(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 February 2008 (07.02.2008)

PCT

(10) International Publication Number
WO 2008/016978 A1

(51) International Patent Classification:
B60Q 3/02 (2006.01)

(21) International Application Number:
PCT/US2007/074978

(22) International Filing Date: 1 August 2007 (01.08.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/821,066 1 August 2006 (01.08.2006) US

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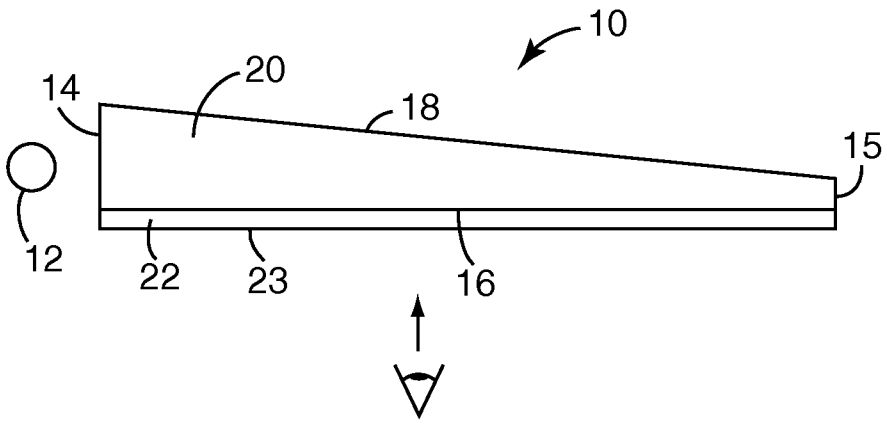
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, LV, MC, MT, 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 applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(54) Title: ILLUMINATION DEVICE



(57) Abstract: The present invention is generally directed to illumination devices, and particularly directed to illumination devices which utilize thin light sources or edge-lit sources in combination with a light turning plate. The illumination devices may be used in a broad range of applications, and are particularly suited for the interior lighting of vehicles.

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ILLUMINATION DEVICE

Technical Field

The present invention is generally directed to illumination devices, and particularly directed to illumination devices which utilize unique cover materials.

Background

Light fixtures are used to provide illumination to a broad range of surfaces or spaces. Examples of known light fixtures include dome lights in vehicles, lights affixed to the interior or exterior of a home or building, and lights affixed to an appliance or tool. Many light fixtures used for these applicants utilize bulky housings containing light bulbs and reflectors. Further, many light fixtures provide direct illumination where the light source emits light directly toward the targeted area, which may cause undesired glare on illuminated surfaces or to the user.

Summary

In one embodiment, the present disclosure is directed to an illumination device for the interior lighting of a vehicle, comprising:

a. at least one light source,

b. at least one light management device comprising a front light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light output face, and

c. a cover operatively adapted (i.e., dimensioned and designed) to form a portion of the interior surface a vehicle.

In a further embodiment, the present disclosure is directed to an illumination device for the interior or exterior lighting of a vehicle, comprising:

a. at least one light source,

b. at least one light management device comprising a light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light exit face, and

c. a cover operatively adapted to form a portion of the interior or exterior surface a vehicle.

In another embodiment the present disclosure is directed to vehicle glazing, comprising:

a. at least one light source,

b. a first light management device comprising a front light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light exit face, and

c. a second light management device.

Brief Description of the Drawings

FIG. 1 is a side view of an illumination device in an embodiment of the invention.

FIG. 2 is a side view of an illumination device in an embodiment of the invention.

FIG. 3 is an exploded side view of an illumination device in an embodiment of the invention.

FIG. 4 is a perspective view of an illumination device in a further embodiment of the invention.

Detailed Description

In one embodiment, the present disclosure is directed to illumination devices for vehicles wherein the light source illuminates a cover that blends in with a surface of the vehicle (e.g., an interior surfaces). These surfaces can include but are not limited to surfaces that are or have the appearance of metal, fabric, plastic (e.g., vinyl), leather, synthetic leather, wood, paint, or other typical vehicle interior surfaces. When the illumination device is used on the exterior of a vehicle, such surfaces can also be or have the appearance of being metal, fabric, plastic (e.g., vinyl), synthetic leather, wood or painted surfaces. When the illumination device is used on the the interior or exterior of a building or other structure, such surfaces can also have the appearance of being (e.g., being faux) or can be metal, fabric, plastic (e.g., vinyl), leather, synthetic leather, wood, paper (e.g., wall paper, paper used in drywall, etc.), paint, stucco, brick, slate, tile, siding, plaster, marble, granite, concrete or other such surfaces that may be used in the construction or decorating of a building or other structure. In some embodiments, when the light source is turned on, the cover material is no longer visible. In other embodiments the cover material is visible when the light source is turned on, and creates a variety of appearances as illuminating light shines through it.

In other embodiments, the cover of the illumination device may appear transparent, translucent, or reflective. The cover materials described herein may have one appearance (e.g., a mirror) when the light is off, while also allowing light from the source to permeate through when the light is turned on. The light from the hidden light source can be made to permeate through the cover using a variety of mechanisms. These mechanisms can vary based on the makeup of the covers as well as the desired characteristics of the output light.

In further embodiments, the illumination devices disclosed herein may be configured (i.e., dimensioned and designed) to form at least part or all of a vehicle glazing, such as a sunroof. In such an embodiment, the illumination device may project light into or out of the vehicle, as may be desired. In this embodiment, the illumination device may have a transparent or translucent appearance when the light source is turned of, while illuminating the interior or exterior of the vehicle while the light is on.

The lighting devices disclosed herein provide illumination for the interior or exterior of vehicles and are thin, efficient, evenly illuminating and aesthetically attractive. As one skilled in the art may appreciate, such lighting devices may be used in other applications where one desires to have a light source which blends in with the surrounding environment. Further applications for the illumination devices disclosed herein may be in the interior or exterior of buildings or other objects or structures.

When terms such as "above", "upper", “atop”, "upward", "beneath", "below", "lower" and "downward" are used in this application to describe the location or orientation of components in an illumination device, these terms are used merely for purposes of convenience and assuming that the viewing face of the illumination device is horizontal and is viewed from above. These terms are not meant to imply any required orientation for the completed illumination device or for the path taken by supplied or ambient light in actual use of the completed device.

As used herein, the term “vehicle” is defined broadly as a means of carrying or transporting something. Types of vehicles which may utilize the illumination devices disclosed herein include, by way of non-limiting example, automobiles, trucks, buses, trains, recreational vehicles, boats, aircraft, motorcycles, and the like.

As used herein, the term “light source” means any light generating source, including, by way of non-limiting example, LEDs, fluorescent or incandescent lamps, electroluminescent lights, and the like. A light source could also take the form of the illumination devices, as described herein. Preferably, the light source is powerful enough (i.e., produces enough lumens or candlelight) to enable the illumination device to sufficiently illuminate an area of interest so as to meet or exceed the applicable illumination standards associated with the desired use of the illumination device (e.g., in order to function as an overhead light, a map light or a glove box light in the interior of a vehicle; or as a security light or flood light on the exterior of a building; as a reading light; etc.).

As used herein, the term “light management device” means any material or device that alters the properties of visible light. Non-limiting examples of such properties include reflection, refraction, dispersion, diffraction, interference, and the like.

As used herein the term "light guide" or "light turning plate" means a material capable of guiding a flow or propagation of light by means of reflection. Light guides and light turning plates are specific types of light management devices.

As used herein, the term "cover" refers to a material used to partially or completely cover the illumination devices described herein. The covers may be made of a wide variety of materials designed to permit at least a portion of the light to penetrate through the surfaces of the material. In some embodiments covers are made of materials similar to the surrounding environment of the illumination device to create a hidden light source.

The term "transparent" as used herein is generally meant that an article allows light to pass through it without substantial portions of light being absorbed. Accordingly, transparent materials in connection with the present disclosure can be optically clear and have and have a visible light transmission in the range of from about 70% up to and including about 100%.

The term "translucent", as used herein, means that an article has a visible light transmission in the range of from about 30% to less than about 70%.

The term "glazing" as used herein, refers to transparent or translucent panels or panes that allow light to pass into or out of a vehicle, building or other structure, such as a window, front or rear windshield, sky light, sunroof, and the like. Conventional materials, such as glass and plastic, can be used in the construction of the transparent and translucent panels.

Referring now to the drawings, FIG 1. illustrates an illumination device 10 in an embodiment of the present disclosure. The illumination device 10 includes a light source 12, a light guide 20 having an input face 14, an output face 16 and a light directing face 18. In the embodiment depicted in FIG.1, light guide 20, is in the form of a wedge that decreases in thickness from light input face 14 toward end 15. As described below, the light guide need not be made as a wedge, and in some embodiments will have a relatively constant thickness. An optically transparent adhesive (not shown) fastens an optional structured light extraction layer 22 to light output face 16 of light guide 20.

Due to the inclusion of the light extraction layer 22, the light guides described herein are capable of reflecting light in a direction that is normal or near normal with

respect to a plane parallel to the output face 16, of the light guide 20. Light extraction layer 22, has a light exit face 23 and an upper surface opposite the light exit face having a plurality of projections (not shown). Those skilled in the art will appreciate that additional antireflection coating layers or other light management devices or features can be applied to exit face 23, so long as care is taken preserve the substantially flat topography of exit face 23 and to avoid introduction of undesirable distortions in the viewed image. For further discussion of the light extraction layer, see U.S. Patent No. 6,592,234, the entire contents of which are incorporated by reference herein.

FIG. 2 shows an illumination device 30 in a further embodiment of the present disclosure. Light guide 32, has a light input face 34, a light output face 36, a light directing face 38, and an optional extraction layer 22. Unlike the generally tapered light guide of FIG. 1, light guide 32 has a generally planar shape, and is shown to have relatively constant thickness from the light input face 34 toward end 35.

In operation, light provided by the light source 12, passes through the light guide 20, 32 and is reflected by the surface of the corresponding light directing face 18, 38 to the output face 16, 36. Alternatively, light could be confined within the light guide 20, 32 by manipulating the incident angle of the light, or utilizing cladding materials or further light management devices having a low refractive index. Further, when one or more surfaces of the light guide is structurally embossed, or optically designed, for example, with a differential refractive index patterned coating, light can be uniformly extracted from one surface of the light guide. Light guides suitable for use in the illumination devices described herein are disclosed in U.S. Patent Numbers 6,738,051, 6,663,262, 6,592,234, 6,576,887, the entire contents of which are incorporated by reference herein.

Turning now to FIG. 3, a further embodiment of an illumination device is shown having a light source 12, a front light guide 20 having a light input face 14, a light output face 16 and a light directing face 18. The illumination device in this embodiment additionally contains a reflector material 42. The reflector 42 imparts various qualities to the light, such as color or reflective properties. Reflector materials 42 may be a mirror films, opaque films, or other materials capable of light reflection. An example of such a film is Vikuiti™ Enhanced Specular Reflector (ESR) film available from 3M Company, St. Paul MN. The ESR film is a non-metallic, highly reflective mirror film.

The embodiment shown in FIG. 3 further contains a diffuser film 44, placed atop the light guide 20. Diffuser film 44 is effective in evenly distributing the light reflected from the light guide. The illumination device of FIG. 3 further contains two layers of a brightness enhancement film 46, 48 placed atop the diffuser film 44. Brightness enhancement films function to redirect and recycle light to increase the brightness of the light from the illumination device. In some embodiments, layers of brightness enhancement film 46, 48, may be placed in an orthogonal relationship.

The illumination device in the embodiment of FIG. 3 further contains a cover 50, placed atop the layers of brightness enhancement film 46, 48. Cover 50 may be comprised of a wide variety of materials. In some embodiments, the cover 50 has the appearance of, or is made of the same material used to, fabricate a portion of the vehicle surface (e.g., interior surface), such that when the light source of the illumination device is turned off, the illumination device blends into or becomes less distinguishable from the surrounding surface of the vehicle.

In some embodiments, the cover 50 may be made of metallic material (e.g., elemental metal, metal alloy or metal compound), metallic film (e.g., a metallic coated polymeric film), or a material or film with a metallic appearance. If such a material is used, the thickness of the metal may be controlled to provide appropriate light reflection and light transmission. In some cases, perforations may be made in the material in order to allow light to pass through the material or, in the case of a material that already allows light transmission, a higher light transmission. The perforations can be made by any suitable technique, which may include laser or flame ablation, mechanical perforation, or chemical etching. In some embodiments, the cover 50 can be made with a metallic looking or mirror-like film that is non-metallic. These films can be made to selectively reflect and transmit light based on the wavelength of the light impinging upon them. In a preferred embodiment, a multilayer interference film can be used to make such a metallic looking or mirror-like film, where the film has high reflectivity and high transmission through light recycling. Such multilayer interference films can be found in U.S. Patents Nos. 6,080,467 and 5,882,774, which are incorporated herein by reference in their entirety.

Cover 50 may further be made of a fabric or textile material, thus enabling the illumination device to blend in with a vehicle interior surface covered in fabric, such as the headliner, seatbelt, seat or other fabric or textile surface of a vehicle. For fabric or textile covers 50, applications that illuminate the cloth trim, seats, speaker covers, headliners, textile wall or ceiling panels, safety belts, head rests, arm rests, and even carpet or floor mats can make a vehicle more safe and convenient to operate and improve the occupant experience.

A cover 50 with a fabric or textile appearance can be made light permeable by making the weave of the textile loose enough to permit the light to pass between the fibers of the fabric or textile. A cover with a fabric or textile appearance can also be made light permeable by perforating the cover material via laser or flame ablation, mechanical perforation, or chemical etching. These perforations allow light to permeate through an otherwise opaque membrane. A cover 50 with a fabric or textile appearance can also be made to illuminate by incorporating optical fibers within the weave of the textile. When illuminated, these fibers then emit light along their length and illuminate the textile.

A cover with a colored, painted, printed or patterned appearance can be made light permeable for example, by perforating the appearance forming portion of the cover, or through the use of translucent or transparent substrates and pigments. Such covers could be fabricated with, for example, wood grain, faux wood grain, leather, synthetic leather, polymer, vinyl or other natural or artificial material used in the interior of vehicles.

The illumination devices described herein may be used in any location on the interior of a vehicle where decorative or functional elements (e.g., colored, painted or patterned elements) are employed that could benefit from the increased conspicuity or decorative appeal that internal illumination can provide.

As one skilled in the art would appreciate, the illumination devices described herein could also be used to illuminate surfaces on the exterior of a vehicle, or in other applications where it is desired to conceal the illumination device. For example, one could use the illumination devices described herein as safety lights under a carpet or tile surface, on or along stairs, or on a wall panel made of wood or other material, or as part or all of a mirror. Illumination devices described herein could also be used, for example, as a signal light (e.g., a stop or turn signal light) on the exterior surface of a vehicle. Examples

of further applications for the illumination devices described include the exterior surface of a building or other structure or mobile objects such as an appliance or furniture.

While the illumination devices depicted in the figures show the devices as substantially planar articles, it should be appreciated that the devices may be constructed to form curved surfaces (e.g., circular, oval or other arcuate structures). For example, referring to the illumination device 10 of Fig. 1, the light guide 20 could be formed so as to curve along a lateral or longitudinal axis. Such an alternative embodiment is shown in Fig. 4. In this embodiment, the light source 12' is modified to better provide light to the curved input face 14' of the light guide 20'. For example, the light source 12' could take the form of a series of LEDs or other individual light sources aligned along the curved light input face 14'. Alternatively, a single curved light source may be used (e.g., a curved light pipe).

In other embodiments, the light guide 20 could be formed into a cylindrical, oval or other arcuate shape with the light source 12 modified to provide light along the input face 14. As one skilled in the art will appreciate, the light guide may be configured in various ways to provide illumination devices for a number of applications.

The light guides described herein could be made to be transparent or translucent, to allow ambient light to pass through the light guide. This could be useful for applications such as the illumination of a glazing (e.g., a window, sunroof or sky light). Depending on the material used for the light guide, a glazing or other surface could comprise the light guide material, thus providing a surface with dual function within the vehicle. For example, a sunroof, sky light, window or other glazing could be made in part, entirely or substantially of a transparent or translucent light guide material, such that the glazing would function to allow ambient light to pass through, and additionally, the glazing could be illuminated by a light source to provide lighting within a vehicle, building or other structure (e.g., overhead lighting from a sunroof or sky light). Additionally or alternatively, the light guide could be configured such that light is projected outside of the vehicle, building or other structure.

The optical qualities of the illumination devices described herein, may be further enhanced by the use of additional light management devices. Suitable light management devices for use in the illumination devices described herein include, light control films for

glare and reflection management, prismatic brightness enhancement films, diffuser films, reflective films, reflective polarizer brightness enhancement films, and turning films.

Optionally, a protection layer could be placed on the top surface of the light output face 16 to improve surface durability and reduce surface reflection of the illumination device 10, 30. Those skilled in the art will appreciate that the protection layer could additionally comprise a hard coating, smudge resistant coating, or an antireflection coating. The protection layer may also provide weathering resistant features through UV resistant coatings or UV stabilizers.

Further, the light guides as described herein could be coupled with one or more light management devices to produce, for example, an illuminated reflective surface, such as an illuminated mirror. As a further example, a light management device could be used on the end surfaces 15, 35 to prevent light leakage out of the device.

The light guides described herein can have any desired overall size and thickness, and in some embodiments, are relatively thin, e.g., 5 mm or less. The light guide can be wedge-shaped, rectangular, oval or any other desired shape. The size and shape of the light guide usually will be dictated by the size and shape of the desired illumination device. In some embodiments, light guide thickness ranges from about 0.1 to about 5 mm, and in other embodiments, from about 1 to about 2 mm.

The light guides can be fabricated from a wide variety of optically suitable materials including glass; polycarbonate; polyacrylates such as polymethyl methacrylate; and polystyrene. The light input face and viewing face of the light guide can each be generally planar or can have a convex or concave curvature. When the light source is a point or line source, the light input face may be provided with a convex curvature, lenslets, prisms, a roughened surface or other features in order to distribute the incoming light more evenly. The light directing face preferably has an optically smooth finish, in order to minimize transmission losses, undesired scattering and distortion.

Reflector materials 42 suitable for use in the illumination devices described herein are described in the following U.S. patents, incorporated by reference herein in their entirety: 5,094,788, 5,122,905, 5,269,995, 5,389,324, 5,882,774, 5,976,424, 6,080,467, 6,088,163, 6,101,032, 6,117,530, 6,157,490, 6,208,466, 6,210,785, 6,296,927.

Suitable diffuser films 44 are described in the following U.S. Patents, incorporated by reference in their entirety: 5,217,794, 5,528,720, 5,751,388, 5,783,120, 5,825,542, 5,825,543, 5,867,316, 5,991,077, 5,999,239, 6,005,713, 6,025,897, 6,031,665, 6,057,961, 6,111,696, 6,141,149, 6,179,948, 6,256,146. As would be appreciated by one skilled any the art, any number of light management devices may be appropriate for use in the illumination devices described herein, such as the light management devices described above.

Suitable brightness enhancement films 46, 48 are described in the following U.S. Patents, incorporated by reference herein: 4,542,449, 4,791,540, 4,799,131, 4,883,341, 4,984,144, 5,056,892, 5,161,041, 5,175,030, 5,183,597, 5,626,800, 5,771,328, 5,828,488, 5,858,139, 5,908,874, 5,917,664, 5,919,551, 6,025,897, 6,052,164, 6,091,547, 6,280,063.

As discussed above, cover 50 may be made of a variety of materials. In some embodiments, the cover is made from a transparent or translucent material. Additionally, cover 50 may be made of any of the light management devices described herein.

Further, films described in the following U.S. patents and patent applications may be used as a light management device or cover 50 for the illumination devices described herein. Such films are available from the 3M Company under the trade designation Accentrim™ and are covered by one or more of the following U.S. patents and patent applications, the entire contents of which are incorporated by reference herein: 3,908,056; 5,840,407; US 2004157031; 6,773,537; 6,805,932; 6,571,849; 6,634,401; 6,700,712.

As would be appreciated by one skilled any the art, any number of optical devices or films may be appropriate for use in the illumination devices described herein, such as the light management devices described above. Further, it should be appreciated that any combination of light guides and light management devices as described above may be appropriate to fabricate illumination devices as disclosed herein.

As one skilled in the art would further appreciate, light sources used in the devices described herein can be provided in a variety of forms. The light source may be for example, a linear array of LEDs, or other form of light source such as fluorescent or incandescent lamps, electroluminescent lights and the like. In some embodiments, the light may be colored. In some embodiments, there may be more than one light source provided in the illumination device. In further embodiments, the light may be input into a

light guide in a variety of configurations. The light source may be supplied with a dimmable control, on/off control, color control and the like.

Further, the illumination devices described herein are suitable for use as fixtureless lighting systems in a variety of applications for illuminating spaces inside and around a vehicle, whenever and wherever sufficient illumination with minimal direct glare is needed and space conservation is needed. The typical examples of such applications are include, but not limited to, overhead dome lighting, glove box lighting, floor lighting, map lights, mirror lights, reading lights, puddle lights, bunk lights, cabin lights, ambient lights, cuddy lights, decorative lights, taillights, brake lights, and the like.

The illumination devices described herein are suitable for use on any surface of a vehicle traditionally provided with lighting such as overhead dome lighting, glove box lighting, floor lighting, map lights, mirror lights, decorative lights, and the like. In addition, the illumination devices described herein are suitable for providing lighting in places where prior art lighting systems would be difficult or impractical. Due to the thin construction of the devices and the configuration of the light source (e.g., side lighting) the illumination devices of the present invention may be installed in confined spaces.

As one skilled in the art may appreciate, there are a variety of combinations of the components described herein that would be suitable to provide suitable illumination devices.

Examples

The following abbreviations were used in the examples:

LL1: 12- high intensity white light emitting diodes (LEDs), commercially available under the trade designation "TG White Hi LED, Part Number E1S42-AW0C6-03 Bin B6" from Toyoda Gosei North America, Troy, Michigan, and 6 high intensity yellow LEDs commercially available under the trade designation "LED Yellow 594 nm CLR 4-PLCC SMD, Model Number LY E67B U2AA-26-1" from Osram OptoSemiconductor GmbH, Regensburg, Germany, were bonded in a linear array to a printed circuit board (12.7 cm x 6mm) wherein the yellow LEDs were sequentially spaced between two white LEDs.

LL2: A linear array of 18 high intensity red light emitting diodes (LEDs), commercially available under the trade designation LED Red 645 nm 4-PLCC SMD model number LS E67B-T2V1-1-1 from Osram OptoSemiconductor, equally spaced and bonded to a printed circuit board (12.7 cm x 6mm).

LG1: A wedge-shaped PMMA light guide, 7.6 cm x 11.4 cm, one smooth, light output side, and an opposing, light re-directing side comprising an array of uniformly distributed microreplicated elongated parallel prisms, made according to the method described in U.S. Patent No. 6,379,016 (Boyd et al.). The proximal, i.e., the propagation end of the light guide, was 3 mm, and the distal end was 1.0 mm.

Example 1

A light assembly was made as follows. Light source LL1 was secured to the one end of a 7.6 cm x 12.7 cm x 6 mm open faced plastic housing. A sheet of opaque white polyester film was placed on the bottom face of the housing. Light guide LG1 was placed, proximal edge adjacent to the LEDs and the light re-directing side facing the white polyester sheet. A 5 mil. (127 micrometers) x 7.6 cm x 12.7 cm diffuser film, commercially available under the trade designation "Lexan XL4251 Bottom Diffuser Film 0.005 White WH5A201X" from GE Polymershapes Film Division, Fairfield, Connecticut, was placed on top of the light guide. Two orthogonally crossed sheets of brightness enhancement film, commercially available under the trade name "Vikuiti BEF" (BEF) from 3M Company were then p[laced on top of the diffuser film.. The LED was illuminated using a milliamp current supply, commercially available from Hewlett Packard Company, Palo Alto, California under model number 6214.

Example 2

Example 1 was repeated, wherein LL1 was replaced with LL2 and a sheet of enhanced specular reflector film, commercially available under the trade designation "ESR" from 3M Company, St. Paul, Minnesota, was placed on top of the upper most layer of the BEF. When the LED array is off, the light device had a reflective metallic look or

mirror-like appearance. When the LED array is turned on, an essentially uniform red light emission was observed in lieu of the reflective metallic face.

Example 3

Example 1 was repeated, wherein a printed open weave fabric, obtained under the trade name "Tan Thru" from Solar Fashion GmbH, Bandlach, Germany was placed on top of the upper most layer of the BEF. When the LED array is off, the face side of the light device maintained the fabric's printed appearance. When the LED array is turned on, an essentially uniform white light emission was observed in lieu of the fabric face.

Example 4

Example 1 was repeated, wherein a sheet of diffuser film and two sheets of BEF films were removed, and a sheet of reflective polarizer film, commercially available under the trade designation "DBEF" from 3M Company, St. Paul, Minnesota, was directly placed on top of the light guide. When the LED array is off, the light device had a glossy whitish look. When the LED array is turned on, an essentially uniform white light emission and only light emission, but no light sources was observed.

Prophetic Examples

The light transmissive membrane may comprise reflective film made according to the methods described in U.S. Pat. Nos. 5,353,154 (Lutz et al.) and 5,684,633 (Lutz et al.). The membrane may also be a loose weave fabric, or made light transmissive by perforating minute holes (full or partial) through the medium. Techniques include laser ablation, flame ablation, chemical etching or perforation via mechanical, laser or ultrasonic methods.

The light transmissive membranes may comprise or otherwise be formed from other translucent conformable films, such as cast polyvinyl chloride films obtained under the trade designation "Scotchcal" from 3M Company. Furthermore, the film may be textured to create a diffuser, structured or microstructured or, to create other lighting effects, may be colored, or employ other optically modified films, such as multiple optical layer film obtained under the Vikuiti Brand from 3M Company

Likewise, the present invention may be prepared with other visible colors of LEDs, such as those commercially obtained under the part number "QTLT601C1T" from Fairchild Semiconductor or even LEDs emitting beyond the visible portion of the electromagnetic spectrum, such as infrared LEDs obtained under the part number "AP1608F3C" from Kingbright Corporation, City of Industry, California, or ultraviolet LEDs, obtained under the part number "SM1206UV-395-IL" from Bivar, Inc., Irvine, California.

What is claimed is:

1. An illumination device for the interior lighting of a vehicle, comprising:

a. at least one light source,

b. at least one light management device comprising a front light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light output face, and

c. a cover operatively adapted to form a portion of the interior surface a vehicle.

2. The illumination device of claim 1, wherein the cover has a metallic appearance.

3. The illumination device of claim 1 wherein the cover is made of a material selected from the group consisting of mirror film, a fabric material, a textile material, a leather material, a polymer material, a faux wood grain, and leather.

4. The illumination device of claim 1 wherein the light guide is wedge-shaped.

5. The illumination device of claim 1, wherein the light guide is curved about a longitudinal or lateral axis.

6. The illumination device of claim 1 or 2 wherein the illumination device contains at least two light management devices.

7. The illumination device of any one of claims 1 to 3 wherein the illumination device includes a mirror film.

8. The illumination device of any one of claims 1 to 5 wherein the light exit face of the light extraction layer is substantially flat.

9. The illumination device of any one of claims 1 to 6 wherein the light exit face of the light extraction layer is flat.

10. The illumination device of any one of claims 1 to 5 wherein the light exit face of the light extraction layer is curved.

11. The illumination device of any one of claims 1 to 8 wherein the light input face is a substantially straight edge.

12. The illumination device of any one of claims 1 to 9 wherein the light input face is a straight edge.

13. The illumination device of any one of claims 1 to 8 wherein the light input face has a curved shape.

14. The illumination device of any one of claims 1 to 8 wherein the light input face has a circular shape.

15. The illumination device of any one of claims 1 to 8 wherein the light input face has a circuitous shape.

16. The illumination device of any one of claims 1 to 14 wherein said illumination device is substantially thinner than it is wide or long.

17. An illumination device for the interior or exterior lighting of a vehicle, comprising:

a. at least one light source,

b. at least one light management device comprising a light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light exit face, and

c. a cover operatively adapted to form a portion of the interior or exterior surface a vehicle.

18. The illumination device of claim 17, wherein the cover has a metallic appearance.

19. The illumination device of claim 17, wherein the cover is made of a material selected from the group consisting of: a mirror film, a fabric material, a textile material, a leather material, a polymer material, a faux wood grain, and leather.

20. A vehicle glazing, comprising:

a. at least one light source,

b. a first light management device comprising a front light guide having at least one light input face through which light from the source can be supplied to the light guide, a light directing face, and a light output face opposite the light directing face, the light output face having a light extraction layer thereon, the light extraction layer having a light exit face and containing buried reflective facets that extract supplied light from the light guide through the light exit face, and

c. a second light management device.

21. The vehicle glazing of claim 20, wherein the glazing forms at least part of the sunroof of a vehicle.

22. The vehicle glazing of claim 21 wherein the light output face of the light guide is positioned to project light into the vehicle.

23. The vehicle glazing of claim 20 wherein the second light management device is a brightness enhancement film (BEF).

24. The vehicle glazing of claim 20 wherein the glazing is at least partially transparent when the light source is turned off.

25. The vehicle glazing of claim 20, wherein the glazing is at least partially translucent when the light source is turned off.

26. The vehicle glazing of claim 20, wherein the light exit face of the light extraction layer is substantially flat.

27. The vehicle glazing of claim 20, wherein the light exit face of the light extraction layer is flat.

28. The vehicle glazing of claim 20, wherein the light exit face of the light extraction layer is curved.

29. The vehicle glazing of claim 20, wherein the light input face is a substantially straight edge.

30. The vehicle glazing of claim 20, wherein the light input face is a straight edge.

31. The vehicle glazing of claim 20, wherein the light input face has a curved shape.

32. The vehicle glazing of claim 20, wherein the light guide is substantially planar.

33. The vehicle glazing of claim 20, wherein the light guide is curved about a longitudinal or lateral axis.

34. The illumination device of claim 1 or 17, wherein the cover comprises an optical fiber.

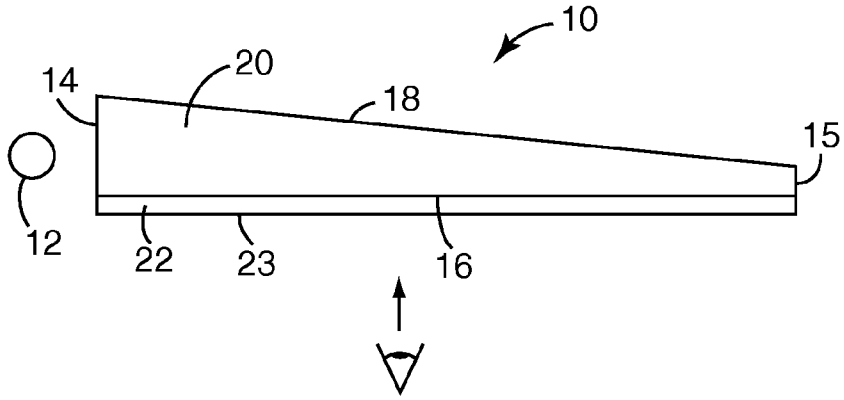

Fig. 1

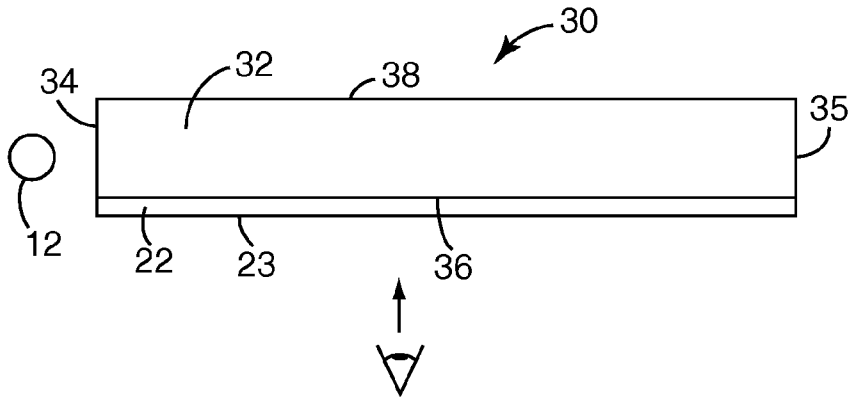

Fig. 2

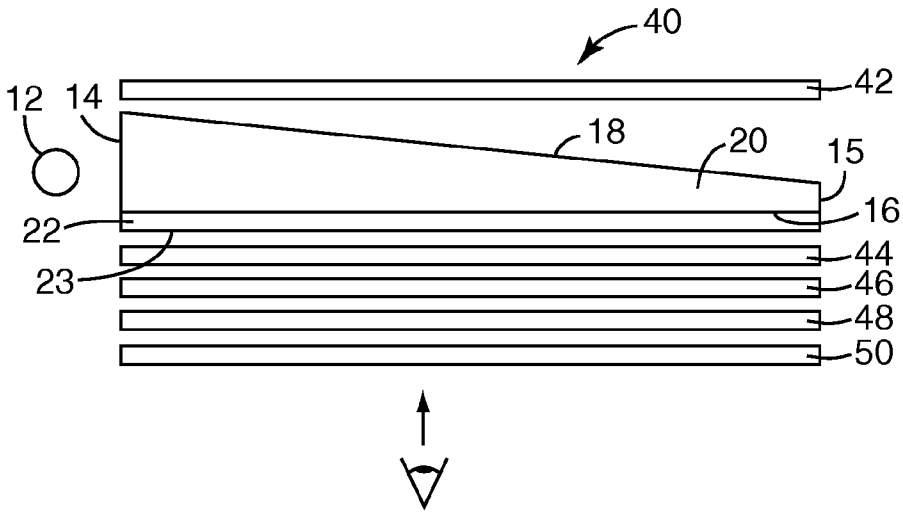

Fig. 3

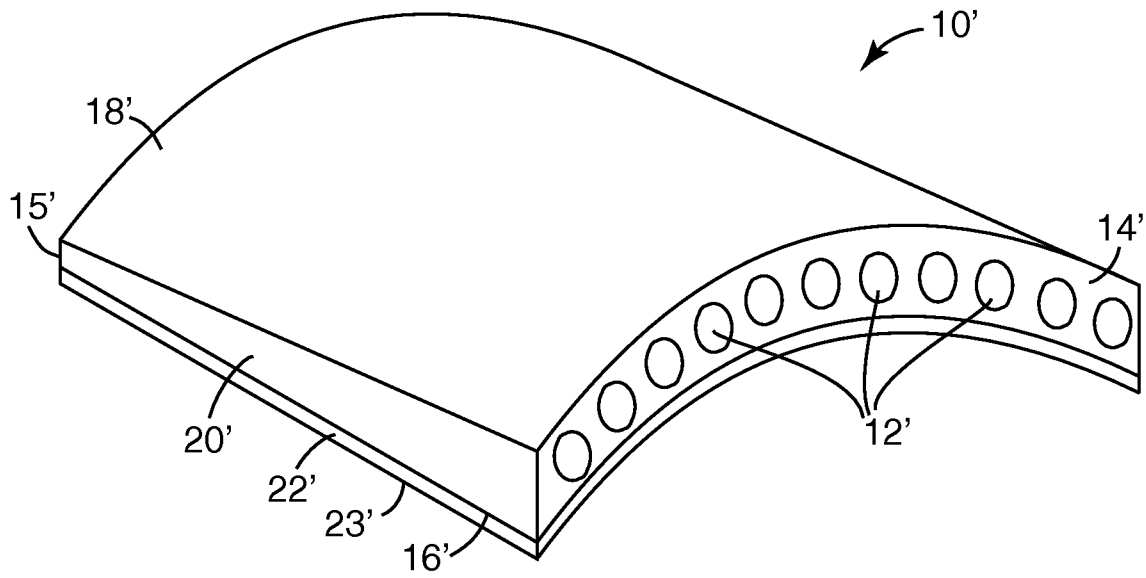

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/074978

A. CLASSIFICATION OF SUBJECT MATTER

B60Q 3/02(2006.01)i

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 8 B60Q 3/02, F21V7/04, B60R 19/44, G02B 6/10, G02B 6/26, G09G 5/00

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

Korean Utility Models and applications for Utility Models since 1975
Japanese Utility Models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) & keyword : light source, light guide, and vehicle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,592,234 B2 (KENNETH A. EPSTEIN et al.) 15 JULY 2003 See Abstract, Fig. 1, claim 1, column 3 line 47 - column 4 line 24	1, 4, 8, 17, 20, 22, 26, 27, 29, 30, 32
A	JP 2000-127847 A (TOYOTA AUTO BODY CO LTD , TOYOTA MOTOR KYUSHU INC) 9 MAY 2000 See Figs. 1, 4, claims 1-3	1, 4, 8, 17, 20, 22, 26, 27, 29, 30, 32
A	JP 03-217349 A (KOITO MFG CO LTD) 25 SEPTEMBER 1991 See Figs. 1, 5-7	1, 4, 7, 8, 17, 20, 22, 26, 27, 29, 30, 32
A	KR 20-0347643 Y1 (KIM, JOO HYUN) 17 APRIL 2004 See Figs. 3-5, claim 1	17, 19
A	US 6,347,874 B1 (GARY T. BOYD et al.) 19 FEBRUARY 2002 See Abstract, Fig. 7, claim 1	1, 4, 8, 17, 20, 22, 26, 27, 29, 30, 32

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

☒ 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 application or patent 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 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
21 DECEMBER 2007 (21.12.2007)	**24 DECEMBER 2007 (24.12.2007)**

Name and mailing address of the ISA/KR

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Facsimile No. 82-42-472-7140

Authorized officer

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Telephone No. 82-42-481-5731

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/074978

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 9, 11-16
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2007/074978

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		JP 2003-523536 A	05.08.2003
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