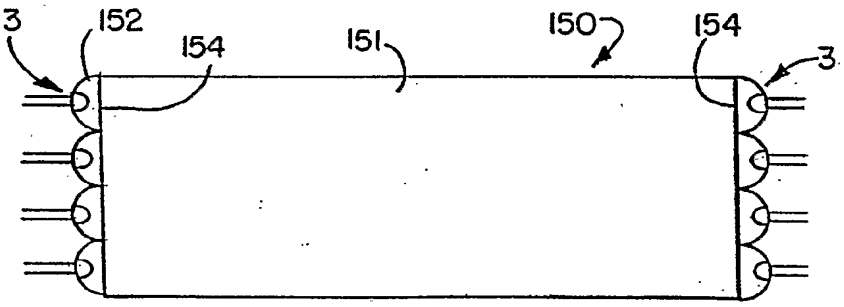
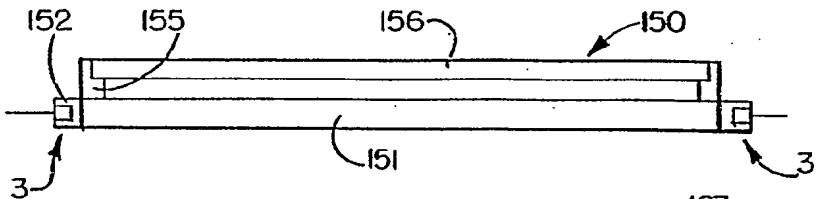


FIG. 44



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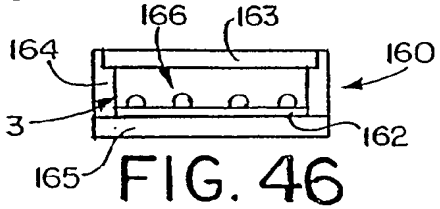
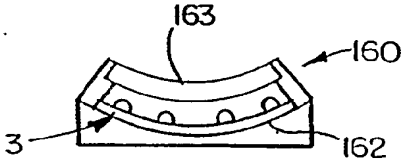


FIG. 46



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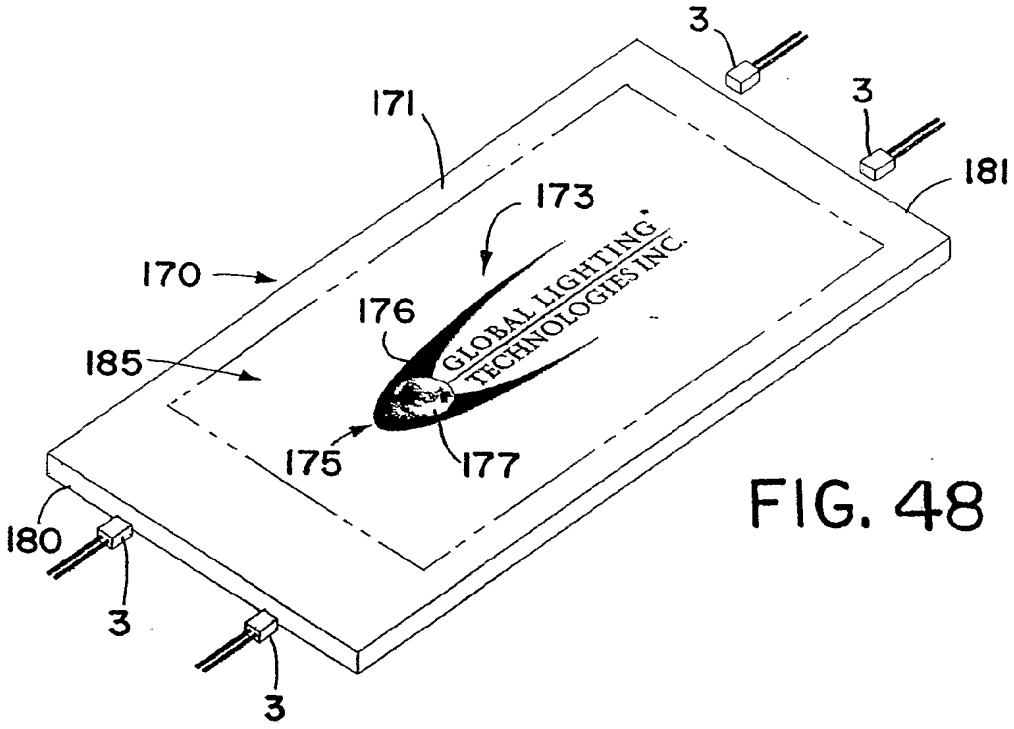
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GLOBAL LIGHTING TECHNOLOGIES INC.
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FIG. 48

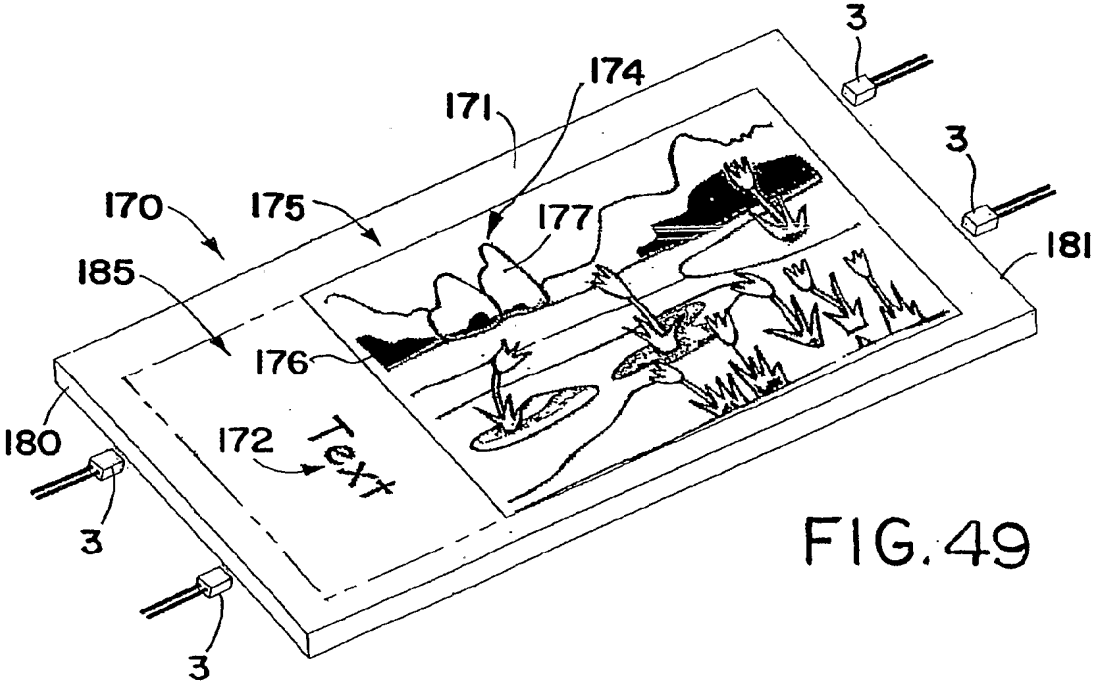
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FIG. 49

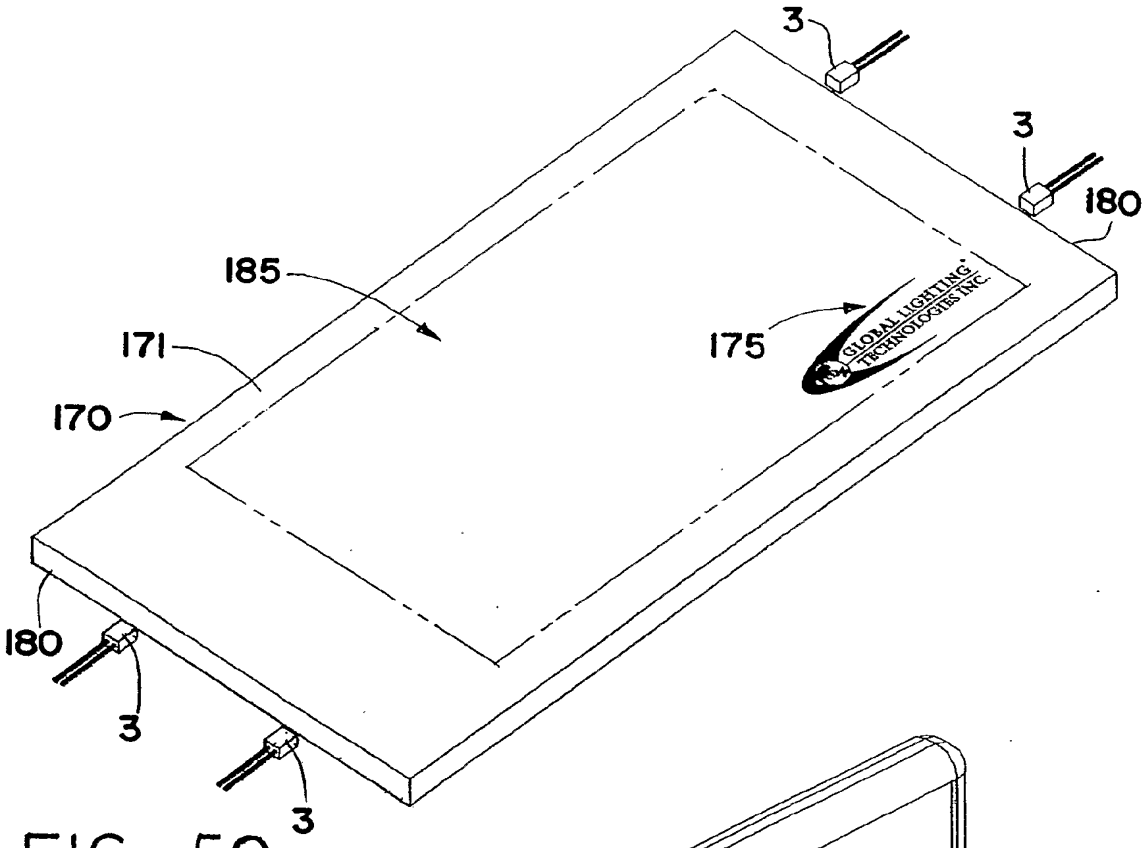
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FIG. 50

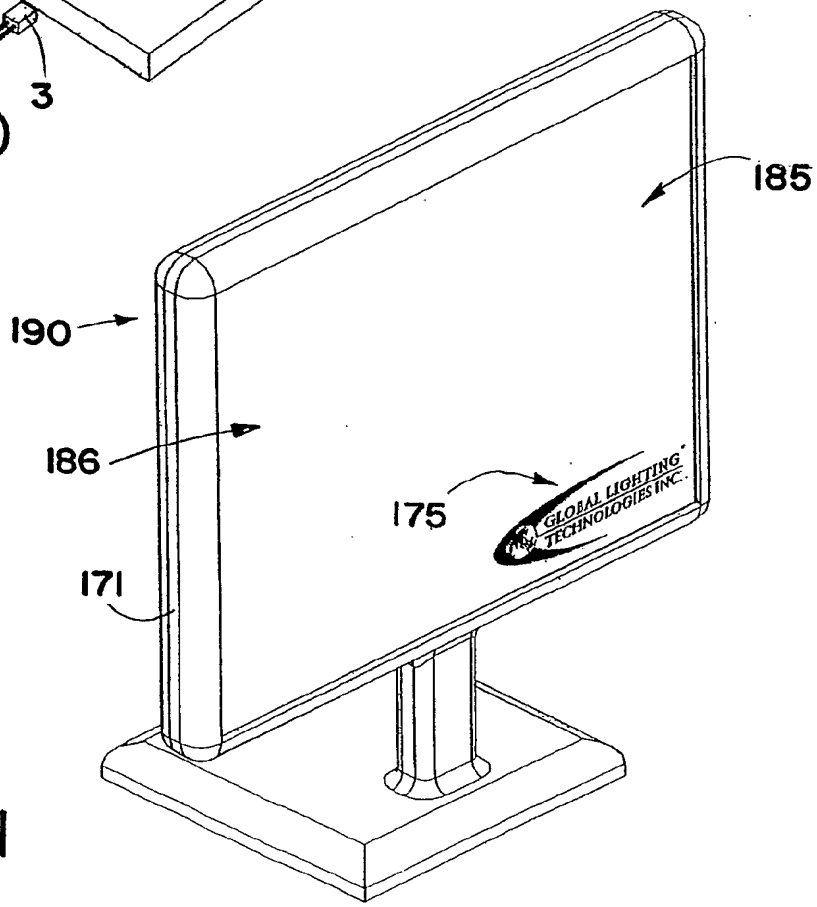
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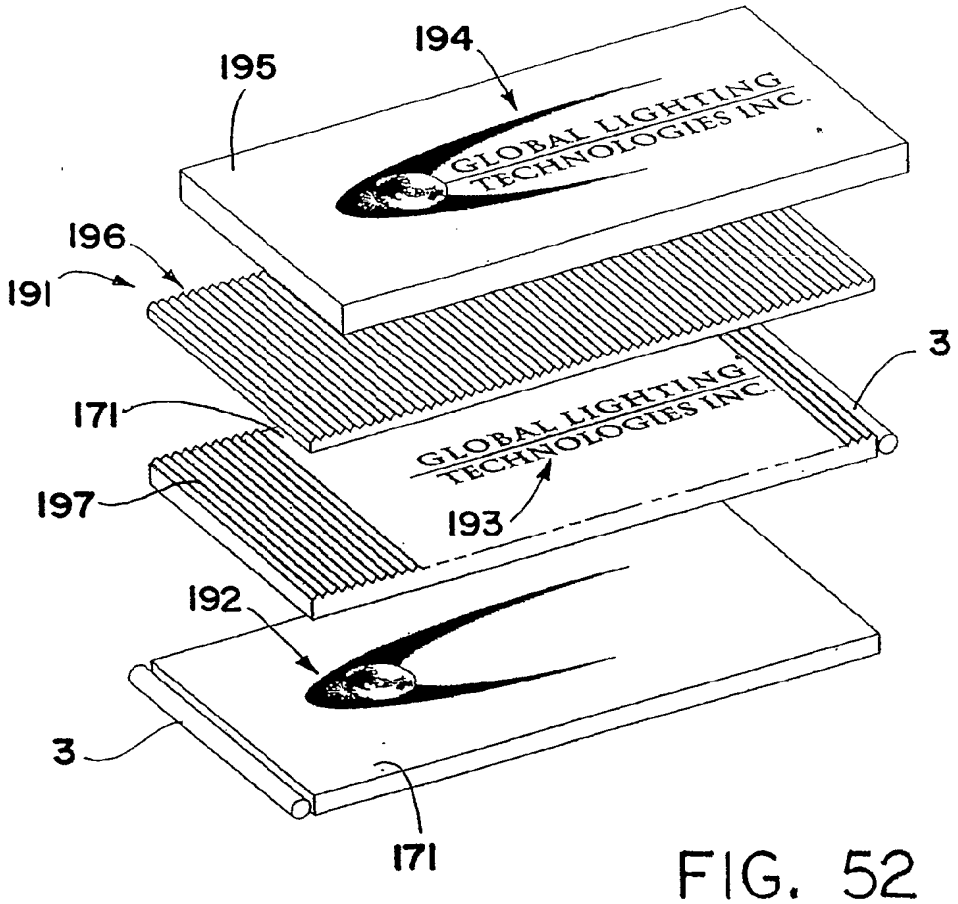
FIG. 51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GLOBAL LIGHTING TECHNOLOGIES INC.
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GLOBAL LIGHTING TECHNOLOGIES INC.
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FIG. 52

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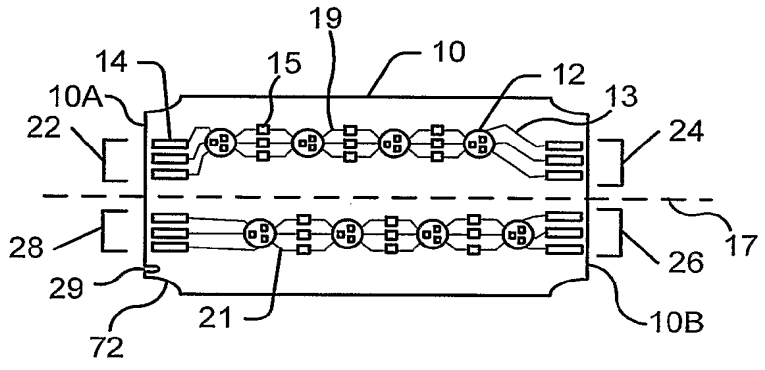
(54) Title: TILES FOR SOLID STATE LIGHTING



(57) Abstract: A solid state lighting tile (10) includes a substrate having a planar surface. A first plurality of solid state light emitting devices (LEDs) are on the substrate. The first plurality of LEDs (19) are connected in series to form a first string of LEDs of a first color having an anode contact (22) at a first end of the tile and a cathode contact (24) at a second end of the tile. A second plurality of LEDs are on the substrate. The second plurality of LEDs (21) are connected in series to form a second string of LEDs of the first color having a cathode contact (28) at the first end of the tile and an anode contact (26) at the second end of the tile.

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TILE FOR SOLID STATE LIGHTING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of and priority to U. S. Provisional Patent Application No. 60/738,305 entitled "SYSTEM AND METHOD FOR INTERCONNECTION AND INTEGRATION OF LED BACKLIGHTING MODULES" filed November 18, 2005, and U. S. Provisional Patent Application No. 60/749,133 entitled " SOLID STATE BACKLIGHTING UNIT ASSEMBLY AND METHODS" filed December 9, 2005, the disclosures of which are hereby incorporated herein by reference as if set forth in their entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to solid state lighting, and more particularly to components for solid state lighting units.

BACKGROUND

[0003] Solid state lighting panels may be used as solid state backlight units for displays, as lighting panels for general illumination, as backlights for signage, and/or for other purposes. Solid state backlighting units for LCD displays typically include a two dimensional array of discrete light sources arranged behind an LCD screen. The discrete light sources may generate light having a white or near-white color that may be used to illuminate an LCD display, such as a full-color LCD display. In order for the LCD display to display an image on the screen having uniform color and/or intensity, it may be desirable for the backlight unit to provide a light to the LCD screen that is spatially uniform, both in color and intensity. This may be difficult, however, as the discrete light sources may be spaced apart from each other in the backlight unit. In particular, as the brightness of solid state light sources increases, it may be desirable to arrange the light sources with a larger and larger pitch between sources, for example, in order to reduce heat dissipation and/or to increase the efficiency of the display.

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[0004] Similar problems relating to color uniformity, efficiency and/or heat dissipation may arise when solid state lighting units including arrays of solid state light emitting devices are used for general illumination.

SUMMARY

[0005] A solid state lighting tile according to some embodiments of the invention includes a substrate having a planar surface. A first plurality of solid state light emitting devices (LEDs) are on the substrate. The first plurality of LEDs are connected in series to form a first string of LEDs of a first color having an anode contact at a first end of the tile and a cathode contact at a second end of the tile. A second plurality of LEDs are on the substrate. The second plurality of LEDs are connected in series to form a second string of LEDs of the first color having a cathode contact at the first end of the tile and an anode contact at the second end of the tile.

[0006] The solid state lighting tile may further include a loopback connector that electrically connects the cathode contact of the first string to the anode contact of the second string so that the first string and the second string form a single string having an anode contact and a cathode contact on the first end of the tile.

[0007] The solid state light emitting devices may include solid state light emitting diodes arranged in a plurality of clusters. Each cluster may include solid state light emitting diodes configured to emit at least two different colors. A respective one of the clusters may include a substrate and a plurality of LED chips mounted on the substrate. In some embodiments, a respective one of the clusters may include a plurality of LED chips mounted on respective traces on the substrate and an encapsulant material on the plurality of LED chips. The substrate may include an FR-4 printed circuit board (PCB) and/or a metal core PCB.

[0008] The solid state lighting tile may further include a plurality of first strings of series-connected LEDs, the first strings having respective anode contacts at a first end of the tile and cathode contacts at a second end of the tile opposite the first end, and a plurality of second strings of series-connected LEDs, the second strings having respective anode contacts at the second end of the tile and cathode contacts at the first end of the tile. At least one of the

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first strings and at least one of the second strings may include electrical test pads between a pair of adjacent LEDs.

[0009] Each of the plurality of first strings and the plurality of second strings may include at least a first color string of LEDs configured to emit light having a first wavelength when energized, and a second color string of LEDs configured to emit light having a second wavelength when energized.

[0010] The tile may have a longitudinal center axis, and the first plurality of strings and the second plurality of strings may run generally parallel to the longitudinal center axis. The anode and cathode contacts of the first color string of the first plurality of strings and the anode and cathode contacts of the first color string of the second plurality of strings may be disposed nearer to the longitudinal center axis of the tile than the anode and cathode contacts of the second color string of the first plurality of strings and the anode and cathode contacts of second color string of the second plurality of strings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate certain embodiment(s) of the invention. In the drawings:

[0012] Figure 1 is a plan view illustration of a tile for a solid state lighting unit according to some embodiments of the invention.

[0013] Figure 2 is a plan view illustration of a solid state light source for a solid state lighting unit according to some embodiments of the invention.

[0014] Figure 3 is a circuit diagram illustrating the electrical interconnection of light sources on a tile according to some embodiments of the invention.

[0015] Figure 4 is a plan view illustration of a tile including a loopback connector according to some embodiments of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0016] Embodiments of the present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which

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embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

[0017] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of the present invention. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0018] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises," "comprising," "includes," and/or "including" when used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0019] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms used herein should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0020] It will be understood that when an element such as a layer, region or substrate is referred to as being "on" or extending "onto" another element, it can be directly on or extend directly onto the other element or intervening elements may also be present. In contrast, when an element is

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referred to as being "directly on" or extending "directly onto" another element, there are no intervening elements present. It will also be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present.

[0021] Relative terms such as "below" or "above" or "upper" or "lower" or "horizontal" or "vertical" may be used herein to describe a relationship of one element, layer or region to another element, layer or region as illustrated in the figures. It will be understood that these terms are intended to encompass different orientations of the device in addition to the orientation depicted in the figures.

[0022] Referring now to Figure 1, a solid state lighting tile 10 for use in a solid state lighting unit may include thereon a number of solid state lighting element clusters 12 arranged in a regular and/or irregular two dimensional array. The tile 10 may include, for example, a printed circuit board (PCB) on which one or more circuit elements may be mounted. In particular, a tile 10 may include a metal core PCB (MCPCB) including a metal core having thereon a polymer coating on which patterned metal traces 13 may be formed. MCPCB material, and material similar thereto, is commercially available from, for example, The Bergquist Company. The PCB may further include heavy clad (4 oz. copper or more) and/or conventional FR-4 PCB material with thermal vias. MCPCB material may provide improved thermal performance compared to conventional PCB material. However, MCPCB material may also be heavier than conventional PCB material, which may not include a metal core.

[0023] In the embodiments illustrated in Figure 1, the lighting element clusters 12 are multi-chip clusters of three solid state emitting devices per cluster. In the tile 10, four lighting element clusters 12 are serially arranged in a first path 19, while four lighting element clusters 12 are serially arranged in a second path 21. The lighting element clusters 12 of the first path 19 are connected, for example via electrical traces 13, to a set of three anode contacts 22 arranged at a first end 10A of the tile 10, and a set of three

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cathode contacts 24 arranged at a second end 10B of the tile 10. The lighting element clusters 12 of the second path 21 are connected to a set of three anode contacts 26 arranged at the second end 10B of the tile 10, and a set of three cathode contacts 28 arranged at the first end 10A of the tile 10. The tile 10 may further include electrical test pads 15 between the lighting element clusters 12. The electrical test pads 15 are configured to permit individual testing of the light emitting devices of the lighting element clusters 12.

[0024] An alignment notch 29 may be provided in the tile 10 to assist connection of an edge connector (not shown) and also to prevent incorrect installation of the edge connector. Furthermore, notches 33 may be provided in the corners of the tiles 10 to avoid contact between the tile 10 and screws of a support member (not shown) on which the tile 10 is mounted. The tile 10 may further include one or more automation indexing holes (not shown) that may be used to move the tile 10 during automated manufacturing steps.

[0025] The solid state lighting element clusters 12 may include, for example, organic and/or inorganic light emitting devices. An example of a solid state lighting element cluster 12 for high power illumination applications is illustrated in Figure 2. A solid state lighting element cluster 12 may include a packaged discrete electronic component including a carrier substrate 13 on which a plurality of LED chips 16 are mounted. In other embodiments, one or more solid state lighting element clusters 12 may include LED chips 16 mounted directly onto electrical traces on the surface of the tile 10, forming a multi-chip module or chip-on-board assembly.

[0026] The LED chips 16 may include at least a red LED 16R, a green LED 16G and a blue LED 16B. The blue and/or green LEDs may include InGaN-based blue and/or green LED chips available from Cree, Inc., the assignee of the present invention. The red LEDs may be, for example, AlInGaP LED chips available from Epistar, Osram and others. The lighting device 12 may include an additional green LED in order to make more green light available.

[0027] In some embodiments, the LEDs 16 may have a square or rectangular periphery with an edge length of about 900 μm or greater (i.e. so-called "power chips." However, in other embodiments, the LED chips 16 may

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have an edge length of 500 μm or less (i.e. so-called "small chips"). In particular, small LED chips may operate with better electrical conversion efficiency than power chips. For example, green LED chips with a maximum edge dimension less than 500 microns, and as small as 260 microns, commonly have a higher electrical conversion efficiency than 900 micron chips, and are known to typically produce 55 lumens of luminous flux per Watt of dissipated electrical power and as much as 90 lumens of luminous flux per Watt of dissipated electrical power.

[0028] As further illustrated in Figure 2, the LEDs 16 may be covered by an encapsulant dome 14, which may be clear and/or may include light scattering particles, phosphors, and/or other elements to achieve a desired emission pattern, color and/or intensity. The encapsulant dome 14, which may include a curable epoxy resin, may provide mechanical and/or environmental protection for the LEDs 16. While not illustrated in Figure 2, the lighting element cluster 12 may further include a reflector cup surrounding the LEDs 16, a lens mounted above the LEDs 16, one or more heat sinks for removing heat from the lighting device, an electrostatic discharge protection chip, and/or other elements.

[0029] The LED chips 16 of the lighting element clusters 12 in the tile 10 may be electrically interconnected as shown in the schematic circuit diagram in Figure 3. As shown therein, the LEDs 16 may be interconnected such that the blue LEDs 16B in the first path 19 are connected in series to form a string 30B. Likewise, the green LEDs 16G in the first path 19 may be arranged in series to form a string 30G. The red LEDs 16R may be arranged in series to form a string 30R. Each string 30R, 30G, 30B may be connected to a respective anode contact 22R, 22G, 22B arranged at a first end of the tile 10 and a cathode contact 24 arranged at the second end of the tile 10, respectively.

[0030] A string 30R, 30G, 30B may include all, or less than all, of the corresponding LEDs in the first path 19. For example, the string 30B may include all of the blue LEDs 16B from all of the lighting element clusters 12 in the first path 19. Alternatively, a string 30R, 30G, 30B may include only a subset of the corresponding LEDs in the first path 19. Accordingly the first

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path 19 may include three strings 30R, 30G, 30B arranged in parallel on the tile 10.

[0031] The second path 21 on the tile 10 may include three strings 31R, 31G, 31B arranged in parallel. The strings 31R, 31G, 31B are connected to anode contacts 26R, 26G, 26B, which are arranged at the second end of the tile 10 and to cathode contacts 28R, 28G, 28B, which are arranged at the first end of the tile 10, respectively.

[0032] The first group of strings 30R, 30G, 30B have anode contacts 22R, 22G and 22B generally adjacent a first end 10A of the tile 10 and cathode contacts 24R, 24G, 24B generally adjacent a second end 10B of the tile 10. The second group of strings 31R, 31G, 31B have anode contacts 26R, 26G and 26B generally adjacent the second end 10B of the tile 10 and cathode contacts 28R, 28G, 28B generally adjacent the first end 10A of the tile 10.

[0033] As shown in Figures 1 and 3, The tile 10 may have a longitudinal center axis 17, and the first group of strings 30R, 30G, 30B and the second group of strings 31R, 31G, 31B may run generally parallel to the longitudinal center axis 17.

[0034] The anode and cathode contacts of a first color string of the first group of strings and the anode and cathode contacts of the first color string of the second group of strings may be disposed nearer to the longitudinal center axis 17 of the tile 10 than the anode and cathode contacts of the second and/or third color strings of the first and second groups of strings. For example, the anode and cathode contacts 22B, 24B, 26B, 28B of the blue strings 30B and 31B may be disposed closer to the longitudinal center axis 17 than the anode and cathode contacts 22G, 24G, 26G, 28G of the green strings 30G and 31G. Likewise, the anode and cathode contacts 22G, 24G, 26G, 28G of the green strings 30G and 31G may be disposed closer to the longitudinal center axis 17 than the anode and cathode contacts 22R, 24R, 26R, 28R of the red strings 30R and 31R.

[0035] The cathode contact of a first color string of the first group of strings and the anode contact of the first color string of the second group of strings may be offset in a direction parallel to the longitudinal center axis 17 of the tile 10 from the cathode contact of a second color string of the first group

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of strings and the anode contact of the second color string of the second group of strings. In particular, the cathode contact of the first color string of the first group of strings and the anode contact of the first color string of the second group of strings may be farther from an end 10A, 10B of the tile 10 than the cathode contact of the second color string of the first group of strings and the anode contact of the second color string of the second group of strings.

[0036] For example as shown in Figure 3, the cathode contact 24B of the blue string 30B and the anode contact 26B of the blue string 31B may be disposed farther from the end 10B of the tile 10 than the cathode contact 24G of the green string 30G and the anode contact 26G of the green string 31G. Staggering the contacts from the end 10B of the tile 10 may facilitate connecting the contacts of the respective strings, for example to form a loopback connector using wire loops.

[0037] It will be appreciated that, while the embodiments illustrated in Figures 1-3 include three LED chips 16 per cluster 12 which are electrically connected to form at least three strings of LEDs 16 per path 19, 21, more and/or fewer than three LED chips 16 may be provided per lighting device 12, and more and/or fewer than three LED strings may be provided per path 19, 21 on the tile 10. For example, a cluster 12 may include two green LED chips 16G, in which case the LEDs may be connected to form four strings per path 19, 21. Likewise, in some embodiments including two green LED chips per cluster 12, the two green LED chips in a cluster 12 may be connected in series to one another, in which case there may only be a single string of green LED chips per path 19, 21. Further, a tile 10 may include only a single path 19 instead of plural paths 19, 21 and/or more than two paths 19, 21 may be provided on a single tile 10.

[0038] Referring to Figures 1, 3 and 4, the cathode contacts 24 of the first path 19 of the tile 10 may be electrically connected to the anode contacts 26 of the second path 21 of the tile 10 by a loopback connector 35. For example, the loopback connector 35 may electrically connect the cathode 24R of the string 30R of red LED chips 16R of the first path 19 of the tile 10 with the anode 26R of the string 31R of red LED chips of the second path 21 of the tile 10. In this manner, the string 29R of the first path 19 may be connected in

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series with the string 31R of the second path 21 by a conductor 35R of the loopback connector 35 to form a single string of red LED chips 16R. The other strings of the paths 19, 21 of the tile 10 may be connected in a similar manner.

[0039] The loopback connector 35 may include an edge connector, a flexible wiring board, or any other suitable connector. In addition, the loop connector may include printed traces and/or wire loops formed on/in the tile 10.

[0040] In the drawings and specification, there have been disclosed typical embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

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WHAT IS CLAIMED IS:

1. A solid state lighting tile, comprising:

a substrate having a planar surface;

a first plurality of solid state light emitting devices (LEDs) on the substrate, wherein the first plurality of LEDs are connected in series to form a first string of LEDs of a first color, the first string having an anode contact at a first end of the tile and a cathode contact at a second end of the tile; and

a second plurality of LEDs on the substrate, the second plurality of LEDs connected in series to form a second string of LEDs of the first color, the second string having a cathode contact at the first end of the tile and an anode contact at the second end of the tile.

2. The solid state lighting tile of Claim 1, further comprising a loopback connector that electrically connects the cathode contact of the first string to the anode contact of the second string so that the first string and the second string form a single string having an anode contact and a cathode contact on the first end of the tile.

3. The solid state lighting tile of Claim 1, wherein the solid state light emitting devices comprise solid state light emitting diodes arranged in a plurality of clusters.

4. The solid state lighting tile of Claim 3, wherein each cluster comprises solid state light emitting diodes configured to emit at least two different colors.

5. The solid state lighting tile of Claim 3, wherein a respective one of the clusters comprises a substrate and a plurality of LED chips mounted on the substrate.

6. The solid state lighting tile of Claim 3, wherein a respective one of the clusters comprises a plurality of LED chips mounted on respective traces on the substrate and an encapsulant material on the plurality of LED chips.

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7. The solid state lighting tile of Claim 1, wherein the substrate comprises an FR-4 printed circuit board (PCB) and/or a metal core PCB.

8. A solid state lighting tile, comprising:

a substrate having a planar surface, a first end, and a second end opposite the first end;

a plurality of first strings of series-connected LEDs on the surface of the substrate, the first strings having respective anode contacts at the first end of the tile and cathode contacts at the second end of the tile; and

a plurality of second strings of series-connected LEDs, the second strings having respective anode contacts at the second end of the tile and cathode contacts at the first end of the tile.

9. The solid state lighting tile of Claim 8, wherein at least one of the first strings and at least one of the second strings comprises electrical test pads between a pair of adjacent LEDs.

10. The solid state lighting tile of Claim 8, wherein each of the plurality of first strings and the plurality of second strings includes at least a first color string of LEDs configured to emit light having a first wavelength when energized, and a second color string of LEDs configured to emit light having a second wavelength when energized.

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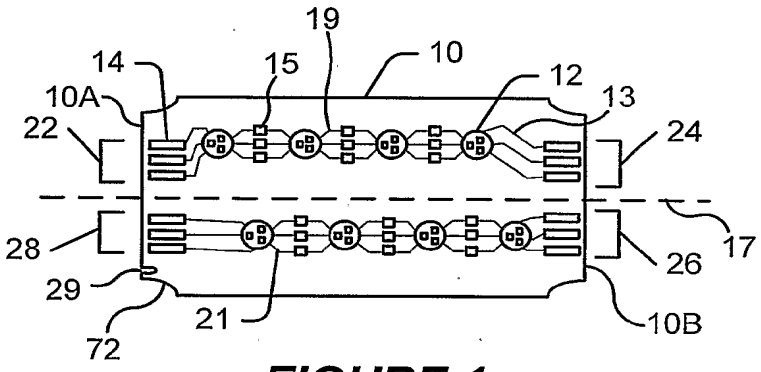

FIGURE 1

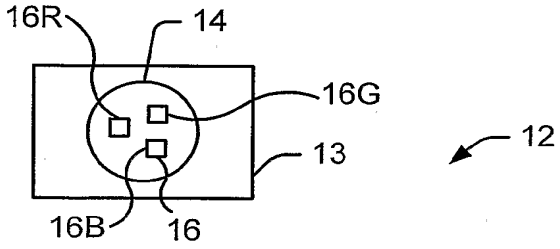

FIGURE 2

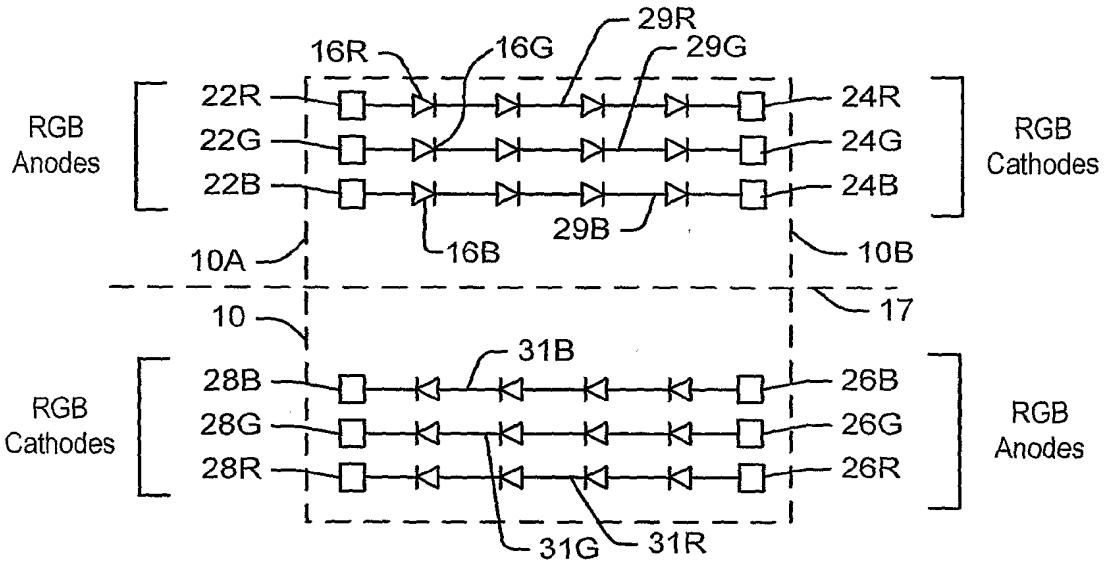

FIGURE 3

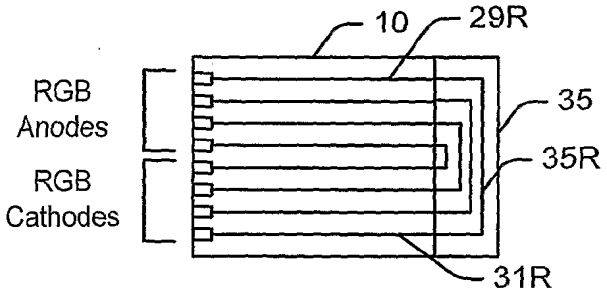

FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/044519

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21K7/00 H01L25/075 H01L25/13 H05B33/08
ADD. F21Y101/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F21K H01L H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 426 381 A1 (BOURBOULON HENRI [FR]) 14 December 1979 (1979-12-14)	1,2,7-9
Y	figure 5	3-6,10
X	JP 09 199756 A (TOKYO SHIBAURA ELECTRIC CO) 31 July 1997 (1997-07-31) figure 3	1,2,7-9
X	WO 2004/071141 A (MATSUSHITA ELECTRIC IND CO LTD [JP]; MATSUI NOBUYUKI; SETOMOTO TATSUMI) 19 August 2004 (2004-08-19) pages 41-42; figures 13,14	1,8
X	WO 96/18210 A (QUANTUM DEVICES INC [US]) 13 June 1996 (1996-06-13) figure 33	1,8

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 March 2007	28/03/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Chao, Oscar

Form PCT/ISA/210 (second sheet) (April 2005)

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Exhibit 1002 - Page 224 of 482

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/044519

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001 024235 A (SONY CORP) 26 January 2001 (2001-01-26) figure 7	1,8
Y	WO 2004/032235 A (SIEMENS AG [DE]; OSRAM OPTO SEMICONDUCTORS GMBH [DE]; BOGNER GEORG [DE) 15 April 2004 (2004-04-15) page 5, line 22; figures 1,2,4	3-6,10

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/044519

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2426381 A1	14-12-1979	BE 876284 A1	16-11-1979
		ES 480663 A1	16-08-1980
		IT 1118686 B	03-03-1986
		LU 81269 A1	16-12-1980
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		JP 2006517738 T	27-07-2006
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		JP 2006501503 T	12-01-2006
		KR 20050075341 A	20-07-2005
		US 2006007553 A1	12-01-2006

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

23448 7590 06/12/2009

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER	
KIANNI, KAVEH C	

ART UNIT	PAPER NUMBER
2883	

MAIL DATE	DELIVERY MODE
06/12/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	11/829,912	MEDENDORP ET AL.	
	Examiner	Art Unit	
	K. Cyrus Kianni	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *1* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 July 2007*.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-52* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-52* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

P. Claims 1-44 and 47-52, drawn to LCD system, classified in class 349 subclass 064-72.

M. Claims 45-46, drawn to a method of utilizing a LCD panel; b) at least one waveguide element having a first and at least a second light entry region; c) a first light-emitting source; and d) at least a second light-emitting source positioned to emit light into the at least one waveguide element, classified in class 349, subclass 60-62.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product. See MPEP § 806.05(h). In the instant case Invention I can be used in a different step of use such as using an array of light sources in a single step into one or an array of waveguides rather than in two steps in which the step of first light source coupling into waveguide(s) and the second step of light source coupling into waveguide(s) two.

Restriction for examination purposes as indicated is proper because all these inventions listed in this action are independent or distinct for the reasons given above

and there would be a serious search and examination burden if restriction were not required because one or more of the following reasons apply:

(a) the inventions have acquired a separate status in the art in view of their different classification;

(b) the inventions have acquired a separate status in the art due to their recognized divergent subject matter;

(c) the inventions require a different field of search (for example, searching different classes/subclasses or electronic resources, or employing different search queries);

(d) the prior art applicable to one invention would not likely be applicable to another invention;

(e) the inventions are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a invention to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected invention**.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement

will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected invention.

If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

This application contains claims directed to the following patentably distinct species

I) claims 1-38 are directed to including a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions;

If applicant opts to elect Group I invention then:

Claim 1 is generic to the following disclosed patentably distinct species:

Species designated by each of the embodiments as follows:

A1) Fig. 1c, A2)Fig. 2; A3) FIG. 3 ; A4) FIG. 4; A5) FIG. 5;

B1) Fig. 6; B2)Fig. 7; B3)Fig. 8; B4) Fig. 9

Applicant should choose **one o**f the Figures A1 through A5 as well as **one of** the figures B1 through B4 for examination

II) claims 39-43 (claim 1 is generic) are directed to including a LCD panel with a viewable surface having a diagonal measurement of at least about 12 inches; wherein each of the first light-emitting source and the at least second light-emitting source comprises a plurality of LEDs arranged in at least one strip

III) claim 44 is directed to including at least a second light-emitting source positioned to emit direct backlight onto the LCD panel

IV) claims 47-50 are directed to including at least a second light-emitting source positioned to emit light into the at least a second waveguide element at the first light entry region;

V) claim 51 is directed to including at least one waveguide element comprising an outer light entry region at an edge of said at least one waveguide element and an inner light entry region spaced from said edge of said at least one waveguide element;

VI) claim 52 is directed to including a LCD panel having a peripheral region and an inner region; b) at least one waveguide element comprising a light entry region at an edge of said LCD panel.

The species are independent or distinct because claims to the different species recite the mutually exclusive characteristics of such species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, claim 1 is only generic to Group II, claim 39.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

The examiner has required restriction between product and process claims. Where applicant elects claims directed to the product, and the product claims are subsequently found allowable, withdrawn process claims that depend from or otherwise require all the limitations of the allowable product claim will be considered for rejoinder. All claims directed to a nonelected process invention must require all the limitations of an allowable product claim for that process invention to be rejoined.

There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or the prior art applicable to one species would not likely be applicable to another species; and/or the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election of the species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species.

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

In the event of rejoinder, the requirement for restriction between the product claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product are found allowable, an otherwise proper restriction requirement between product claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product claim will not be rejoined. See MPEP § 821.04(b). Additionally, in order to retain the right to rejoinder in accordance with the above policy, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product claims. **Failure to do so may result in a loss of the right to rejoinder**. Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to K. Cyrus Kianni whose telephone number is 571-272-2417. The examiner can normally be reached on 9:30-19:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached on 571-272-2415. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

May 28, 2009
/K. Cyrus Kianni/

Primary Examiner, Art Unit 2883

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BIB DATA SHEET

CONFIRMATION NO. 2008

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/829,912	07/29/2007	349	2883	4241-696

APPLICANTS

Nicholas W. Medendorp JR., Raleigh, NC;
Norbert Hiller, Chapel Hill, NC;
Russell G. Villard, Apex, NC;

**** CONTINUING DATA ***************************

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
08/10/2007

Foreign Priority claimed ☐ Yes ☑ No 35 USC 119(a-d) conditions met ☐ Yes ☐ No Verified and Acknowledged /KAVEH C KIANNI/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		NC	11	52	7

ADDRESS

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709
UNITED STATES

TITLE

LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

FILING FEE RECEIVED	FEES: Authority has been given in Paper	☐ All Fees
3530	No._____ to charge/credit DEPOSIT ACCOUNT	☐ 1.16 Fees (Filing)
	No._____ for following:	☐ 1.17 Fees (Processing Ext. of time)
		☐ 1.18 Fees (Issue)
		☐ Other _____
		☐ Credit

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**	**Art Unit:**	**2883**
Date Filed:	**July 29, 2007**	**Examiner:**	**K. Cyrus Kianni**
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

CERTIFICATE OF EFS FILING

I hereby certify that this document is being filed via EFS in the United States Patent and Trademark Office on **July 10, 2009**.
/vincent k. gustafson/

RESPONSE TO JUNE 12, 2009 OFFICE ACTION CONTAINING RESTRICTION REQUIREMENT IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

This responds to the June 12, 2009 Office Action in the above-identified application.

The time for responding to the June 12, 2009 Office Action without extension fee payment was set at one month, or July 12, 2009.

In the June 12, 2009 Office Action, the Examiner has required restriction under the provisions of 35 U.S.C. 121 between:

- Group P, claims 1-44 and 47-52, drawn to LCD system, classified in class 349, subclass 64-72; and

- Group M, claims 45-46, drawn to a method of utilizing a LCD panel; b) at least one waveguide element having a first and at least a second light entry region; c) a first light-emitting source; and d) at least a second light-emitting source positioned to email light into the at least one waveguide element, classified in class 349, subclass 60-62.

In response, **applicant hereby provisionally elects Group P, claims 1-44 and 47-52.**

Such election is with traverse.

The Office Action at page 2 thereof bases the restriction requirement as between Group P (also described by the examiner as "Invention I") and Group M (also described by the examiner as "Invention II") on the allegation that the *distinctness* of the subject matter of the Group P and Group P claims, and thereby ignores the statutory criteria for restriction in 35 U.S.C. 121, which requires that:

> **"[I]f two or more independent and distinct inventions are claimed in one application, the Director may require the application to be restricted to one of the inventions."**

The statute therefore requires as a basis for legally permissible restriction that the subject matter of respective claims be **both** independent **and** distinct. Neither criterion alone is sufficient. Both must be present in order for the restriction requirement to be proper under the statute.

The examiner's attention is directed in this respect to the provisions of MPEP Section 802.01 (Meaning of "Independent" and "Distinct"), which states, *inter alia*:

> **"The term 'independent' (i.e., not dependent) means that there is no disclosed relationship between the two or more**

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> **subjects disclosed, that is, they are unconnected in design, operation, or effect..."**

It is apparent from this provision of the MPEP that the subject matter of the Group P and Group M claims is not "independent" within the meaning of 35 U.S.C. 121, particularly where as here the examiner has expressly acknowledged that the respective Groups "**are related**" (Office Action, page 2, paragraph 2, stating that "Inventions I and II are related as product and process of use"), and that therefore Groups P and M are NOT properly restricted.

Further, it is pointed out that the subject matter of the respective claims imposes no serious burden of searching on the Examiner, particularly since Group II contains only two claims.

According to MPEP Section 803:

> **"[I]f the search and examination of an entire application can be made without serious burden, the examiner must examine it on the merits, even though it includes claims to independent or distinct inventions." MPEP § 803.**

In the Office Action, the examiner indicated that "there would be serious search and examination burden if restriction were not required because *one or more of the following reasons* apply [citing reasons (a) to (e)]." Office Action, pages 2-3. As the examiner has failed to specifically identify the reason for serious search and examination burden, it appears that the requirement of MPEP 803 ("[e]xaminers must provide reasons and/or examples to support conclusions") has not been satisfied.

Under the applicable criteria of 35 U.S.C. 121 and MPEP Sections 802.01 and 803, the examiner is required to submit all of the Group P and Group M claims (i.e., all claims 1-52) to examination on the merits. Substantive examination of all claims 1-52 is hereby requested.

To the extent that the examiner maintains the present restriction, Applicants reserve the right to rejoin the subject matter of the non-elected (Group M) method claims pursuant to MPEP § 821.04 upon allowance of the elected (Group P) product/system claims. Applicant further

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reserve the right to withdraw the traversal of restriction requirement at a future point if necessary or desirable to do so.

B. Response to Species Election Requirement

In the Office Action, the Examiner further imposed a species election requirement as to the following allegedly patentably distinct species:

- Species I, claims 1-38 (claim 1 is generic), directed to including a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions, designated by each of the following embodiments:

  A1) Fig 1, A2) Fig 2, A3) Fig. 3. A4) Fig. 4, A5) Fig 5;
  B1) Fig. 6, B2) Fig 7, B3) Fig 8, B4) Fig. 9;

- Species II, claims 39-43 (claim 1 is generic), directed to including a LCD panel with a viewable surface having a diagonal measurement of at least about 12 inches; wherein each of the first light-emitting source and the at least second light-emitting source comprises a plurality of LEDs arranged in at least one strip;

- Species III, claim 44, directed to including at least a second light-emitting source positioned to emit direct backlight onto the LCD panel;

- Species IV, claims 47-50, directed to including at least a second light-emitting source positioned to emit light into the at least a second waveguide element at the first light entry region;

- Species V, claim 51, directed to including at least one waveguide element comprising an outer light entry region at an edge of said at least one waveguide element and an inner light entry region spaced from said edge of said at least one waveguide element; and

- Species VI, claim 52, directed to including a LCD panel having a peripheral region and an inner region; b) at least one waveguide element comprising a light entry region at an edge of said LCD panel.

As set forth in MPEP §806.04, a proper restriction between species is made when the species are independent or distinct as claimed (MPEP § 806.04(b)). However, if species are connected in any of "design, operation or effect" and the species are related, then requiring election of a single species is improper (MPEP § 806.04(b)).

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It is submitted that the various categories of species identified in the Office Action mailed June 12, 2009 each include species that possess a commonality of design, operation or effect and are therefore not independent, but are inter-related. Specifically, all species identified in the Office Action relating to any of claims 1-44 and 47-52 of Group P relate to LCD systems comprising at least: a LCD panel, at least one waveguide element; a first light-emitting source positioned to emit light into the at least one waveguide element; and at least a second light-emitting source, to provide the effect of more uniform backlighting of a LCD panel. The foregoing claims therefore possess commonality of design, operation, and/or effect, such that imposition of the species election requirement is not proper under MPEP § 806.04(b).

Subject to the foregoing traversal of the species election requirement, **Applicants provisionally elect Species I**, as designated by each of the embodiments of FIG. 4 and FIG. 6[1]. drawn to FIG. 1 and readable on at least claims 12-16 and the first portion of claims 19 and 81.

It is understood that in a species election, if any species including a generic claim is found to be allowable, then Applicants will be entitled to consideration of claims (i.e., one or more species will be examined) drawn to additional species that depend from or otherwise include all limitations of an allowable generic claim. If the examiner's understanding of the applicable procedure differs from the foregoing, then the examiner is invited to summarize the procedure that the examiner plans to follow in case any species including a generic claim should be allowed.

[1] It is noted that FIG. 4 corresponds to item "A1," and FIG. 6 corresponds to item "B1," as stated at page 4, last paragraph of the June 12, 2009 Office Action, and that the Examiner stated at page 5 of the Office Action that "Applicant should choose one of the Figures A1 through A5 as well as one of the Figures B1 through B4 for examination."

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CONCLUSION

Under the applicable criteria of 35 U.S.C. 121 and MPEP Sections 802.01 and 803, the examiner is required to submit all of the Group P and Group M claims (i.e., all claims 1-52) to examination on the merits. Substantive examination of all claims 1-52 is hereby requested.

The examiner is requested to favorably consider the foregoing, and to responsively issue a substantive action or Notice of Allowance. If any issues require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same.

Respectfully submitted,

/vincent k. gustafson/
Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

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Exhibit 1002 - Page 243 of 482

Electronic Acknowledgement Receipt

EFS ID:	5683820
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson
Filer Authorized By:	
Attorney Docket Number:	4241-696
Receipt Date:	10-JUL-2009
Filing Date:	29-JUL-2007
Time Stamp:	19:31:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	696_Response_to_06-12-09_OA_with_Restriction.pdf	47355 50c99a5d30965f13e32cf940b3ee52b79037d87d	no	6

Warnings:

Information:

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Exhibit 1002 - Page 244 of 482

Total Files Size (in bytes):	47355

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (03-08)
Approved for use through 05/31/2008. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

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	1	2006002146	WO	A2	2006-01-05	Champion, D. et al.		☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	KIANNI, KAVEH C.
	Attorney Docket Number	4241-696

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/vincent k. gustafson/	Date (YYYY-MM-DD)	2009-09-27
Name/Print	Gustafson, Vincent K.	Registration Number	46182

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
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PCT

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10/876,293 23 June 2004 (23.06.2004) US

(71) Applicant *(for all designated States except US)*: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 20555 S.H. 249, HOUSTON, TX 77070 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **CHAMPION, David** [US/US]; 1000 NE Circle Blvd.,, Corvallis, OR 97330-4239 (US). **BARNES, Ted** [US/US]; 100 NE Circle Blvd., Corvallis, OR 97330-4239 (US). **GOVYADINOV, Alexander** [BY/US]; 1000 NE Circle Blvd., Corvallis, OR 97330-4239 (US).

(74) Agents: **MYERS, Timothy, F.** et al.; Hewlett-Packard Company, Intellectual Property Administration, P.O. Box 272400, Mail Stop 35, Fort Collins, CO 80527-2400 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

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(54) Title: PLASMA LAMP WITH LIGHT-TRANSMISSIVE WAVEGUIDE

(57) Abstract: A lamp (10) may include a waveguide (18) having a solid dielectric body (19) and may have a bulb (22) disposed in the body (19). The bulb (22) may be adapted to produce light (24) when excited by electromagnetic energy (14). The waveguide body (19) may have at least a portion that is transmissive of light (24). The waveguide (18) may be configured to guide electromagnetic energy (14) recived from a source (16), and may have one or more apertures (40) adapted to allow light (24) to exit the waveguide body (19).

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PLASMA LAMP WITH LIGHT-TRANSMISSIVE WAVEGUIDE

BACKGROUND

Plasma lamps provide intense light produced from ionized gas. A waveguide containing a bulb receives microwave electromagnetic energy from a source. Substances in the bulb form plasma when in the presence of sufficient energy. In some plasma lamps, the waveguide has a solid dielectric. The bulb is positioned at the edge of the waveguide so that light can be emitted from the waveguide through a window. In other plasma lamps, the waveguide is gas filled and a light reflector disposed around the waveguide directs light away from the bulb.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a plasma lamp system according to an embodiment of the invention.

FIG. 2 is a cross-section of a plasma lamp according to another embodiment of the invention.

FIG. 3 is a graph illustrating an exemplary mapping of relative output to input power ratio for an ellipsoid resonance waveguide useable for a plasma lamp, as illustrated in FIG. 2.

FIG. 4 is a cross-section of a plasma lamp according to yet another embodiment of the invention.

FIG. 5 is a cross-section of a plasma lamp according to another embodiment of the invention.

DETAILED DESCRIPTION

FIG. 1 depicts a block diagram of a plasma lamp system, shown generally at 10. System 10 may include a plasma lamp 12 that is adapted to receive electromagnetic energy 14 from an energy source 16. Lamp 12 may include a waveguide 18 having a body 19 defining a perimeter 20 within which a bulb 22 is

disposed. Bulb 22 contains a gas-fill that forms plasma and emits light when excited by sufficient electromagnetic energy. Light 24 produced by the bulb is transmitted out of the waveguide.

Any electromagnetic energy 14 that is suitable and sufficient to produce plasma in bulb 22 may be used. For example, electromagnetic energy may include one or more of radio frequency (RF) energy, sub-infrared energy, microwave energy, millimeter-wave energy, light (infrared, visible or ultraviolet) energy, and x-ray energy. In some examples, energy in the range of 1 gigahertz (GHz) to 10 GHz may be used. Energy with a single frequency, multiple frequencies, and varying or constant phase, amplitude, and frequency may be used.

The electromagnetic energy 14 may be transmitted to waveguide 18 by any appropriate transmission link, such as by a coplanar, planar or coaxial transmission line, a connecting waveguide, a wireless transmission link, or a combination of such links. The energy may be transmitted with or without conversion in form or frequency at the source 16, along the transmission link, or at the lamp waveguide 18.

Resonance produces high relative power that may be coupled to bulb 22 for exciting plasma formation in the gaseous envelope. Waveguide 18 may be dimensioned to produce resonance of the received energy 14 in a particular mode of resonance, such as a transverse electric (TE) or a transverse magnetic (TM) mode. A bulb may be positioned at or near a point of resonance. In a fundamental mode, resonance may occur when a dimension of the waveguide corresponds to an integral multiple of one-half of the wavelength of a frequency of the applied energy in the dielectric or dielectrics forming body 19. A waveguide in which resonance occurs may also be referred to as a resonant cavity or a resonator.

The bulb 22 may be a small chamber filled with an appropriate gas, such as a noble gas. A second element or compound may be included to provide light in a desired frequency range. For example, light may be produced that is in one or more of the infrared, visible and ultraviolet frequency ranges.

The bulb may also be positioned where appropriate to provide for outputting of the produced light from the waveguide. The bulb may be positioned in a light-transmissive chamber 26 that may be bounded by a light-chamber perimeter 28. Chamber 26 may be coextensive with, overlap, be contained within, or contain the waveguide. The bulb may be in both the waveguide 18 and the light-transmissive chamber 26. The shapes and/or sizes of the waveguide and light-transmissive chamber may be different. In an example in which the waveguide and light-transmissive chamber are coextensive, the bulb may be positioned along the waveguide perimeter or within the waveguide, spaced from the perimeter. One or more bulbs may be used at a location or locations that may correspond to a local energy peak or peaks, or other position suitable for igniting and maintaining plasma in the bulb or bulbs, such as at a resonant energy peak.

The waveguide dielectric body 19 may include one or more gases (including air and vacuums), liquids, and solids, and combinations of two or more of these dielectrics. Dielectrics with higher dielectric constants allow the waveguide to have smaller dimensions while providing resonance. Examples of solid materials suitable for dielectrics include alumina, zirconia, titanates, and variations and combinations of these materials. Other examples that may include a further characteristic of being light transmissive may include such materials as silicone oil, sapphire, zirconia, magnesia, or any transparent or other light transmissive dielectric. Porous materials or materials that may be made porous, such as aerogel, silica, alumina, zirconia and the like, may also be used.

Light produced by the bulbs may be transmitted out of the waveguide. A bulb may be positioned next to a window in the waveguide, or may be spaced from a window. Light produced by a bulb may be transmitted along one or more light-transmissive mediums extending directly or indirectly between the bulb and a waveguide window or aperture.

Many variations in the shapes of waveguide 18 and light-transmissive chamber 26 may be used. FIGS. 2, 4 and 5 depict three sets of examples of shapes that may be used for plasma lamps. These figures primarily illustrate waveguides and light-transmissive chambers with continuously curved

perimeters. Depending on the embodiments, other configurations may also be used. For example, waveguides may have a combination of flat surfaces, such as a box-shape, a combination of flat and curved surfaces, such as a cylinder with flat ends or a parabola with a flat end, or continuous curved surfaces, such as a cylinder with curved ends, a sphere, a combination of a hemisphere and a portion of an ellipsoid or parabaloid, or other suitable regular or irregular shapes. In these figures, additional, alternative or optional embodiments of features may be identified with the same reference number, with or without one or more primes, such as 28a, 28a′, 28a″, and 28a‴. These various embodiments may also be referred to collectively by use of the base reference number, such as 28a in this example.

FIG. 2 in particular depicts a plasma lamp 12′ adapted to be used in a lamp system 10. Lamp 12′ may include a waveguide 18′ having a body 19′ with a perimeter 20′, and a bulb 22′. Electromagnetic energy from a source may be coupled to waveguide 18′, such as by an energy feed 30. More than one energy feed from one or more energy sources and more than one bulb may be used. Each feed and bulb may be placed at any respective location appropriate in view of the geometry of the waveguide, the frequency or frequencies of energy applied, and the relative locations of the feeds and bulbs. For example, an optional feed position might be the center of the waveguide or the center of an end section, such as at the center of the hemispherical perimeter portion 20a′, as represented by the feed 30 shown in dashed lines and extending in from a side of the waveguide.

In this example, body 19′ may include a solid dielectric 32 that also transmits light. Waveguide body 19′ and light-transmissive chamber 26′ thus may be coextensive. For example, dielectric 32 may be sapphire, which may have a dielectric constant, k, greater than 9, making the waveguide body smaller than if the dielectric constant was lower, as in the case of air. The waveguide may also be gas filled or be filled partially or completely with a porous dielectric, such as aerogel, fibrous silica, alumina, zirconia, or the like to facilitate heat removal by airflow through the dielectric. A liquid-filled waveguide may allow for the use of conductive or convective cooling. Dielectric 32 also may be formed of

a plurality of different dielectric portions, which may be one or more of a solid, a liquid, a gas, a light transmissive material, and a light non-transmissive material. Light-transmissive chamber 26' may also be one or a combination of electromagnetic energy conductive materials and electromagnetic energy non-conductive materials, depending on the particular application and configuration desired.

Perimeter 20′ may be defined by a boundary 34 that may be reflective of one or both of light, whether infrared, visible, or ultraviolet, and electromagnetic energy. Boundary 34 thereby may function as a waveguide shield 36 with waveguide perimeter 20′, as a light shield or director 38 with light perimeter 28′, or as both a waveguide shield and a light shield. Director 38 may also include additional elements within light-transmissive chamber 26′.

A waveguide shield 36 may be any suitable material that reflects or guides electromagnetic energy. For example, it may be a continuous conductive material, such as solid metal, or discontinuous conductive materials, such as a solid metal with apertures, a metal mesh or a screen. Discontinuous materials may have regularly or irregularly spaced apertures, such as apertures between lines of criss-crossing wires forming a mesh. A waveguide shield, such as a mesh, may be a hot mirror in that it reflects electromagnetic energy and transmits (is transparent to) light. A light director affects the transmission of light, and may include one or more light director elements, such as reflective elements, refractive elements, and filters. A director functioning as a reflector, such as a thin metal coating, may be a cold mirror in that it reflects light and transmits electromagnetic energy.

Optically highly reflective, thin metal coatings may be used for light director 38 forming light perimeter 28′. Highly reflective coatings may be non-transparent and reflective of light emitted from the bulb. For example, for broad spectrum visible light, the coating may reflect light having wavelengths in the range of 0.4 and 0.7 micrometers. In embodiments in which it is desired to have electromagnetic waves, such a radio frequency (RF) waves, microwaves, and millimeter waves, pass through it, a coating may be used that is transparent to such waves. The bulbs may be very hot, such as high as 1000°C, and the

coating may tolerate high temperatures. In order to assist in removing heat from the lamp, high thermal conductivity may be desirable. Such coatings may be in an appropriate form, such as a thin metal having a skin effect, a thin metal coating with a dielectric reflective coating, and a highly reflective dielectric coating.

A dielectric coating may also have broad light spectrum reflectivity, such as reflectivity over a wavelength range of 0.35 to 0.8 micrometers, for example. As a further example, a dielectric layer may be used that has a thickness approximately equal to one quarter of a wavelength of applied electromagnetic energy, formed as a laminate of multiple dielectric layers, including light-reflective layers. A reflective dielectric coating can be used that is reflective of the desired range of light frequencies produced by the bulb. Metal mirrors enhanced with thin dielectric films may be used. Such overcoatings may be made more durable with the use of protective dielectric layers that have an appropriate thickness, such as a thickness approximately an integral number of half-wavelengths of a selected optical frequency to be reflected.

In the embodiment shown, perimeters 20′, 28′ include partial spherical portions 20a′, 28a′ having a common generally hemispherical shape with a radius R. The perimeters may also include non-spherical portions 20b′, 28b′. In some examples, portions 20b′, 28b′ form a partial generally ellipsoid, paraboloid, or other shape. As has been mentioned, the metal coating forms the light director 38. Accordingly, the portion of the metal coating (or other reflective or refractive device) corresponding to light chamber perimeter portion 28a′, forms a light directing element 39 having a reflective surface 39a. Similarly, the portion of the metal coating corresponding to perimeter portion 28b′ forms a directing element 41 having a reflective surface 41a.

One or more apertures, such as aperture 40, may allow for the transmitting of light out of waveguide 18′. Optical directors 42, such as an integration rod 44, may further process the light 24 after it exits cavity waveguide 18′. Other forms of optical devices, such as lenses, filters and reflectors, may also be included.

A bulb 22′ may be positioned within waveguide 18′ at about an optical focal point F of non-spherical portion 28b′. This non-spherical portion may be

adapted to direct light produced by bulb 22′ toward aperture 40. Other configurations and orientations may also be provided. In an example in which portion 28b′ includes a partial ellipsoid or paraboloid shape with bulb 22′ located at an optical focal point, light reflected from the perimeter portion 28b′ may be directed in a common, parallel direction. In an embodiment in which upper portion 28a′ is not reflective of light, then this light would form a wide beam directed upwardly, as viewed in FIG. 2.

In embodiments in which dielectric 32 is a solid dielectric, bulb 22′ may be positioned in waveguide body 19′ by drilling or otherwise forming a channel 46 from the perimeter 20′ to the desired position of the bulb. The bulb may then be placed in the channel, or the void formed by the channel may be filled with the appropriate plasma-forming material, including any light emitter material. The channel may be sealed or blocked by insertion of a pedestal or rod 48 that is adhered to or fused to the body along the walls of the channel, as shown. One or more energy feeds 30 may be positioned in the base of rod 48, or other locations as appropriate. Bulb 22′ may thus be formed in dielectric 32, or it may be encased in an envelope or shell 50 embedded in the dielectric, or placed through a sufficiently wide channel 46. Shell 50 may be formed of any suitable light-transmissive, refractory dielectric material, such as quartz, alumina, zirconia, magnesia, or the like.

Bulb or bulbs 22′ may be positioned in any appropriate location within the intersection of waveguide 18′ and light-transmissive chamber 26′. For instance, an optional position for bulb 22′ is shown in dashed lines. Such positions may correspond to a location with a high-energy field, or may correspond to a position from which emitted light is readily focused or otherwise transmitted out of the waveguide and/or light-transmissive chamber.

An optional configuration for lamp 12′ is with either or both of the waveguide 18′ and light-transmissive chamber 26′ shaped as a full ellipsoid. In such an embodiment, the upper perimeter portions 20a′, 28a′ may have a shape approximately as represented by dashed lines in FIG. 2. In this example in which an ellipsoid shape is used, various ellipsoid shapes may be used, so the shape

shown is for illustration purposes. As discussed previously, the locations of the energy feeds and bulbs may be selected based on the particular features and characteristics of the desired lamp. In some configurations, a bulb may be located at one or each of the two foci of the light-transmissive chamber. Energy feeds may then be placed to appropriately energize the bulb or bulbs.

An aperture may be located at one or both ends of the chamber in line with the two foci. For example, an aperture 40 is shown at the upper end of the chamber. Light emitted from an idealized point-sized bulb at one of the foci may tend to be reflected by the light shield through the other focus. Depending upon the angle of the light and the size and location of the aperture(s), the light may then be directly transmitted out of the chamber through an aperture, or reflected back and forth through the respective foci until the angle of the light is sufficiently aligned with an axis or line 51 passing through the foci that the light exits through an aperture.

FIG. 3 illustrates the relative proportion of power coupled from an energy feed located near the center of an ellipsoid waveguide to an output probe located near alternate aperture 40 shown in FIG. 2, for frequencies in the range of 2722 megahertz (MHz) to 2732 MHz, with –4.75 dB forward transmission coefficient, representing the coupling of power from the input probe to the output probe. The waveguide used for these measurements has an approximately ellipsoid shape that is about five inches long and four inches wide, and has air as the dielectric. It is seen that resonance occurs at a center frequency of about 2727 MHz. Defining a quality factor, Q, as the ratio of the center frequency to the bandwidth ($\pm$ 3 dB), this waveguide has a Q $\approx$ 2727 MHz/1.2 MHz $\approx$ 2300 for the position of input and output probes used for measurement. This value may decrease when increased coupling to a bulb is provided, and may vary depending upon the positions of the energy feed(s) and bulb(s), and the frequency and amplitude of the applied electromagnetic energy. For example, by moving the output probe deeper into the microwave, there is increased coupling to the output probe (- 1.4 dB), but reduced quality factor (about 270). In designing a lamp for use in a particular application, a balance between quality factor and coupling coefficient may be selected.

FIG. 4 illustrates another example of a plasma lamp, shown generally at 12″, having a waveguide 18″ and a coextensive light-transmissive chamber 26″. A perimeter 20″ of the waveguide may have an upper portion 20a″ having a substantially hemispherical shape, and a lower portion 20b″ having a modified ellipsoid or paraboloid shape. Electromagnetic energy may be transmitted into the waveguide through one or more energy feeds, such as energy feed 30. Light-transmissive chamber 26″ may have a similarly shaped perimeter 28″ with a hemispherical portion 28a″ and a non-spherical portion 28b″. Light-transmissive chamber 26″ is defined by a director 38′ including directing elements 39′ and 41′. Surfaces 39a′ and 41a′ of the respective directing elements 39′ and 41′ correspond to light chamber perimeter portions 28a″ and 28b″. A bulb 22″ may be positioned at the radial center C of portion 28a″, which position may also be a focal point of portion 28b″. It may also be appropriate to displace the bulb from a point of peak resonance.

Light transmitted from bulb 22″ initially directed toward portion 28a″ may be reflected back through the bulb 22″ toward portion 28b″. Light from the bulb directed toward portion 28b″ may be reflected toward an aperture 40′, as represented by light 24. In an embodiment in which upper portion 28a″ is not reflective of all light emitted from bulb 22″, such as when waveguide shield 36′ is formed of a mesh with multiple regularly spaced apertures 40′, perimeter portion 28b″, as shown by the segment as a dashed line, may be adapted to reflect light from the bulb in a parallel direction through portion 28a″, as shown by light 24′.

Waveguide 18″ may have a body 19″ filled with a gas, liquid and/or solid dielectric 32′ surrounded by a waveguide shield 38′. Bulb 22″ may be supported in the dielectric as was described for lamp 12′ shown in FIG. 2. Bulb 22″ may be contained within a shell 50′, which in turn may be supported on a dielectric supporting leg, pedestal or rod 48′, or other supporting device.

FIG. 5 illustrates yet further embodiments of a plasma lamp, shown generally at 12‴. In one embodiment depicted in FIG. 5, the entire perimeter 20‴ of a waveguide 18‴, including portions 20a‴ and 20b‴, may be spherical, with electromagnetic energy being input via an energy feed 30. This structure

may be sized to produce electromagnetic energy resonance with a high Q when fed with energy of an appropriate frequency for a mode of resonance. In other embodiments, the waveguide may have other shapes. For instance, a waveguide 18''' shown in dash-dot lines may be box-shaped or cylindrical.

A light-transmissive chamber 26''' may take any of various forms, each of which may be defined, at least in part by a director 38'' including one or more directing elements, such as directing elements 39'' and 41'', that define perimeter 28'''. In these examples, the directing elements are reflectors, and may include respective surfaces 39a'' and 41a''. For example, the light-transmissive chamber may conform to the shape of the waveguide. However, due to the spherical shape of the perimeter 28''', relatively little light may be conducted through an aperture 40'' with this embodiment.

In another example, upper perimeter portion 28a''' may conform with an upper perimeter portion 20a''' of the waveguide, as in the embodiments described with reference to FIGS. 2 and 4. Optionally, the partial-spherical perimeter portion 28a''' may be supported within waveguide 18''', as shown by the reduced-size perimeter portions 28a''', optionally separated by a light aperture 52. Optionally, perimeter portion 28a''' may be supported outside of the waveguide, as represented by the dashed lines. In this case, waveguide shield 36'' allows light to pass through multiple apertures 40'', as is characterized by a conductive mesh.

In other examples, lower portion 28b''' of the light chamber perimeter may be positioned within waveguide 18''' or outside waveguide 18''', as shown. This lower portion then may have a shape that reflects light toward the aperture, or other selected direction. When lower portion 28b''' is within the waveguide, a portion 32a'' of the waveguide dielectric 32'' below lower perimeter portion 28b''' may or may not be transmissive of light. Any part of portion 32a'' of dielectric 32'' through which light is transmitted, accordingly may be included within light-transmissive chamber 26'''. Various other combinations of upper perimeter portions 28a and lower portions 28b also may be used.

Referring generally to the various embodiments shown in FIGS. 1, 2, 4 and 5, a light-transmissive chamber 26 may include regions bounded by respective light chamber perimeter portions 28a, perimeter portions 28b, and any associated light apertures, such as apertures 40 and 52. Similarly, to the extent that all or a portion of a waveguide may be coextensive with a light-transmissive chamber 26, then all or a portion of the coextensive portion of the waveguide body may be light-transmissive as well. The examples of waveguides and light-transmissive chambers shown are illustrative, it being possible to configure waveguides and light-transmissive chambers in a variety of ways to produce a plasma lamp 12. For example, more or fewer optical devices may be used for directing light produced by the one or more bulbs along different light paths to one or more apertures.

As has been mentioned, the coextensive portions of a waveguide 18 and a light-transmissive chamber 26 may be one or more of a gas dielectric, a liquid dielectric, and a solid dielectric, and may be partially or completely light transmissive. Accordingly, portions of a waveguide that are not coextensive with a light-transmissive chamber may also be one or more of a gas dielectric, a liquid dielectric, and a solid dielectric, and may or may not be light-transmissive. A waveguide body may be considered light transmissive so long as at least a portion of the body is light transmissive, whether made of a single dielectric or a combination of dielectrics.

Thus, while the present disclosure references the foregoing embodiments, many variations may be made without departing from the spirit and scope of the following claims. The foregoing embodiments are illustrative, and no single feature, procedure or element is essential to all possible combinations that may be claimed in this or a later application. Moreover, the description includes all novel and non-obvious combinations of elements described herein, and claims may be presented in this or a later application to any novel and non-obvious combination of these elements. Where the claims recite "an", “a first”, or "another" element or the equivalent thereof, such claims include incorporation of one or more such elements, neither requiring nor excluding two or more such elements. Further, cardinal indicators, such as first, second or third, for identified

elements are used to distinguish between the elements, do not indicate a required or limited number of such elements, and do not indicate a particular position or order of such elements unless otherwise specifically stated.

What is claimed is:

1. A lamp (10) comprising: a waveguide (18) including a solid dielectric body (19), the body being substantially transmissive of light (24), the waveguide (18) being configured to guide electromagnetic energy (14) received from a source (16), and having at least one aperture (40) adapted to allow light to exit the body (19); and at least one bulb (22) disposed in the body (19), the bulb (22) being adapted to produce light (24) when excited by the electromagnetic energy (14).

2. The lamp (10) of claim 1, further comprising a director (38) adapted to direct the produced light (24) along a pathway through the body (19).

3. The lamp (10) of claim 2, in which the director (38) includes at least one directing element (41) configured to direct light (24) produced by the bulb (22) toward the aperture (40).

4. The lamp (10) of claim 3, in which the director (38) further comprises at least one directing element (39) configured to direct light (24) produced by the bulb (22) back toward the bulb (22).

5. The lamp (10) of claim 3, in which the director (38) has a substantially ellipsoid shape.

6. The lamp (10) of claim 5, in which the director (38) has two foci (F), and in which the one bulb (22) is disposed at one of the foci (F).

7. The lamp (10) of claim 1, in which the waveguide (18) further includes a plurality of apertures (40), and the lamp (10) further comprises a director (38) disposed outside of the waveguide (18) and adapted to direct light (24) that has exited the body (19).

8. The lamp (10) of claim 1, in which the body (19) is made of transparent dielectric material.

9. A lamp (10) comprising: a waveguide (18) including a dielectric body (19), the waveguide (18) being configured to guide electromagnetic energy (14) received from a source (16), and having at least one aperture (40) adapted to allow light (24) to exit the body (19), the body (19) having at least a portion that is transmissive of light (24); at least one bulb (22) disposed in the waveguide (18) and adapted to produce light (24) when excited by the electromagnetic energy

(14); and a director (38) disposed in the waveguide (18), spaced from the bulb (22), and adapted to direct a first portion of the produced light (24) through the light-transmissive body portion (19) toward the at least one aperture (40).

10. The lamp (10) of claim 9, in which the director (38) is further adapted and to direct a second portion of the produced light (24) back to the bulb (22).

11. The lamp (10) of claim 10, wherein the director (38) includes at least a first surface (41a) that reflects the first portion of the produced light (24), and at least a second surface (37a) that reflects the second portion of the produced light (24).

12. The lamp (10) of claim 11, in which the waveguide (18) has a perimeter (20), and at least one of the first and second surfaces (37a, 41a) is disposed one or more of (a) along at least a portion of the waveguide perimeter (20), and (b) within the body (19).

13. The lamp (10) of claim 9, in which the director (38) has a substantially ellipsoid shape.

14. The lamp (10) of claim 13, in which the director (38) has two foci (F), and the one bulb (22) is disposed at one of the foci (F).

15. A lamp (10) comprising: a waveguide (18) having a substantially continuously curved perimeter (20) with at least a non-partial spherical first portion (20b), the waveguide (18) being configured to guide electromagnetic energy (14) received from a source (16), and having at least one aperture (40) adapted to allow light (24) to exit the waveguide (18); and at least one bulb (22) disposed in the waveguide (18) and adapted to produce light (24) when excited by the electromagnetic energy (14), the waveguide (18) and bulb (22) configured to transmit light (24) from the bulb (22) to the at least one aperture (40).

16. The lamp (10) of claim 15, in which the waveguide (18) further includes a partial spherical second portion (20a).

17. The lamp (10) of claim 15, in which the waveguide (18) includes a light-transmissive body (19), and the lamp (10) further comprises a director (38) disposed in the light-transmissive body (19), spaced from the bulb (22), and adapted to direct a first portion of light (24) produced by the bulb (22) along a

pathway through the light-transmissive body (19) toward the at least one aperture (40).

18. The lamp (10) of claim 15, in which the director (38) has a substantially ellipsoid shape.

19. The lamp (10) of claim 18, in which the director (38) has two foci (F), and the one bulb (22) is disposed at one of the foci (F).

20. The lamp (10) of claim 19, in which the one aperture (40) is generally disposed along a line (51) passing through the two foci (F).

Fig. 1

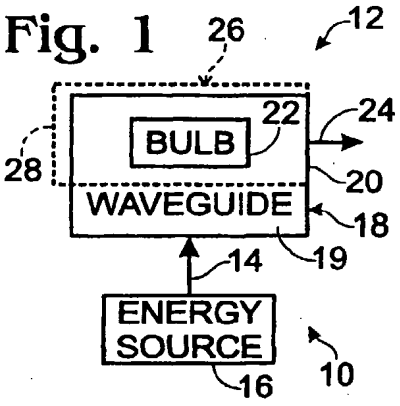


Fig. 2

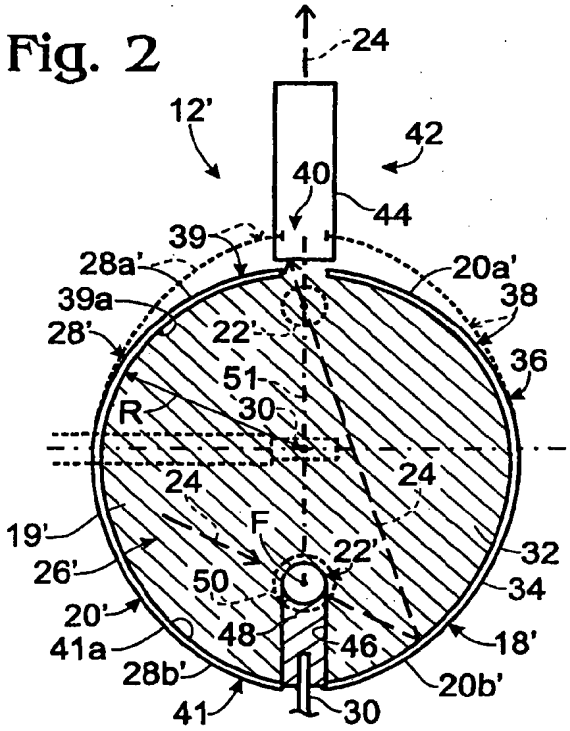


Fig. 4

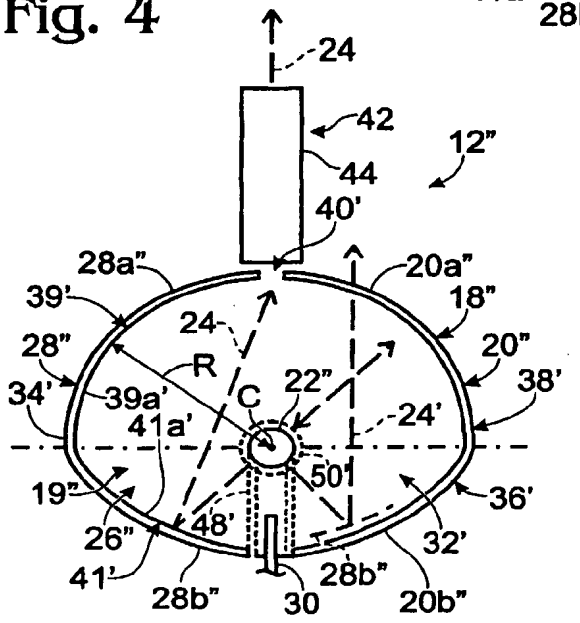
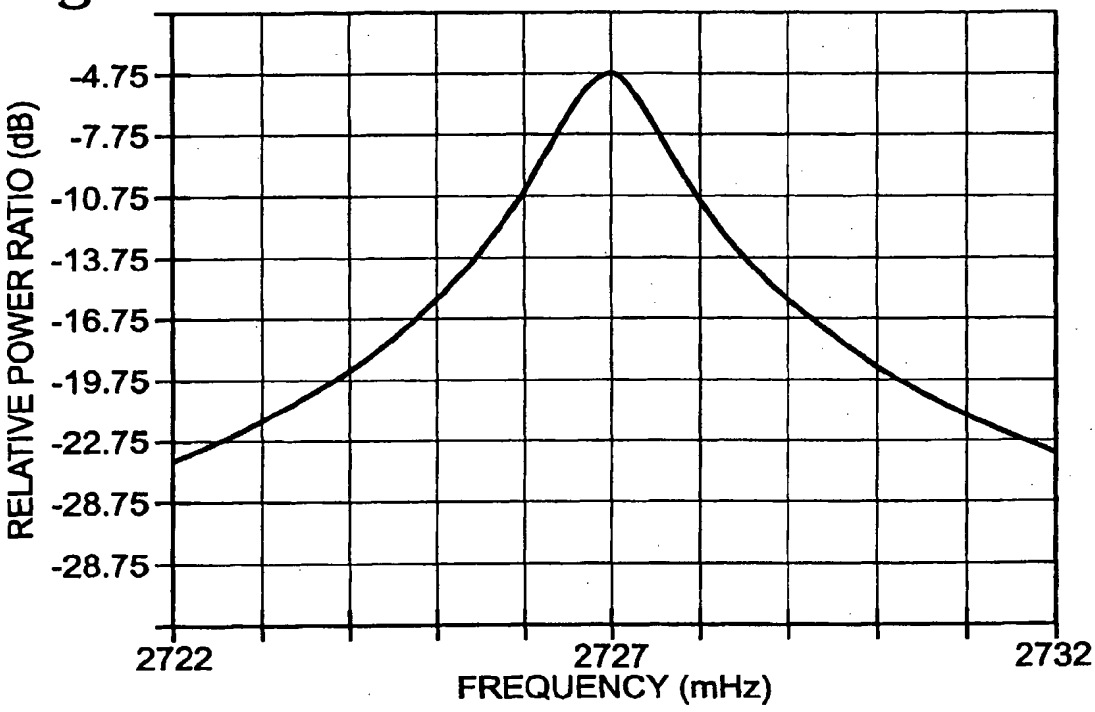


Fig. 3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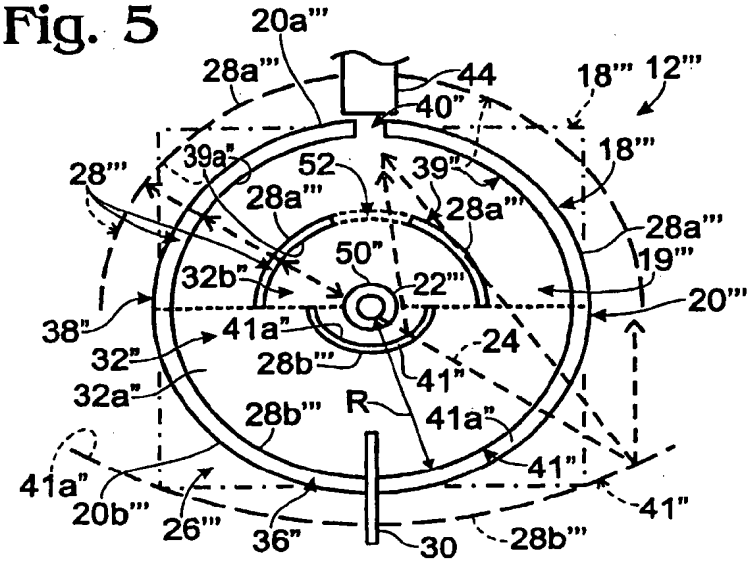
-10.75
-13.75
-16.75
-19.75
-22.75
-28.75
-28.75
RELATIVE POWER RATIO (dB)
2722
2727
2732
FREQUENCY (mHz)

Fig. 5


20a'''
28a'''
44
40"
18''' 12'''
18'''
39a"
52
39"
28'''
28a'''
28a'''
28a'''
50"
19'''
32b"
22'''
20'''
38"
41a"
24
32"
28b'''
41"
32a"
28b'''
R
41a"
41"
41a"
20b'''
26'''
36"
30
28b'''
41"

Electronic Acknowledgement Receipt

EFS ID:	6152847
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson/Jason Navari
Filer Authorized By:	Vincent Kayne Gustafson
Attorney Docket Number:	4241-696
Receipt Date:	27-SEP-2009
Filing Date:	29-JUL-2007
Time Stamp:	16:07:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed (SB/08)	696_2nd_Supp_IDS.pdf	865389 fbf03da1c6e0812bca29a8adc01ae545c53f019f	no	4

Warnings:	
Information:	

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 268 of 482

2	Foreign Reference	WO2006002146A2.pdf	793728 b75119549f082582d16484d9842c99acfd917ab8	no	18

Warnings:	
Information:	
Total Files Size (in bytes):	1659117

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

23448 7590 10/29/2009

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER	
KIANNI, KAVEH C	

ART UNIT	PAPER NUMBER
2883	

MAIL DATE	DELIVERY MODE
10/29/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	11/829,912	MEDENDORP ET AL.	
	Examiner	Art Unit	
	K. Cyrus Kianni	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *1* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 July 2007*.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-52* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-52* are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

- Applicant's election of Group P (product claims) claims 1-44 and 47-52 acknowledged and further applicant's species election of **Species I claims 1-38** is acknowledged in which claim 1 is generic to claims 1-38.
- Upon reviewing of the applicant's remarks in response to the election requirement the examiner noticed that the applicant election of **species I** indicates claims 12-16 and 81 in which claim 81 does not exist. Upon telephone calls and conversations, Mr. Gustafson left a message on 10/23/09 in the examiner's answering machine indicating that the applicant's election regarding species I was wrong, but made an election that involved such claims as 36-44, in which claims 39-44 are even within the elected species claim 1-38.

- Thus, to simplify the matter, the examiner lists the election of Species I requirement as follows:

Election/Restrictions

Claim 1 is generic to the following disclosed patentably distinct species:

IA) claims 2-3 are directed to including herein the LCD panel has a viewable surface, the at least one waveguide element has a transmissive surface, and the transmissive surface is approximately the same size as the viewable surface. wherein the viewable surface has a diagonal measurement of at least about 12 inches.

IB) claim 4 is directed to including wherein each of the first light entry region and the at least a second light entry region is disposed at a different location on the at least one waveguide

element selected from: a top edge of the at least one waveguide element, a bottom edge of the at least one waveguide element, a first side edge of the at least one waveguide element, a second side edge of the at least one waveguide element, and a back side of the at least one waveguide element.

IC) claims 8-19 are directed to including control circuitry in which wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs

ID) claims 20-26 are directed to including wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to the at least one waveguide element; and including wherein the extensions are bent toward a principal plane of the at least one waveguide element.

IE) claims 27-31 are directed to including wherein the at least one waveguide element comprises a first waveguide element and a second waveguide element; and including wherein the first light emitting source is optically coupled to the first waveguide element and the at least a second light-emitting source is optically coupled to the second waveguide element

IF) claim 35 is directed to including wherein the at least one waveguide element comprises a prism

IG) claim 36 is directed to including at least a third light-emitting source, positioned to emit direct backlight onto the LCD panel.

Other claims not listed above which are within species I claims 1-38 would be examined with the elected species.

The species are independent or distinct because as disclosed the different species have mutually exclusive characteristics for each identified species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable.

There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or the prior art applicable to one species would not likely be applicable to another species; and/or the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election of the species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at

the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species.

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

The examiner has required restriction between product and process claims. Where applicant elects claims directed to the product, and the product claims are subsequently found allowable, withdrawn process claims that depend from or otherwise

require all the limitations of the allowable product claim will be considered for rejoinder. All claims directed to a nonelected process invention must require all the limitations of an allowable product claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product claims and the rejoined process claims will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product are found allowable, an otherwise proper restriction requirement between product claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product claim will not be rejoined. See MPEP § 821.04(b). Additionally, in order to retain the right to rejoinder in accordance with the above policy, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product claims. **Failure to do so may result in a loss of the right to rejoinder**. Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to K. Cyrus Kianni whose telephone number is 571-272-2417. The examiner can normally be reached on 9:30-19:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Frank Font can be reached on 571-272-2415. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/K. Cyrus Kianni/
Primary Examiner, Art Unit 2883
October 24, 2009

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**	**Art Unit:**	**2883**
Date Filed:	**July 29, 2007**	**Examiner:**	**K. Cyrus Kianni**
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

CERTIFICATE OF EFS FILING

I hereby certify that this document is being filed via EFS in the United States Patent and Trademark Office on **November 24, 2009**.
/vincent k. gustafson/

RESPONSE TO OCTOBER 29, 2009 SPECIES ELECTION REQUIREMENT IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

This responds to the October 29, 2009 Office Action containing a species election requirement in the above-identified application. The time for responding to the October 29, 2009 Office Action without extension was set at one month, or November 29, 2009. This response is timely filed without need for extension fee payment.

The above-identified application was filed with 52 claims. On July 10, 2009, Applicants elected Group P (product claims) 1-44 and 47-52 responsive to a restriction requirement issued on June 12, 2009. The June 12, 2009 restriction requirement further included a species election requirement; Applicants' July 10, 2009 submission included provisional election of Species I, inclusive of claims 1-38.

In the October 29, 2009 Office Action, the examiner indicated that pending claim 1 is generic to the following allegedly distinct Species IA to IG within restriction Group P and within Species I:

IA) Claims 2-3, wherein the LCD panel has a viewable surface, the at least one waveguide element has a transmissive surface, and the transmissive surface is approximately the same size as the viewable surface wherein the viewable surface has a diagonal measurement of at least about 12 inches

IB) Claim 4, wherein each of the first light entry region and the at least a second light entry region is disposed at a different location on the at least one waveguide element selected from: a top edge of the at least one waveguide element, a bottom edge of the at least one waveguide element, a first side edge of the at least one waveguide element, and a back side of the at least one waveguide element.

IC) Claims 8-19, including control circuitry in which wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs.

ID) Claims 20-26, wherein any of the first light-emitting source and the at least a second light-emitting source is optically coupled to the at least one waveguide element; and including wherein the extensions are bent toward a principal plane of the at least one waveguide element.

IE) Claims 27-31, wherein the at least one waveguide element comprises a first waveguide element and a second waveguide element; and including wherein the first light emitting course is optically coupled to the first waveguide element and the at least a second light emitting source is optically coupled to the second waveguide element.

IF) Claim 35, wherein the at least one waveguide element comprises a prism.

IG) Claim 36, including at least a third light-emitting source, positioned to emit direct backlight on to the LCD panel.

The examiner noted at page 3 of the October 29, 2009 Office Action that other claims not listed within the claims of Species IA to IG (i.e., claims 1, 5-7, 32-34, 37, and 38) would be examined with the elected species.

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In response to the foregoing species election requirement, **Applicants provisionally elect Species IC**, inclusive of claims 8-19.

It is understood that in a species election, if any species including a generic claim is found to be allowable, then Applicants will be entitled to consideration of claims (i.e., one or more species will be examined) drawn to additional species that depend from or otherwise include all limitations of an allowable generic claim. If the examiner's understanding of the applicable procedure differs from the foregoing, then the examiner is invited to summarize the procedure that the examiner plans to follow in case any species including a generic claim should be allowed.

Should the examiner seek additional guidance from Applicants on desired order for further searches after Species IC, Applicants request that further searches be conducted next for the subject matter of Species IB, and thereafter for the subject matter of Species IE. If guidance for further searching after Species IC, IB, and IE should be desired, the examiner is invited to contact the undersigned attorney.

The foregoing election of Species IC is **with traverse**, for at least the reason that the examiner has not demonstrated the existence of an examination and search burden for the allegedly distinct species IA to IG.

MPEP 808.02 states in pertinent part:

> "Where the inventions as claimed are shown to be independent or distinct under the criteria of MPEP §806.05 – §806.06, the examiner, in order to establish reasons for insisting upon restriction, must explain why there would be a serious burden on the examiner if restriction is not required. Thus the examiner must show by appropriate explanation one of the following:
>
> (A) **Separate classification thereof**: This shows that each invention has attained recognition in the art as a separate subject for inventive effort, and also a separate field of search. Patents need not be cited to show separate classification.
>
> (B) **A separate status in the art when they are classifiable together**: Even though they are classified together, each invention can be shown to have formed a separate subject for inventive effort when the examiner can show a

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Exhibit 1002 - Page 280 of 482

> recognition of separate inventive effort by inventors. Separate status in the art may be shown by citing patents which are evidence of such separate status, and also of a separate field of search.
>
> (C) **A different field of search**: Where it is necessary to search for one of the inventions in a manner that is not likely to result in finding art pertinent to the other invention(s) (e.g., searching different classes/subclasses or electronic resources, or employing different search queries, a different field of search is shown, even though the two are classified together. The indicated different field of search must in fact be pertinent to the type of subject matter covered by the claims. Patents need not be cited to show different fields of search.
>
> Where, however, the classification is the same and the field of search is the same and there is no clear indication of separate future classification and field of search, no reasons exist for dividing among independent or related inventions." (Emphasis added.)

In the October 29, 2009 Office Action at page 4 thereof, the examiner alleged generally that:

> "[A] There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. [B] The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or [C] the prior art applicable to one species would not likely be applicable to another species; and/or [D] the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph. "

The foregoing general allegations by the examiner are insufficiently detailed or specific to demonstrate a search and examination burden. With respect to item [A] above, presence of mutually exclusive characteristics is commonplace among dependent claims, and does not necessarily give rise to burden. With respect to item [B] above, the examiner's bare allegation that "the species require a different field of search" is not supported by any identification of different classes or subclasses or electronic resources applicable to different species, and therefore lacks merit or proper basis. It is further noted that multiple search queries are required in the case of every patent application (especially in applications including dependent claims), such that need to employ different search queries does not alone give rise to undue search and examination burden. With respect to item [C] above, it is mere speculation to suggest that prior art applicable to one species would not be applicable to another species, particularly where each species depends from generic independent claim 1. Such speculation does not provide proper basis to establish search and examination burden, since prior art applicable to one species of species IA-IG may apply to many or all of such species. With respect to item [D] above, it is

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mere speculation to suggest that species IA-IG are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph. Such speculation does not provide proper basis to establish search and examination burden, without detailed exposition of specific reasons why different issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph are likely to be raised among different species of species IA-IG.

Based on the foregoing, the examiner has failed to demonstrate that search and examination burden would result from examination of all claims 1-38. Accordingly, the species election requirement is improper and should be withdrawn. Withdrawal of the species election requirement and examination of all claims 1-38 on the merits is warranted, and is respectfully requested.

If any issues require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same.

Respectfully submitted,

/vincent k. gustafson/
Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 282 of 482

Electronic Acknowledgement Receipt

EFS ID:	6522230
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson
Filer Authorized By:	
Attorney Docket Number:	4241-696
Receipt Date:	24-NOV-2009
Filing Date:	29-JUL-2007
Time Stamp:	19:39:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	696_Response_to_10-29-09_Species_Election_Requirement.pdf	36749 8d4148b9c9abd67ddc11bacb4ca171d8013ec74e	no	5

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (03-08)
Approved for use through 05/31/2008. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	Kianni, Kaveh C.
Attorney Docket Number	4241-696

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060002146	A1	2006-01-05	Baba, M.	
	2	20040130515	A	2004-07-08	Chuang, M. et al.	
	3	20010038532	A1	2001-11-08	Harbers, G. et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	Kianni, Kaveh C.
	Attorney Docket Number	4241-696

If you wish to add additional Foreign Patent Document citation information please click the Add button			Add
NON-PATENT LITERATURE DOCUMENTS			Remove
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐
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EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	Kianni, Kaveh C.
Attorney Docket Number	4241-696

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/vincent k. gustafson/	Date (YYYY-MM-DD)	2009-12-27
Name/Print	Gustafson, Vincent K.	Registration Number	46182

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	6709338
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson/Jason Navari
Filer Authorized By:	Vincent Kayne Gustafson
Attorney Docket Number:	4241-696
Receipt Date:	27-DEC-2009
Filing Date:	29-JUL-2007
Time Stamp:	19:52:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed (SB/08)	696_3rd_Supp_IDS.pdf	882661 e38d99d31ab4f5190f15ab3ff4d538945af1939e	no	4

Warnings:	
Information:	

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 289 of 482

Total Files Size (in bytes):	882661

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

23448 7590 03/25/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER
KIANNI, KAVEH C

ART UNIT	PAPER NUMBER
2883	

MAIL DATE	DELIVERY MODE
03/25/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	11/829,912	MEDENDORP ET AL.	
	Examiner	Art Unit	
	K. Cyrus Kianni	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 November 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-52* is/are pending in the application.

4a) Of the above claim(s) *2-4, 19-31, 35-36 and 39-52* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,5-18,32-34,37 and 38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *20 September 2007* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *see action*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Applicant's election with traverse of claims 1, 8-19, including claims 5-7, 32-34 and 37-38 in response submitted on 11/24/09 is acknowledged. The traversal is on the ground(s) that search and the examination of the entire claims 1-38 and/or application can be made without serious burden. This is not found persuasive because each of the group species as was specified in the previous office action contains limitations that are not found in other group species that would require a different search that that of other group inventions and because each of the above species defining an invention that is distinct that that of the other and requiring a different search. The requirement is still deemed proper and is therefore made FINAL.

- IDS submitted on 11/14/07, 3/9/09, 9/27/09 and 12/27/09 are acknowledged.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the electrostatic discharge diode, television and computer monitor must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate

changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 16 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 16 recites the limitation wherein the at least one strip in the 1st line. There is insufficient antecedent basis for this limitation in the claims 1 and 8. In claim 17, the phrase 'communication any of' is indefinite/incomplete. Corrections are required.

Claims 18-19 depend on claim 16 and thus are also rejected.

Note: If claims 16 and 17 are properly amended then claim 17 *may be* allowable in which has to include all limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

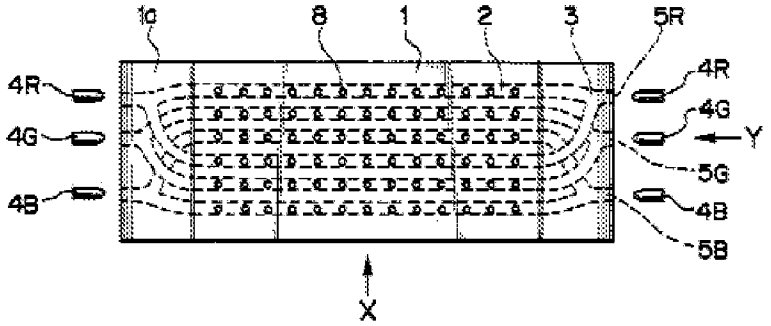
This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 5-16, 18, 32-34 and 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori, US 6288700 B1.

Mori teaches a liquid crystal display (LCD) system (see figures 1-6 and col. 2, last parag. and col. 5, 4th parag.) comprising:

a) a flat panel (see fig. 2);

FIG. 2



b) at least one waveguide element 3 comprising a plurality of light entry regions 5B;

c) a first light-emitting source 4 positioned to emit light into the at least one waveguide element 3 at a first light entry region of the plurality of light entry regions 5G;

and d) at least a second light-emitting source 3 positioned to emit light into the at least one waveguide element 3 at at least a second light entry region of the plurality of light entry regions 5; wherein any of the first light-emitting source and the at least a second light-emitting source comprises a LED 4 adapted to emit any of white light and single color light BGR; wherein any of the first light-emitting source and the at least a second light-emitting source comprises a direct LED (see at least fig. 2); wherein any of the first light-emitting source and the at least a second light-emitting source comprises a side view LED (see at least fig. 2); wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs (see at least fig. 2); wherein each of the first plurality of LEDs and the second plurality of LEDs comprises LEDs adapted to emit different wavelengths (B,G,R); wherein each LED of the first plurality of LEDs and second plurality of LEDs is adapted to output substantially the same

wavelength (see abstract, monocolor); wherein the first plurality of LEDs is adapted to emit a first wavelength and the second plurality of LEDs is adapted to emit a second wavelength (see field of invention having monocolor and multicolor in which different wavelengths of LCDs can be used as light source); wherein the first plurality of LEDs and the second plurality of LEDs are arranged in at least one strip (se fig. 2); wherein the LEDs arranged in the at least one strip are linearly arranged (see fig. 2);
wherein any of the first light emitting source and the at least a second light-emitting source is disposed along an edge region of the LCD system, and positioned to emit light into an edge of the at least one waveguide element (see fig. 2);
wherein any of the first light emitting source and the at least a second light-emitting source is disposed at a location selected from: 1) along an edge region of the LCD system, positioned to emit light into an edge of the at least one waveguide element, and 2) along a center region of the LCD system behind the LCD panel, positioned to emit light into a back side of the at least one waveguide element (see fig. 2).

However, Mori does not explicitly state that A) the above flat panel is “LCD panel" and B) wherein any of the first light emitting source and the at least a second light-emitting source is disposed along a center region of the LCD system behind the LCD panel, and is positioned to emit light into a back side of the at least one waveguide element, C) wherein the at least one strip comprises a first strip and a second strip, with the first plurality of LEDs being arranged in the first strip and the second plurality of LEDs being arranged in the second strip; D) an electrostatic discharge diode in electrical communication with any of the first plurality of LEDs and the second plurality

of LEDs; Nevertheless, Mori states that the flat panel is panel that is used in display region of the liquid crystal monocolor/multicolor display (see col. 2, last parag. and col. 5, 4th parag.). Regarding limitation A) it is obvious/well-known to those of ordinary skill in the art when the invention was made that the above flat panel of the LCD display is/known as is “LCD panel"; and regarding limitation (B) to (D) the examiner takes official notice, as such limitations are extremely conventional: for limitation B see for example US 20090257215 A1, US 20070247872 A1; for limitation C see for example US 20070064444 A1 and US 20090257215 A1;and regarding limitation D see US 20080089072 A1 and US 20070236443 A1, since such limitations would provide a plurality of dot light emitting parts which can be used as a back-light for a thin transit type monocolor and/or multi-color display device and thus it is obvious/well-known to those of ordinary skill in the art when the invention was made to modify and/or combine the teachings of Mori with that of the teachings of the prior art in order to provide an LCD device that includes the above limitations since device would be compact, low price and small in size (see summary).

Citation of Relevant Prior Art

Prior art made of record and not relied upon is considered pertinent to applicant’s disclosure. In accordance with MPEP 707.05 the following references are pertinent in rejection of this application since they provide substantially the same information disclosure as this patent does. These references are:

US 5479275 A

US 20070297168 A1

US 20080019149 A1

US 20090257215 A1

US 20040042194 A1

US 6874900 B2

US 20070018185 A1

US 20060114690 A1

US 20050002110 A1

US 7210815 B2

JP 2006000164 A

US 20060245209 A1

US 20090073721 A1

US 20070242718 A1

US 7576309 B2

US 7514662 B2

US 20080089072 A1

US 20070171341 A1

US 20070064444 A1

US 20050024848 A1

US 7331682 B2

US 20070236443 A1

US 20070247872 A1

US 20070008456 A1

US 20090040426 A1

US 20060186826 A1

US 20090322985 A1

US 6288700 B1

US 20090091920 A1

US 20080002099 A1

US 7548287 B2

US 20040263500 A1

US 7325932 B2

US 20080285306 A1

US 20090185394 A1

US 5299042 A

US 20050122741 A1

US 20060125772 A1

US 7515131 B2

US 20070063943 A1

US 20080175129 A1

US 20060077688 A1

These references are cited herein to show the relevance of the apparatus/methods taught within these references as prior art.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to K. Cyrus Kianni whose telephone number is 571-272-2417. The examiner can normally be reached on 9:30-19:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Robinson can be reached on 571-272-2319. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/K. Cyrus Kianni/
Primary Examiner, Art Unit 2883
March 23, 2010

Auto-Fill | Add A Page | Delete Last Page

Notice of References Cited	Application/Control No. 11/829,912	Applicant(s)/Patent Under Reexamination MEDENDORP ET AL.	
	Examiner K. Cyrus Kianni	Art Unit 2883	Page 1 of 4

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,299,042 A	03-1994	Takanashi et al.	349/7
*	B	US-5,479,275 A	12-1995	Abileah, Adiel	349/5
*	C	US-6,288,700 B1	09-2001	Mori, Hiroki	345/102
*	D	US-2004/0042194 A1	03-2004	Hsieh, Chih Chieh	362/031
*	E	US-2004/0263500 A1	12-2004	Sakata, Hidefumi	345/204
*	F	US-2005/0002110 A1	01-2005	Imade, Shinichi	359/640
*	G	US-2005/0024848 A1	02-2005	Lee et al.	362/031
*	H	US-6,874,900 B2	04-2005	Hsieh, Chih Chieh	362/26
*	I	US-2005/0122741 A1	06-2005	Takata, Yoshiki	362/613
*	J	US-2006/0077688 A1	04-2006	Uehara et al.	362/613
*	K	US-2006/0114690 A1	06-2006	Iki et al.	362/612
*	L	US-2006/0125772 A1	06-2006	Takeda, Hiroshi	345/102
*	M	US-2006/0186826 A1	08-2006	Miyazawa, Yasunaga	315/169.4

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 11/829,912	Applicant(s)/Patent Under Reexamination MEDENDORP ET AL.	
	Examiner K. Cyrus Kianni	Art Unit 2883	Page 2 of 4

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0245209 A1	11-2006	Jeong et al.	362/612
*	B	US-2007/0008456 A1	01-2007	Lesage et al.	349/062
*	C	US-2007/0018185 A1	01-2007	HUNG, Chen-Pin	257/098
*	D	US-2007/0063943 A1	03-2007	Tanaka et al.	345/087
*	E	US-2007/0064444 A1	03-2007	Kim et al.	362/612
*	F	US-7,210,815 B2	05-2007	Imade, Shinichi	362/234
*	G	US-2007/0171341 A1	07-2007	Kim et al.	349/114
*	H	US-2007/0236443 A1	10-2007	Lee, Jong-Hwae	345/102
*	I	US-2007/0247872 A1	10-2007	Lee et al.	362/616
*	J	US-2007/0242718 A1	10-2007	Kawakami, Hisanori	372/50.12
*	K	US-2007/0297168 A1	12-2007	Chang et al.	362/223
*	L	US-2008/0002099 A1	01-2008	Oh, Ji Soon	349/65
*	M	US-2008/0019149 A1	01-2008	Chang et al.	362/616

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 11/829,912	Applicant(s)/Patent Under Reexamination MEDENDORP ET AL.	
	Examiner K. Cyrus Kianni	Art Unit 2883	Page 3 of 4

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,331,682 B2	02-2008	Lee et al.	362/19
*	B	US-7,325,932 B2	02-2008	Sakata, Hidefumi	353/85
*	C	US-2008/0089072 A1	04-2008	Kim et al.	362/294
*	D	US-2008/0175129 A1	07-2008	Tanaka et al.	369/112.23
*	E	US-2008/0285306 A1	11-2008	Sugihara et al.	362/617
*	F	US-2009/0040426 A1	02-2009	Mather et al.	349/65
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*	H	US-7,514,662 B2	04-2009	Kawakami, Hisanori	250/205
*	I	US-7,515,131 B2	04-2009	Takeda, Hiroshi	345/87
*	J	US-2009/0091920 A1	04-2009	Naijo et al.	362/97.3
*	K	US-7,548,287 B2	06-2009	Oh, Ji Soon	349/65
*	L	US-2009/0185394 A1	07-2009	Takahashi, Yuhji	362/613
*	M	US-7,576,309 B2	08-2009	Kawakami, Hisanori	250/205

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 11/829,912	Applicant(s)/Patent Under Reexamination MEDENDORP ET AL.	
	Examiner K. Cyrus Kianni	Art Unit 2883	Page 4 of 4

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2009/0257215 A1	10-2009	Gomi, Shuji	362/97.1
*	B	US-2009/0322985 A1	12-2009	Mizuuchi, Kiminori	349/62
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	Art Unit
	K. Cyrus Kianni	2883

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/23/2010								
	1	✓								
	2	N								
	3	N								
	4	N								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
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	29	N								
	30	N								
	31	N								
	32	✓								
	33	✓								
	34	✓								
	35	N								
	36	N								

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 306 of 482

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	Art Unit
	K. Cyrus Kianni	2883

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/23/2010								
	37	✓								
	38	✓								
	39	N								
	40	N								
	41	N								
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	47	N								
	48	N								
	49	N								
	50	N								
	51	N								
	52	N								

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

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	1	20040130515	A	2004-07-08	Chang, M. et al.	

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	1	2006002146	WO	A2	2006-01-05	Champion, D. et al.		☐

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Receipt date: 09/27/2009	Application Number	11829912	11829912 - GAU: 2883
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2007-07-29	
	First Named Inventor	Medendorp, Jr.	
	Art Unit	2883	
	Examiner Name	KIANNI, KAVEH C.	
	Attorney Docket Number	4241-696	

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Examiner Signature	/Kaveh Kianni/ (03/23/2010)	Date Considered	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	Art Unit
	K. Cyrus Kianni	2883

SEARCHED			
Class	Subclass	Date	Examiner
			KCK

SEARCH NOTES		
Search Notes	Date	Examiner
Searched through EAST:USPGPUB, USPAT, EPO, JPO and DERWENT and NPLSearched inverntorship threough PALM	3/23/2010	KCK
		KCK

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
			kck

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	14	(US-20100053497-$ or US-20100026929-$ or US-20100007818-$ or US-20090322985-$ or US-20080247150-$ or US-20070229451-$ or US-20070052882-$ or US-20070014097-$ or US-20070013663-$ or US-20040130885-$).did. or (US-7364339-$ or US-7364337-$ or US-6979113-$ or US-6288700-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/23 13:17
L2	1	(US-6288700-$).did.	USPAT	OR	OFF	2010/03/23 13:17
L3	14	1 2	US-PGPUB; USPAT	OR	OFF	2010/03/23 13:17
L4	14	3 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 13:19
L5	1	(US-20090322985-$).did.	US-PGPUB	OR	OFF	2010/03/23 14:41
L7	23	(US-20080019149-$ or US-20090257215-$ or US-20040042194-$ or US-20050002110-$ or US-20060245209-$ or US-20070242718-$ or US-20070171341-$ or US-20070064444-$ or US-20050024848-$ or US-20070247872-$ or US-20060186826-$ or US-20090091920-$ or US-20080002099-$ or US-20040263500-$ or US-20090185394-$ or US-20050122741-$ or US-20060125772-$ or US-20070063943-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did. or (JP-	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/23 14:48

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file:///C|/Documents%20and%20Settings/kkianni/My%20D...912/EASTSearchHistory.11829912_AccessibleVersion.htm 1 of 23 3/23/2010 7:29:14 PM

		2006000164-$).did.				
L8	18	7 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 14:49
L9	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/03/23 15:47
L10	3	2 5 9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:20
L11	2	10 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (light adj1 emit$4 adj1 diod $2 led$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:51
L12	3	10 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:51
L13	3	10 and (source$1 LED$1 emit$5 light adj1 emit$5) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:52
L14	1	(US-20090322985-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:23
L15	2	10 and (electrostatic static $1 discharg$3 diode$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:24
L18	1	11/829912	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:28
L19	1	18 and (electrostatic static $1 discharg$3 near12 diode $1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:28
L20	24	led$1 near12 (electrostatic static$1 discharg$3 near12 diode$1) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (lcd$1 display $1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:32

L21	24	(US-20060236262-$ or US-20090167192-$ or US-20070242185-$ or US-20080049051-$ or US-20090118667-$ or US-20080252986-$ or US-20030149347-$ or US-20050143793-$ or US-20090225567-$ or US-20100053995-$ or US-20090312063-$ or US-20070189667-$ or US-20060034566-$ or US-20060227546-$).did. or (US-7471284-$ or US-7468764-$ or US-5301090-$ or US-7548670-$ or US-6687556-$ or US-7236663-$ or US-7431489-$).did. or (FR-2912245-$ or WO-2006114743-$ or JP-2009295285-$).did.	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/03/23 18:33
L22	24	21 and led$1 near12 (electrostatic static$1 discharg$3 near12 diode $1) same (light adj1 guid $2 lightguide$1 waveguide $1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:34
L23	0	21 and led$1 near12 (electrostatic electro adj1 static$1) near7 discharg$3 near2 diode$1 same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:36
L24	0	led$1 near12 (electrostatic electro adj1 static$1) near7 discharg$3 near2 diode$1 same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:37
L25	1	18 and (electrostatic near2 discharg$3 near2 diode$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:40
L26	3	led$1 near12 (electrostatic near2 discharg$3 near2 diode$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:41
L27	13	led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:43

L28	0	27 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:44
L29	1	27 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and led$2 near9 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:45
L30	3	27 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:45
L31	1	(US-20070236443-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:46
L32	1	(US-20080089072-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:46
L33	2	31 32	US-PGPUB	OR	OFF	2010/03/23 18:46
S1	1	12/033547	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 13:59
S2	0	("1020050000803" "200359321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:16
S3	5	("20050000803" "59321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:22
S4	4	("0000803" "59321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:23
S5	7	("97199").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:23
S6	6	("1097199").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:24
S7	177	(first second) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:35

S8	26	(first second) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film$1 coat$5 material) near12 (light near7 (angle$2 adjust$5 absor$5) same (light adj1 guid$4 prism$5 waveguide$2))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:39
S9	25	(US-20090316433-$ or US-20090196069-$ or US-20090067156-$ or US-20090040426-$ or US-20080158853-$ or US-20080151540-$ or US-20080086289-$ or US-20080084513-$ or US-20080084512-$ or US-20070284564-$ or US-20070247872-$ or US-20070031106-$ or US-20070002585-$ or US-20060262558-$ or US-20060077688-$ or US-20060012732-$ or US-20050002110-$).did. or (US-7623198-$ or US-7518663-$ or US-7478942-$ or US-7210815-$ or US-6337946-$ or US-6160948-$ or US-6031958-$ or US-5695269-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 14:40
S10	25	S9 and (first second) adj2 (source$1 LED$1 emit$5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:41
S11	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 14:51
S12	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 15:04
S13	1	(US-20060077688-$).did.	US-PGPUB	OR	OFF	2010/02/26 15:12

S14	116	((first second) adj2 (source $1 LED$1 emit$5) (main sub vertic$4 near5 horizontal$4) adj2 (source $1 LED$1 emit$5) same prism$5 and ((source$1 LED$1 emit$5) (main sub vertic$4 near5 horizontal $4)) adj2 (source$1 LED$1 emit$5)) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film$1 coat$5 material) same (light near7 (angle$2 adjust$5 absor$5) same (light adj1 guid$4 prism$5 waveguide $2))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:19
S15	103	S14 not S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:20
S16	102	(US-20100027242-$ or US-20100007816-$ or US-20090316058-$ or US-20090273948-$ or US-20090237593-$ or US-20090128735-$ or US-20090073142-$ or US-20090034264-$ or US-20090032827-$ or US-20090016081-$ or US-20080316767-$ or US-20080259643-$ or US-20080232135-$ or US-20080204871-$ or US-20080159736-$ or US-20080145960-$ or US-20080117356-$ or US-20080094853-$ or US-20080094528-$ or US-20080068836-$ or US-20080018575-$ or US-20080002393-$ or US-20070297168-$ or US-20070285913-$ or US-20070279931-$ or US-20070279551-$).did. or (US-20070274102-$ or US-20070274095-$ or US-20070274094-$ or US-20070272839-$ or US-20070216828-$ or US-20070127269-$ or US-20070064417-$ or US-	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/02/26 15:20

		20070058258-$ or US-20070058127-$ or US-20070047219-$ or US-20070025121-$ or US-20070013624-$ or US-20070008456-$ or US-20060291244-$ or US-20060291240-$ or US-20060291238-$ or US-20060268574-$ or US-20060268571-$ or US-20060262376-$ or US-20060221638-$ or US-20060221631-$ or US-20060109396-$ or US-20060104093-$ or US-20060104092-$ or US-20060104089-$ or US-20060066783-$ or US-20050212995-$).did. or (US-20050185390-$ or US-20050180017-$ or US-20050001952-$ or US-20040246402-$ or US-20040239831-$ or US-20040150981-$ or US-20040145915-$ or US-20040141119-$ or US-20040136172-$ or US-20040114396-$ or US-20040004826-$ or US-20030214474-$ or US-20030112619-$ or US-20030048639-$).did. or (US-7660509-$ or US-7626210-$ or US-7607814-$ or US-7600880-$ or US-7571696-$ or US-7534025-$ or US-7518664-$ or US-7513670-$ or US-7503674-$ or US-7458710-$ or US-7443464-$ or US-7430028-$ or US-7374329-$ or US-7344291-$ or US-7334934-$ or US-7322731-$ or US-7317182-$ or US-7311431-$ or US-7293899-$ or US-7277079-$ or US-7226201-$ or US-7210839-$ or US-7161647-$ or US-7139048-$ or US-7086774-$ or US-7038638-$).did. or (US-6882380-$ or US-6820991-$ or US-6820990-$ or US-6132053-$ or US-5956107-$ or US-5831698-$ or US-				

		5748828-$ or US-5592332-$).did. or (EP-1403689-$).did.				
S17	13	S16 and ((first second) adj2 (source$1 LED$1 emit $5) (main sub vertic$4 near5 horizontal$4) adj2 (source$1 LED$1 emit$5)) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:22
S18	64	((first second) adj2 (source $1 LED$1 emit$5) (main sub vertic$4 near5 horizontal$4) adj2 (source $1 LED$1 emit$5)) same light same prism$5 and (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film $1 coat$5 material) same (light near7 (angle$2 adjust$5 absor$5)) same (light adj1 guid$4 prism$5 waveguide$2)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:27
S19	39	S18 not S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:28
S20	38	(US-20100027242-$ or US-20090316058-$ or US-20090237593-$ or US-20090174700-$ or US-20090154157-$ or US-20080232136-$ or US-20080165812-$ or US-20080165307-$ or US-20080159736-$ or US-20080129925-$ or US-20080068836-$ or US-20070297168-$ or US-20070183038-$ or US-20070064417-$ or US-20070008456-$ or US-20060221642-$ or US-20050275327-$ or US-20050180017-$ or US-20040246697-$ or US-20040232812-$ or US-20040145915-$ or US-20030234900-$ or US-20030076423-$ or US-20020080433-$).did. or (US-7542491-$ or US-7527398-$ or US-7518593-$ or US-7503674-$ or US-7489373-$ or US-7344291-	US-PGPUB; USPAT	OR	OFF	2010/02/26 15:28

		$ or US-6960872-$ or US-6644824-$ or US-6123430-$ or US-6079840-$ or US-5957561-$ or US-5900982-$ or US-5748828-$ or US-5602679-$).did.				
S21	38	S20 and ((first second) adj2 (source$1 LED$1 emit $5) (main sub vertic$4 near5 horizontal$4) adj2 (source$1 LED$1 emit$5))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:28
S22	9	kianni and (first second) adj2 (source$1 LED$1 emit $5) and prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:54
S23	4	kianni and (first second) adj2 (source$1 LED$1 emit $5) and prism$5 and (liquid display lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:54
S24	5	kianni and (first second) adj2 (source$1 LED$1 emit $5) and diffus$4 and (liquid display lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:56
S25	4	S24 not S23	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:56
S26	118	S7 not (S9 S18)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:58
S27	119	(US-20090316388-$ or US-20090290339-$ or US-20090267879-$ or US-20090256494-$ or US-20090230878-$ or US-20090219463-$ or US-20090147501-$ or US-20090115713-$ or US-20090109683-$ or US-20090091668-$ or US-20090091667-$ or US-20090073348-$ or US-20090052204-$ or US-20090034291-$ or US-20090033832-$ or US-20090027919-$ or US-20080285306-$ or US-20080225522-$ or US-20080225201-$ or US-20080175129-$ or US-20080137373-$ or US-20080112187-$ or US-20080084519-$ or US-20080084518-$ or US-20080074899-$ or US-20080068846-$).did. or	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/02/26 15:59

		(US-20080030650-$ or US-20080002114-$ or US-20070297194-$ or US-20070279934-$ or US-20070275512-$ or US-20070268426-$ or US-20070268325-$ or US-20070230215-$ or US-20070222360-$ or US-20070217227-$ or US-20070188681-$ or US-20070147071-$ or US-20070146298-$ or US-20070139966-$ or US-20070127264-$ or US-20070104415-$ or US-20070070305-$ or US-20070070304-$ or US-20070063943-$ or US-20070058359-$ or US-20070018185-$ or US-20070002579-$ or US-20060244880-$ or US-20060239026-$ or US-20060232995-$ or US-20060186826-$ or US-20060170640-$).did. or (US-20060146570-$ or US-20060121940-$ or US-20060072342-$ or US-20060056200-$ or US-20060039046-$ or US-20050280756-$ or US-20050269560-$ or US-20050259440-$ or US-20050248818-$ or US-20050180169-$ or US-20050117368-$ or US-20050111239-$ or US-20050083813-$ or US-20050078080-$ or US-20040263500-$ or US-20040228109-$ or US-20040124764-$ or US-20040076396-$ or US-20040001340-$ or US-20030076669-$ or US-20030030596-$ or US-20020118865-$).did. or (US-7659880-$ or US-7629957-$ or US-7575357-$ or US-7553045-$ or US-7527411-$ or US-7520652-$ or US-7502009-$ or US-7494835-$ or US-7474050-$ or US-7465073-$ or US-				

		7452119-$ or US-7448788-$ or US-7377681-$ or US-7364338-$ or US-7356211-$ or US-7325932-$ or US-7270427-$ or US-7237939-$ or US-7213936-$ or US-7160003-$ or US-7159987-$ or US-7128460-$ or US-7113621-$ or US-7085027-$ or US-7068404-$ or US-7039286-$).did. or (US-7002534-$ or US-6880953-$ or US-6856464-$ or US-6805468-$ or US-6285423-$ or US-6268904-$ or US-6123431-$ or US-6069565-$ or US-5990993-$ or US-5838239-$ or US-5479275-$ or US-5299042-$).did. or (TW-322562-$ or KR-2004084298-$ or KR-2003008270-$ or JP-08220345-$ or US-5396350-$).did.				
S28	118	S27 and (first second) adj2 (source$1 LED$1 emit $5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:00
S29	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 16:00
S30	1	(US-20060186826-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:21
S31	1	(US-20040263500-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:28
S32	1	(US-5299042-$).did.	USPAT	OR	OFF	2010/02/26 16:38
S33	1	(US-20080175129-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:49
S34	0	(sub) adj1 (source$1 LED $1 emit$5) same prism$5 and (source$1 LED$1 emit $5) same (light adj1 (emit $5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:56
S35	26	(sub vertical$4) adj2 (source$1 LED$1 emit$5) same prism$5 and (source $1 LED$1 emit$5) adj1 (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:57

S36	24	S35 not (S7 S9 S18 S26)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:58
S37	0	(peripheral) adj1 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) adj1 (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:06
S38	0	(peripheral$2) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) adj1 (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:06
S39	190	(first second$3) adj2 (source$1 LED$1 emit$5) same prism$5 and (source $1 LED$1 emit$5) same (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:07
S40	13	S39 not S7	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:07
S41	13	(US-20080247150-$ or US-20080204682-$ or US-20060132711-$ or US-20040174512-$ or US-20040085750-$ or US-20030227578-$ or US-20020034016-$).did. or (US-7470025-$ or US-7011442-$ or US-6992718-$ or US-6910775-$ or US-6480337-$ or US-6264331-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 17:08
S42	13	S41 and (first second$3) adj2 (source$1 LED$1 emit $5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:08

S43	1	(horizontal$4) adj2 (source $1 LED$1 emit$5) same vertical$4 adj2 (source$1 LED$1 emit$5) same prism $5 and (source$1 LED$1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:15
S44	0	S11 S12 S13 S29 S30 S31 S32 S33	EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:17
S45	8	(S11 S12 S13 S29 S30 S31 S32 S33)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:18
S46	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S47	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S48	1	(US-20060077688-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S49	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 19:45
S50	1	(US-20060186826-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S51	1	(US-20040263500-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S52	1	(US-5299042-$).did.	USPAT	OR	OFF	2010/02/26 19:45
S53	1	(US-20080175129-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S54	8	(S46 S47 S48 S49 S50 S51 S52 S53)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:45
S55	8	(US-20050002110-$ or US-20070247872-$ or US-20060186826-$ or US-20040263500-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 19:45
S56	1	12/033547	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:47
S57	8	S55 and (source$1 LED$1 emit$5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:51

S58	8	S55 and (source$1 LED$1 emit$5) same (direct$5 prism$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:54
S59	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 19:58
S60	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 20:00
S61	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 20:06
S63	3	S59 S60 S61	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 20:17
S64	1	11/829912	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 19:44
S65	8	(US-20050002110-$ or US-20070247872-$ or US-20060186826-$ or US-20040263500-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/22 19:45
S66	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/03/22 19:46
S67	637	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:03
S68	9	(edge$1 side$1) near3 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:12

S69	23	(edge$1 side$1) near5 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near7 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:13
S70	23	S67 and S69	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:13
S71	22	(US-20100014027-$ or US-20090316077-$ or US-20090257215-$ or US-20090237587-$ or US-20090237585-$ or US-20090219463-$ or US-20090141208-$ or US-20090091920-$ or US-20090073347-$ or US-20090059621-$ or US-20090059127-$ or US-20080186427-$ or US-20080165308-$ or US-20080002099-$ or US-20070018185-$ or US-20060274548-$ or US-20060114690-$).did. or (US-7553045-$ or US-7548287-$ or US-7334930-$).did. or (JP-2009186523-$ or JP-2009008856-$). did.	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/22 20:14
S72	22	S71 and (edge$1 side$1) near5 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near7 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:16

S73	1	(US-20090091920-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:31
S74	1	(US-20080002099-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:33
S75	1	(US-20090257215-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:35
S76	1046	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:37
S77	544	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:39
S78	238	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1 back front bottom beneath rear) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:41

S79	31	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:43
S80	11	S65 S73 S74 S75	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:44
S81	31	(US-20070018185-$ or US-20100066939-$ or US-20100027296-$ or US-20100007816-$ or US-20090219463-$ or US-20090207343-$ or US-20090185394-$ or US-20090147178-$ or US-20090135625-$ or US-20080260328-$ or US-20080165308-$ or US-20080142682-$ or US-20080049168-$ or US-20080043171-$ or US-20080019149-$ or US-20070242718-$ or US-20070064444-$ or US-20070063943-$ or US-20060125772-$ or US-20060120106-$ or US-20050253980-$ or US-20050024848-$ or US-20040042194-$).did. or (US-7576309-$ or US-7553061-$ or US-7553045-$ or US-7515131-$ or US-7514662-$ or US-7331682-$ or US-6874900-$).did. or (JP-2009186523-$).did.	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/22 20:45

S82	31	S81 and (first plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (second plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:45
S83	1	(US-20080019149-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:49
S84	1	(US-20040042194-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:50
S85	1	(US-20070242718-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:51
S86	1	(US-20070064444-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:53
S87	1	(US-20050024848-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:56
S88	1	(US-20090185394-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:59
S89	1	(US-20060125772-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:00
S90	1	(US-20070063943-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:01
S91	0	S81 and (first plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:06

S92	0	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:07
S93	0	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:09
S94	40	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:10

S95	11	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near4 (front bottom beneath rear back side$1 edge$) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:13
S96	40	S94 not S82	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:13
S97	40	(US-20090262519-$ or US-20090122231-$ or US-20090103328-$ or US-20090097277-$ or US-20090086507-$ or US-20090086505-$ or US-20090046220-$ or US-20080304288-$ or US-20080304286-$ or US-20080304285-$ or US-20080101061-$ or US-20070171341-$ or US-20070146572-$ or US-20070109792-$ or US-20060245209-$ or US-20060238670-$ or US-20050135118-$ or US-20050122741-$ or US-20050068471-$ or US-20040155994-$ or US-20030043122-$ or US-20020180923-$ or US-20010024249-$).did. or (US-7520632-$ or US-7486348-$ or US-7455441-$ or US-7322717-$ or US-7309143-$ or US-7303326-$ or US-7202920-$ or US-6839100-$ or US-6825894-$ or US-6633279-$ or US-6567137-$ or US-6529188-$ or US-6441874-$).did. or (JP-2006000164-$).did. or (EP-2000831-$ or JP-2006000164-$ or JP-	US-PGPUB; USPAT; JPO; DERWENT	OR	OFF	2010/03/22 21:13

		11064845-$).did.				
S98	40	S97 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:14
S99	1	(JP-2006000164-$).did.	JPO	OR	OFF	2010/03/22 21:20
S100	1	(US-20060245209-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:20
S101	1	(US-20070171341-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:22
S102	1	(US-20050122741-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:31
S106	23	S80 S83 S84 S85 S86 S87 S88 S89 S90 S99 S100 S101 S102	US-PGPUB; USPAT; JPO; DERWENT	OR	OFF	2010/03/22 21:36
S107	0	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$2 extension$1) adj2 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:38

S108	1	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near2 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:40
S109	2	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:40
S110	10	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:41

S111	8	S110 not S109	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:42
S112	1	(US-20090073721-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:45
S113	24	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:48
S114	14	S113 not S110	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:48
S115	14	(US-20100053497-$ or US-20100026929-$ or US-20100007818-$ or US-20090322985-$ or US-20080247150-$ or US-20070229451-$ or US-20070052882-$ or US-20070014097-$ or US-20070013663-$ or US-20040130885-$).did. or (US-7364339-$ or US-7364337-$ or US-6979113-$ or US-6288700-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/22 21:49
S116	14	S115 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension $1) near5 (light adj1 guid $2 lightguide$1 waveguide $1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:49
S117	1	(US-6288700-$).did.	USPAT	OR	OFF	2010/03/22 21:53

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7195364	B2	2007-03-27	Hahm, H. et al.	

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	1	2005001892	WO	A2	2005-01-06	McCollum, T. et al.		☐
	2	2007061758	WO	A1	2007-05-31	Negley, G. et al.		☐
	3	2004068909	WO	A1	2004-08-12	Setmoto, T. et al.		☐

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Petitioner Hisense USA Corporation
Exhibit 1002 - Page 334 of 482

Receipt date: 03/09/2009	Application Number	11829912	11829912 - GAU: 2883
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2007-07-29	
	First Named Inventor	Medendorp, Jr.	
	Art Unit	2883	
	Examiner Name	KIANNI, KAVEH C.	
	Attorney Docket Number	4241-696	

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Examiner Signature	/Kaveh Kianni/ (03/23/2010)	Date Considered	

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Exhibit 1002 - Page 335 of 482

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	1	6964497	B2	2005-11-15	Greiner, Horst	

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	1	20070019129	A1	2007-01-25	Negley, Gerald H.	
	2	20070115670	A1	2007-05-24	Roberts, John K., et al.	

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Exhibit 1002 - Page 336 of 482

Receipt date: 11/14/2007	Application Number	11829912	11829912 - GAU: 2883
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2007-07-29	
	First Named Inventor	Medendorp, Jr.	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	4241-696	

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	1	YU, MICHAEL, "Backlight Technology Overview", "http://www.densitron.com/uploadedFiles/Displays/Products/whitepaper17.pdf", February 16, 2006, Page(s) 1-18, Publisher: Densitron Technologies, plc.	☐

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	1	20060002146	A1	2006-01-05	Baba, M.	
	2	20040130515	A	2004-07-08	Chuang, M. et al.	
	3	20010038532	A1	2001-11-08	Harbers, G. et al.	

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Petitioner Hisense USA Corporation
Exhibit 1002 - Page 338 of 482

Receipt date: 12/27/2009	Application Number	11829912	11829912 - GAU: 2883
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2007-07-29	
	First Named Inventor	Medendorp, Jr.	
	Art Unit	2883	
	Examiner Name	Kianni, Kaveh C.	
	Attorney Docket Number	4241-696	

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Exhibit 1002 - Page 339 of 482

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**	**Art Unit:**	**2883**
Date Filed:	**July 29, 2007**	**Examiner:**	**K. Cyrus Kianni**
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

CERTIFICATE OF EFS FILING

I hereby certify that this document is being filed via EFS in the United States Patent and Trademark Office on **June 25, 2010**.
/vincent k. gustafson/

RESPONSE TO MARCH 25, 2010 OFFICE ACTION IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

This responds to the March 25, 2010 Office Action in the above-identified application.

The time for responding to the March 25, 2010 Office Action without extension fee payment was set at three months, or June 25, 2010.

Please amend the claims of the above-identified patent application as set out in **Section I (Amendments to the Claims)** hereof.

Please amend the drawings of the above-identified patent application as set out in **Section II (Amendments to the Drawings)** hereof.

Please amend the specification of the above-identified patent application as set out in **Section III (Amendments to the Specification)** hereof.

Remarks concerning the amendments to the application and the substance of the March 25, 2010 Office Action are set out in **Section IV (Remarks)** hereof.

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Section I (Amendments to the Claims)

Please amend claims 1, 4-7, 9, 10, 13-15, 17-19, 21-26, 28, 29, and 32-34; cancel claims 8, 12, 16, 30, and 31; and add new claim 53, as set out in the following listing of the claims of the application.

1. **(Currently amended)** A liquid crystal display (LCD) system comprising:
   a) a LCD panel;
   b) at least one waveguide element comprising a plurality of light entry regions;
   c) a first light-emitting source comprising a first plurality of LEDs arranged in a first strip and positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions; ~~and~~
   d) ~~at least~~ a second light-emitting source comprising a second plurality of LEDs arranged in a second strip and positioned to emit light into the at least one waveguide element at ~~at least~~ a second light entry region of the plurality of light entry regions; and
   e) a common control circuit in electrical communication with at least one of the first plurality of LEDs and the second plurality of LEDs.

2. **(Withdrawn)** The LCD system of claim 1, wherein the LCD panel has a viewable surface, the at least one waveguide element has a transmissive surface, and the transmissive surface is approximately the same size as the viewable surface.

3. **(Withdrawn)** The LCD system of claim 2, wherein the viewable surface has a diagonal measurement of at least about 12 inches.

4. **(Withdrawn – currently amended)** The LCD system of claim 1, wherein each of the first light entry region and the ~~at least a~~ second light entry region is disposed at a different location on the at least one waveguide element selected from: a top edge of the at least one waveguide element, a bottom edge of the at least one waveguide element, a first side edge of the at least one waveguide element, a second side edge of the at least one waveguide element, and a back side of the at least one waveguide element.

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5. **(Currently amended)** The LCD system of claim 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source comprises a [[LED]] plurality of LEDs adapted to emit any of white light and single color light.

6. **(Currently amended)** The LCD system of claim 5, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source comprises a plurality of direct LEDs [[LED]].

7. **(Currently amended)** The LCD system of claim 5, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source comprises a plurality of side view LEDs [[LED]].

8. **(Cancelled)** ~~The LCD system of claim 1, wherein the first light-emitting source comprises a first plurality of LEDs and the at least a second light-emitting source comprises a second plurality of LEDs~~.

9. **(Currently amended)** The LCD system of claim [[8]] 1, wherein each of the first plurality of LEDs and the second plurality of LEDs comprises LEDs adapted to emit different wavelengths.

10. **(Currently amended)** The LCD system of claim [[8]] 1, wherein each LED of the first plurality of LEDs and second plurality of LEDs is adapted to output substantially the same wavelength.

11. **(Currently amended)** The LCD system of claim [[8]] 1, wherein the first plurality of LEDs is adapted to emit a first wavelength and the second plurality of LEDs is adapted to emit a second wavelength.

12. **(Cancelled)** ~~The LCD system of claim 8, wherein the first plurality of LEDs and the second plurality of LEDs are arranged in at least one strip~~.

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13. **(Currently amended)** The LCD system of claim [[12]] 1, ~~wherein the at least one strip comprises~~ further comprising a common control circuit in electrical communication with each LED of at least one of the first plurality of LEDs and the second plurality of LEDs ~~arranged in the at least one strip~~.

14. **(Currently amended)** The LCD system of claim [[12]] 1, wherein ~~the~~ at least one of the first strip and the second strip comprises a common electrostatic discharge diode in electrical communication with the plurality of LEDs arranged in the ~~at least one~~ respective strip.

15. **(Currently amended)** The LCD system of claim [[12]] 1, wherein each LED of at least one of the first plurality of LEDs and the second plurality of LEDs is ~~arranged in the at least one strip are~~ linearly arranged.

16. **(Cancelled)** ~~The LCD system of claim 8, wherein the at least one strip comprises a first strip and a second strip, with the first plurality of LEDs being arranged in the first strip and the second plurality of LEDs being arranged in the second strip~~.

17. **(Currently amended)** The LCD system of claim [[16]] 1, ~~further comprising a~~ wherein the common control circuit is in electrical communication ~~any~~ with each of the first plurality of LEDs and the second plurality of LEDs.

18. **(Currently amended)** The LCD system of claim [[16]] 1, ~~wherein~~ further comprising an electrostatic discharge diode in electrical communication with ~~any~~ each of the first plurality of LEDs and the second plurality of LEDs.

19. **(Withdrawn – currently amended)** The LCD system of claim [[16]] 1, wherein each of the first plurality of LEDs and the second plurality of LEDs is linearly arranged.

20. **(Withdrawn)** The LCD system of claim 1, wherein any of the first light-emitting source and the ~~at least~~ a second light-emitting source is optically coupled to the at least one waveguide element.

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21. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source is optically coupled to extensions of the at least one waveguide element ~~surface~~ that are non-coplanar with a principal plane of the at least one waveguide element.

22. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 21, wherein the extensions are ~~bent~~ angled toward a principal plane of the at least one waveguide element.

23. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source is embedded within a surface of the at least one waveguide element.

24. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source is optically coupled to at least one recess defined in a surface of the at least one waveguide element.

25. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source is optically coupled to a back portion of the at least one waveguide element.

26. **(Withdrawn – currently amended)** The LCD system of claim [[20]] 1, wherein any of the first light-emitting source and the ~~at least a~~ second light-emitting source is optically coupled to an edge of the at least one waveguide element.

27. **(Withdrawn)** The LCD system of claim 1, wherein the at least one waveguide element comprises a first waveguide element and a second waveguide element.

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28. **(Withdrawn – currently amended)** The LCD system of claim 27, wherein the first light emitting source is optically coupled to the first waveguide element and the ~~at least a~~ second light-emitting source is optically coupled to the second waveguide element.

29. **(Withdrawn – currently amended)** The LCD system of claim 28, wherein the first light-emitting source comprises a first plurality of LEDs and the ~~at least a~~ second light-emitting source comprises a second plurality of LEDs.

30. **(Cancelled)** ~~The LCD system of claim 29, wherein the first plurality of LEDs and the second plurality of LEDs are arranged in a common strip~~.

31. **(Cancelled)** ~~The LCD system of claim 29, wherein first plurality of LEDs and the second plurality of LEDs are arranged in a plurality of strips~~.

32. **(Currently amended)** The LCD system of claim 1, wherein any of the first light emitting source and the ~~at least a~~ second light-emitting source is disposed along an edge region of the LCD system, and positioned to emit light into an edge of the at least one waveguide element.

33. **(Currently amended)** The LCD system of claim 1, wherein any of the first light emitting source and the ~~at least a~~ second light-emitting source is disposed along a center region of the LCD system behind the LCD panel, and is positioned to emit light into a back side of the at least one waveguide element.

34. **(Currently amended)** The LCD system of claim 1, wherein any of the first light emitting source and the ~~at least a~~ second light-emitting source is disposed at a location selected from: [[1)]] (a) along an edge region of the LCD system, positioned to emit light into an edge of the at least one waveguide element, and [[2)]] (b) along a center region of the LCD system behind the LCD panel, positioned to emit light into a back side of the at least one waveguide element.

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35. **(Withdrawn)** The LCD system of claim 1, wherein the at least one waveguide element comprises a prism.

36. **(Withdrawn)** The LCD system of claim 1, further comprising at least a third light-emitting source, positioned to emit direct backlight onto the LCD panel.

37. **(Original)** The LCD system of claim 1, embodied in a television.

38. **(Original)** The LCD system of claim 1, embodied in a computer monitor.

39. **(Withdrawn)** A liquid crystal display (LCD) system comprising:

a) a LCD panel with a viewable surface having a diagonal measurement of at least about 12 inches;

b) at least one waveguide element comprising a plurality of light entry regions;

c) a first light-emitting source positioned to emit light into the at least one waveguide element at a first light entry region of the plurality of light entry regions; and

d) at least a second light-emitting source positioned to emit light into the at least one waveguide element at at least a second light entry region of the plurality of light entry regions;

wherein each of the first light-emitting source and the at least second light-emitting source comprises a plurality of LEDs arranged in at least one strip.

40. **(Withdrawn)** The LCD system of claim 39, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a direct LED.

41. **(Withdrawn)** The LCD system of claim 39, wherein any of the first light-emitting source and the at least a second light-emitting source comprises a side view LED.

42. **(Withdrawn)** The LCD system of claim 39, wherein each strip of the at least one strip comprises a common control circuit in electrical communication with the plurality of LEDs arranged in the at least one strip.

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43. **(Withdrawn)** The LCD system of claim 39, further comprising an electrostatic discharge diode in electrical communication with the at least one strip.

44. **(Withdrawn)** A liquid crystal display (LCD) system comprising:

a) a LCD panel;

b) at least one waveguide element comprising at least one light entry region;

c) a first light-emitting source positioned to emit light into the at least one waveguide element at a light entry region; and

d) at least a second light-emitting source positioned to emit direct backlight onto the LCD panel.

45. **(Withdrawn)** A method utilizing a) a LCD panel; b) at least one waveguide element having a first and at least a second light entry region; c) a first light-emitting source; and d) at least a second light-emitting source positioned to emit light into the at least one waveguide element, the method comprising:

optically coupling the first light-emitting source to the at least one waveguide element at the first light entry region;

optically coupling the at least a second light-emitting source to the at least one waveguide element at the at least a second light entry region; and

positioning the at least one waveguide element to backlight the LCD panel.

46. **(Withdrawn)** The method of claim 45, further comprising illuminating the LCD panel with the first light emitting source and the least a second light-emitting source.

47. **(Withdrawn)** A waveguide system comprising:

a) a first waveguide element comprising at least one light entry region;

b) a first light-emitting source positioned to emit light into the first waveguide element at the first light entry region;

c) at least a second waveguide element comprising at least one light entry region; and

d) at least a second light-emitting source positioned to emit light into the at least a second waveguide element at the first light entry region.

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48. **(Withdrawn)** A liquid crystal display (LCD) system comprising:

a) a LCD panel; and

b) the waveguide system of claim 47.

49. **(Withdrawn)** The LCD system of claim 48, wherein the LCD panel has a viewable surface area, the first waveguide element has a first transmissive surface area, the at least a second waveguide element has a second transmissive surface area and the sum of the first transmissive surface area and the second transmissive surface area is approximately the same size as the viewable surface area.

50. **(Withdrawn)** The LCD system of claim 48, further comprising at least a third light-emitting source, positioned to emit direct backlight onto the LCD panel.

51 **(Withdrawn)** A liquid crystal display (LCD) system comprising:

a) a LCD panel;

b) at least one waveguide element comprising an outer light entry region at an edge of said at least one waveguide element and an inner light entry region spaced from said edge of said at least one waveguide element;

c) a first light-emitting diode source positioned to emit light into said outer entry region; and

d) at least a second light-emitting diode source positioned to emit light into said inner light entry region.

52. **(Withdrawn)** A liquid crystal display (LCD) system comprising:

a) a LCD panel having a peripheral region and an inner region;

b) at least one waveguide element comprising a light entry region at an edge of said LCD panel;

c) a first light-emitting diode source positioned to emit light into said light entry region; and

d) at least a second light-emitting diode source positioned to emit light into an inner region of said LCD panel.

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53. **(New)** The LCD system of claim 1, further comprising a third light-emitting source positioned to emit light into the at least one waveguide element.

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Section II (Amendments to the Drawings)

Please amend the drawings by substituting the enclosed Replacement Drawing Sheet 1 (including Figures 1A, 1B, and 1D) for Drawing Sheet 1 (including Figures 1A and 1B) as previously submitted.

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Section III (Amendments to the Specification)

Please amend the specification by substituting the following replacement paragraphs [0020] and [0064] for the correspondingly-numbered paragraphs as originally filed.

[0020] FIG. 1C is a schematic perspective view of the multi-LED strip light source of FIG. 1A and 1B, disposed adjacent to a waveguide. FIG. 1D is a perspective view of a television or computer monitor including a LCD system according to FIG. 1B.

[0064] FIG. 1A is a schematic front view illustration of at least a portion of an exemplary LCD system 1 including a LCD panel 2 and multiple light sources 3A, 3B. FIG. 1B is a schematic side view illustration of the system of FIG. 1A, depicting the LCD panel 2, light sources 3A, 3B and waveguide element 4. FIG. 1C is a schematic side view illustration of an exemplary light source 3B, comprising a plurality of side view LED packages, 6A-6E arranged as a strip on base 7 and emitting light 8, parallel to the plane of base 7, into waveguide 4. FIG. 1D is a perspective view of a television or computer monitor 100 including a LCD system according to FIG. 1B, with the LCD panel 2 arranged in the foreground.

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Section IV (Remarks)

A. Summary of Amendments

By the present Amendment, claims 1, 4-7, 9, 10, 13-15, 17-19, 21-26, 28, 29, and 32-34 have been amended; claims 8, 12, 16, 30, and 31 have been cancelled; and new claim 53 has been added.

Claim 1 has been amended to include the features of original claims 16 and 17, and also to substitute the term "a second light emitting source" for "at least a second light emitting source." The other amended claims have been amended to promote consistency with amended claim 1.

New claim 53 (reciting a third light-emitting source positioned to emit light into the at least one waveguide element) has been added, consistent in character with original claims 1 and 36.

Replacement Drawing Sheet 1 includes new Figure 1D, which has been added at the request of the examiner responsive to a drawing objection raised in the March 25, 2010 Office Action. Paragraphs [0020] and [0064] of the specification have been amended to refer to new Figure 1D of the drawings.

The amendments made herein are fully consistent with and supported by the originally-filed disclosure of this application. No new matter within the meaning of 35 U.S.C. §132(a) has been introduced by the foregoing amendments.

B. Response to Objections to the Drawings

In the March 25, 2010 Office Action, the examiner objected to the drawings under 37 CFR 1.83(a) on the basis that the drawings as filed did not show every feature of the invention specified in the claims. The examiner indicated that the electrostatic discharge diode, television, and computer monitor must be shown or the features cancelled from the claims.

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In response to the examiner's objection to the drawings for allegedly failing to disclose an electrostatic discharge ("ESD") diode, the examiner is respectfully pointed to element 102 of FIG. 5 and the corresponding paragraphs [0063]-[0064] of the specification, as reproduced in pertinent part below.

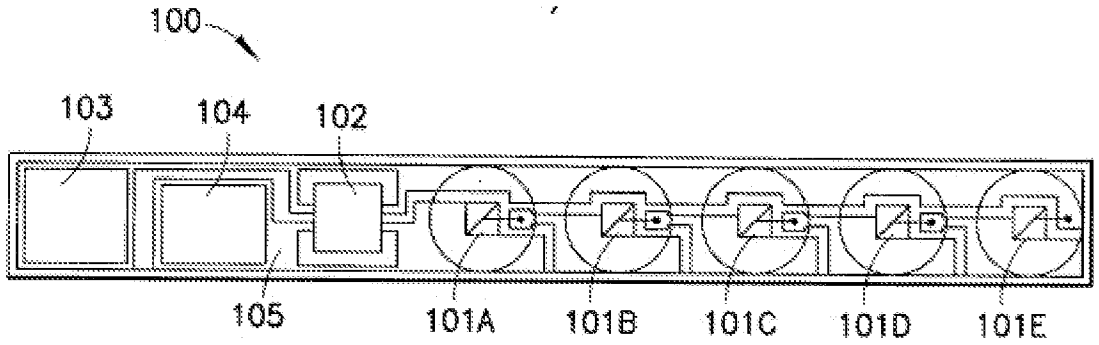

FIG.5

> [0063] … Additionally, **a strip of LEDs may include or be connected to one or more common electrostatic discharge (ESD) diodes**, providing protection from voltage spikes to multiple LEDs within the strip. Moreover, multiple strips may be subject to control from a single master control circuit or CPU.
>
> [0064] FIG. 5 illustrates of an exemplary light source for use in a LCD system, including a plurality of LED packages arranged in a strip 100. In a preferred embodiment, the strip 100 has dimensions of 20 mm x 2.5 mm and contains five or more LED packages 101A-101E, which may be disposed in series. Optionally, such a strip 100 comprises a circuit board 105 including a 2.5 mil thickness FR4 substrate and 1 oz. copper, electroless Nickel Immersion Gold plating, and does not contain soldermask on the back surface. **The strip 100 includes a common ESD diode 102 in electrical communication with the LEDs 101A-101**E. Contacts 103, 104 may be provided to serve as common electrical inputs for the strip 100.

Since element 102 is shown in FIG. 5 and described in paragraphs [0062]-[0063] as an electrostatic discharge (ESD) diode 102, the objection to the drawings for allegedly failing to illustrate an electrostatic discharge diode is without merit. Withdrawal of such objection is warranted, and is respectfully requested.

In response to the examiner's objection to the drawings for failing to illustrate a television or computer monitor, new FIG. 1D has been added herewith to illustrate a television or computer

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monitor 100, with text corresponding to such figure also added to paragraphs [0020] and [0064] of the specification. Addition of new FIG. 1D fully addresses the examiner's objection to the original drawings for failing to illustrate a television or computer monitor. Accordingly, withdrawal of the objection to the drawings corresponding to such issue is warranted, and is respectfully requested.

C. Response to Claim Rejections Under 35 U.S.C. 112, Second Paragraph

In the March 25, 2010 Office Action, claims 16-19 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Specifically, in claim 16, the examiner indicated that the claim lacked antecedent basis for "the at least one strip," and in claim 17, the examiner indicated that the phrase "communication any of" was indefinite / incomplete. Claims 18 and 19, which depend from claim 16, were rejected on the same basis as claim 16.

Claim 16 has been cancelled herewith; accordingly, the rejection of such claim under 35 U.S.C. 112, second paragraph, is moot.

Claim 17 has been amended herewith to depend from claim 1, and to substitute the phrase "in electrical communication with each of" for the phrase "in electrical communication any of" as originally recited. The foregoing substitution eliminates any basis for the rejection of claim 17 under 35 U.S.C. 112, second paragraph.

Claims 18 and 19 have been amended to depend from claim 1, rather than claim 16; accordingly, the rejections of claims 18 and 19 premised on dependency of such claims from rejected claim 16 should be withdrawn.

D. Acknowledgement of Allowable Subject Matter

In the March 25, 2010 Office Action at page 3 thereof, the examiner indicated that "if claims 16 and 17 are properly amended, then claim 17 may be allowable" assuming the inclusion of all limitations of the base claim and any intervening claims.

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E. Response to Claim Rejections Under 35 U.S.C. 103

In the March 25, 2010 Office Action, claims 1, 5-16, 18, 32-34, and 37-38 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable for obviousness over U.S. Patent No. 6,288,700 to Mori ("Mori"). No rejections were raised with respect to original claim 17.

Since claims 8, 12, and 16 have been cancelled herewith, the rejections of such claims under 35 U.S.C. 103 are moot.

Claim 1 has been amended herewith to include all of the features of original claim 17, and the examiner has acknowledged the allowable character of the subject matter recited in original claim 17. All of the remaining, non-withdrawn claims depend, whether directly or indirectly, from amended claim 1, and therefore inherently include all of the features of amended claim 1 pursuant to 35 U.S.C. 112, fourth paragraph.

Since amended claim 1 is directed to subject matter acknowledged as allowable by the examiner, and all of the remaining, non-withdrawn claims of the application include the features of amended claim 1, all rejections under 35 U.S.C. 103 should be withdrawn. Withdrawal of all rejections under 35 U.S.C. 103 is warranted, and is respectfully requested.

F. Request for Rejoinder of Withdrawn Claims Depending (Directly or Indirectly) From Claim 1

The March 15, 2010 Office Action indicated that claims 2-4, 19-31, 35, 36, and 39-52 were withdrawn. Claims 30 and 31 have been cancelled herewith. Of the foregoing withdrawn claims still pending, claims 2-4, 19-29, 35, and 36 depend (whether directly or indirectly) from claim 1.

MPEP 821.04 states in pertinent part:

> The propriety of a restriction requirement should be reconsidered when all the claims directed to the elected invention are in condition for allowance, and the nonelected invention(s) should be considered for rejoinder. Rejoinder involves withdrawal of a restriction requirement between an allowable elected invention and a nonelected invention and examination of the formerly nonelected invention on the merits.

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> In order to be eligible for rejoinder, a claim to a nonelected invention must depend from or otherwise require all the limitations of an allowable claim.

Applicants request rejoinder of withdrawn claims 6, 10-17, 21-25, 27, and 31 pursuant to MPEP 821.04 upon recognition by the examiner of the allowability of amended claim 1, and allowance of such claims.

CONCLUSION

Based on the foregoing, Applicants' claims 1-7, 9-11, 13-15, 17-29, 32-38, and 53 are patentably distinguished over the art, and in form and condition for allowance. The examiner is requested to favorably consider the foregoing, and to responsively issue a Notice of Allowance confirming allowability of claims 1-7, 9-11, 13-15, 17-29, 32-38, and 53. If any issues require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same.

Respectfully submitted,

/vincent k. gustafson/
Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

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Exhibit 1002 - Page 357 of 482

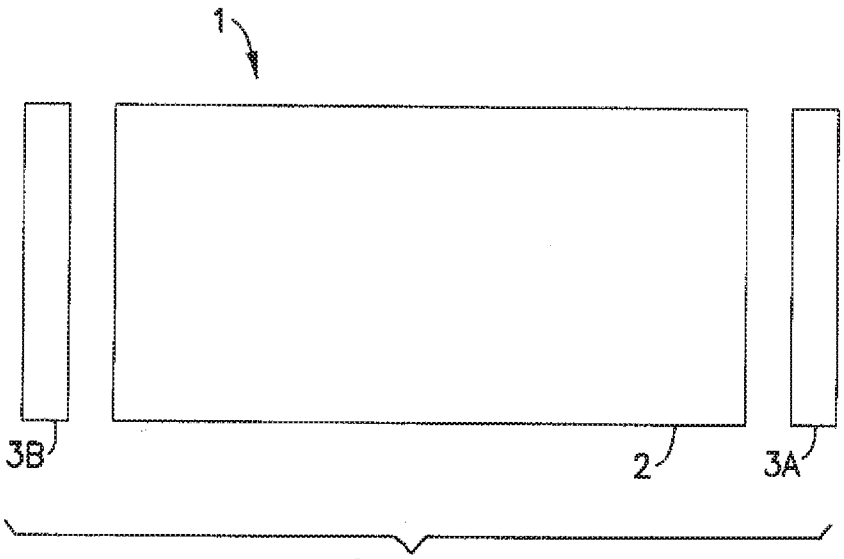

FIG. 1A

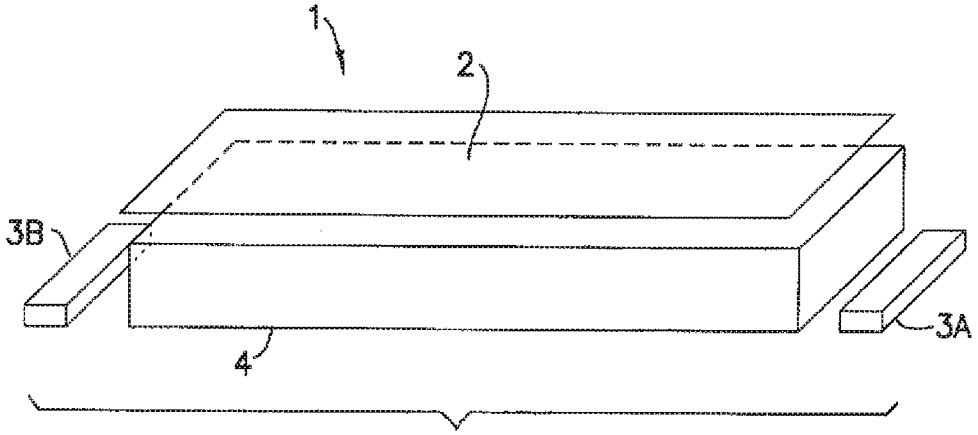

FIG. 1B

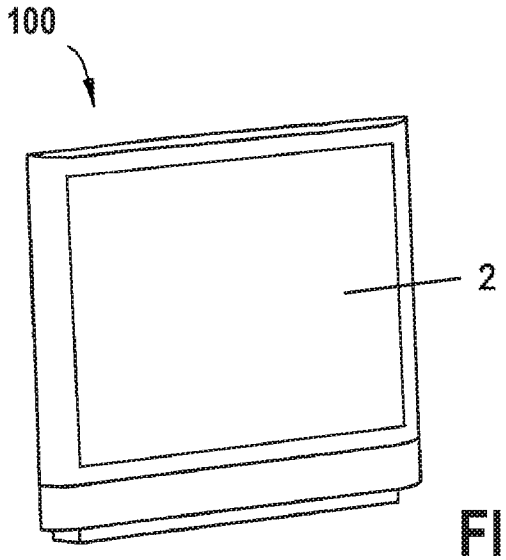

FIG. 1D

Electronic Acknowledgement Receipt

EFS ID:	7892034
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson
Filer Authorized By:	
Attorney Docket Number:	4241-696
Receipt Date:	25-JUN-2010
Filing Date:	29-JUL-2007
Time Stamp:	11:27:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	696_Response_to_03-25-10_Office_Action.pdf	91166 96493835ccbb5486c1269805d6e6a47bd9245e83	no	18

Warnings:	
Information:	

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Exhibit 1002 - Page 359 of 482

2	Drawings-only black and white line drawings	696_Replacement_Drawing_Sheet_1.pdf	234484 97531a1a91db8eb8fadd00985092a7e4a94124e8	no	1

Warnings:	
Information:	
Total Files Size (in bytes):	325650

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
11/829,912	07/29/2007	

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY ☐ RATE ($)	SMALL ENTITY ☐ FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT 06/25/2010	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 48	Minus	** 52	= 0	X $ =		OR	X $52=	0
Independent (37 CFR 1.16(h))	* 7	Minus	***7	= 0	X $ =		OR	X $220=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/MARSHA R. RICHARDS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

U.S.PATENTS Remove

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	1	2007074933	WO	A1	2007-07-05	Naijo, S. et al.		☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	KIANNI, KAVEH C.
	Attorney Docket Number	4241-696

	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	11829912
	Filing Date	2007-07-29
	First Named Inventor	Medendorp, Jr.
	Art Unit	2883
	Examiner Name	KIANNI, KAVEH C.
	Attorney Docket Number	4241-696

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/vincent k. gustafson/	Date (YYYY-MM-DD)	2010-09-10
Name/Print	Gustafson, Vincent K.	Registration Number	46182

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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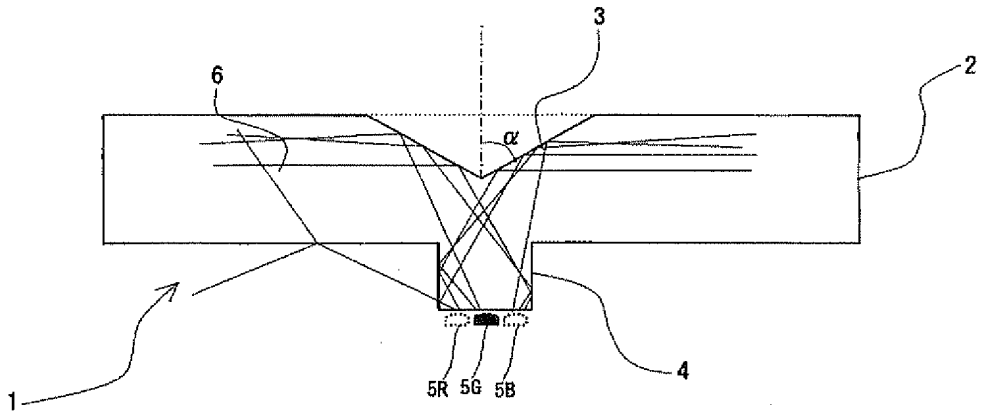
(54) **Title:** LIGHT GUIDE MEMBER, FLAT LIGHT SOURCE DEVICE, AND DISPLAY DEVICE



(57) **Abstract:** A light guide member capable of reducing an unevenness of luminescent color and further a nonuniformity in luminance when obtaining a white color by a color mixture using a plurality of light sources, a flat light source device and a display device are provided. A protrusion 4 of a cylindrical shape is formed upward a plurality color of LED light sources 5R, 5G, 5B, e.g., RGB color at a backside face of a light guide member 1, and a conical depression 3 is disposed at the position directly over the protrusion. Lights of each color from LED light sources 5R, 5G, 5B are mixed at the protrusion 4, thereafter reflect at the depression 3 and propagates in a horizontal direction at a light guide portion 2.

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DESCRIPTION

LIGHT GUIDE MEMBER, FLAT LIGHT SOURCE DEVICE, AND DISPLAY DEVICE

CROSS REFERENCES OF RELATED APPLICATION

This application is an application filed under 35 U.S.C. §111(a) claiming benefit pursuant to 35 U.S.C. §119(e)(1) of the filing date of Provisional Application 60/755,791 filed on January 4, 2006 pursuant to 35 U.S.C. §111(b).

TECHNICAL FIELD

The present invention relates to a light guide member for a flat light source device, a flat light source device using the light guide member, and a display device provided with the flat light source device that are used as a back light for a liquid crystal display for instance.

BACKGROUND OF THE INVENTION

In recent years, a light emission efficiency of a light-emitting diode device has been extremely improved, and an application of the luminous diode device to an illumination is being progressed. In particular, in the case in which there is used a light emitting diode device

as a back light for a liquid crystal display, a satisfactory gamut of reproducible colors and a high speed response can be implemented and it is expected that a high quality display be achieved.

Conventionally, the main stream of such a back light for a liquid crystal display has been the so-called edge light type in which a cold cathode tube as an light source is disposed on the edge face of the chassis for thinning and low power consumption of the apparatus. However, a demand of enlarging a liquid crystal display has been increased in recent years, and the edge light type has a limitation in the case in improving a luminance and a uniformity in the luminance. Therefore, an adoption of a direct lighting type light has been examined for a large size liquid crystal display.

Fig. 12 is a cross sectional view for showing a configuration of a conventional flat light source device of a direct lighting type used in a liquid crystal display (TECHNO-FRONTIER SYMPOSIUM 2005, Thermal Design and Countermeasure Technology Symposium, Issue Date: April 20, 2005 (Japan Management Association), Session G3: Latest Design Case of Heat Radiation Mounting I (pp. G3-3-1 to G3-3-4), and so on). The flat light source device 101 is disposed directly below a liquid crystal panel 21. In the

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flat light source device 101, LED light sources 5 using a light emitting diode device are disposed in an array pattern on a bottom face of a chassis 12. Moreover, the bottom face and side faces of the chassis 12 are covered with a reflecting sheet 13. Furthermore, over the LED light source 5, a diffusing sheet 14 and a prism sheet 15 are disposed in the range of 1 to 5 cm in general apart from the LED light source 5.

In the case in which a light is emitted from the LED light source 5, the emitted light travels directly toward the diffusing sheet 14, or is reflected by the reflecting sheet 13 and travels toward the diffusing sheet 14. The emitted light is then irregularly reflected in the diffusing sheet 14, and is inclined in a vertical direction by passing through the prism sheet 15. The emitted light then enters a liquid crystal panel 21. Lights emitted from different LED light source 5 are mixed in a space between the LED light sources and the diffusing sheet 14. The mixing is then improved by an irregular reflection in the diffusing sheet 14, thereby implementing a uniform luminance and a uniform chromaticity. Moreover, a luminance at the section directly over the LED light sources 5 is higher than that of other sections. Therefore, a uniformity in a luminance can be further improved by

increasing a diffusability of the diffusing sheet 14 at the section directly over the LED light sources 5, thereby improving a uniformity of a luminance of the entire liquid crystal panel 21.

In the conventional flat light source device, the diffusing sheet is disposed and the diffusing sheet is apart from the LED light sources in order to uniform a luminance and a chromaticity as described above. However, in the case in which a color mixture is carried out by using LED light sources of a plurality of colors such as RGB, a color mixture is insufficient and unevenness of colors may be found. In addition, there is a problem that a luminance of the section directly over the LED light sources becomes higher.

Accordingly, to reduce an unevenness of luminance and the like, a luminance of the section directly over the LED light sources 5 is reduced by increasing a diffusability of the diffusing sheet 14 directly over the LED light source 5, or a so-called lighting curtain for improving a uniformity of a luminance of the entire liquid crystal panel 21 is disposed directly over the LED light sources in order to reduce a luminance of the section directly over the LED light sources in some cases. However, the above means cause a utilization efficiency of a light

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to be lowered.

Moreover, in the case in which the diffusing sheet is made further apart from the LED light sources, a nonuniformity in chromaticity and a nonuniformity in luminance can be reduced. However, this method causes a thickness of a back light to be enlarged, and is not preferable for a flat panel display.

In order to implement a uniform chromaticity and a uniform luminance and suppress a thickness of the flat light source device, it is effective to use a light guide plate to shut up and propagate a light emitted from a linear type light source or a dot type light source in the light guide plate, and to emit a uniform light forward from the light guide plate (Japanese Patent Publication No. 3151830).

In the above described flat light source device of a direct lighting type, in order to sufficiently implement a uniform chromaticity and a uniform luminance and suppress a thickness of the planar light source device, it is effective to dispose a light guide plate that faces to LED light sources in front of a substrate in which a plurality of LED light sources is disposed and to dispose a reflecting layer on the back face side of the light guide plate if necessary, thereby propagating a light that has

been emitted from the LED light source and has traveled to the back face in the light guide plate and then extracting the light from the front face of the light guide plate.

However, even in the case in which such a light guide plate is used, in the case in which LED light sources of a plurality of colors such as RGB are used, a nonuniformity in chromaticity may be found. In addition, a luminance of the light guide plate at the position directly over the LED light sources becomes higher, and a nonuniformity in luminance cannot be canceled to a sufficient level.

As effective technology for canceling a nonuniformity in luminance, Japanese Laid-Open Patent Publication No. 2003-8081, Japanese Laid-Open Patent Publication No. 2003-8068, and Japanese Laid-Open Patent Publication No. 2004-133391 disclose a lens for changing a direction of a light emitted from an LED light source to a horizontal direction. As shown in Fig. 13(a), a lens 31 is provided with a depression 32 in a funnel shape on the upper face and a saw tooth shaped portion 33 on the periphery. A light emitted from an LED light source 5 disposed below the lens 31 is reflected and refracted at the funnel shaped portion 32 and the saw tooth shaped portion 33, thereby spreading an irradiation region of a

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light in a horizontal direction and suppressing an increase in a luminance at the position directly over the LED light source 5.

Although the lens 31 can guide most lights emitted from the LED light source 5 in a horizontal direction, the shape of the lens is complicated. On the other hand, as shown in Fig. 13(b), while a lens 41 provided with a conical depression 42 on the upper face of a cylindrical substrate has a simple shape, part of lights emitted from the LED light source 5 is reflected at a side face 43 of the cylinder and travels upward through the lens. The light that travels upward through the lens may cause a nonuniformity in chromaticity.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a light guide member capable of reducing an unevenness of colors of a flat light source device in the case in which LED light sources of a plurality of colors such as RGB are used.

Another object of the present invention is to provide a light guide member capable of reducing a nonuniformity in luminance of a flat light source device caused by a higher luminance at the section directly over

a light source.

Another object of the present invention is to provide a flat light source device in which an irregular luminescent color is reduced in the case in which LED light sources of a plurality of colors such as RGB are used.

Another object of the present invention is to provide a flat light source device in which there is reduced a nonuniformity in luminance of the flat light source device caused by a higher luminance at the section directly over an light source.

Another object of the present invention is to provide a display device provided with the flat light source device described above.

The present invention involves the following modes (1) to (10).

(1) A light guide member for propagating inside a light that has been emitted from an light source disposed on a back face side and for emitting the light outside from a front face, is characterized by comprising:

a light guide portion provided with the back face and the front face that is a reflecting face for propagating in a horizontal direction a light emitted from the light source, and

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a protrusion that is protruded downward from the back face of the light guide portion and under which a plurality of light sources generating different colors is disposed,

wherein the protrusion is integrated with the light guide portion,

the protrusion improves a color mixture of lights irradiated inside from a plurality of the light sources, and

the light guide portion propagates in a horizontal direction the lights that have been emitted from a plurality of the light sources and that have been mixed in the protrusion.

(2) A light guide member as defined in above (1) is characterized in that the protrusion is in a cylindrical shape and the light guide portion is provided with a conical depression in such a manner that the depression is disposed at the position of the front face directly over the protrusion.

(3) A light guide member as defined in above (1) or (2) is characterized in that one protrusion is provided with.

(4) A light guide member as defined in above (1) or (2) is characterized in that a plurality of protrusions is provided with.

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(5) A light guide member as defined in any one of above (1) to (4) is characterized by further comprising a reflecting part on the side face of the protrusion.

(6) A light guide member as defined in any one of above (1) to (5) is characterized by further comprising a reflecting part on the depressed face of the depression.

(7) A flat light source device is characterized by comprising:

the light guide member as defined in any one of above (1) to (6), and

a plurality of light sources generating colors different from each other, which are disposed below the protrusion of the light guide member.

(8) A flat light source device is characterized by comprising:

the light guide member as defined in above (2), and

a plurality of light sources generating different colors, which are disposed below the protrusion of the light guide member,

wherein the protrusion reflects part of lights emitted from a plurality of the light sources at the side face and guides the lights to the depression, and

the depression reflects the lights reflected at the protrusion and the lights directly irradiated from a

plurality of the light sources and propagates the lights in a horizontal direction in the light guide portion.

(9) A display device is characterized by comprising the flat light source device as defined in above (7) or (8).

(10) A display apparatus as defined in above (9) is characterized in that a display portion is a liquid crystal panel.

For the invention in above (1), the protrusion "below" which the light sources are disposed involves both types in which the light sources are disposed directly below the protrusion apart from the bottom face of the protrusion as shown in Fig. 2, and in which the light sources are disposed (buried) in the bottom section of the protrusion as shown in Fig. 6. The expression of disposing the light sources "below" the protrusion can be applied to the both types. In the latter case, for the light guide member and the light sources integrated with the protrusion, the section from which the light sources are excluded is a light guide member.

A light guide member related to the present invention can reduce an unevenness of luminescent color of a flat light source device in the case in which LED light sources of a plurality of colors such as RGB are used.

A light guide member related to the present

invention can reduce a nonuniformity in luminance of a flat light source device caused by a higher luminance at the section directly over a light source.

A flat light source device related to the present invention has a satisfactory uniformity of a chromaticity and a luminance.

A display device related to the present invention is a display device such as a liquid crystal display in which the flat light source device described above is used as a back light, thereby implementing a high quality image.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing an entire configuration of an example of a liquid crystal display device in which an embodiment of the present invention is applied;

Fig. 2 is a cross sectional view showing an example of a light guide member related to the present invention;

Fig. 3 is a top view showing the light guide member of Fig. 1;

Fig. 4 is a cross sectional view for illustrating a course of a light emitted from a light source in a light guide member related to the present invention;

Fig. 5 is a cross sectional view showing another example of a light guide member related to the present invention;

Fig. 6 is a cross sectional view showing another example of a light guide member related to the present invention;

Fig. 7 is a partial top view showing an arrangement of the light sources of a flat light source device and a light guide member related to an example of the present invention;

Fig. 8 is a cross sectional view showing another example of a light guide member related to the present invention;

Fig. 9 is a top view showing the light guide member of Fig. 8;

Fig. 10 is a top view showing another example of a light guide member related to the present invention;

Fig. 11 is a cross sectional view showing an entire configuration of a flat light source device related to an example of the present invention;

Fig. 12 is a cross sectional view for showing a configuration of a conventional flat light source device of a direct lighting type used in a liquid crystal display;

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Figs. 13(a) and 13(b) are cross sectional views showing a lens for changing a direction of a light emitted from an LED light source to a horizontal direction.

BEST MODE FOR CARRYING OUT THE INVENTION

An embodiment of the present invention will be described below in detail with reference to the drawings. However, the present invention is not restricted to the embodiment.

Fig. 1 is a view showing an entire configuration of an example of a liquid crystal display device to which an embodiment of the present invention is applied. A liquid crystal display device to which the embodiment is applied includes, as a flat light source device of a direct lighting type (back light) 50, a back light flame (chassis) 51 that accommodates a light emitting part and an LED substrate (mounting substrate) 52 as a substrate in which a plurality of light emitting diodes (LED) 53, which is a solid-state lighting device, are arranged as illumination sources.

Further, on the LED substrate (mounting substrate) 52, the back light device 50 includes a light guide member 54 which is a feature of the present invention, and which is accommodated in the back light flame (chassis) 51.

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The difference from a conventional direct lighting type back light device as shown in Fig. 12 lies in that the light guide member interposes in a space between the light emitting diodes and the diffusing sheet, thereby enabling to shorten an interval between the light emitting diodes and the diffusing sheet without increasing a thickness of the back light.

On the light guide member, as a laminate of optical compensation sheets, it is equipped with a diffusing sheet 55 that diffuses and scatters a light to render a uniform brightness to the entire surface, and prism sheets 56, 57 that are grating films which exhibit a light collection effect to the forward direction.

Also, as a liquid crystal display module 60, it is equipped with a liquid crystal panel 61 in which a liquid crystal is sandwiched between two glass substrates, and polarizing plates (polarizing filters) 62, 63 for restricting a vibration of a light wave to a certain direction.

Further, the liquid display device is arranged with peripheral members, e.g., a driver LSI (not shown).

The liquid crystal panel 61 is constituted with including many kinds of components that are not shown in the figure. For instance, it is equipped with a display

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electrode, an active device such as a TFT (Thin Film Transistor), and a liquid crystal, a spacer, a sealing agent, an alignment film, a common electrode, a protection film, a color filter, etc., which are not shown, on or between the two glass substrates.

Fig. 2 is a cross sectional view showing an embodiment of a light guide member related to the present invention, and Fig. 3 is a top view thereof. As shown in the figures, a light guide member 1 is provided with a light guide portion 2 having a front face and a back face that are reflecting faces for propagating lights emitted from a red LED light source 5R, a green LED light source 5G, and a blue LED light source 5B in a horizontal direction.

A cylindrical protrusion 4 directly below which LED light sources 5R, 5G, and 5B are disposed is formed in a protruding manner on the back face of the light guide member 2.

A conical depression 3 is formed on the front face at the position directly over the protrusion 4.

Fig. 4 is a cross sectional view for illustrating a course of a light emitted from a light source in a light guide member related to the present invention. As shown in the figure, part of each of color lights emitted from the

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LED light sources 5R, 5G, and 5B is reflected at the side face of the cylindrical protrusion 4, and the reflected lights travel to the depression 3. Of the reflected lights, a light irradiated to the depressed face of the depression 3 at an angle smaller than a total reflection angle is reflected at the depression 3 and is guided in a horizontal direction in the light guide portion 2.

Of lights that have been emitted from the LED light sources 5R, 5G, and 5B and traveled to the protrusion 4, lights in a vertical direction and in a close direction are directly irradiated to the depression 3. The conical depression 3 is formed at an inclination angle α in such a manner that all or most lights directly irradiated from the LED light sources 5R, 5G, and 5B are totally reflected and guided in a horizontal direction in the light guide portion 2. Consequently, most of the lights directly irradiated from the LED light sources 5R, 5G, and 5B to the depression 3 are reflected at the depression 3 and guided in a horizontal direction in the light guide portion 2.

As described above, by the operations of the cylindrical protrusion 4 and the conical depression 3, a part of lights irradiated from the LED light sources 5R, 5G, and 5B disposed directly below the protrusion 4 is

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guided in a horizontal direction in the light guide portion 2. A light guided in the light guide portion 2 is propagated in the light guide portion 2, and emitted outside from the front face of the light guide portion 2 by forming a reflection part made by a minute uneven structure or made by drawing a dot shape with a reflection ink, for instance, on the back face of the light guide portion 2.

Consequently, by externally extracting lights emitted from the LED light sources 5R, 5G, and 5B after making the lights pass through a light guide member 1, an increase in a luminance at the position directly over the LED light sources 5R, 5G, and 5B is suppressed, and a uniformity of a luminance of a light emitted from a flat light source device can be improved. In particular, the depression 3 is formed at the position directly over the LED light sources 5R, 5G, and 5B, and lights emitted from the light sources are reflected in a horizontal direction, thereby greatly suppressing an unevenness of luminance caused by a higher luminance at the position directly over the light sources.

In the present embodiment, since the protrusion 4 is formed and the LED light sources 5R, 5G, and 5B of three colors are disposed directly below the protrusion, part of

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each of color lights that have been emitted from the LED light sources 5R, 5G, and 5B and that have traveled to the protrusion 4 travels upward on the course of a reflection at the side face of the protrusion 4. A color mixture is improved by repeating a reflection at the side face of the protrusion 4, and lights of mixed colors are propagated in a horizontal direction in the light guide portion 2. Consequently, lights with less unevenness of colors can be extracted from the front face of the light guide member, thereby improving a uniformity of a chromaticity of a light emitted from a flat light source device.

Fig. 5 is a cross sectional view showing another embodiment of a light guide member related to the present invention. As shown in the figure, for the light guide member 1, while the depression 3 of the light guide portion 2 is in a shape similar to a circular cone, the reflecting face is a curved face in such a manner that the angle gradually increases toward the center. In the present invention, the conical shape involves such a shape.

Fig. 6 is a cross sectional view showing another embodiment of a light guide member related to the present invention. As shown in the figure, for the light guide member 1, the LED light sources 5R, 5G, and 5B are buried in the bottom of the cylindrical protrusion 4. Such a

light guide member 1 can be fabricated, for instance, by integrating the light guide member 1 onto a substrate in which the LED light sources 5R, 5G, and 5B have been disposed by using a material such as a thermosetting resin, a photo curing resin, and a thermoplastic resin. More specifically, a light guide member can be fabricated by the integration with a method of bonding using an adhesive such as an epoxy resin or of an integral molding to a package provided with a substrate in which a circuit for supplying a current to an LED bare chip is formed, a reflector, and each of LED bare chips of R, G, and B that are mounted in the substrate, in such a manner that the LED bare chips are incorporated in the bottom of the protrusion.

Fig. 7 is a part of top view showing an arrangement of the light sources of a flat light source device and a light guide member related to an embodiment of the present invention, and Fig. 11 is a cross sectional view showing an entire configuration. As shown in Fig. 7, for the flat light source device, a plurality of light guide members 1 provided with a protrusion 4 as shown in each embodiment of Figs. 2 to 6 are regularly arranged in such a manner that the protrusion 4 is disposed at the position directly over one unit of LED light sources 5R, 5G, and 5B for an

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LED light source in which three LED light sources 5R, 5G, and 5B as one unit are arranged.

As shown in Fig. 11, the flat light source device 11 related to the present embodiment is disposed directly below a liquid crystal panel 21. In the flat light source device 11, LED light sources 5 are disposed in an array pattern on a bottom face of a chassis 12. Moreover, the bottom face and side faces of the chassis 12 are covered by a reflecting sheet 13. Furthermore, above the LED light sources 5, a diffusing sheet 14 and a prism sheet 15 are disposed in the range of 1 to 5 cm for instance apart from the LED light sources 5.

In the case in which lights are generated from the LED light sources 5, the emitted lights are propagated in a horizontal direction in the light guide member 1 disposed thereon and emitted outside. Then, the lights travel directly toward the diffusing sheet 14, or are reflected by the reflecting sheet 13 and travel toward the diffusing sheet 14. The lights are mixed in a space between the LED light sources and the diffusing sheet 14. The mixing is then improved by an irregular reflection in the diffusing sheet 14, thereby implementing a uniform chromaticity and a uniform luminance. The lights that have been irregularly reflected in the diffusing sheet 14 are

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inclined in a vertical direction by passing through the prism sheet 15. The lights then enter the liquid crystal panel 21.

Fig. 8 is a cross sectional view showing another embodiment of a light guide member related to the present invention, and Fig. 9 is a top view thereof. As shown in the figures, the light guide member 1 is provided with a plurality of protrusions 4 arranged linearly.

A conical depression 3 is formed on the front face of the light guide portion 2 at the position directly over each of a plurality of protrusions 4. The LED light sources 5R, 5G, and 5B are disposed directly below each of a plurality of protrusions 4.

As illustrated in Fig. 4, for the light guide member 1, some of lights emitted from the LED light sources 5R, 5G, and 5B is reflected at the side face of the protrusion 4 and is irradiated to the depression 3, and some of lights emitted from the LED light sources 5R, 5G, and 5B travels to the protrusion 4 and is directly irradiated to the depression 3. Part of the above lights is reflected at the depression 3 at an angle smaller than the total reflection angle and is guided in a horizontal direction in the light guide portion 2.

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As described above, by the operations of the cylindrical protrusion 4 and the conical depression 3, a light irradiated from the LED light sources 5R, 5G, and 5B disposed directly below the protrusion 4 is guided in a horizontal direction in the light guide portion 2. The light guided in the light guide portion 2 is propagated in the light guide portion 2, and is emitted outside from the front face of the light guide portion 2.

Consequently, by externally extracting lights emitted from the LED light sources 5R, 5G, and 5B after making the lights pass through a light guide member 1, an increase in a luminance at the position directly over the LED light sources 5R, 5G, and 5B is suppressed, and a uniformity of a luminance of a light emitted from a flat light source device can be improved. In particular, the depression 3 is formed at the position directly over the LED light sources 5R, 5G, and 5B, and lights emitted from the light sources are reflected in a horizontal direction, thereby greatly suppressing a nonuniformity in luminance caused by a higher luminance at the position directly over the light sources.

In the present embodiment, since the protrusion 4 is formed and the LED light sources 5R, 5G, and 5B of three colors are disposed directly below the protrusion, part of

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each of color lights that have been emitted from the LED light sources 5R, 5G, and 5B and that have traveled to the protrusion 4 travels upward on the course of a reflection at the side face of the protrusion 4. A color mixture is improved by the above means, and lights of mixed colors are propagated in a horizontal direction in the light guide portion 2. Consequently, lights with less unevenness of colors can be extracted from the front face of the light guide member, thereby improving a uniformity of a chromaticity of a light emitted from a flat light source device.

While a plurality of protrusions 4 is arranged linearly in the present embodiment, a plurality of protrusions 4 can also be arranged in array-like manner as shown in the top view of Fig. 10.

A light guide member and a flat light source device related to the present invention will be described below in detail further.

A light guide member related to the present invention is a plate shaped member made of a resin, a glass, a composite thereof, or the like capable of propagating a light. A thickness of the light guide portion is, for instance, in the range of 0.1 to 50 mm, preferably in the range of 1 to 30 mm.

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In the present invention, a conical depression is formed in the shape in which part of lights that have been reflected at the side face of the cylindrical protrusion and irradiated to the depression and part of lights that have traveled to the protrusion and been directly irradiated to the depression are totally reflected in a direction of the light guide portion. In the case in which the depression has such an operation, a shape of the depression is not strictly required to be a circular cone, and a face of the depression 3 can also be curved for instance as shown in Fig. 5.

The cylindrical protrusion is formed in such a manner that the central axis of the protrusion almost corresponds to that of the conical depression and in such a manner that part of lights that have been emitted from the light sources and that have been reflected at the side face of the protrusion is irradiated to the depression at an angle smaller than a total reflection angle and is totally reflected in a direction of the light guide portion. In general, a diameter of the protrusion is almost equivalent to or smaller than that of the most front face of the conical depression.

A reflecting layer for reflecting a light irradiated from the light source into the protrusion can be formed on

the side face of the cylindrical protrusion. By forming the reflecting part, part of lights irradiated into the protrusion is prevented from being emitted outside, thereby increasing an amount of lights irradiated into the light guide portion.

Moreover, the depressed face of the conical depression can be provided with a reflecting part for reflecting a light that has reached the depressed face directly through the protrusion from the light source or reached the depressed face after being reflected at the side face of the protrusion. By forming the reflecting part, the above lights are prevented from being emitted outside from the depression, thereby improving a light propagation in a horizontal direction in the light guide portion.

As the above reflecting part, a white paint is coated, or there are mentioned a white layer formed by printing and a metal shiny layer formed by aluminum deposition.

The flat light source device related to the present invention is provided with a plurality of light sources disposed at a specified pitch and one or a plurality of light guide plates in such a manner that the light guide plate faces to a plurality of the light sources and the

above protrusion disposed at the position over a plurality of the light sources with different luminescent colors.

A plurality of the above light sources is mounted on a substrate, and the light guide member is disposed in front of the substrate with the light sources interposed. If necessary, a reflecting member is disposed on the back face of the light guide member.

The disposed position of each light source corresponding to the protrusion of the light guide member is not restricted in particular in the case in which part of lights that have traveled to the protrusion from each light source is reflected at the side face of the protrusion and part of lights from each light source is propagated in a horizontal direction in the light guide portion by a reflection at the depression. However, in order to carry out a sufficient color mixture in the protrusion, it is preferable to uniformly dispose a plurality of the light sources of each color at the position close to the periphery of the bottom face of the protrusion.

As a light source, for instance, a light emitting diode device with a size in the range of several hundreds μm to 1 mm can be used. As a specified type of an LED light source using a light emitting diode device, there

are mentioned a bare chip type, a type in which a light emitting diode device is mounted in a package, a type in which a light emitting diode device is integrated with a member having a lens function, and so on.

As a mode in which LED light sources are disposed on the substrate, it is preferable to dispose light emitting diode devices of red (R), green (G), and blue (B) on the substrate and to emit a white color light by carrying out a color mixture of the three primary colors. In such a case, as illustrated in the above embodiments, it is preferable to dispose each light source of RGB below one protrusion.

In the case in which the planar light source device is for a white color illumination, an LED light source with a so-called intermediate color such as yellow and orange can also be used to emit a white color light by carrying out a color mixture with a light emitted from another LED light source. It is not required that each light emitting diode devices of each color is used as one component. In case where these are composed of three primary color of R, G, B, each light emitting diode devices of each different color may be used as one component, or a number of light sources may be altered according to a color, e.g., one R, two G and one B, etc.

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While a disposition pitch of LED light sources is not restricted in particular, as the pitch is smaller, a color mixture is better in general.

As a substrate on which LED light sources are disposed, there is mentioned, for instance, a substrate in which a circuit is formed for supplying a current to an LED light source or a laminate of a circuit substrate and a heat radiating substrate. An anode and a cathode of the LED light source are electrically connected to an electrode pad on the circuit substrate. As a method of obtaining the circuit substrate, there is mentioned, for instance, a method of bonding a copper foil to an insulating resin substrate such as a glass epoxy substrate and etching the copper foil in a circuit pattern.

The radiating substrate is a substrate made of a material with a high thermal conductivity, such as a metal such as aluminum, copper, and a stainless steel, or a ceramics such as aluminum nitride. By bonding the radiating substrate to the back face of the circuit substrate, a heat generated from a light emitting diode device is radiated.

As a method of fixing an LED light source onto the substrate, there is mentioned, for instance, a method of a connection by using a connecting means with a small

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thermal resistance, such as a method of forming a through hole at the section on which an LED light source is mounted in the circuit substrate and bonding the LED light source onto the radiating substrate exposed to the through hole by using a silver paste or a thermal conductivity silicone, and a method of thermally melting a metal such as a lead solder and a gold-tin eutectic solder and of connecting the anode and cathode of a bare chip with the electrode pad of the circuit substrate by means of a face down bonding through a bump.

As a reflecting part disposed on the back face of the light guide member, there are mentioned, for instance, a white reflecting sheet bonded to the back face of the light guide member, a film of a white paint printed on the back face of the light guide member, and a white reflecting layer (resist) formed on the circuit substrate.

Moreover, for the protrusion of the light guide member, a package provided with a circuit substrate, a reflector, and a light source of each color mounted on the circuit substrate can be integrated with the protrusion.

In front of the light guide member in front of the LED light source disposed on the substrate, a diffusing sheet as shown in Fig. 11 is preferably disposed, with a distance according to requirement to lower a nonuniformity

in luminance and a nonuniformity in chromaticity. For instance, the light sources are disposed on the bottom of the chassis in which the bottom face and the side face are covered by a reflecting sheet, and a diffusing sheet is disposed on the upper face side of the chassis.

In the present invention, a light scattering dot can be formed on the front face and the back face of the light guide member in order to improve a uniformity of a luminance if necessary. The light scattering dot can be formed by the dot printing of a scattering ink or the integral molding with the light guide member.

The display device related to the present invention is provided with the flat light source device as described above. Typically, a display portion of the display device is a liquid crystal panel, and the flat light source device is disposed on the back face of the liquid crystal panel as a back light as shown in Fig. 11.

Examples

While the detailed examples of the present invention will be described below, the present invention is not restricted to the examples.

[Example 1]

There was fabricated a light guide member, as shown in Fig. 4, provided with a square light guide portion with

a side of 50 mm and with a thickness of 12 mm, a cylindrical protrusion with a diameter of 6 mm and with a height of 6 mm, and a conical depression with a diameter of 14 mm and with an inclination angle of 60 degrees by cutting an acrylic plate with a thickness of 18 mm (product name: SUMIPEX, manufactured by Sumitomo Chemical Co., Ltd.) by using a milling machine.

There was then fabricated an LED package in which a 0.5 W class red LED chip and 1 W class blue and green LED chips were mounted/disposed at a 1.5 mm pitch at vertex positions of an almost equilateral triangle in a package in which a copper wiring pattern capable of mounting an LED on a square substrate with a side of 13 mm was formed and in which a reflector was formed with a bottom face diameter of 6 mm, with a top face diameter of 6 mm, and with a height of 0.5 mm.

A material of the reflector was the white GENESTAR (Registered Trademark, highly heat resistant polyamide resin of a white type manufactured by KURARAY CO., LTD.), and the epoxy resin (product name: NLD-SL-1101 manufactured by SANYU REC CO. LTD.) was filled in the LED chips to seal the LED chips.

The above light guide member was then bonded to the LED package in such a manner that the periphery of the

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bottom face of the protrusion corresponds to the periphery of the top face of the reflector. An epoxy adhesive of a room temperature setting type (product name: Alardyte manufactured by SHOWA HIGHPOLYMER CO., LTD.) was used as an adhesive for the bonded face.

[Example 2]

There was fabricated a light guide member with a size equivalent to that of Example 1, provided with a cylindrical counter boring hole with a diameter of 4 mm on the bottom face of the protrusion, by metal molding using the epoxy resin (product name: NLD-SL-1101 manufactured by SANYU REC CO. LTD.).

Moreover, an LED package equivalent to that of Example 1 was fabricated except that there was no reflector and no epoxy resin sealing.

The above epoxy resin was filled into the cylindrical counter boring hole of the protrusion of the light guide member, and the light guide member was bonded to the LED package in such a manner that each of LED chips of red, green, and blue is disposed in the cylindrical counter boring hole. The heat setting at 100°C for two hours and then at 130°C for three hours was carried out to integrate the light guide member with the LED package.

[Example 3]

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An LED package with a light guide member was fabricated similarly to Example 1 except that a white reflecting layer was formed on the side face of the protrusion of Example 1. The white reflecting layer was formed by coating a pigment paint (product name: White type number 01 of Acrylic lacquer spray manufactured by Nippon Paint Home Products Co., Ltd.) with a thickness of approximately 100 mm.

[Comparison example 1]

An LED package with a light guide member was fabricated similarly to Example 1 except that there was used a light guide member provided with only a depression without the protrusion of Example 1. The light guide member was bonded to the LED package in such a manner that the central axis of the depression corresponds to that of the LED package. An epoxy adhesive of a room temperature setting type (product name: Alardyte manufactured by SHOWA HIGHPOLYMER CO., LTD.) was used as an adhesive for the bonded face.

The LED package with a light guide member fabricated in Examples 1 to 3 and the comparison example 1 was disposed and fixed to an aluminum chassis with a front face opened with a bottom face of longitudinal 60 mm x transverse 60 mm and with a depth of 40 mm. A reflecting

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part in which white reflecting films (product name: Lumirror 60L (Registered Trademark) manufactured by Toray Industries, Inc.) were bonded to each other was formed on the inside faces of the chassis except for the opening portion.

Moreover, a diffusing sheet (polycarbonate, product name: PC9391-50HL manufactured by TEIJIN CHEMICALS LTD.) with a thickness of 1 mm was fixed to the front face of the opening portion of the aluminum chassis to fabricate a flat light source device.

Then, currents of 180 mA (red), 250 mA (green), and 90 mA (blue) were applied to LED chips, and a total average luminance and a chromaticity coordinate on the diffusing sheet were measured by the colorimeter (product name: CS1000 manufactured by Konica Minolta, Inc.). Moreover, there were measured a dispersion of a luminance of each point ([(maximum luminance - minimum luminance) / average luminance] x 100%) and a dispersion of the chromaticity coordinate of each point (a difference of the maximum value from the minimum value of chromaticity coordinates X and Y) in the case in which each point was measured at the 3 mm pitch on the diagonal line from the point corresponding to the normal line at the center

position of the lens on the diffusing sheet. The measured results are listed in Table 1.

Table 1

	Average luminance (cd/m^2)	Luminance dispersion (%)	Average chromaticity (X, Y)	Chromaticity dispersion (ΔX, ΔY)
Example 1	2200	45	(0.29, 0.29)	(0.012, 0.012)
Example 2	2800	35	(0.29, 0.29)	(0.015, 0.014)
Example 3	2700	42	(0.30, 0.31)	(0.019, 0.018)
Comparison example 1	1900	51	(0.30, 0.32)	(0.019, 0.019)

There were obtained satisfactory results in which the total luminance of the examples 1 to 3 is higher than that of the comparison example 1, and the luminance dispersion is smaller. In particular, a reduction effect of the luminance dispersion is large in the example 2.

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CLAIMS

1. A light guide member for propagating inside a light that has been emitted from an light source disposed on a back face side and for emitting the light outside from a front face, comprising:

a light guide portion provided with the back face and the front face that is a reflecting face for propagating in a horizontal direction a light emitted from the light source, and

a protrusion that is protruded downward from the back face of the light guide portion and under which a plurality of light sources generating colors different from each other is disposed,

wherein the protrusion is integrated with the light guide portion,

the protrusion improves a color mixture of lights irradiated inside from a plurality of the light sources, and

the light guide portion propagates in a horizontal direction the lights that have been emitted from a plurality of the light sources and that have been mixed in the protrusion.

2. A light guide member as defined in claim 1, wherein the protrusion is in a cylindrical shape and the light guide portion is provided with a conical depression in such a manner that the depression is disposed at the position of the front face directly over the protrusion.

3. A light guide member as defined in claim 1 or 2, wherein one protrusion is provided with.

4. A light guide member as defined in claim 1 or 2, wherein a plurality of protrusions is provided with.

5. A light guide member as defined in any one of claims 1 to 4, further comprising a reflecting part on the side face of the protrusion.

6. A light guide member as defined in any one of claims 1 to 5, further comprising a reflecting part on the depressed face of the depression.

7. A flat light source device comprising:

the light guide member as defined in any one of claims 1 to 6, and

a plurality of light sources generating colors

different from each other, which are disposed below the protrusion of the light guide member.

8. A flat light source device comprising:

the light guide member as defined in claim 2, and

a plurality of light sources generating colors different from each other, which are disposed below the protrusion of the light guide member,

wherein the protrusion reflects part of lights emitted from a plurality of the light sources at the side face and guides the lights to the depression, and

the depression reflects the lights reflected at the protrusion and the lights directly irradiated from a plurality of the light sources and propagates the lights in a horizontal direction in the light guide portion.

9. A display device comprising the flat light source device as defined in claim 7 or 8.

10. A display device as defined in claim 9, wherein a display portion is a liquid crystal panel.

DRAWINGS

Fig. 1

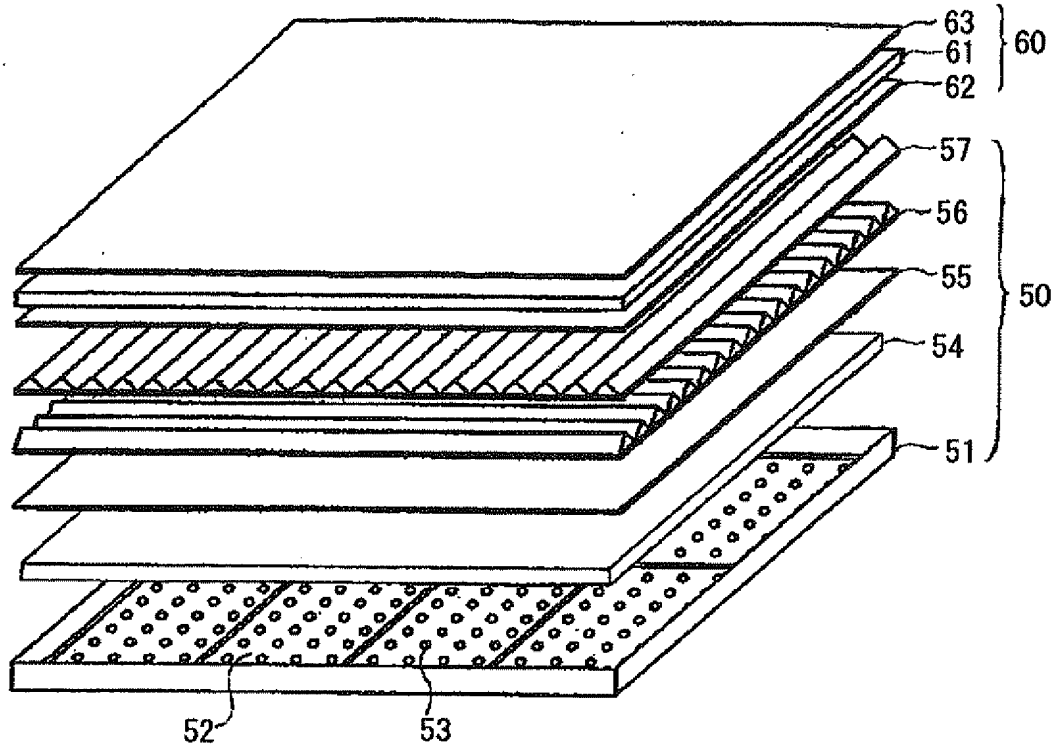


Fig. 2

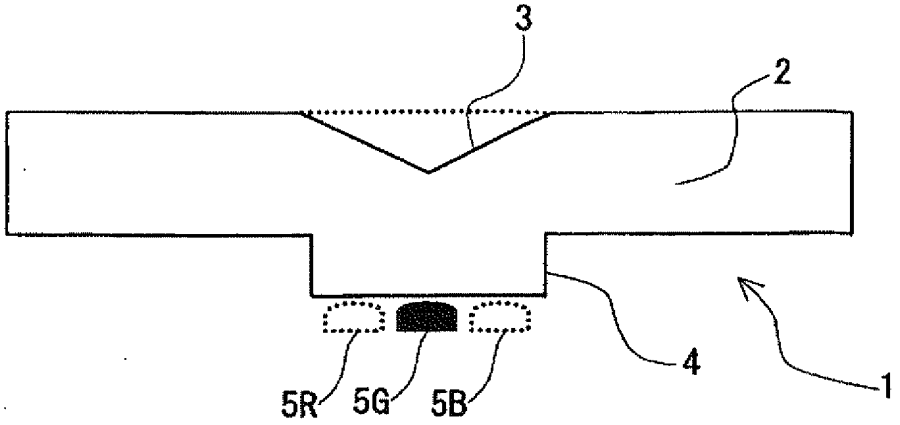


Fig. 3

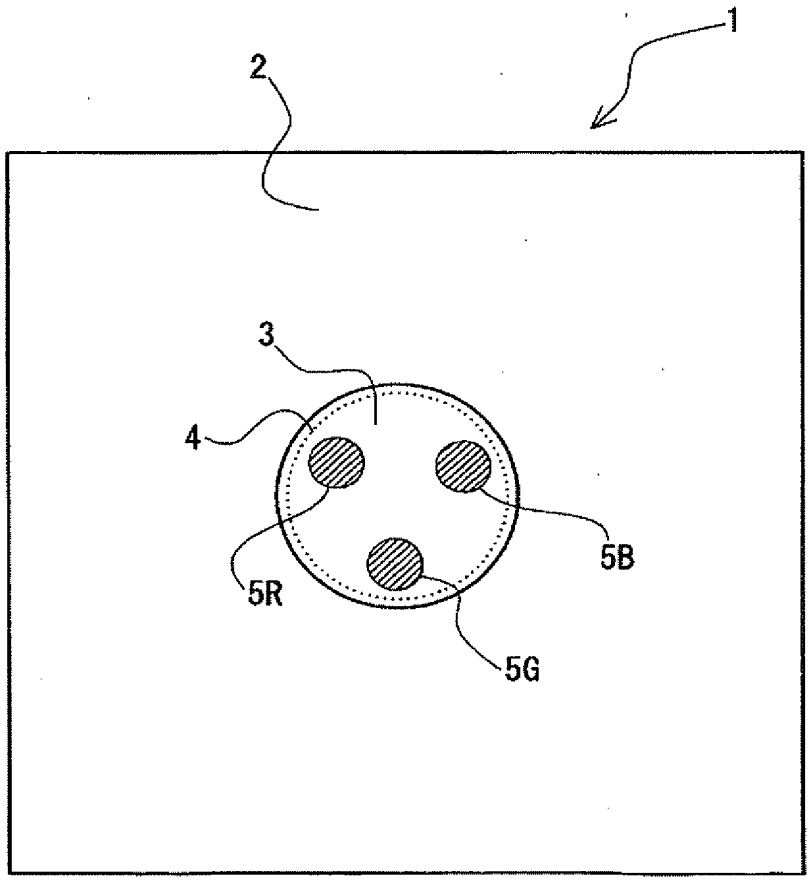


Fig. 4

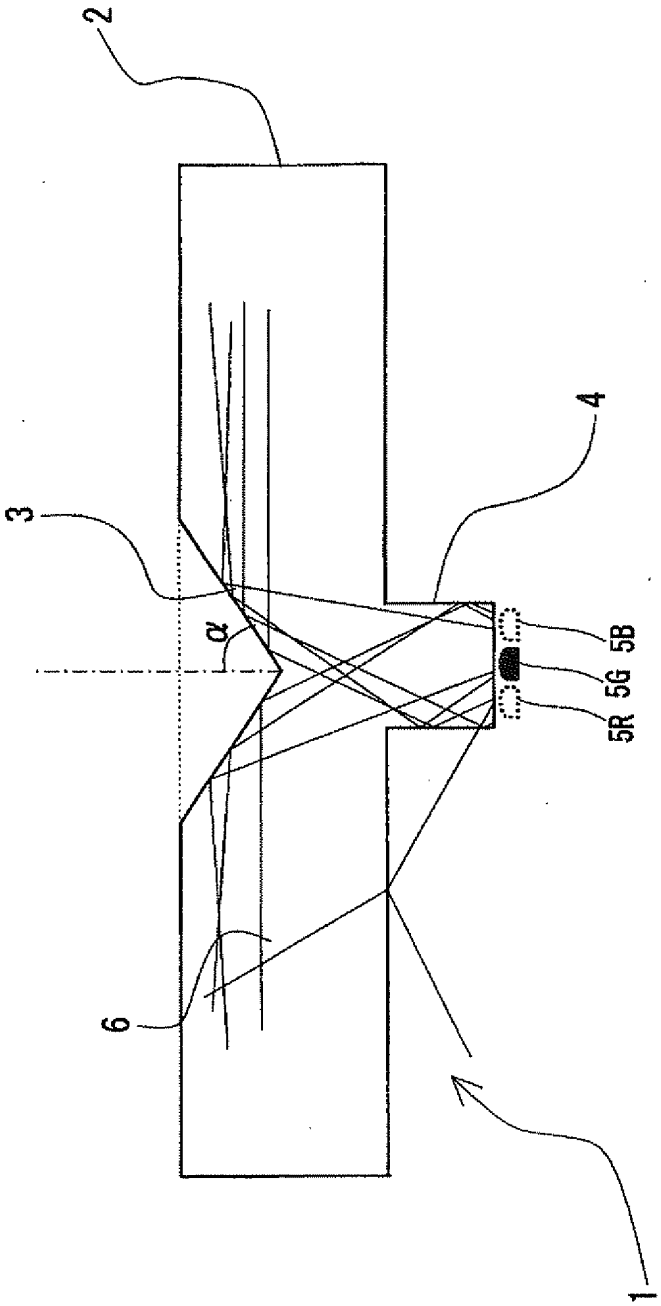


Fig. 5

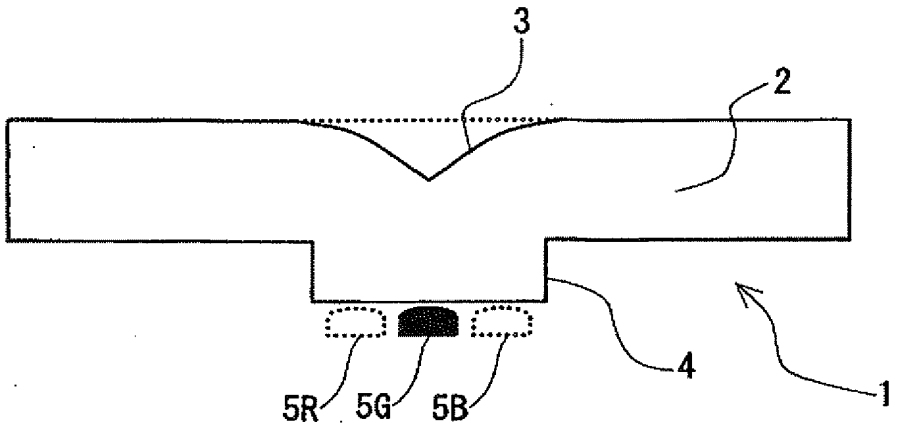


Fig. 6

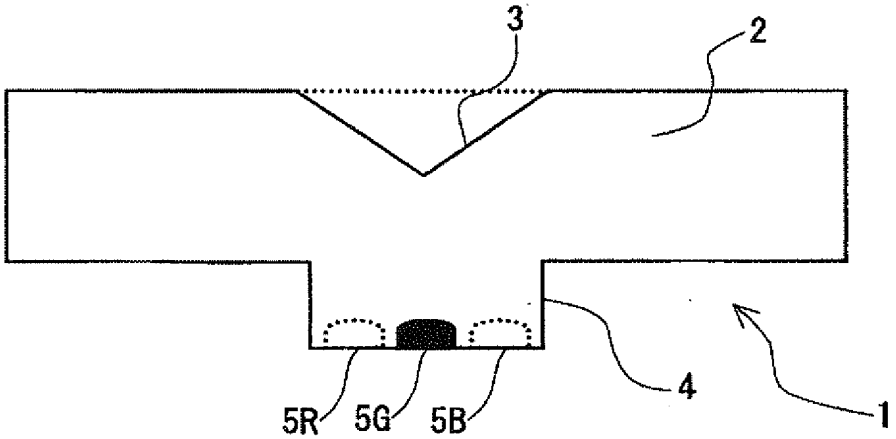


Fig. 7

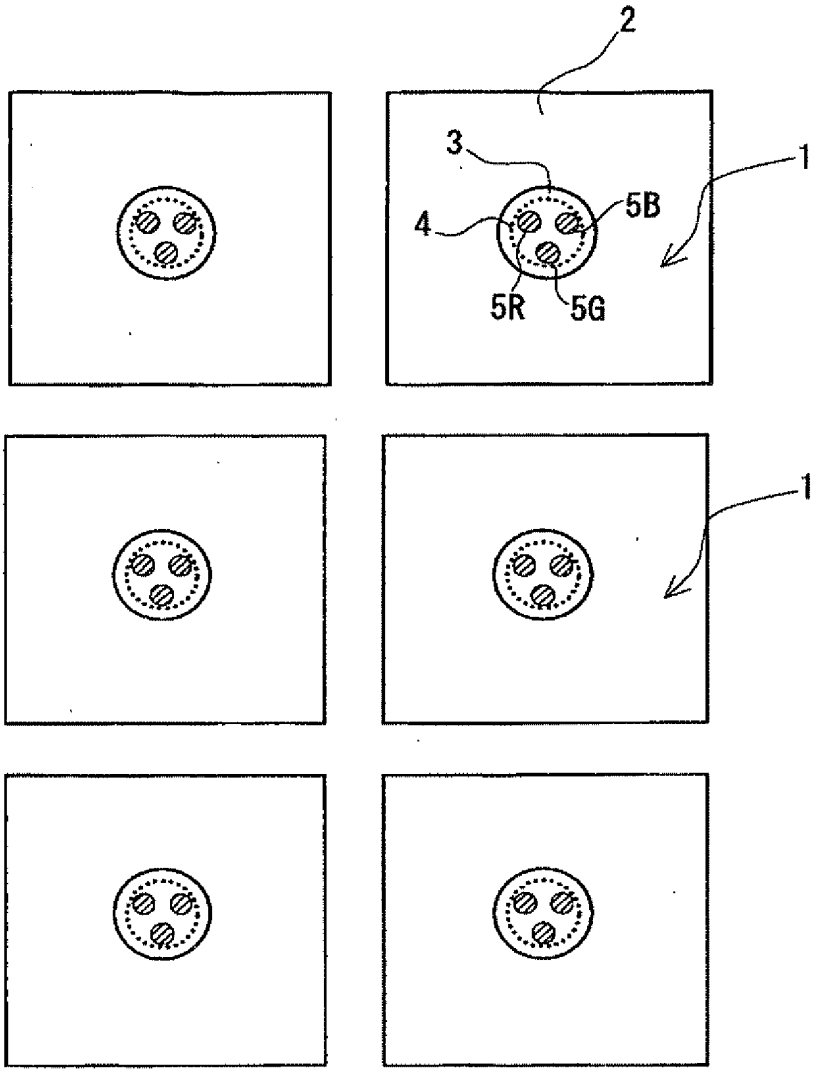


Fig. 8

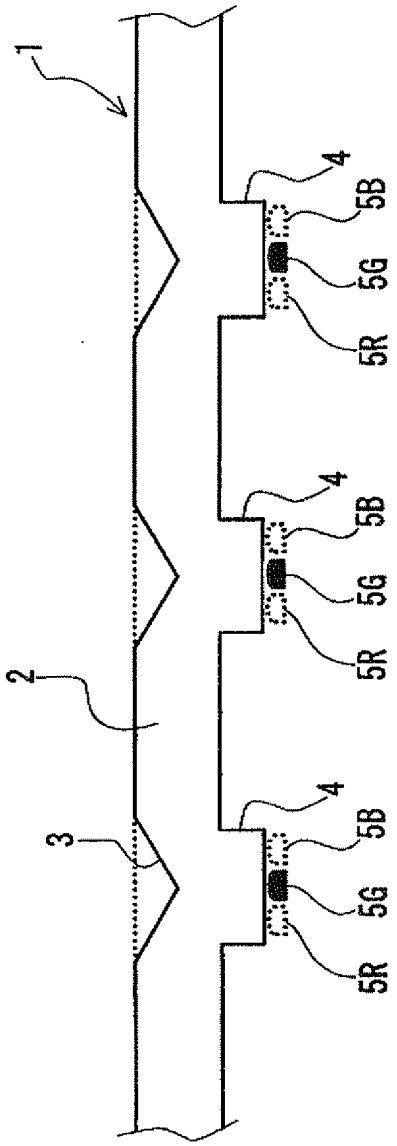


Fig. 9

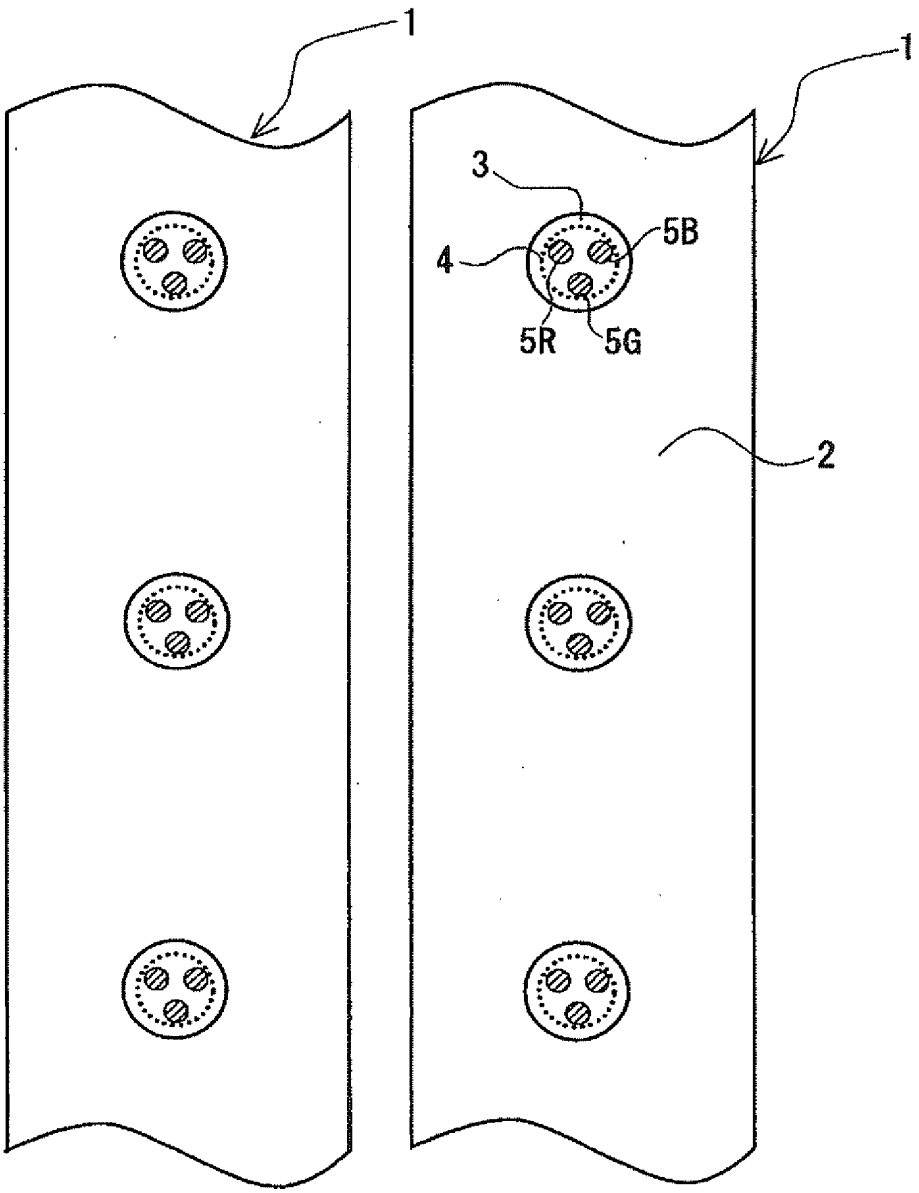


Fig. 10

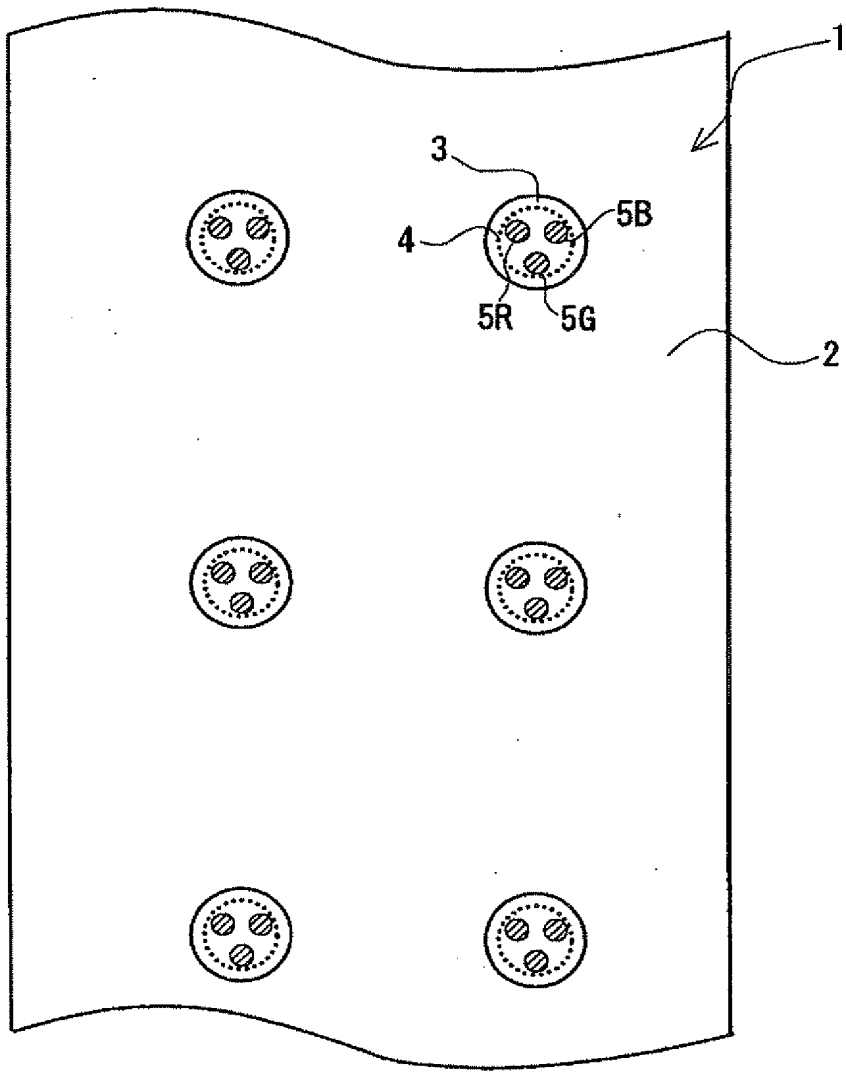


Fig. 11

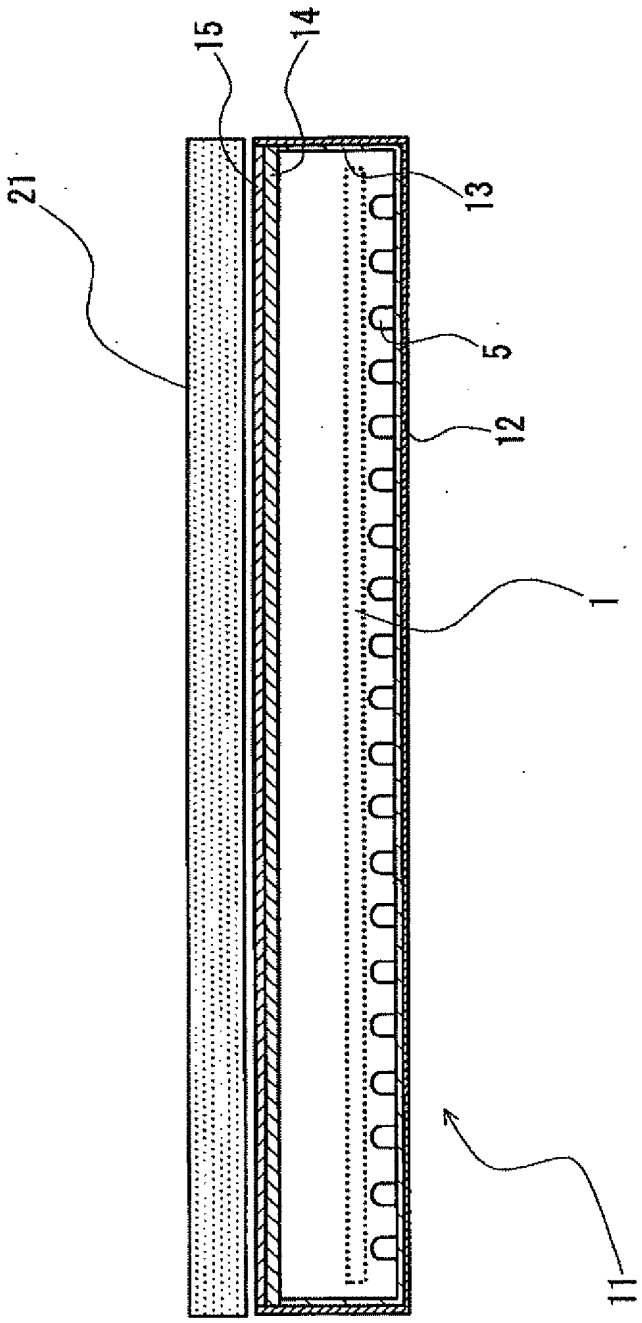


Fig. 12

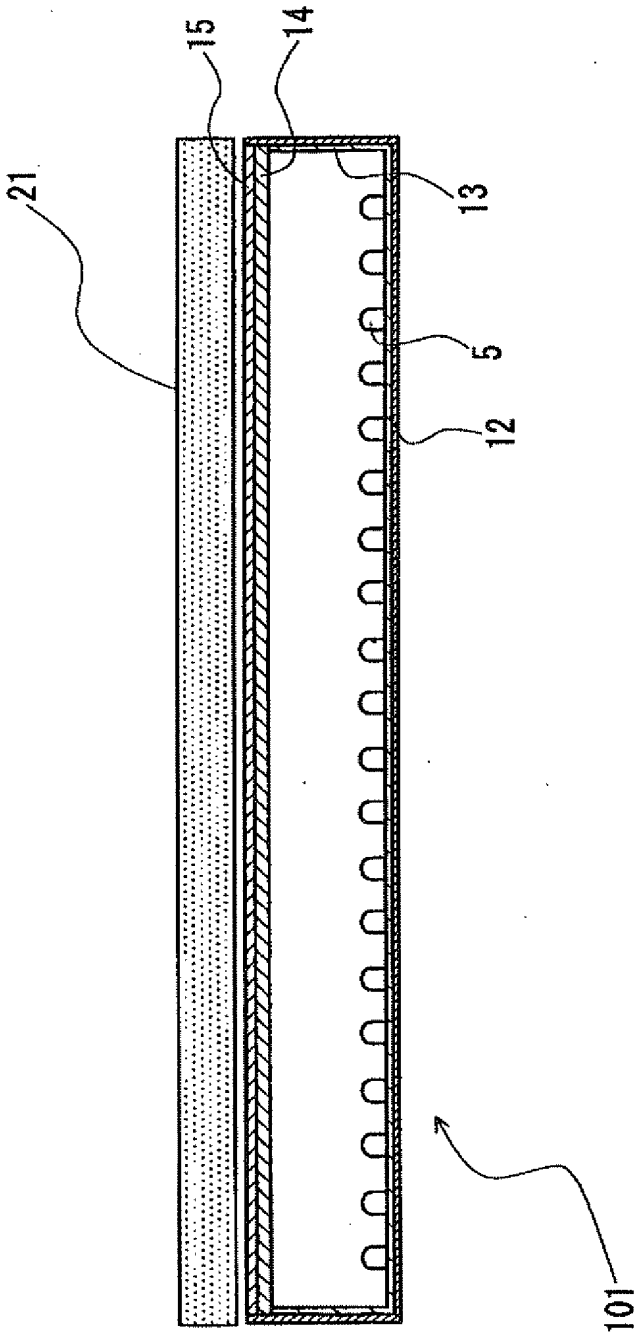
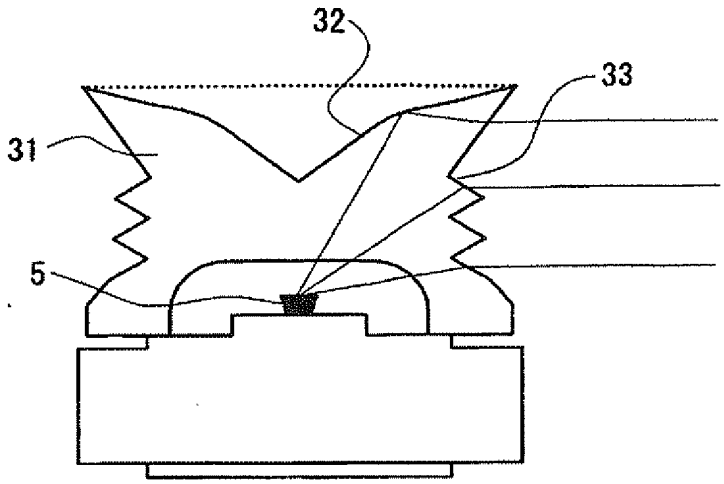
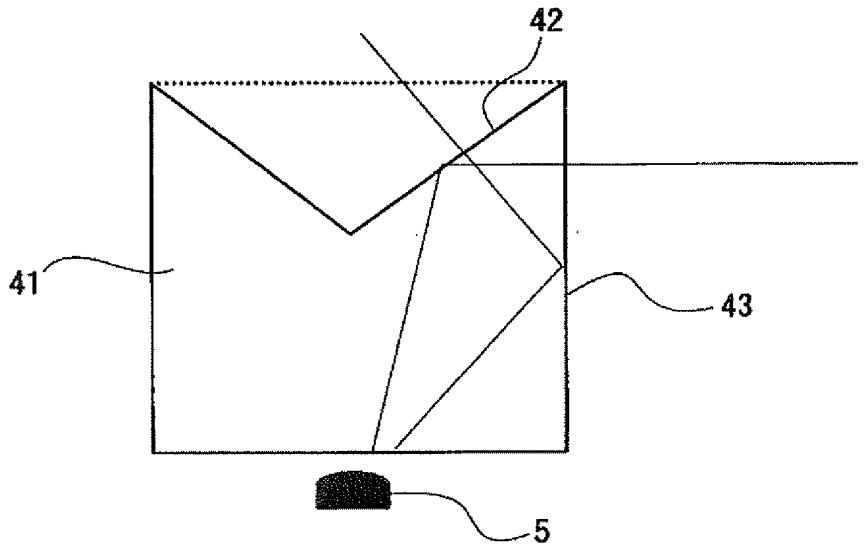


Fig. 13

(a)



(b)



INTERNATIONALSEARCHREPORT

International application No.
PCT/JP2006/326346

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. F21V8/00(2006.01)i, F21S8/04(2006.01)i, F21V5/04(2006.01)i,
G02B6/00(2006.01)i, G02F1/13357(2006.01)i, F21Y101/02(2006.01)n

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. F21V8/00, F21S8/04, F21V5/04, G02B6/00, G02F1/13357, F21Y101/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2007
Registered utility model specifications of Japan 1996-2007
Published registered utility model applications of Japan 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-340829 A (Epistar Corp.) 2005.12.08, whole description, whole figure & US 2005-0276068 A1 & DE 102005024084 A	1-10
Y	JP 2004-31180 A (KAWAGUCHIKOSEIMITSU KABUSHIKI KAISYA) 2004.01.29, whole description, whole figure (family; none)	1-10
Y	JP 2002-298629 A (NICHIA CORPORATION) 2002.10.11, whole description, Figs1 (family; none)	4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
02.02.2007	13.02.2007

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Electronic Acknowledgement Receipt

EFS ID:	8393893
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson/Jason Navari
Filer Authorized By:	Vincent Kayne Gustafson
Attorney Docket Number:	4241-696
Receipt Date:	10-SEP-2010
Filing Date:	29-JUL-2007
Time Stamp:	14:43:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Filed (SB/08)	696_4th_Supp_IDS.pdf	763811 e8971a52fa9e47847044767fe25d1c86095c7cc8	no	4

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2	Foreign Reference	WO2007074933A1.pdf	2155553 c59fcd3059a17b3205dd3a16a80b5923ade61962	no	52

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New International Application Filed with the USPTO as a Receiving Office

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KIANNI, KAVEH C	
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2883	

DATE MAILED: 09/14/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

TITLE OF INVENTION: LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/14/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 420 of 482

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23448 7590 09/14/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

TITLE OF INVENTION: LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/14/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
KIANNI, KAVEH C	2883	349-064000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 421 of 482

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

23448 7590 09/14/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER	
KIANNI, KAVEH C	
ART UNIT	PAPER NUMBER
2883	

DATE MAILED: 09/14/2010

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 145 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 145 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 422 of 482

Notice of Allowability	Application No.	Applicant(s)	
	11/829,912	MEDENDORP ET AL.	
	Examiner	Art Unit	
	K. Cyrus Kianni	2883	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to _____.

2. ☒ The allowed claim(s) is/are *1-7,9-11,13-15,17-29,32-38 and 53*.

3. ☒ The drawings filed on _____ are accepted by the Examiner.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/K. Cyrus Kianni/
Primary Examiner, Art Unit 2883

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Gustafson in order to cancel the non-elected claims 39-52 so as to facilitate allowing of the case.

Please cancel claims 39-52

Reason for Allowance

Claims 1-7, 9-11, 13-15, 17-29, 32-38 and 53 are allowed for the following reasons:
The instant application is deemed to be directed to a nonobvious improvement over the invention patented in Pat. No. Mori, US 6288700 B1.
Claim 1 is allowed because the prior art of record, taken alone or in combination, fails to disclose or render obvious a common control circuit in electrical communication with at least one of the first plurality of LEDs and the second plurality of LEDs (which it regulates for example power to LEDs intensity of the emitted light, wavelength of the emitted light, and/or other parameters) in combination with the rest of the limitations of the base claim. Claims 2-7, 9-11, 13-15, 17-29, 32-38 and 53 are allowed by virtue of dependency.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to K. Cyrus Kianni whose telephone number is 571-272-2417. The examiner can normally be reached on 9:30-19:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Robinson can be reached on (571) 272-2319. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/K. Cyrus Kianni/
Primary Examiner, Art Unit 2883

September 9, 2010

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	Art Unit
	K. Cyrus Kianni	2883

SEARCHED

Class	Subclass	Date	Examiner
349	62-64	9/9/2010	KCK

SEARCH NOTES

Search Notes	Date	Examiner
Searched through EAST:USPGPUB, USPAT, EPO, JPO and DERWENT and NPLSearched inverntorship threough PALM	9/9/2010	KCK
		KCK

INTERFERENCE SEARCH

Class	Subclass	Date	Examiner
349	62, 63, 64	9/9/2010	kck

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	49	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/09/09 15:29
S1	1	12/033547	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 13:59
S2	0	("1020050000803" "200359321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:16
S3	5	("20050000803" "59321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:22
S4	4	("0000803" "59321").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:23
S5	7	("97199").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:23
S6	6	("1097199").pn.	EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:24
S7	177	(first second) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:35

S8	26	(first second) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film$1 coat$5 material) near12 (light near7 (angle$2 adjust$5 absor$5) same (light adj1 guid$4 prism$5 waveguide$2))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:39
S9	25	(US-20090316433-$ or US-20090196069-$ or US-20090067156-$ or US-20090040426-$ or US-20080158853-$ or US-20080151540-$ or US-20080086289-$ or US-20080084513-$ or US-20080084512-$ or US-20070284564-$ or US-20070247872-$ or US-20070031106-$ or US-20070002585-$ or US-20060262558-$ or US-20060077688-$ or US-20060012732-$ or US-20050002110-$).did. or (US-7623198-$ or US-7518663-$ or US-7478942-$ or US-7210815-$ or US-6337946-$ or US-6160948-$ or US-6031958-$ or US-5695269-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 14:40
S10	25	S9 and (first second) adj2 (source$1 LED$1 emit$5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 14:41
S11	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 14:51
S12	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 15:04
S13	1	(US-20060077688-$).did.	US-PGPUB	OR	OFF	2010/02/26 15:12

S14	116	((first second) adj2 (source $1 LED$1 emit$5) (main sub vertic$4 near5 horizontal$4) adj2 (source $1 LED$1 emit$5) same prism$5 and ((source$1 LED$1 emit$5) (main sub vertic$4 near5 horizontal $4)) adj2 (source$1 LED$1 emit$5)) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film$1 coat$5 material) same (light near7 (angle$2 adjust$5 absor$5) same (light adj1 guid$4 prism$5 waveguide $2))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:19
S15	103	S14 not S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:20
S16	102	(US-20100027242-$ or US-20100007816-$ or US-20090316058-$ or US-20090273948-$ or US-20090237593-$ or US-20090128735-$ or US-20090073142-$ or US-20090034264-$ or US-20090032827-$ or US-20090016081-$ or US-20080316767-$ or US-20080259643-$ or US-20080232135-$ or US-20080204871-$ or US-20080159736-$ or US-20080145960-$ or US-20080117356-$ or US-20080094853-$ or US-20080094528-$ or US-20080068836-$ or US-20080018575-$ or US-20080002393-$ or US-20070297168-$ or US-20070285913-$ or US-20070279931-$ or US-20070279551-$).did. or (US-20070274102-$ or US-20070274095-$ or US-20070274094-$ or US-20070272839-$ or US-20070216828-$ or US-20070127269-$ or US-20070064417-$ or US-	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/02/26 15:20

		20070058258-$ or US-20070058127-$ or US-20070047219-$ or US-20070025121-$ or US-20070013624-$ or US-20070008456-$ or US-20060291244-$ or US-20060291240-$ or US-20060291238-$ or US-20060268574-$ or US-20060268571-$ or US-20060262376-$ or US-20060221638-$ or US-20060221631-$ or US-20060109396-$ or US-20060104093-$ or US-20060104092-$ or US-20060104089-$ or US-20060066783-$ or US-20050212995-$).did. or (US-20050185390-$ or US-20050180017-$ or US-20050001952-$ or US-20040246402-$ or US-20040239831-$ or US-20040150981-$ or US-20040145915-$ or US-20040141119-$ or US-20040136172-$ or US-20040114396-$ or US-20040004826-$ or US-20030214474-$ or US-20030112619-$ or US-20030048639-$).did. or (US-7660509-$ or US-7626210-$ or US-7607814-$ or US-7600880-$ or US-7571696-$ or US-7534025-$ or US-7518664-$ or US-7513670-$ or US-7503674-$ or US-7458710-$ or US-7443464-$ or US-7430028-$ or US-7374329-$ or US-7344291-$ or US-7334934-$ or US-7322731-$ or US-7317182-$ or US-7311431-$ or US-7293899-$ or US-7277079-$ or US-7226201-$ or US-7210839-$ or US-7161647-$ or US-7139048-$ or US-7086774-$ or US-7038638-$).did. or (US-6882380-$ or US-6820991-$ or US-6820990-$ or US-6132053-$ or US-5956107-$ or US-5831698-$ or US-				

		5748828-$ or US-5592332-$).did. or (EP-1403689-$).did.				
S17	13	S16 and ((first second) adj2 (source$1 LED$1 emit $5) (main sub vertic$4 near5 horizontal$4) adj2 (source$1 LED$1 emit$5)) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:22
S18	64	((first second) adj2 (source $1 LED$1 emit$5) (main sub vertic$4 near5 horizontal$4) adj2 (source $1 LED$1 emit$5)) same light same prism$5 and (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd) and (film $1 coat$5 material) same (light near7 (angle$2 adjust$5 absor$5)) same (light adj1 guid$4 prism$5 waveguide$2)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:27
S19	39	S18 not S9	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:28
S20	38	(US-20100027242-$ or US-20090316058-$ or US-20090237593-$ or US-20090174700-$ or US-20090154157-$ or US-20080232136-$ or US-20080165812-$ or US-20080165307-$ or US-20080159736-$ or US-20080129925-$ or US-20080068836-$ or US-20070297168-$ or US-20070183038-$ or US-20070064417-$ or US-20070008456-$ or US-20060221642-$ or US-20050275327-$ or US-20050180017-$ or US-20040246697-$ or US-20040232812-$ or US-20040145915-$ or US-20030234900-$ or US-20030076423-$ or US-20020080433-$).did. or (US-7542491-$ or US-7527398-$ or US-7518593-$ or US-7503674-$ or US-7489373-$ or US-7344291-	US-PGPUB; USPAT	OR	OFF	2010/02/26 15:28

		$ or US-6960872-$ or US-6644824-$ or US-6123430-$ or US-6079840-$ or US-5957561-$ or US-5900982-$ or US-5748828-$ or US-5602679-$).did.				
S21	38	S20 and ((first second) adj2 (source$1 LED$1 emit $5) (main sub vertic$4 near5 horizontal$4) adj2 (source$1 LED$1 emit$5))	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:28
S22	9	kianni and (first second) adj2 (source$1 LED$1 emit $5) and prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:54
S23	4	kianni and (first second) adj2 (source$1 LED$1 emit $5) and prism$5 and (liquid display lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:54
S24	5	kianni and (first second) adj2 (source$1 LED$1 emit $5) and diffus$4 and (liquid display lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:56
S25	4	S24 not S23	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:56
S26	118	S7 not (S9 S18)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 15:58
S27	119	(US-20090316388-$ or US-20090290339-$ or US-20090267879-$ or US-20090256494-$ or US-20090230878-$ or US-20090219463-$ or US-20090147501-$ or US-20090115713-$ or US-20090109683-$ or US-20090091668-$ or US-20090091667-$ or US-20090073348-$ or US-20090052204-$ or US-20090034291-$ or US-20090033832-$ or US-20090027919-$ or US-20080285306-$ or US-20080225522-$ or US-20080225201-$ or US-20080175129-$ or US-20080137373-$ or US-20080112187-$ or US-20080084519-$ or US-20080084518-$ or US-20080074899-$ or US-20080068846-$).did. or	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/02/26 15:59

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		(US-20080030650-$ or US-20080002114-$ or US-20070297194-$ or US-20070279934-$ or US-20070275512-$ or US-20070268426-$ or US-20070268325-$ or US-20070230215-$ or US-20070222360-$ or US-20070217227-$ or US-20070188681-$ or US-20070147071-$ or US-20070146298-$ or US-20070139966-$ or US-20070127264-$ or US-20070104415-$ or US-20070070305-$ or US-20070070304-$ or US-20070063943-$ or US-20070058359-$ or US-20070018185-$ or US-20070002579-$ or US-20060244880-$ or US-20060239026-$ or US-20060232995-$ or US-20060186826-$ or US-20060170640-$).did. or (US-20060146570-$ or US-20060121940-$ or US-20060072342-$ or US-20060056200-$ or US-20060039046-$ or US-20050280756-$ or US-20050269560-$ or US-20050259440-$ or US-20050248818-$ or US-20050180169-$ or US-20050117368-$ or US-20050111239-$ or US-20050083813-$ or US-20050078080-$ or US-20040263500-$ or US-20040228109-$ or US-20040124764-$ or US-20040076396-$ or US-20040001340-$ or US-20030076669-$ or US-20030030596-$ or US-20020118865-$).did. or (US-7659880-$ or US-7629957-$ or US-7575357-$ or US-7553045-$ or US-7527411-$ or US-7520652-$ or US-7502009-$ or US-7494835-$ or US-7474050-$ or US-7465073-$ or US-				

		7452119-$ or US-7448788-$ or US-7377681-$ or US-7364338-$ or US-7356211-$ or US-7325932-$ or US-7270427-$ or US-7237939-$ or US-7213936-$ or US-7160003-$ or US-7159987-$ or US-7128460-$ or US-7113621-$ or US-7085027-$ or US-7068404-$ or US-7039286-$).did. or (US-7002534-$ or US-6880953-$ or US-6856464-$ or US-6805468-$ or US-6285423-$ or US-6268904-$ or US-6123431-$ or US-6069565-$ or US-5990993-$ or US-5838239-$ or US-5479275-$ or US-5299042-$).did. or (TW-322562-$ or KR-2004084298-$ or KR-2003008270-$ or JP-08220345-$ or US-5396350-$).did.				
S28	118	S27 and (first second) adj2 (source$1 LED$1 emit $5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:00
S29	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 16:00
S30	1	(US-20060186826-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:21
S31	1	(US-20040263500-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:28
S32	1	(US-5299042-$).did.	USPAT	OR	OFF	2010/02/26 16:38
S33	1	(US-20080175129-$).did.	US-PGPUB	OR	OFF	2010/02/26 16:49
S34	0	(sub) adj1 (source$1 LED $1 emit$5) same prism$5 and (source$1 LED$1 emit $5) same (light adj1 (emit $5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:56
S35	26	(sub vertical$4) adj2 (source$1 LED$1 emit$5) same prism$5 and (source $1 LED$1 emit$5) adj1 (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:57

S36	24	S35 not (S7 S9 S18 S26)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 16:58
S37	0	(peripheral) adj1 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) adj1 (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:06
S38	0	(peripheral$2) adj2 (source $1 LED$1 emit$5) same prism$5 and (source$1 LED $1 emit$5) adj1 (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:06
S39	190	(first second$3) adj2 (source$1 LED$1 emit$5) same prism$5 and (source $1 LED$1 emit$5) same (light adj1 (emit$5 sourc $2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:07
S40	13	S39 not S7	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:07
S41	13	(US-20080247150-$ or US-20080204682-$ or US-20060132711-$ or US-20040174512-$ or US-20040085750-$ or US-20030227578-$ or US-20020034016-$).did. or (US-7470025-$ or US-7011442-$ or US-6992718-$ or US-6910775-$ or US-6480337-$ or US-6264331-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 17:08
S42	13	S41 and (first second$3) adj2 (source$1 LED$1 emit $5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:08

S43	1	(horizontal$4) adj2 (source $1 LED$1 emit$5) same vertical$4 adj2 (source$1 LED$1 emit$5) same prism $5 and (source$1 LED$1 emit$5) same (light adj1 (emit$5 sourc$2)) same (backlight back adj1 light) and (Liquid adj1 crystal lcd)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:15
S44	0	S11 S12 S13 S29 S30 S31 S32 S33	EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:17
S45	8	(S11 S12 S13 S29 S30 S31 S32 S33)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 17:18
S46	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S47	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S48	1	(US-20060077688-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S49	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 19:45
S50	1	(US-20060186826-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S51	1	(US-20040263500-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S52	1	(US-5299042-$).did.	USPAT	OR	OFF	2010/02/26 19:45
S53	1	(US-20080175129-$).did.	US-PGPUB	OR	OFF	2010/02/26 19:45
S54	8	(S46 S47 S48 S49 S50 S51 S52 S53)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:45
S55	8	(US-20050002110-$ or US-20070247872-$ or US-20060186826-$ or US-20040263500-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did.	US-PGPUB; USPAT	OR	OFF	2010/02/26 19:45
S56	1	12/033547	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:47
S57	8	S55 and (source$1 LED$1 emit$5) same prism$5	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:51

S58	8	S55 and (source$1 LED$1 emit$5) same (direct$5 prism$5)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 19:54
S59	1	(US-5479275-$).did.	USPAT	OR	OFF	2010/02/26 19:58
S60	1	(US-20050002110-$).did.	US-PGPUB	OR	OFF	2010/02/26 20:00
S61	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/02/26 20:06
S63	3	S59 S60 S61	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/02/26 20:17
S64	1	11/829912	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 19:44
S65	8	(US-20050002110-$ or US-20070247872-$ or US-20060186826-$ or US-20040263500-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/22 19:45
S66	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/03/22 19:46
S67	637	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:03
S68	9	(edge$1 side$1) near3 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:12

S69	23	(edge$1 side$1) near5 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near7 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:13
S70	23	S67 and S69	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:13
S71	22	(US-20100014027-$ or US-20090316077-$ or US-20090257215-$ or US-20090237587-$ or US-20090237585-$ or US-20090219463-$ or US-20090141208-$ or US-20090091920-$ or US-20090073347-$ or US-20090059621-$ or US-20090059127-$ or US-20080186427-$ or US-20080165308-$ or US-20080002099-$ or US-20070018185-$ or US-20060274548-$ or US-20060114690-$).did. or (US-7553045-$ or US-7548287-$ or US-7334930-$).did. or (JP-2009186523-$ or JP-2009008856-$). did.	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/22 20:14
S72	22	S71 and (edge$1 side$1) near5 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near3 (additional back front bottom) near7 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:16

S73	1	(US-20090091920-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:31
S74	1	(US-20080002099-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:33
S75	1	(US-20090257215-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:35
S76	1046	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) and (Liquid adj1 crystal lcd LC) near3 panel $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:37
S77	544	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:39
S78	238	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1 back front bottom beneath rear) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:41

S79	31	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:43
S80	11	S65 S73 S74 S75	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:44
S81	31	(US-20070018185-$ or US-20100066939-$ or US-20100027296-$ or US-20100007816-$ or US-20090219463-$ or US-20090207343-$ or US-20090185394-$ or US-20090147178-$ or US-20090135625-$ or US-20080260328-$ or US-20080165308-$ or US-20080142682-$ or US-20080049168-$ or US-20080043171-$ or US-20080019149-$ or US-20070242718-$ or US-20070064444-$ or US-20070063943-$ or US-20060125772-$ or US-20060120106-$ or US-20050253980-$ or US-20050024848-$ or US-20040042194-$).did. or (US-7576309-$ or US-7553061-$ or US-7553045-$ or US-7515131-$ or US-7514662-$ or US-7331682-$ or US-6874900-$).did. or (JP-2009186523-$).did.	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/22 20:45

S82	31	S81 and (first plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (second plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 20:45
S83	1	(US-20080019149-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:49
S84	1	(US-20040042194-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:50
S85	1	(US-20070242718-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:51
S86	1	(US-20070064444-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:53
S87	1	(US-20050024848-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:56
S88	1	(US-20090185394-$).did.	US-PGPUB	OR	OFF	2010/03/22 20:59
S89	1	(US-20060125772-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:00
S90	1	(US-20070063943-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:01
S91	0	S81 and (first plural$3) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:06

S92	0	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (side$1 edge$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) near12 (front bottom beneath rear back) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:07
S93	0	(first plural$3) adj2 (source $1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit $5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:09
S94	40	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:10

S95	11	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near4 (front bottom beneath rear back side$1 edge$) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (Liquid adj1 crystal lcd LC) near3 panel $1 and (backlight back adj1 light)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:13
S96	40	S94 not S82	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:13
S97	40	(US-20090262519-$ or US-20090122231-$ or US-20090103328-$ or US-20090097277-$ or US-20090086507-$ or US-20090086505-$ or US-20090046220-$ or US-20080304288-$ or US-20080304286-$ or US-20080304285-$ or US-20080101061-$ or US-20070171341-$ or US-20070146572-$ or US-20070109792-$ or US-20060245209-$ or US-20060238670-$ or US-20050135118-$ or US-20050122741-$ or US-20050068471-$ or US-20040155994-$ or US-20030043122-$ or US-20020180923-$ or US-20010024249-$).did. or (US-7520632-$ or US-7486348-$ or US-7455441-$ or US-7322717-$ or US-7309143-$ or US-7303326-$ or US-7202920-$ or US-6839100-$ or US-6825894-$ or US-6633279-$ or US-6567137-$ or US-6529188-$ or US-6441874-$).did. or (JP-2006000164-$).did. or (EP-2000831-$ or JP-2006000164-$ or JP-	US-PGPUB; USPAT; JPO; DERWENT	OR	OFF	2010/03/22 21:13

		11064845-$).did.				
S98	40	S97 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) same (Auxiliary supplementa$2 periphery) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:14
S99	1	(JP-2006000164-$).did.	JPO	OR	OFF	2010/03/22 21:20
S100	1	(US-20060245209-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:20
S101	1	(US-20070171341-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:22
S102	1	(US-20050122741-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:31
S106	23	S80 S83 S84 S85 S86 S87 S88 S89 S90 S99 S100 S101 S102	US-PGPUB; USPAT; JPO; DERWENT	OR	OFF	2010/03/22 21:36
S107	0	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$2 extension$1) adj2 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:38

S108	1	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near2 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:40
S109	2	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:40
S110	10	(first second plural$3) adj2 (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:41

S111	8	S110 not S109	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:42
S112	1	(US-20090073721-$).did.	US-PGPUB	OR	OFF	2010/03/22 21:45
S113	24	(source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (backlight back adj1 light) and (Liquid adj1 crystal lcd LC) near3 panel$1 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension$1) near5 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:48
S114	14	S113 not S110	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:48
S115	14	(US-20100053497-$ or US-20100026929-$ or US-20100007818-$ or US-20090322985-$ or US-20080247150-$ or US-20070229451-$ or US-20070052882-$ or US-20070014097-$ or US-20070013663-$ or US-20040130885-$).did. or (US-7364339-$ or US-7364337-$ or US-6979113-$ or US-6288700-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/22 21:49
S116	14	S115 and (source$1 LED$1 emit$5 light adj1 emit$5) near7 (branch$3 extension $1) near5 (light adj1 guid $2 lightguide$1 waveguide $1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/22 21:49
S117	1	(US-6288700-$).did.	USPAT	OR	OFF	2010/03/22 21:53

S118	14	(US-20100053497-$ or US-20100026929-$ or US-20100007818-$ or US-20090322985-$ or US-20080247150-$ or US-20070229451-$ or US-20070052882-$ or US-20070014097-$ or US-20070013663-$ or US-20040130885-$).did. or (US-7364339-$ or US-7364337-$ or US-6979113-$ or US-6288700-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/23 13:17
S119	1	(US-6288700-$).did.	USPAT	OR	OFF	2010/03/23 13:17
S120	14	S118 S119	US-PGPUB; USPAT	OR	OFF	2010/03/23 13:17
S121	14	S120 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 13:19
S122	1	(US-20090322985-$).did.	US-PGPUB	OR	OFF	2010/03/23 14:41
S123	23	(US-20080019149-$ or US-20090257215-$ or US-20040042194-$ or US-20050002110-$ or US-20060245209-$ or US-20070242718-$ or US-20070171341-$ or US-20070064444-$ or US-20050024848-$ or US-20070247872-$ or US-20060186826-$ or US-20090091920-$ or US-20080002099-$ or US-20040263500-$ or US-20090185394-$ or US-20050122741-$ or US-20060125772-$ or US-20070063943-$ or US-20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-5299042-$).did. or (JP-2006000164-$).did.	US-PGPUB; USPAT; JPO	OR	OFF	2010/03/23 14:48
S124	18	S123 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 14:49

S125	1	(US-20070247872-$).did.	US-PGPUB	OR	OFF	2010/03/23 15:47
S126	3	S119 S122 S125	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:20
S127	2	S126 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (light adj1 emit$4 adj1 diod $2 led$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:51
S128	3	S126 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:51
S129	3	S126 and (source$1 LED$1 emit$5 light adj1 emit$5) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 16:52
S130	1	(US-20090322985-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:23
S131	2	S126 and (electrostatic static$1 discharg$3 diode $1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:24
S134	1	11/829912	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:28
S135	1	S134 and (electrostatic static$1 discharg$3 near12 diode$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:28
S136	24	led$1 near12 (electrostatic static$1 discharg$3 near12 diode$1) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (source$1 LED$1 emit$5 light adj1 emit$5) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (lcd$1 display $1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:32

S137	24	(US-20060236262-$ or US-20090167192-$ or US-20070242185-$ or US-20080049051-$ or US-20090118667-$ or US-20080252986-$ or US-20030149347-$ or US-20050143793-$ or US-20090225567-$ or US-20100053995-$ or US-20090312063-$ or US-20070189667-$ or US-20060034566-$ or US-20060227546-$).did. or (US-7471284-$ or US-7468764-$ or US-5301090-$ or US-7548670-$ or US-6687556-$ or US-7236663-$ or US-7431489-$).did. or (FR-2912245-$ or WO-2006114743-$ or JP-2009295285-$).did.	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/03/23 18:33
S138	24	S137 and led$1 near12 (electrostatic static$1 discharg$3 near12 diode $1) same (light adj1 guid $2 lightguide$1 waveguide $1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:34
S139	0	S137 and led$1 near12 (electrostatic electro adj1 static$1) near7 discharg$3 near2 diode$1 same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:36
S140	0	led$1 near12 (electrostatic electro adj1 static$1) near7 discharg$3 near2 diode$1 same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:37
S141	1	S134 and (electrostatic near2 discharg$3 near2 diode$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:40
S142	3	led$1 near12 (electrostatic near2 discharg$3 near2 diode$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:41
S143	13	led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:43

S144	0	S143 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) same (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:44
S145	1	S143 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and led$2 near9 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:45
S146	3	S143 and led$1 near12 (electrostatic near2 discharg$3 near6 diode$1) and (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and lcd	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 18:45
S147	1	(US-20070236443-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:46
S148	1	(US-20080089072-$).did.	US-PGPUB	OR	OFF	2010/03/23 18:46
S149	2	S147 S148	US-PGPUB	OR	OFF	2010/03/23 18:46
S150	41	(US-20070297168-$ or US-20080019149-$ or US-20090257215-$ or US-20040042194-$ or US-20070018185-$ or US-20060114690-$ or US-20050002110-$ or US-20060245209-$ or US-20090073721-$ or US-20070242718-$ or US-20080089072-$ or US-20070171341-$ or US-20070064444-$ or US-20050024848-$ or US-20070236443-$ or US-20070247872-$ or US-20070008456-$ or US-20090040426-$ or US-20060186826-$ or US-20090091920-$ or US-20080002099-$ or US-20040263500-$ or US-20080285306-$ or US-20090185394-$ or US-20050122741-$ or US-20060125772-$).did. or (US-20070063943-$ or US-	US-PGPUB; USPAT; DERWENT	OR	OFF	2010/03/23 20:44

		20080175129-$ or US-20060077688-$).did. or (US-5479275-$ or US-6874900-$ or US-7210815-$ or US-7576309-$ or US-7514662-$ or US-7331682-$ or US-6288700-$ or US-7548287-$ or US-7325932-$ or US-5299042-$ or US-7515131-$).did. or (JP-2006000164-$).did.				
S151	22	S150 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 control$3	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:45
S152	16	S150 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 control$3 and LED $1	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:46
S153	16	(US-20050002110-$ or US-20070242718-$ or US-20070064444-$ or US-20060186826-$ or US-20040263500-$ or US-20080285306-$ or US-20090185394-$ or US-20060125772-$ or US-20070063943-$ or US-20060077688-$).did. or (US-7210815-$ or US-7576309-$ or US-7514662-$ or US-6288700-$ or US-7325932-$ or US-7515131-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/23 20:46
S154	16	S153 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 control$3	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:46
S155	16	S153 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (monitor$3 control $4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:49
S156	10	S153 and (source$1 LED$1 emit$5 light adj1 emit$5) near8 (light adj1 guid$2 lightguide$1 waveguide$1 wave adj1 guide$1) and (light adj1 emit$4 adj1 diod $2 led$1)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:50

S157	10	(US-20070242718-$ or US-20070064444-$ or US-20090185394-$ or US-20060125772-$ or US-20070063943-$ or US-20060077688-$).did. or (US-7576309-$ or US-7514662-$ or US-6288700-$ or US-7515131-$).did.	US-PGPUB; USPAT	OR	OFF	2010/03/23 20:51
S158	10	S157 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (monitor$3 control $4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/03/23 20:51
S159	1	(US-20070064444-$).did.	US-PGPUB	OR	OFF	2010/03/23 21:12
S160	1	(US-20090257215-$).did.	US-PGPUB	OR	OFF	2010/03/23 21:36
S161	1	(US-20090091920-$).did.	US-PGPUB	OR	OFF	2010/03/23 21:38
S162	1	11/829912	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/09/08 16:33
S163	10	(US-20070242718-$ or US-20070064444-$ or US-20090185394-$ or US-20060125772-$ or US-20070063943-$ or US-20060077688-$).did. or (US-7576309-$ or US-7514662-$ or US-6288700-$ or US-7515131-$).did.	US-PGPUB; USPAT	OR	OFF	2010/09/08 16:37
S164	10	S163 and (source$1 LED$1 emit$5 light adj1 emit$5) near12 (monitor$3 control $4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/09/08 16:37
S165	1	(US-6288700-$).did.	USPAT	OR	OFF	2010/09/08 16:41
S166	1	S165 and (control$4 circuit $4 shut$4) same (led light emit$4)	US-PGPUB; USPAT; EPO; JPO; DERWENT	OR	OFF	2010/09/08 16:42

EAST Search History (Interference)

<This search history is empty>

9/9/2010 3:31:03 PM
C:\Documents and Settings\kkianni\My Documents\EAST\Workspaces\9912.wsp

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	**Art Unit**
	K. Cyrus Kianni	2883

ORIGINAL		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
349	64	G 0 2 F 1 / 1335 (2006.01)	

CROSS REFERENCE(S)

CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
349	62	63			

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		17		33		49								
	2		18		34		50								
	3		19		35		51								
	4		20		36		52								
	5		21		37										
	6		22		38										
	7		23		39										
	8		24		40										
	9		25		41										
	10		26		42										
	11		27		43										
	12		28		44										
	13		29		45										
	14		30		46										
	15		31		47										
	16		32		48										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	34	
/K. Cyrus Kianni/	9/9/10	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	Art Unit
	K. Cyrus Kianni	2883

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/23/2010	09/09/2010							
1	1	✓	=							
2	2	N	=							
3	3	N	=							
4	4	N	=							
5	5	✓	=							
6	6	✓	=							
7	7	✓	=							
	8	✓	-							
8	9	✓	=							
9	10	✓	=							
10	11	✓	=							
	12	✓	-							
11	13	✓	=							
12	14	✓	=							
13	15	✓	=							
	16	✓	-							
14	17	✓	=							
15	18	✓	=							
16	19	N	=							
17	20	N	=							
18	21	N	=							
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23	26	N	=							
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26	29	N	=							
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	31	N	-							
27	32	✓	=							
28	33	✓	=							
29	34	✓	=							
30	35	N	=							
31	36	N	=							

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	11829912	MEDENDORP ET AL.
	Examiner	**Art Unit**
	K. Cyrus Kianni	2883

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/23/2010	09/09/2010							
32	37	✓	=							
33	38	✓	=							
	39	N	-							
	40	N	-							
	41	N	-							
	42	N	-							
	43	N	-							
	44	N	-							
	45	N	-							
	46	N	-							
	47	N	-							
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	49	N	-							
	50	N	-							
	51	N	-							
	52	N	-							
34	53		=							

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**	**Art Unit:**	**2883**
Date Filed:	**July 29, 2007**	**Examiner:**	**K. Cyrus Kianni**
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

CERTIFICATE OF EFS FILING

I hereby certify that this document is being filed via EFS in the United States Patent and Trademark Office on **September 16, 2010**.
/jason navari /

REQUEST FOR CONSIDERATION OF SEPTEMBER 10, 2010 INFORMATION DISCLOSURE STATEMENT IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

A Notice of Allowance was mailed in the above-referenced application on September 14, 2010. An Information Disclosure Statement (IDS) was filed on September 10, 2010. Review of the Patent Applicant Information Retrieval system file history for the above-referenced application indicates that the IDS filed on September 10, 2010 was not considered by the examiner prior to issuance of the Notice of Allowance.

It is respectfully requested that the IDS filed on September 10, 2010 be expressly considered, and that the reference be made of record in the above-referenced application and appear among the "References Cited" on any patent to issue therefrom.

Respectfully submitted,

/vincent k. gustafson/
Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 457 of 482

Electronic Acknowledgement Receipt

EFS ID:	8437021
Application Number:	11829912
International Application Number:	
Confirmation Number:	2008
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Vincent Kayne Gustafson/Jason Navari
Filer Authorized By:	Vincent Kayne Gustafson
Attorney Docket Number:	4241-696
Receipt Date:	16-SEP-2010
Filing Date:	29-JUL-2007
Time Stamp:	18:28:14
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Miscellaneous Incoming Letter	696_Request_for_Consideration_of_IDS.pdf	20691 f96323c0a80bbf56f5dc7d9404c19f688ecec ca3	no	2

Warnings:	
Information:	

Total Files Size (in bytes):	20691

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

23448 7590 10/18/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER	
KIANNI, KAVEH C	

ART UNIT	PAPER NUMBER
2883	

MAIL DATE	DELIVERY MODE
10/18/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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U.S. Patent and Trademark Office
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APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR / PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
11829912	7/29/2007	MEDENDORP ET AL.	4241-696

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER	
K. Cyrus Kianni	
ART UNIT	**PAPER**
2883	20101014

DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

The IDS submitted by the Applicant on 09/10/2010 is ackknowledged by the examiner; enclosed is ae copy of the signed IDS.

/K. Cyrus Kianni/
Primary Examiner, Art Unit 2883

PTO-90C (Rev.04-03)

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	11829912
Filing Date	2007-07-29
First Named Inventor	Medendorp, Jr.
Art Unit	2883
Examiner Name	KIANNI, KAVEH C.
Attorney Docket Number	4241-696

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2007074933	WO	A1	2007-07-05	Naijo, S. et al.		☐

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /K.K./

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 462 of 482

Receipt date: 09/10/2010	Application Number	11829912	11829912 - GAU: 2883
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2007-07-29	
	First Named Inventor	Medendorp, Jr.	
	Art Unit	2883	
	Examiner Name	KIANNI, KAVEH C.	
	Attorney Docket Number	4241-696	

	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/Kaveh Kianni/	Date Considered	10/14/2010

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /K.K./

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 463 of 482

Section III (Amendments to the Specification)

Please amend the specification by substituting the following replacement paragraphs [0020] and [0066] for the correspondingly-numbered paragraphs as originally filed.

[0020] FIG. 1C is a schematic perspective view of the multi-LED strip light source of FIG. 1A and 1B, disposed adjacent to a waveguide. FIG. 1D is a perspective view of a television or computer monitor including a LCD system according to FIG. 1B.

[~~0064~~ 0066] FIG. 1A is a schematic front view illustration of at least a portion of an exemplary LCD system 1 including a LCD panel 2 and multiple light sources 3A, 3B. FIG. 1B is a schematic side view illustration of the system of FIG. 1A, depicting the LCD panel 2, light sources 3A, 3B and waveguide element 4. FIG. 1C is a schematic side view illustration of an exemplary light source 3B, comprising a plurality of side view LED packages, 6A-6E arranged as a strip on base 7 and emitting light 8, parallel to the plane of base 7, into waveguide 4. FIG. 1D is a perspective view of a television or computer monitor 100 including a LCD system according to FIG. 1B, with the LCD panel 2 arranged in the foreground.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 464 of 482

Section III (Amendments to the Specification)

Please amend the specification by substituting the following replacement paragraphs [0020] and [0064] for the correspondingly-numbered paragraphs as originally filed.

KMO 10/22/10

[0020] FIG. 1C is a schematic perspective view of the multi-LED strip light source of FIG. 1A and 1B, disposed adjacent to a waveguide. FIG. 1D is a perspective view of a television or computer monitor including a LCD system according to FIG. 1B.

KMO 10/22/10

[0064] FIG. 1A is a schematic front view illustration of at least a portion of an exemplary LCD system 1 including a LCD panel 2 and multiple light sources 3A, 3B. FIG. 1B is a schematic side view illustration of the system of FIG. 1A, depicting the LCD panel 2, light sources 3A, 3B and waveguide element 4. FIG. 1C is a schematic side view illustration of an exemplary light source 3B, comprising a plurality of side view LED packages, 6A-6E arranged as a strip on base 7 and emitting light 8, parallel to the plane of base 7, into waveguide 4. FIG. 1D is a perspective view of a television or computer monitor 100 including a LCD system according to FIG. 1B, with the LCD panel 2 arranged in the foreground.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 465 of 482

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

23448 7590 09/14/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

12/13/2010 EEKUBAY2 00000042 11829912

01 FC:1501 1510.00 OP
02 FC:1504 300.00 OP

OPAP IAP11 DEC 10 2010 PATENT & TRADEMARK OFFICE

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Alison Szafran	(Depositor's name)
	(Signature)
December 10, 2010	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	07/29/2007	Nicholas W. Medendorp JR.	4241-696	2008

TITLE OF INVENTION: LED BACKLIGHT SYSTEM FOR LCD DISPLAYS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1510	$300	$0	$1810	12/14/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
KIANNI, KAVEH C	2883	349-064000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Vincent K. Gustafson
2 Intellectual Property/ Technology Law
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Cree, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Durham, NC

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)
☐ A check is enclosed.
☒ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge ~~the required fee(s)~~ ONLY, any deficiency, or credit any overpayment, to Deposit Account Number 08-3284 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature Vincent K. Gustafson Date December 10, 2010

Typed or printed name Vincent K. Gustafson Registration No. 46,182

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PAGE 3/4 * RCVD AT 12/10/2010 4:42:18 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/11 * DNIS:2732885 * CSID:9194011807 * DURATION (mm-ss):01-28

OPAP IAP11 DEC 10 2010 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent Application of:		**Docket No.:**	**4241-696**
Applicants:	**MEDENDORP, JR., Nicholas W., et al.**	**Conf. No.:**	**2008**
Application No.:	**11/829,912**	**Art Unit:**	**2883**
Date Filed:	**July 29, 2007**	**Examiner:**	**K. Cyrus Kianni**
Title:	**LED BACKLIGHT SYSTEM FOR LCD DISPLAYS**	**Customer No.:**	**23448**

FACSIMILE TRANSMISSION CERTIFICATE
Fax No. (571) 273-2885

I hereby certify that this document is being filed in the United States Patent and Trademark Office, via facsimile transmission, addressed to Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date specified below, and transmitted to United States Patent and Trademark Office facsimile transmission number (571) 273-2885.

4 pages
Number of Pages

Alison Szafran

December 10, 2010
Date

SUBMISSION OF ISSUE FEE IN U.S. PATENT APPLICATION NO. 11/829,912

Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

4241-696

Enclosed is the completed Issue Fee Transmittal, along with a Credit Card Form authorizing payment of the amount of $1,810.00 ($1,510.00 for the issue fee and $ 300.00 for the publication fee), in response to the Notice of Allowance dated September 14, 2010 in the above-identified patent application.

Respectfully submitted,

Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants

INTELLECTUAL PROPERTY/
TECHNOLOGY LAW
P.O. Box 14329
Research Triangle Park, NC 27709
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

Enclosures:
Issue Fee Transmittal [1 pg.]
Credit Card Form [1 pg.]

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

PAGE 2/4 * RCVD AT 12/10/2010 4:42:18 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-6/11 * DNIS:2732885 * CSID:9194011807 * DURATION (mm-ss):01-28

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Exhibit 1002 - Page 468 of 482

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/829,912	01/18/2011	7872705	4241-696	2008

23448 7590 12/28/2010

INTELLECTUAL PROPERTY / TECHNOLOGY LAW
PO BOX 14329
RESEARCH TRIANGLE PARK, NC 27709

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 318 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Nicholas W. Medendorp JR., Raleigh, NC;
Norbert Hiller, Chapel Hill, NC;
Russell G. Villard, Apex, NC;

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MAR 31 2011

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re United States Patent of:		Docket No.:	4241-696
Applicants:	MEDENDORP, JR., Nicholas W., et al.	Conf. No.:	2008
Application No.:	11/829,912	Date Filed:	July 29, 2007
Patent No.:	7,872,705	Date Issued:	January 18, 2011
Title:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS	Customer No.:	23448

FACSIMILE TRANSMISSION CERTIFICATE
Fax No. (571) 273-8300

I hereby certify that this document is being filed in the United States Patent and Trademark Office, via facsimile transmission, addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, and transmitted on the date specified below, to United States Patent and Trademark Office facsimile transmission number (571) 273-8300.

2
Number of Pages

Kate Pope

March 31, 2011
Date

IDENTIFICATION OF MINOR ERROR NOT WARRANTING CERTIFICATE OF CORRECTION IN U.S. PATENT NO. 7,872,705

Commissioner for Patents
Attn: Certificate of Correction Branch
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

A review of the above-identified patent has revealed the presence of an error attributable to

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 470 of 482

applicants/patentees. Such error is of a minor and self-evident character, and is identified below:

Column 2, line 17: "effect Depending" should be -- effect. Depending --.

While this error is not of a serious enough nature to warrant a Certificate of Correction, patentees nevertheless wishes to bring same to the attention of the Patent and Trademark Office, so that the error is made of record in the file of this patent.

Respectfully submitted,

Vincent K. Gustafson
Reg. No. 46,182
Attorney for Applicants/Patentees

HULTQUIST IP
P.O. Box 14329
Research Triangle Park, NC 27709
Phone: (919) 419-9350
Fax: (919) 419-9354
Attorney File No.: 4241-696

The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

PAGE 2/2 * RCVD AT 3/31/2011 9:08:34 AM [Eastern Daylight Time] * SVR:W-PTOFAX-002/40 * DNIS:2738300 * CSID:9194199354 * DURATION (mm-ss):01-23

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 471 of 482

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Divison on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00170	5/24/2022	Eastern District of Texas - Marshall Divison

PLAINTIFF	DEFENDANT
BRIGHTPLUS VENTURES LLC	LG ELECTRONICS, INC. and LG ELECTRONICS U.S.A., INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,960,812	4/6/2010	Brightplus Ventures LLC
2	7,872,705	1/18/2011	Brightplus Ventures LLC
3	8,177,382	5/15/2012	Brightplus Ventures LLC
4	8,294,075	10/23/2012	Brightplus Ventures LLC
5	8,330,710	12/11/2012	Brightplus Ventures LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas - Marshall Divison on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00170	5/24/2022	Eastern District of Texas - Marshall Divison

PLAINTIFF	DEFENDANT
BRIGHTPLUS VENTURES LLC	LG ELECTRONICS, INC. and LG ELECTRONICS U.S.A., INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,941,331	1/27/2015	Brightplus Ventures LLC
2	9,605,835	3/28/2017	Brightplus Ventures LLC
3	RE42,598	8/9/2011	Brightplus Ventures LLC
4	RE45,796	11/10/2015	Brightplus Ventures LLC
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Northern District of Georgia on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
1:22-cv-02774-TCB	7/14/2022	for the Northern District of Georgia

PLAINTIFF	DEFENDANT
Hisense USA Corporation	Brightplus Ventures LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	See Attachment A		
2			
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
KEVIN P. WEIMER	s/ A. Edwards	7/15/2022

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

Print Save As...

Attachment A to Form AO 120

Patent No.	Date of Patent	Holder of Patent
7,690,812	4/6/2010	Brightplus Ventures LLC
7,872,705	1/18/2011	Brightplus Ventures LLC
8,177,382	5/15/2012	Brightplus Ventures LLC
8,294,075	10/23/2012	Brightplus Ventures LLC
8,330,710	12/11/2012	Brightplus Ventures LLC
8,941,331	1/27/2015	Brightplus Ventures LLC
9,605,835	5/28/2017	Brightplus Ventures LLC
RE42,598	8/9/2011	Brightplus Ventures LLC
RE45,796	11/10/2015	Brightplus Ventures LLC

PETITION TO ACCEPT UNINTENTIONALLY DELAYED PAYMENT OF MAINTENANCE FEE IN AN EXPIRED PATENT (37 CFR 1.378(b))

Patent Number	Issue Date	Application Number	Filing Date	Docket Number (if applicable)
7872705	18-Jan-2011	11829912	29-Jul-2007	

CAUTION: Maintenance fee (and surcharge, if any) payment must correctly identify: (1) the patent number and (2) the application number of the actual U.S. application leading to issuance of that patent to ensure the fee(s) is/are associated with the correct patent. 37 CFR 1.366(c) and (d).

Applicants claims the following fee status:

◯ Small Entity

◯ Micro Entity

◉ Regular Undiscounted

Applicants selects the following :

◯ 3 1/2	◯ 7 1/2	◉ 11 1/2

PETITION FEE
The petition fee required by 37 CFR 1.17(m) (Fee Code 1558/2558) must be paid as a condition of accepting unintentionally delayed payment of the maintenance fee.

MAINTENANCE FEE (37 CFR 1.20(e)-(g))
The appropriate maintenance fee must be submitted with this petition.

STATEMENT

The delay in payment of the maintenance fee for this patent was unintentional.

Petitioner is reminded that a delay resulting from a deliberately chosen course of action or a change in circumstance is not an unintentional delay.

Petitioner is further reminded that a person seeking reinstatement of an expired patent should not make a statement that the delay in payment of the maintenance fee was unintentional unless the entire delay was unintentional, including the period from discovery that the maintenance fee was not timely paid until payment of the maintenance fee. For example, a statement that the delay in payment of the maintenance fee was unintentional would not be proper when the patentee becomes aware of an unintentional failure to timely pay the maintenance fee and then intentionally delays filing a petition for reinstatement of the patent under 37 CFR 1.378. See MPEP 2590.

NOTE: Where the petition under 37 CFR 1.378 is filed more than two years after the date the patent expired for nonpayment of the maintenance fee, the United States Patent and Trademark Office requires an additional explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional. This requirement is in addition to the requirement to provide a statement that the entire delay was unintentional. See *Clarification of the Practice for Requiring Additional Information in Petitions Filed in Patent Applications and Patents Based on Unintentional Delay*, 85 FR 12222 (March 2, 2020). See MPEP 711.03(c)(II)(C)-(F) for additional guidance on the information required to establish that the entire delay was unintentional.

PETITIONER(S) REQUEST THAT THE DELAYED PAYMENT OF THE MAINTENANCE FEE BE ACCEPTED AND THE PATENT REINSTATED

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

37 CFR 1.378(c) states: "Any petition under this section must be signed in compliance with 37 CFR 1.33(b) ."

I certify, in accordance with 37 CFR 1.4(d)(4) that I am

- ○ An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.
- ◉ An attorney or agent registered to practice before the Patent and Trademark Office
- ○ A sole patentee
- ○ A joint patentee; I certify that I am authorized to sign this submission on behalf of all the other patentees as evidenced by the power of attorney in the application
- ○ A joint patentee; all of whom are signing this e-petition
- ○ The assignee of record of the entire interest that qualifies as an authorized party under 37 CFR 1.33(b)

Patent Practitioner			
A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature			
Signature	/Jason Bourgeois/		
Name	Jason Bourgeois	Registration Number	66000

Electronic Patent Application Fee Transmittal

Application Number:	11829912
Filing Date:	29-Jul-2007
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Filer:	Jason Keshav Bourgeois
Attorney Docket Number:	4241-696

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
MAINTENANCE FEE DUE AT 11.5 YEARS	1553	1	7700	7700
PET. DELAY PYMT MAINTAIN PATENT IN FORCE	1558	1	2100	2100
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**9800**

UNITED STATES PATENT AND TRADEMARK OFFICE

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In re Patent No. 7872705
Issue Date: January 18,2011
Application No. 11829912
Filed: July 29,2007
Attorney Docket No. 4241-696

:
:DECISION GRANTING PETITION
:UNDER 37 CFR 1.378(b)
:

This is a decision on the electronic petition, filed June 16,2023 ,under 37 CFR 1.378(b) to accept the unintentionally delayed payment of the 11.5 year maintenance fee for the above-identified patent.

The petition is **GRANTED**.

The maintenance fee is accepted, and the above-identified patent reinstated as of June 16,2023 . This decision also constitutes notice that the fee has been accepted. An electronic copy of the petition and this decision has been created as an entry in the Image File Wrapper. Nevertheless, petitioner should print and retain an independent copy.

Telephone inquiries related to this electronic decision should be directed to the Electronic Business Center at 1-866-217-9197.

Electronic Acknowledgement Receipt

EFS ID:	48166246
Application Number:	11829912
Patent Number:	7872705
Confirmation Number:	2008
Petition Issued Date:	June 16,2023
Title of Invention:	LED BACKLIGHT SYSTEM FOR LCD DISPLAYS
First Named Inventor/Applicant Name:	Nicholas W. Medendorp
Customer Number:	23448
Filer:	Jason Keshav Bourgeois
Filer Authorized By:	
Attorney Docket Number:	4241-696
Receipt Date:	16-JUN-2023
Filing Date:	29-JUL-2007
Time Stamp:	13:48:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$9800
RAM confirmation Number	E20236FD48077715
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	ePetition Request Form	petition-request.pdf	47996 72e97e3e40d29f2c3094d942685f23bccf7e1f69	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40566 f9e949b19ef34882d60b5f555d0b35bfc3600ad2	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	88562		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.