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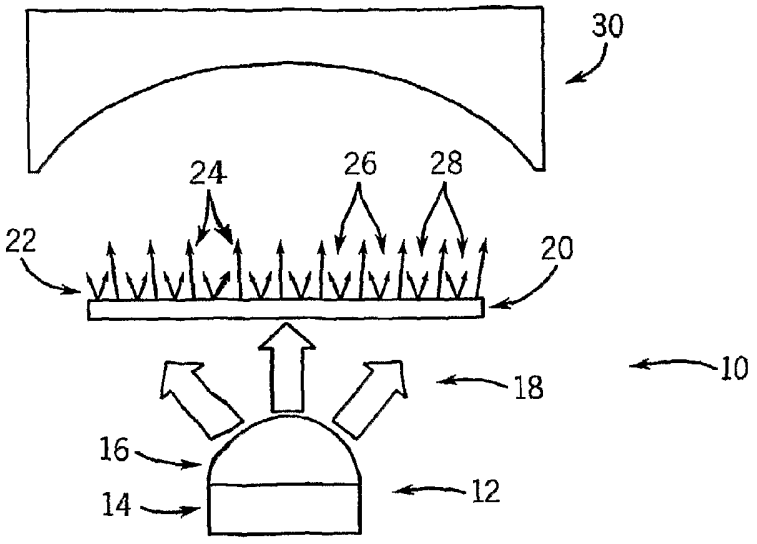
(54) Title: LAMP WITH EMISSIVE MATERIAL OUTSIDE OF LIGHT SOURCE



(57) Abstract: A lighting assembly includes a lamp (10) having a light source (14) configured to emit light of a first color and a material (22) separate from and in front of the light source. The material is configured to take in light from the light source and to emit light of a second color in response to taking in light from the light source. The second color is different than the first color. The lamp may be configured to be used as one of an interior vehicle lamp and an exterior vehicle lamp. Embodiments include using blue or ultraviolet LEDs and emissive material comprising phosphor to produce white light.

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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.

LAMP WITH EMISSIVE MATERIAL OUTSIDE OF LIGHT SOURCE

BACKGROUND

[0001] The present application relates generally to the field of vehicular lighting.

[0002] Light sources are common in a vehicle and may be used for any number of purposes. Such light sources may be used in interior or exterior lighting applications. The light given off by these light sources is often limited to particular colors depending on the type light source.

[0003] One category of light source used in vehicles is light emitting diodes (LEDs) which have been used in motor vehicles to provide illumination in various applications. For a number of years, one limitation on the use of such diodes for many interior and exterior lighting applications was the inability of the diodes to produce white light. Some lighting devices attempted to produce white light by using multiple closely spaced LEDs which included two or more types of LEDs, each type producing a different color of light (e.g. blue and amber or red, green, and blue). When the outputs of these colored LEDs were combined, they produced light that appeared white. One drawback of these multi-color LED lighting devices was that production of the proper color of light was dependent on a proper installation of and proper balance of the output of the multiple LEDs.

[0004] In response to this drawback, which also applies to fields outside of vehicle lighting, white LEDs were produced which LEDs produce light that appeared substantially white when a single LED was illuminated. These LEDs typically rely on producing two colors of light from a single LED package, which colors combine to form light that appears substantially white. One drawback of these white LEDs is that the two colors of light that blend to form the white light may tend to separate as light from the white LED is bent. Another drawback of some these LEDs is that while the light appears white to an observer, the light produced by these LEDs does not resemble typical white light. Typical white light is formed from a broad spectrum of colors whereas the light from some of the white LEDs tends to be formed from two colors, although some modifications work have been done to remove this drawback.

[0005] The teachings hereinbelow extend to those embodiments which fall within the scope of the appended claims, regardless of whether they address or include one or more of the above-mentioned problems.

SUMMARY

[0006] One embodiment is directed to a vehicle lighting assembly. The lighting assembly includes a lamp having a light source configured to emit light of a first color and a material separate from and in front of the light source. The material is configured to take in light from the light source and to emit light of a second color in response to taking in light from the light source. The second color is different than the first color. The lamp may be configured to be used as one of an interior lamp and an exterior lamp.

[0007] Another embodiment is directed to a vehicle lighting assembly. The lighting assembly includes a lamp having an LED and a body separate from the LED. The body carries an emissive material, which emissive material takes in light from the LED and emits light in response to taking in light from the LED. The lamp may be configured to be used as one of an interior lamp and an exterior lamp.

[0008] An additional embodiment relates to a lighting assembly for a vehicle. The lighting assembly includes a housing configured to be mounted in an interior of the vehicle, a circuit carrying element coupled to the housing, an LED mounted to the circuit carrying element and configured to emit light of a first color, an electrical circuit configured to receive power from a power source and provide power to the LED, a body coupled to the housing and separate from the LED, and an optic configured to receive light of the second color emitted by the phosphors. The body carries an emissive material that is configured to take in light of the first color from the LED and to emit light of a second color different than the first color. The light emitted by the phosphors is used to generate light that is substantially white. This may be done by combining the light emitted by the phosphors with other light (such as that emitted by the LED), may be done using a blend of phosphors, or may be done by some other means involving light emitted by the phosphors.. The lighting assembly may be configured to be used as an interior lamp.

[0009] Another embodiment provides a method of generating white light from an interior lamp. The method includes generating light of a first color from a light source, passing light from the light source through an open space, converting light of the first color that has

passed through the open space to light of a second color, and using the light of the second color to generate white light.

[0010] Other principle features, advantages, and variations falling within the scope of the invention will become apparent to those skilled in the art upon review of the following drawings, the detailed description, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Fig. 1 is a diagram of a system including a light source and an emissive material external from the light source which may be used to give off light of a different color than the light from the light source;

[0012] Fig. 2 is a diagram of an emissive material based lamp according to one embodiment;

[0013] Fig. 3 is a diagram of an emissive material based lamp according to another embodiment;

[0014] Fig. 4 is a diagram of an emissive material based lamp according to an additional embodiment;

[0015] Fig. 5 is a diagram of an emissive material based lamp according to another embodiment;

[0016] Fig. 6 is an illustration of some exemplary locations and applications in which an emissive material based lamp may be used in a vehicle; and

[0017] Fig. 7 is an exemplary wavelength spectrum diagram of light which may appear the color white to a person viewing the light.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0018] Referring to Fig. 1, a lighting system 10 for use as a lamp in a vehicle includes an LED 14 or other light source that gives off light 18 of a first color (wavelength or spectrum of wavelengths). The light 18 from the first color is absorbed by an emissive material 22 which then emits light 26 of a second color different than the color emitted by the LED (i.e. the second color contains a different wavelength or combination of wavelengths of light than the first color). A color can be made of one or more wavelengths of light where each wavelength can correspond to a wide peak, a sharp peak, or some other shaped peak of light in a color spectrum.

[0019] Typical LED packages 12 include an LED 14 which is encapsulated in a protective coating 16 such as an epoxy and/or a resin. In lighting system 10, emissive material 22 is not located in LED package 12. Rather, emissive material 22 is located outside LED package 12. Emissive material 22 may be applied to or placed within a film, sheet, appliqué, lens, cover, or other body 20, which could be located anywhere within lighting system 10. Emissive material 22 is placed in front of LED 14, meaning that at least some light from LED 14 passes from LED 14 to emissive material 22 before it can be viewed by a vehicle occupant. Emissive material 22 may be applied as a thin layer on body 20. In some embodiments, emissive material 22 is no more than about 0.01 inch thick. In other embodiments, emissive material 22 is no more than about 0.001 inch thick. Emissive material 22 may also be located within body 20. Emissive material 22 may be applied such that it is continuous (such that little or no space exists through which light 18 can pass) or may applied such that it is discontinuous and allows at least some light 24 to pass through spaces between portions of emissive material 22.

[0020] Emissive material 22 may be a phosphor or may be some other substance. In some embodiments, lighting system 10 including LED 14 and emissive material 22 is configured to give off substantially white light (i.e. is white or appears close to white). This may be achieved using color combinations that tend to combine to give off white light. One example may include using a blue LED 14 that has some of its light absorbed by a phosphor 22 that emits yellow light 26 and where some of the light 24 from the blue LED 14 is not absorbed. The blue light 24 that is not absorbed and the yellow light 26 given off by phosphor 22 may combine to form light that appears substantially white. One exemplary type of phosphor which may be used for this purpose is a YAG phosphor.

[0021] Another example of a lighting system 10 that may give off substantially white light includes a UV LED 14 and a blend of phosphors 22, where the light 26, 28 given off by the blend of phosphors 22 may combine to form white light. Color combinations that may tend to give off light that appears substantially white include a combination of red, green, and blue, a combination of blue and amber, and other similar combinations. In some embodiments, the UV light 18 may be entirely absorbed by phosphors 22 such that little or no UV light 24 passes past phosphors 22. In other embodiments, a UV filter (not shown) may be used to remove any unabsorbed UV light 24.

[0022] The combination of an LED 14 and emissive material 22 may also be used to emit a color that is a variation of white. For instance, it may desirable to emit light that is a

warmer white (e.g. light that appears white with an additional contribution from a wide spectrum amber) or is a white with a tint of another color.

[0023] Also, emissive material 22 may be used to fill in gaps in the spectrum of a light source such that the light emitted by the lamp includes more wavelengths of light than the light source itself. For instance, this may be used to emit a truer white (i.e. is a more inclusive spectrum of wavelengths) than that given off by the light source itself (e.g. where the light source appears white to a viewer but does not actually emit a full array of wavelengths in the visible spectrum).

[0024] Additionally, colors other than white may be desirable for use in vehicle applications. In some cases, the desired color may not completely correspond to a color emitted by a commercially available LED. In these cases, emissive material 22 may be selected (and multiple different types of emissive material may be blended) such that the desired color can be achieved using a commercially available LED.

[0025] Generally, a single color of LED 14 would be used to emit light 18 that is absorbed by emissive material 22. LED 14 used may be selected such that it only emits a selected range of wavelengths of light 18 or, more narrowly, which may only emit a selected wavelength of light 18. Of course, multiple LEDs that produce different colors of light 18 can be used in combination and with emissive material 22 to produce the desired lighting effect.

[0026] The light 26 emitted by emissive material 22 may be directed or focused as needed using various types of optics 30. Some exemplary optics 30 that can be used include lenses, reflectors, diffusers, deviators, transmissive light guides, light guiding bodies, and various other optics. In some embodiments, body 20 and optic 30 can be a single piece where optic 30 is configured to carry emissive material 22. In some embodiments, an optic 30 may be included which is configured to bend light 18 or light 24, 26.

[0027] Referring to Figs. 1 and 6, in some embodiments the lighting system 10 may be used to form an interior lamp, such as a dome lamp, a map/reading lamp, a vanity lamp, a glove box lamp, a footwell lamp, a puddle lamp, a cargo lamp, an ambient lamp, a decorative lamp, or other lamp configured to primarily provide general or targeted light to an interior 250 of a vehicle 200. In some embodiments the lighting system 10 may be formed as a lamp configured for backlighting such as backlighting a control, a switch, and/or a display. In some embodiments the lighting system 10 may comprise an exterior

lamp such as a security lamp, a puddle lamp, or some other type of lamp configured to primarily provide light to areas exterior 260 to the vehicle 200.

[0028] While many LEDs may emit a more focused beam of light, when an emissive material 22 is included on a body 20 outside the LED package 12, the light 24, 26 emitted by the lighting system 10 may tend to be more diffuse. Diffuse light may be desirable for applications such as dome lamps 214 that are configured to provide general illumination to the interior 250 of the vehicle 200. According to some embodiments, a dome lamp 214 having a lighting system 10 that includes an LED 14 and an emissive material 22 does not include any secondary optics 30 that are configured to diffuse light 24, 26 emitted from the lighting system 10. On the other hand, for lamps such as map lamps 212 which tend to be used to provide light at targeted areas in the vehicle interior 250, light 24, 26 that is less diffuse may be desirable. In these applications, diffuse light 26 emitted by emissive material 22 may be focused by a focusing optic 30. In other embodiments, a dome lamp 214 having a lighting system 10 that includes an LED 14 and an emissive material 22 does include a focusing optic 30. A focusing optic in a map lamp 212 may more narrowly focus light than a focusing optic used in a dome lamp 214.

[0029] In vehicles having both dome lamps 214 and map lamps 212, it may be desirable to use lamps that have light of about the same color. In some vehicles 200, this may be achieved with a map lamp and dome lamp that use a similar lighting system 10. Thus, in some embodiments, a vehicle 200 includes a map lamp 212 having a lighting system 10 which includes an LED 14 and an emissive material 22 and includes a dome lamp 214 having a lighting system 10 which includes an LED 14 and an emissive material 22. The map lamp 212 may include a focusing optic 30.

[0030] Referring to Fig. 2, a lamp 100 comprises a plurality of LEDs 114 mounted on a circuit carrying element such as circuit board 110. Additional components such as resistors, transistors, a control circuit, protective elements, switches, and other electronics may also be mounted on the circuit carrying element 110, 111. Lamp 100 further includes a body 116 that is carrying an emissive material. Body 116 is located in front of LEDs 114. Some light emitted by LEDs 114 is absorbed by the emissive material carried by body 116. In turn, the emissive material emits light of a different wavelength or wavelength combination than that absorbed from LEDs 114. Body 116 may be configured to be translucent such that some light emitted by LEDs 114 passes through body 116. Light from the emissive material carried by body 116 (and potentially light from the LEDs 114) combines to give off

light of a desired color. Light emitted by the emissive material then passes through lens 120 which may be configured to focus or to diffuse the light. Body 116 and lens 120 are connected to a housing 118. Body 116 and lens 120 may be connected to housing 118 using any number of techniques, including molding lens 120 to housing 118, snap fitting lens 120 to housing 118, or by using some other form of connection. Lamp 100 may be used to form a map lamp or other type of lamp for use in a vehicle. Lamp 100 may be mounted in an overhead console, in a rear view mirror, or in some other location.

[0031] Referring to Fig. 3, a lamp 100 comprises a plurality of LEDs 114 mounted on a circuit carrying element such as flexible circuit 111. Lamp 100 further includes a body 116 that is carrying an emissive material. The emissive material may be formed as a layer on a top surface 117 or bottom surface 115 of body 116. Further, the emissive material may be embedded in body 116. Light emitted by the emissive material carried by body 116 is directed by opaque housing 118 through space 122 which may direct the light in a direction 123 away from body 116. Lamp 100 may be used to form a map lamp or other type of lamp for use in a vehicle.

[0032] Referring to Fig. 4, a lamp 100 comprises a plurality of LEDs 114 mounted on a circuit carrying element such as circuit board 110. Lamp 100 further includes a protective outer cover 126 that is carrying an emissive material. The emissive material may be deposited on an inner surface 124 of protective cover 126. Protective cover 126 may be further configured to help diffuse light emitted by the emissive material and LEDs 114. Lamp 100 may be used to form a dome lamp, ambient lamp, or other type of lamp for use in a vehicle.

[0033] Referring to Fig. 5, a lamp 100 may be formed from LED chips 114 which are not covered by a resin 16 (see Fig. 1) and which may be deposited using a die on board technique. Lamp 100 contains four groupings 140-146 of LED chips 114. First grouping 146 consists of a single LED chip. First grouping 146 includes a reflector 128 which may reflect light emitted by the LED 114. First grouping 146 also includes a lens 120b in front of the LED 114.

[0034] Second 144, third 140, and fourth 142 groupings share a common lens component 120a. Lens 120a has an interior surface which includes an interior surface portion 121a in front of the second grouping 144 of LEDs, an interior surface portion 121b in front of the second grouping 140 of LEDs, and an interior surface portion 121c in front of the second grouping 142 of LEDs. An emissive material may be located on each of or a subset of

interior surface portions 121a, 121b, and 121c. If more than one interior surface includes emissive materials, the emissive materials may be the same or may be different from each other. Further still, the LEDs of each grouping 140-146 may be the same color(s) or may be different. According to one embodiment, surfaces 121a and 121c carry emissive materials which are configured to emit light which blends (e.g. with light from other emissive materials, with light from LEDs, etc.) to form substantially white light while surface 121b does not carry an emissive material.

[0035] Lamp 100 may further include an additional optic 150. Optic 150 may carry an emissive material which may be located on a surface 151 of optic 150. Both optic 150 and lens 120a may carry emissive materials, only one of optic 150 and lens 120a may carry emissive materials, or neither of optic 150 and lens 120a may carry emissive materials.

[0036] Lamp 100 may further include protective cover 148. Circuit board 110, optic 150, and cover 148 are connected to housing 118. Cover 148 may be configured to protect the various contents located within housing 118 of lamp 100.

[0037] Lamp 100 further includes a circuit 130 connected to circuit board 110 by wires 132. Circuit 130 may include a control circuit, may include resistors, may include protective devices (such as a protective diode), and/or may contain any number of other circuit components.

[0038] Referring to Fig. 6, lamps having a light source and separate body carrying an emissive material (LED/emissive lamps) may be used in various applications in a motor vehicle 200. One such lamp is a reading lamp 212 that is configured to direct light into a passenger seat area. Dome lamp 214 is also an LED/emissive lamp and is configured to emit light radially outwards. The assembly in which dome lamp 214 is mounted may also include an ambient lamp that is configured to provide general, low-level illumination. The ambient lamp may also be an LED/emissive lamp. The low-level illumination emitted by the ambient lamp may be bright enough to illuminate structures in the interior of the vehicle but not bright enough to be easily noticeable by an occupant. An LED/emissive lamp may be used for security lamp 206 and may be mounted in an external rear view mirror. Vehicle 200 may also include a LED/emissive puddle lamp 208 mounted in a trim strip of a vehicle on the vehicle door or an LED/emissive puddle lamp 210 located in a trim strip mounted on the body of the vehicle 200. An advantage of mounting the lamp in the body is that the light emitted by the lamp does not tend to move when the door is open. An LED/emissive

lamp may also be used as a trunk lamp to illuminate the interior spaces of the trunk when a vehicle occupant desires to add or remove something from the trunk.

[0039] Any number of other vehicle lamps, as discussed below, may be formed from LED/emissive lamps. These lamps may include dome lamps, courtesy lamps, map lamps, reading lamps, ambient lamps, orientation lamps, conversation lamps, utility lamps, trunk lamps, cargo lamps, visor vanity lamps, glove box lamps, ash receiver lamps, cup holder lamps, storage bin lamps, including map pockets, footwell lamps, door lamps, lamps for backlighting, decorative lamps, and other vehicular lamps.

[0040] Referring to Fig. 7, an exemplary spectrum diagram of a light spectrum 350 that appears to be the color white to a human observer. Light 350 includes a sharp peak 360 in the short wavelength (blue) region and a wide peak 370 at a midrange wavelength (yellow) in the visible spectrum. The midrange wavelength 370 (i.e. the light at roughly 480 nm and longer) may be generated by the emissive material 22 (Fig. 1) while the short wavelength 360 (i.e. the light at roughly 500 nm and shorter) may be generated by the light source 12 (Fig. 1). The light from the light source and the light from the emissive material combine to form the color of light (corresponding to light spectrum 350) that appears as white light to a person viewing the light. Of course, the light may include additional peaks where a single source of light may be responsible for one or more of the peaks in the spectrum. A truer white can be formed by including additional peaks between peak 360 and peak 370 and peaks that are in the visible region and have a wavelength greater than peak 370.

[0041] Referring again to Fig. 6, some exemplary locations in which LED/emissive dome/courtesy lamps may be incorporated include the headliner, overhead console (including outer surface of bin door), perimeter trim, overhead HVAC vent, visor, overhead rail modules, along or inside of overhead rails, in assist handle & bezel, pillar trim, on sunroof or glass (panoramic) roof, sunroof shade, and other locations. Some exemplary locations in which LED/emissive map/reading lamps may be incorporated include the headliner, overhead console, interior trim around the openings in the vehicle body, overhead HVAC vent, visor, overhead rail modules, on sunroof or glass (panoramic) roof, sunroof shade, and others. Exemplary locations in which LED/emissive ambient, orientation, conversation, and utility lamps may be incorporated include the headliner, overhead console, integrated with task or courtesy lamps, in visor, perimeter trim, overhead HVAC vent, overhead rail modules, along or inside of overhead rails, in assist handle & bezel, coat hook, on sunroof or glass (panoramic) roof, sunroof shade, pillar trim, sidewall trim,

carpeting (along rocker or below 2nd/3rd row cushion), along or inside of floor rails, seat back (front side (office lamp) and rear side (rear seat utility lamp)), seat frame (for floor), seat cushion, seat highlights, head restraint, arm rest, seat belt, seat belt buckle, front or underside of IP, around HVAC vents on IP or floor console, on sides or back of floor console, on door panel, door handle, door pull cup or strap, sill plate, and others. Exemplary locations for LED/emissive trunk lamps include the underside of shelf, in sidewall trim/carpet, on underside of deck lid, and others. Exemplary locations for LED/emissive cargo lamps include the headliner, perimeter trim, glass (panoramic) roof, sidewall trim, seatback, seat frame, lift gate, and others.

[0042] LED/emissive visor vanity lamps may be configured to be located along any or all sides of the vanity mirror, on the mirror cover, and/or on the headliner or the trim above visor. Further, a vanity lamp could also be designed to shine through the mirror. LED/emissive glove box lamps may be configured to be located on the top surface or sides of the box or may shine through the top or sides of the box. LED/emissive ash receiver lamps may be configured to illuminate the ash receiver. Additionally, these lamps could be used to put a ring around all or part of the receiver. LED/emissive cup holder lamps may be configured to be located along the bottom or sides of the cup holder, around the top of the cup holder, or on an adjacent part (for example, the floor console, IP, or sidewall trim) to illuminate the cup holder. LED/emissive storage bin lamps may be configured to be located on the sides or cover of the bin, shine through the sides or cover of the bin, or may be located above the bin. LED/emissive footwell lamps may be configured to be located on the underside of the IP, on the hush panel, on the pillar trim, on the sidewall trim, on the seat frames, on the seat cushion, on the carpeting (such as along the rocker or below the 2nd/3rd row cushion), on the sides or back of the floor console, on the sides or front or back of the floor rail module, and other locations. LED/emissive door lamps may be configured to be located on the lower door panel (such as a puddle/step lamp; door open lamp, with or without reflector), on the map pocket, on the upper door panel (task/utility light), on the rearward edge (e.g. to highlight for aid in ingress/egress), and other locations. LED/emissive lamps may be used to illuminate or backlight decorative features. These decorative features may include features used to identify brands. Further, these lamps could provide bars of light and may define the outline of an object or area such as the passenger or driver seat area. LED/emissive lamps may also be used to illuminate various other

components. These lamps may be configured to illuminate the steering wheel rim, the spokes, the hub, and various other components of a vehicle.

[0043] Referring again to Figs. 2-5, in many cases the luminous intensity of one light-emitting diode 114 alone is not sufficient for illuminating a sufficiently large field of illumination with adequate luminous intensity. In these cases several light-emitting diodes 114 may be combined in the lighting device, in order to add the luminous intensities of the individual light emitting diodes 114 on the field of illumination. This may be especially true in cases where the emissive material is less efficient when converting absorbed light into emitted light.

[0044] One or more secondary optical elements 116, 120, 126, 128 may be used with the above described LED/emissive lamps. Secondary optical elements are components that influence by combination of refraction, reflection, scattering, interference, absorption and diffraction the projected beam shape or pattern, intensity distribution, spectral distribution, orientation, divergence and other properties of the light generated by the LEDs. Secondary optical elements may include one or more of a lens 120, a deviator, and a diffuser, each of which may be in conventional form or otherwise in the form of Fresnel (e.g. a micro-groove Fresnel) equivalent, a HOE, binary optic or TIR equivalent, and/or another form.

[0045] A deviator may be optionally mounted on or attached to the housing or otherwise attached to or made integral with a surface of a lens 120 and may be used to steer the collimated beam in a direction oblique to the optic axis of the lens and/or reflector 128 used in the LED/emissive lamp 100. The deviator may be a molded clear polycarbonate or acrylic prism operating in refractive mode or in TIR mode (such as a periscope prism). This prism may further be designed and manufactured in a microgrooved form such as a Fresnel equivalent or a TIR equivalent. Furthermore, a diffraction grating, binary optic or holographic optical element can be substituted for this prism to serve as a deviator. The deviator may be configured as a sheet or slab and may substantially cover the entire opening of the housing of the lamp from which light is emitted.

[0046] Optionally, a diffuser (e.g. integrated as part of cover 126) may be mounted on or coupled to the housing 118 or may be attached to or made integral with a surface of the lens 120 or with a surface of a deviator. The diffuser may be used to aesthetically hide and/or physically protect the internal components of the lamp, and/or to filter the spectral composition of the resultant light, and/or narrow, broaden or smooth the light's intensity distribution. The diffuser may incorporate a unique spectral filter (such as a tinted

compound or an optical coating such as dichroic or band pass filter) to enhance aesthetics, hide internal components from external view, and/or correct the color of mixed light projected by the lamp. The diffuser may be a compression or injection molded clear polycarbonate or acrylic sheet whose embossed surface or internal structure or composition modifies impinging light by refraction, reflection, total internal reflection, scattering, diffraction, absorption or interference.

[0047] In some embodiments at least two optical components may be combined into one integral piece. For example, a deviator can be incorporated onto an upper surface of a lens 120 by placing an appropriately machined mold insert into the planar half of a mold for a Fresnel or TIR collimator lens. As mentioned above, a diffuser may also be attached to or made integral with the lens surface or the deviator surface.

The individual light-emitting diodes 114 of the LED/emissive lamp 100 may be combined on a printed circuit board 110 or conductor foil 111 (pcb's) so as to form an LED module. Via the printed circuit board 110 or conductor foil 111 the light-emitting diodes 114 can be provided with current centrally and the LED module can be mounted in the form of a prefabricated subassembly in a housing 118. As a matter of principle, the electronics 130 for driving the light-emitting diodes 114 may be arranged at any place in the vehicle 200 (Fig. 5), even at a place remote from the light-emitting diodes 114, for instance by integration into an on-board computer. In some embodiments, the electrical circuits 112 for driving the light-emitting diodes are combined together with the light emitting diodes 114 on a printed circuit board 110 or conductor foil 111 so as to form an LED module.

[0048] If the LED/emissive lamp 100 is employed in the exterior region 260 of the motor vehicle 100 or in a potentially wet region of a vehicle interior (e.g. in a door, a floor carpet, a cup holder, etc.), measures may be taken in order to rule out contact of the LED module with water. The moisture protection can be achieved by casting the LED module at least zonally into a water resistant material, for instance a resin.

The light emitting diode 114 or the LED module may be permanently coupled to the housing 118. This may be accomplished, for instance, by bonding the components with adhesive.

[0049] The lenses 120 may be smooth lenses--that is, lenses having a smooth lens surface. Lenses 120 with surface structure (e.g. Fresnel lenses) are also usable (although the surface structure may tend to reduce the light efficiency of the lighting device).

[0050] The protective cover 126, 148 and the housing 118 may be manufactured jointly in a multi-part injection-molding process. The housing 118 and the cover 126, 148 may be manufactured simultaneously in a common injection mold. In the process, the cover 126, 148 connects to the housing 118 at an interface 152, so that the cover 126, 148 may become an integral constituent of the housing 118. Alternatively, the two components may be manufactured separately and are connected by a clip connection or other type of connection.

[0051] Since the properties of light-emitting diodes 114, in particular the current-carrying capacity and the luminous intensity emitted, may be temperature-dependent, the current supply of the light-emitting diodes may be controlled (e.g. using a device for pulse-width modulation). The LED/emissive lamp 100 may include a temperature sensor configured to sense a temperature in proximity to the LEDs 114. The output signal of this temperature sensor can then be relayed to the control system 112, 130 of the current supply of the light emitting diode 114, and the current supply can be controlled as a function of the temperature in the lighting device as measured by a temperature sensor.

[0052] Since fluctuations in the operating voltage in the on-board supply system of a motor vehicle 200 may occur which can damage the light-emitting diodes 114, measures may be taken to protect the light-emitting diodes 114 and/or circuit components (e.g. control circuit) against overvoltages and/or reverse voltages. For example, at least one protective diode (part of electrical circuit 112, 130) may be connected in series to the light-emitting diodes 114 in order to protect them against polarity reversal.

[0053] An LED/emissive lamp 100 may be configured as an individual subassembly--ie, with its own housing--and to secure it in or on the vehicle 200. Instead, an LED/emissive lamp may be configured as a subassembly to be combined in part of an assembly such as an overhead console, a rear view mirror, or some other assembly. LED/emissive lamp 100 could be integrated into many assemblies of a motor vehicle 200. Exemplary assemblies include bumpers, sunroof operating modules, luggage-compartment covers, engine-compartment covers, glove compartments, ashtrays, storage compartments, center consoles, seats, and other subassemblies.

[0054] While the exemplary and illustrative embodiments illustrated in the FIGS. and described above are presently preferred, it should be understood that these embodiments are offered by way of example only. Accordingly, the present invention is not limited to a particular embodiment, but extends to various modifications that nevertheless fall within the scope of the claims or the invention as a whole. For example, while the disclosure has

largely been directed to the use of an LED as a light source, other light sources may also be used. This is particularly true for light sources that emit limited bands of wavelengths of light. As another example, while many of the exemplary embodiments show a plurality of LEDs, a single LED may be used to provide the intended amount of light. Also, the term translucent as used in the specification is meant encompass both translucent and transparent bodies unless stated otherwise in a claim.

WHAT IS CLAIMED IS:

1. A vehicle lighting assembly, comprising:

a lamp comprising,

a light source configured to emit light of a first color, and

a material separate from and in front of the light source, the material configured to take in light from the light source and to emit light of a second color in response to taking in light from the light source, the second color being different than the first color;

wherein the lamp is configured to be used as one of an interior vehicle lamp and an exterior vehicle lamp.

2. The lighting assembly of claim 1, wherein the emissive layer is deposited as a layer on the body.

3. The lighting assembly of claim 2, wherein the layer of emissive material has a thickness that is less than about 1/100 of an inch thick.

4. The lighting assembly of claim 1, wherein the light source emits blue light.

5. The lighting assembly of claim 1, wherein the lamp is configured to be an interior lamp.

6. The lighting assembly of claim 5, wherein the lamp is configured to provide general illumination to an interior of the vehicle.

7. The lighting assembly of claim 6, wherein the lamp is configured to be a dome lamp.

8. The lighting assembly of claim 5, wherein the lamp is configured to provide targeted illumination.

9. The lighting assembly of claim 8, wherein the lamp is configured to be a map lamp.

10. The lighting assembly of claim 8, further comprising a focusing optic configured to focus light given off by the emissive material.

11. A vehicle lighting assembly, comprising:

a lamp comprising,

an LED, and

a body separate from the LED and carrying an emissive material, the emissive material being configured to take in light from the LED and to emit light in response to taking in light from the LED;

wherein the lamp is configured to be used as one of an interior vehicle lamp and an exterior vehicle lamp.

12. The lighting assembly of claim 11, wherein the emissive material comprises a phosphor.

13. The lighting assembly of claim 11, wherein the emissive layer is deposited as a layer on the body.

14. The lighting assembly of claim 13, wherein the layer of emissive material has a thickness that is less than about 1/100 of an inch thick.

15. The lighting assembly of claim 13, wherein the layer of emissive material has a thickness that is less than about 1/1000 of an inch thick.

16. The lighting assembly of claim 11, wherein the LED comprises an LED that emits blue light.

17. The lighting assembly of claim 11, wherein the LED comprises an LED that emits ultraviolet light.

18. The lighting assembly of claim 11, comprising a plurality of LEDs, wherein the emissive material is configured to take in light from the plurality of LEDs and to emit light in response to taking in light from the plurality of LEDs.

19. The lighting assembly of claim 11, wherein the lamp is configured to be an interior lamp.

20. The lighting assembly of claim 19, wherein the lamp is configured to provide general illumination to an interior of the vehicle.

21. The lighting assembly of claim 20, wherein the lamp is configured to be a dome lamp.

22. The lighting assembly of claim 19, wherein the lamp is configured to provide targeted illumination.

23. The lighting assembly of claim 22, wherein the lamp is configured to be a map lamp.

24. The lighting assembly of claim 22, further comprising a focusing optic configured to focus light given off by the emissive material.

25. The lighting assembly of claim 11, wherein the lamp is configured to emit light that is substantially white by way of the emissive material.

26. The lighting assembly of claim 25, wherein the lamp is configured such that light from the emissive material can combine with light from the LED to emit the light that is substantially white.

27. The lighting assembly of claim 25, wherein the lamp is configured to emit, by way of the emissive material, white light that comprises a broad spectrum of wavelengths of light.

28. The lighting assembly of claim 11, wherein the emissive material comprises a plurality of different types of phosphors.

29. The lighting assembly of claim 11, wherein the body comprises a translucent sheet and the emissive material is embedded in the body.

30. A lighting assembly for a vehicle, comprising:

a housing configured to be mounted in an interior of the vehicle;

a circuit carrying element coupled to the housing;

an LED mounted to the circuit carrying element and configured to emit light of a first color;

an electrical circuit configured to receive power from a power source and provide power to the LED;

a body coupled to the housing and separate from the LED, the body carrying phosphors that are configured to take in light of the first color from the LED and to emit light of a second color different than the first color in response to taking in light of the first color from the LED; and

an optic configured to receive light of the second color emitted by the phosphors; and

wherein the LED and the body are part of an interior vehicle lamp assembly.

31. The lighting assembly of claim 30, wherein the light emitted by the phosphors is used to generate light that is substantially white

32. A lighting assembly for a vehicle, comprising:

a lamp comprising,

a means for providing light of a first color, and

a means for converting the light of the first color to light of a second color;

wherein the lamp comprises an interior vehicle lamp.

33. A method of generating white light from an interior vehicle lamp, comprising:

generating light of a first color from a light source;

passing light from the light source through an open space;

converting light of the first color that has passed through the open space to light of a second color; and

using the light of the second color to generate white light provided to an interior of a vehicle.

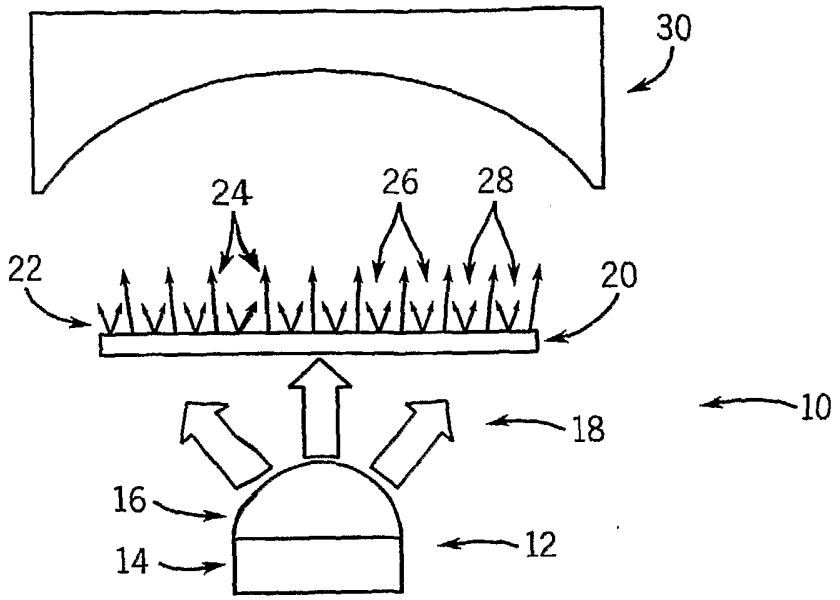

FIG. 1

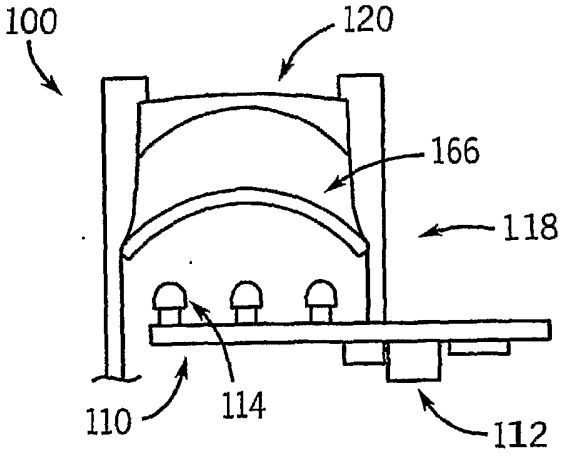

FIG. 2

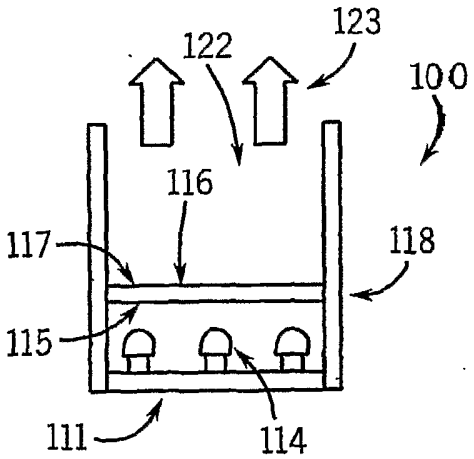

FIG. 3

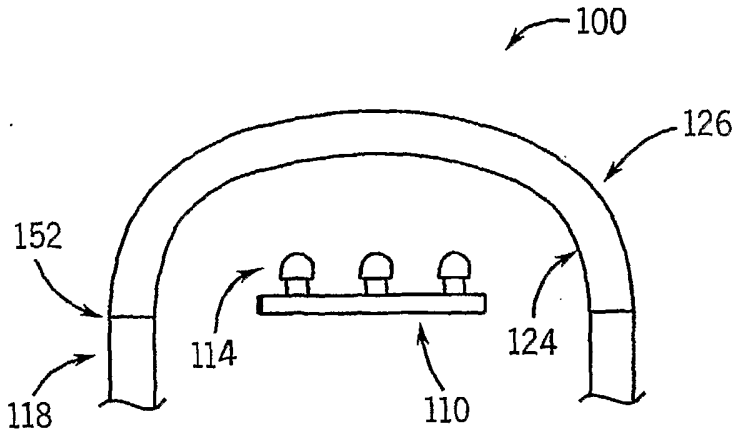

FIG. 4

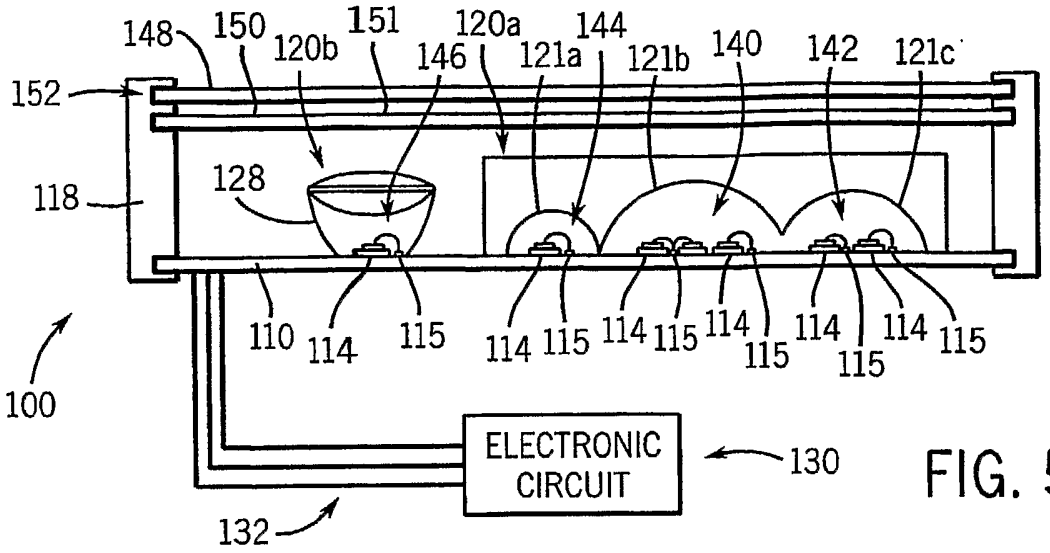

FIG. 5

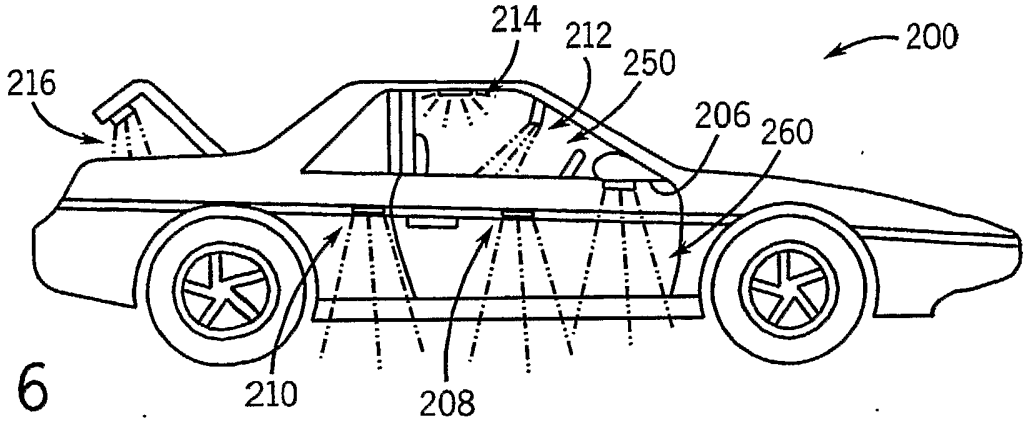

FIG. 6

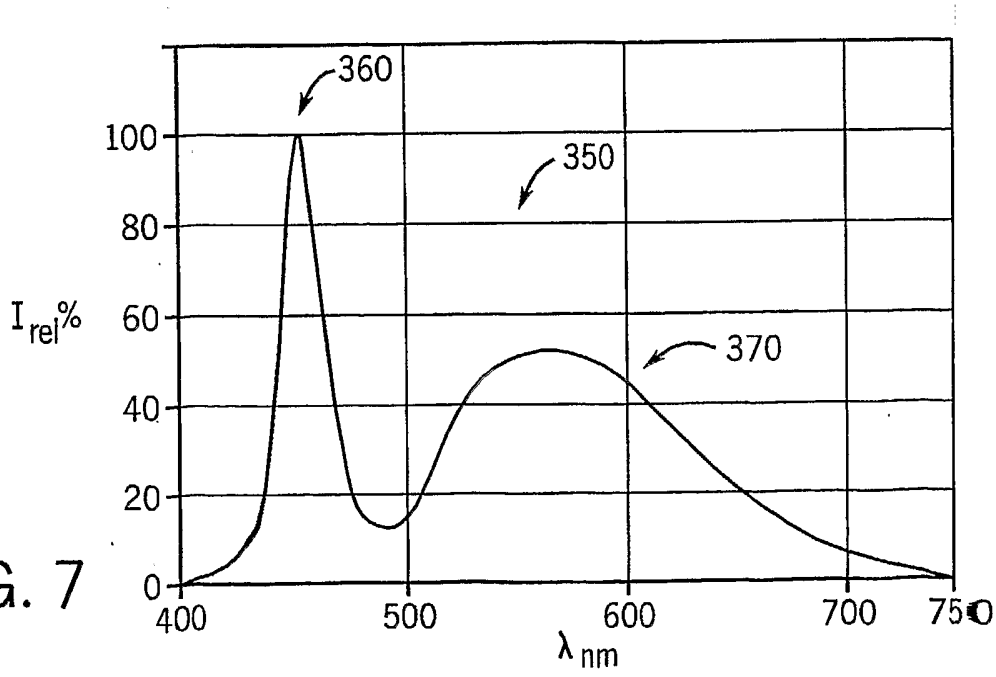

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
T/US2005/037940

A. CLASSIFICATION OF SUBJECT MATTER
B60Q3/02 H01L33/00

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)
B60Q H01L H01K

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	EP 1 467 416 A (WELDON TECHNOLOGIES, INC) 13 October 2004 (2004-10-13) paragraph '0003! paragraph '0048! paragraph '0057! - paragraph '0058! paragraph '0060! paragraph '0066! figures 1,2,8 ----- -/--	1,2, 4-13, 16-27, 30-33

[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
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"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 February 2006	20/02/2006

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
T/US2005/037940

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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