Light guide assemblies including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides are described. The optical coupling component is adapted to couple light between the first and second light guides. The first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article. One of the first and second light guides may include a first light extractor disposed at least partially in the region.

Declarations under Rule 4.17:

— as to applicant's entitlement to claim the priority of the earlier application (Rule 4.1 ?(in))

Published:

— with international search report (Art. 21(3))
Light Guide Assemblies

Background

A light guide may include light extraction features disposed to extract light from a side of the light guide. Such light guides may be used for illumination in various applications such as strip and panel lighting.

Summary

In some aspects of the present description, an article including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides is provided. The first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article. One of the first and second light guides includes a first light extractor disposed at least partially in the region. The first light extractor is configured to extract light from the article through a side of the first or second light guide.

In some aspects of the present description, an article including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides is provided. The first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

In some aspects of the present description, an article including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides is provided. The first light guide, the second light guide and the optical coupling component are coextensive over at least a portion of a length of the article. One of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide. The optical coupling component is adapted to optically couple the first and second light guides with the optical coupling primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

In some aspects of the present description, an article including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides is provided. The first light guide, the second light guide and the optical coupling component are coextensive over at least a portion of a length of the article. One of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide. The optical coupling component is adapted to optically couple the first and second
light guides, and the optical coupling component has at least one location along a length of the optical coupling component adapted to prevent optical coupling.

In some aspects of the present description, an article including a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides is provided. The first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article. One of the first and second light guides includes a first light extractor disposed at least partially in the region. The first light extractor is configured to extract light from the article through a side of the first or second light guide. The first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm. The optical coupling component provides an optical coupling that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

**Brief Description of the Drawings**

FIG. 1 is a perspective view of a portion of a light guide assembly;
FIGS. 2-5 are top views of light guide assemblies;
FIGS. 6-7 are perspective views of light guide assemblies;
FIGS. 8A-12 are cross-sectional views of light guide assemblies;
FIG. 13 is a top view of a light guide having a light extractor; and
FIGS. 14-15 are plots of luminance along the lengths of light guides.

**Detailed Description**

In the following description, reference is made to the accompanying drawings that forms a part hereof and in which various embodiments are shown by way of illustration. The drawings are not necessarily to scale. It is to be understood that other embodiments are contemplated and may be made without departing from the scope or spirit of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense.

Spatially related terms, including but not limited to, "lower," "upper," "beneath," "below," "above," and "on top," if used herein, are utilized for ease of description to describe spatial relationships of an element(s) to another. Such spatially related terms encompass different orientations of the device in use or operation in addition to the particular orientations depicted in the figures and described herein. For example, if an object depicted in the figures is turned over or flipped over, portions previously described as below or beneath other elements would then be above those other elements.

Light guides utilized form illumination may include a light extractor for extracting light from a side of the light guide and may include an input end or opposing input ends which may accept light input
from one or more light sources. The light extractor may include a plurality of discrete spaced apart light extraction features which may be arranged to provide a uniform illumination of a target area. However, it may be difficult to choose a distribution of light extraction features to produce an entirely uniform illumination intensity at the target area. According to the present description, it has been discovered that utilizing two (or more) light guides with light coupling components between the light guides can provide a more uniform illumination and/or allow a simplified light extractor to be used. For example, a light guide article or assembly may include a first light guide that accepts light input from one or more sources and a second light guide that accepts light input from the first light guide through a light coupling component, where the second light guide includes a light extractor that extracts light from the assembly through a side of the second light guide. In some embodiments, the light extracted from the light guide assembly has a substantially uniform intensity over at least half (or over at least 75 percent, or over at least 85 percent, or over at least 90 percent) of an entire length of the light guide assembly. It has been found that the light extractor can be a continuous diffuser, for example, or can be a plurality of uniformly distributed notches at a surface of the second light guide, for example, and still provide a uniform distribution of light output along a length of the light guide assembly for suitable optical coupling components.

FIG. 1 is a perspective view of a portion of a light guide assembly 100 including a first light guide 102, a second light guide 104, and an optical coupling component 106 disposed between and attached to the first and second light guides 102 and 104. The optical coupling component 106 is adapted to couple light between the first and second light guides 102 and 104. In the embodiment illustrated in FIG. 1, the first light guide 102, the second light guide 104 and the optical coupling component 106 may be coextensive over an entire length or over substantially the entire length of the light guide assembly 100. As described further elsewhere herein, in some embodiments, the first light guide 102, the second light guide 104 and the optical coupling component 106 are coextensive over a region of the light guide assembly 100 extending along a portion of a length of the light guide assembly 100. First light guide 102 includes a side 110, a first end 112 and an opposing second end (not illustrated). A light source 130 is disposed adjacent first end 112 to inject light into first light guide 102. Second light guide 104 includes a side 116, a first end 118 and an opposing second end (not illustrated). Second light guide 104 includes a light extractor 108. In some embodiments, the first light guide 102 includes a first light extractor and the second light guide 104 includes a second light extractor. The light extractor 108 is configured to extract light from the light guide assembly 100 through the side 116 of the second light guide 104. In some embodiments, the first light guide includes a light extractor configured to extract light from the light guide assembly 100 through the side 110 of the first light guide 102.

In many embodiments, the propagation of light in light guide assemblies of the present description may be accurately described in terms of geometric optics. In such embodiments, the optical coupling component 106 provides an optical coupling between the first and second light guides 102 and
104 that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide 102 and a second amplitude of a second light propagating in the second light guide 104. The optical coupling may be substantially independent of both a first phase of a first light propagating in the first light guide 102 and a second phase of a second light propagating in the second light guide 104. The optical coupling may, however, depend to some degree on the phases even though the coupling may be primarily determined by the amplitudes. In some embodiments, the optical coupling is a function of at least one of a first phase of a first light propagating in the first light guide 102 and a second phase of a second light propagating in the second light guide 104.

In some embodiments, light injected into one or both ends of first light guide 102 and light is extracted from the article 100 from the second light guide 104. The optical coupling component 106 may be adapted to relatively weakly couple light between the first and second light guides 102 and 104 so that a significant portion of light injected into first light guide 102 is extracted from a middle region of second light guide 104. This can be achieved by limiting a thickness of the optical coupling component 106. For example the thickness of optical coupling component 106 may be less than 1, or 0.8, 0.5, or 0.3, or 0.2 times a diameter or a largest lateral dimension of one or both of the first and second light guides 102 and 104. As discussed further elsewhere herein, in some embodiments, the optical coupling between the first and second light guides 102 and 104 may be further adjusted by one or more regions adapted to prevent optical coupling between the light guides.

FIG. 2 is a top view of light guide assembly 200 including a first light guide 202, a second light guide 204, and an optical coupling component 206 disposed between and attached to the first and second light guides 202 and 204. The optical coupling component 206 is adapted to couple light between the first and second light guides 202 and 204. The first light guide 202, the second light guide 204 and the optical coupling component 206 are coextensive over a region 220 of the light guide assembly 200 extending along a portion of a length L of the light guide assembly 200. In some embodiments, region 220 extends over a length of at least 1 cm, or at least 3 cm, or at least 10 cm. In some embodiments, region 220 extends over at least half (or at least 75 percent, or at least 85 percent) of the length L of the light guide assembly 200 or over all or substantially all of the length L of the light guide assembly 200.

First light guide 202 includes a first end 212 and an opposing second end 213. Second light guide 204 includes a first end 218 and an opposing second end 219. In the illustrated embodiment, a light source 230 is disposed proximate to first end 212 of first light guide 202 and configured to inject light into the first end 212 of the first light guide 202. In other embodiments, one or more light sources are included proximate one or more of first and second ends 212 and 213 of first light guide 202 and first and second ends 218 and 219 of second light guide 204.

Second light guide 204 includes a light extractor 208 which is disposed at least partially in region 220. In some embodiments, the first light guide 202 includes a first light extractor and the second light guide 204 includes a second light extractor. The light extractor 208 is configured to extract light from the
light guide assembly 200 through a side of the second light guide 204. In some embodiments, the first light guide 202 may include a light extractor configured to extract light from the light guide assembly 200 through a side of the first light guide 202. For example, as described further elsewhere herein, the first light guide 202 may include a light extractor adapted to illuminate one or more indicia at a side of the first light guide 202.

In the embodiment illustrated in FIG. 1, light extractor 108 is continuous or substantially continuous, while in the embodiment illustrated in FIG. 2, light extractor 208 is discontinuous. Light extractor 208 includes a plurality of discrete spaced apart light extraction features 209, which may be a plurality of notches on a surface of the second light guide 204, and at least one of the light extraction features 209 is disposed in the region 220.

FIG. 3 is a top view of light guide assembly 300 including a first light guide 302, a second light guide 304, and an optical coupling component 306 disposed between and attached to the first and second light guides 302 and 304. The optical coupling component 306 is adapted to couple light between the first and second light guides 302 and 304. The first light guide 302, the second light guide 304 and the optical coupling component 306 are coextensive over a region 320 of the light guide assembly 300 extending along a portion of a length L of the light guide assembly 300. In some embodiments, region 320 extends over a length of at least 1 cm, or at least 3 cm, or at least 10 cm. In some embodiments, region 320 extends over at least half (or at least 75 percent, or at least 85 percent) of the length L of the light guide assembly 300 or over all or substantially all of the length L of the light guide assembly 300.

In the embodiments illustrated in FIGS. 1 and 2, optical coupling components 106 and 206, respectively, are continuous. In the embodiment illustrated in FIG. 3, optical coupling component 306 is discontinuous. Optical coupling component 306 includes one or more locations 333 adapted to prevent optical coupling between the first and second light guides 302 and 304. Such locations may be included to reduce the overall light coupling between the light guides since it has been found that in some cases this may improve the uniformity of light output from the light guide assembly. In some embodiments, locations 333 extend over less than about half (or less than about one third, or less than about one fourth) of region 320. Optical coupling component 306 may include discrete spaced apart portions 307 which optically couple light between the first and second light guides 302 and 304 and includes locations 333 which may be gaps between portions 307. In other embodiments, optical coupling component 306 may include one or more regions with depressions, openings or other structures that prevent optical coupling between the first and second light guides 302 and 304 in those locations. In still other embodiments, optical coupling component 306 may provide substantially uniform optical coupling between the first and second light guides 302 and 304 without including any structures that prevent optical coupling between the first and second light guides 302 and 304.

First light guide 302 includes a side a first end 312 and an opposing second end 313. Second light guide 304 includes a first end 318 and an opposing second end 319. In the illustrated embodiment, a light
source 330 is disposed proximate to first end 312 of first light guide 302 and configured to inject light into the first end 312 of the first light guide 302. In other embodiments, one or more light sources are included proximate one or more of first and second ends 312 and 313 of first light guide 302 and first and second ends 318 and 319 of second light guide 204.

Second light guide 304 includes a light extractor 308 which is disposed at least partially in region 320. In some embodiments, the first light guide 302 includes a first light extractor and the second light guide 304 includes a second light extractor. The light extractor 308 is configured to extract light from the light guide assembly 300 through a side of the second light guide 304. In some embodiments, the first light guide 302 includes a light extractor configured to extract light from the light guide assembly 300 through a side of the first light guide 302 (e.g., to illuminate indicia). In the embodiment illustrated in FIG. 3, light extractor 308 is continuous.

FIG. 4 is a top view of light guide assembly 400 including a first light guide 402, a second light guide 404, and an optical coupling component 406 disposed between and attached to the first and second light guides 402 and 404. The optical coupling component 406 is adapted to couple light between the first and second light guides 402 and 404. The first light guide 402, the second light guide 404 and the optical coupling component 406 are coextensive over the length L of the light guide assembly 400. In the illustrated embodiment, optical coupling component 406 is continuous. In other embodiments, optical coupling component 406 may be discontinuous as described elsewhere herein.

First light guide 402 includes light extractors 438 and second light guide 404 includes light extractor 408, which in the illustrated embodiment is continuous or substantially continuous. In other embodiments, light extractor 408 may be discontinuous and may include discrete spaced apart light extraction features as described elsewhere herein. Light extractors 438 are adapted to illuminate one or more indicia at a surface of the first light guide 402. In the illustrated embodiment, the one or more indicia includes two indicia; a star and an arrow. In other embodiments, one, two, or more than two indicia may be included. The indicia may be or include a logo or an informational indicium (e.g., a warning sign), for example. Light extractors 438 may include continuous portions such as diffusers to illuminate each indicium or portions of each indicium, and/or may include discrete spaced apart features arranged to illuminate each indicium or portions of each indicium, for example. Light extractors 438 may be disposed on a flat surface or a flat portion of a surface of first light guide 402.

First light guide 402 includes a side a first end 412 and an opposing second end 413. Second light guide 404 includes a first end 418 and an opposing second end 419. A first light source 430 is disposed proximate to first end 412 of first light guide 402 and configured to inject light into the first end 412 of the first light guide 402. A second light source 432 is disposed proximate to first end 418 of second light guide 404 and configured to inject light into the first end 418 of the second light guide 404. A third light source 434 is disposed proximate to second end 413 of first light guide 402 and configured to inject light into the second end 413 of the first light guide 402. A fourth light source 436 is disposed proximate to
second end 419 of second light guide 404 and configured to inject light into the second end 419 of the first light guide 404. In other embodiments, one or more of first through fourth light sources 430, 432, 434, and 436 are omitted. For example, in some embodiments, one or both of first and third light sources 430 and 434 are included, while second and fourth light sources 432 and 436 are omitted.

In some embodiments, one or both of first and third light sources 430 and 434 are included and one or both of second and fourth light sources 432 and 436 are included. First and/or third light sources 430 or 434 may have a first color and second and/or fourth light sources 432 and 436 may have a second color. The first and second color may be the same or different. In some embodiments, one or both of the first and second colors is non-white. In some embodiments, using multiple colored light sources can provide a desirable light output which can be adjusted by turning on or off the various light sources. In some embodiments, one or more of the first through fourth light sources 430, 432, 434, 436, includes one or more Light Emitting Diodes (LEDs). In some cases, at least one of the light sources includes a plurality of LEDs. The plurality of LEDs may include different colored LEDs that may be independently controllable to produce a desired switchable color output.

In some embodiments, the optical coupling components of the present description may include a color selective filter. Such filters can be included to tune the color of the light output and provide, for example, different colors for the illumination light output and light output from indicia. The filters may be used with same or different colored light sources. For example, optical coupling component 406 may contain a color selective dye. This can be formed by coextruding first and second light guides 402 and 404 and optical coupling component 406 with an optically clear polymer coextruded to form the first and second light guides 402 and 404 and a dyed polymer coextruded to form the optical coupling component 406. Light output from the indicia of first light guide 402 may have a first color and illumination light output from second light guide 404 may have a different second color, which may be substantially white.

In some embodiments, the color selective filter may be or may include a polymeric multilayer optical film. Suitable polymeric multilayer optical films include those having alternating high and low refractive index layers having appropriate thickness to reflect light of certain wavelengths through constructive interference. Such polymeric multilayer optical films are generally described in U.S. Patents 3,610,729 (Rogers), 4,446,305 (Rogers et al), 4,540,623 (Im et al), 5,448,404 (Schrenk et al.), and 5,882,774 (Jonza et al.), for example. Polymeric multilayer optical film can be included in an optical coupling component disposed between two light guides by attaching a strip of the multilayer optical film between the two light guides using optically clear adhesives between the multilayer optical film and each of the two light guides, for example.

FIG. 5 is a top view of light guide assembly 500 including a first light guide 502, second, third and fourth light guides 504a, 504b and 504c, and optical coupling components 506a, 506b and 506c, disposed between and attached to the first light guide 502 and to the second through fourth light guides.
504a, 504b and 504c, respectively. In the illustrated embodiments, three smaller light guides are attached to the first light guide 502 through optical coupling components. In other embodiments, one, two, three, or more light guides are attached to first light guide 502.

The optical coupling components 506a-506c are adapted to couple light between the first light guide 502 and the light guides 504a-504c, respectively. The first light guide 502, the second through fourth light guide 504a-504c and the optical coupling components 506a-506c are coextensive over first through third regions 520a-520c, respectively, of the light guide assembly 500 extending along portions of a length L of the light guide assembly 500. In the illustrated embodiment, each of the optical coupling components 506a-506c are continuous. In other embodiments, one or more of the optical coupling components 506a-506c may be discontinuous. In some embodiments, one or more of the optical coupling components 506a-506c may include one or more locations adapted to prevent optical coupling between the respective light guides as described elsewhere herein.

The first light guide 502 includes light extractor 508, which in the illustrated embodiment is continuous or substantially continuous. In other embodiments, light extractor 508 may be discontinuous and may include discrete spaced apart light extraction features as described elsewhere herein. Light extractor 508 is adapted to extract light from light guide assembly 500 through a side of first light guide 502. In some embodiments, first light guide 502 does not include a light extractor 508. In some embodiments, one or more of light guides 504a-504c includes a light extractor, which may be adapted to illuminate one or more indicia at a surface of the light guide including the light extractor.

First light guide 502 includes a side a first end 512 and an opposing second end 413. A first light source 532 is disposed proximate to first end 512 of first light guide 502 and configured to inject light into the first end 512 of the first light guide 502. A second light source 536 is disposed proximate to second end 513 of first light guide 502 and configured to inject light into the second end 513 of the first light guide 502. In other embodiments, one of the first and second light sources 532 and 536 are omitted.

FIG. 6 is a perspective view of a light guide assembly 600 including a first light guide 602, a second light guide 604, a first optical coupling component 606 disposed between and attached to the first and second light guides 602 and 604, a third light guide 605, and a second optical coupling component 607 disposed between and attached to the first and third light guides 602 and 605. The first optical coupling component 606 is adapted to couple light between the first and second light guides 602 and 604, and the second optical coupling component 607 is adapted to couple light between the first and third light guides 602 and 605. In the embodiment illustrated in FIG. 6, the first, second and third light guides 602, 604 and 605, and the first and second optical coupling components 606 and 607 are coextensive over an entire length or over substantially the entire length of the light guide assembly 600. In some embodiments, the first and second light guides 602 and 604, and the first optical coupling component 606 are coextensive over a first region of the light guide assembly 600 extending along a portion of a length of the light guide assembly 600; and the first and third light guides 602 and 605, and the second optical
coupling component 607 are coextensive over a second region of the light guide assembly 600 extending along a portion of a length of the light guide assembly 600. In some embodiments, the first and second regions are the same, and in some embodiments, the first and second regions are different. In some embodiments, the first and second regions overlap and in some embodiments the first and second regions do not overlap.

The first and second optical coupling components 606 and 607 may be continuous or discontinuous and may include one or more locations along a length of the optical coupling component adapted to prevent optical coupling between the respective adjacent light guides.

First light guide 602 includes opposing first and second ends 612 and 613 and includes light extractor 608, which may correspond to any of the light extractors described elsewhere herein. Light extractor 608 is adapted to extract light from the light guide assembly 600 through side 616 of the first light guide 602. Second light guide 604 includes opposing first and second ends 618 and 619, and includes sides comprising one or more flat surfaces 637. Third light guide 605 includes opposing first and second ends 628 and 629, and includes sides comprising one or more flat surfaces 639. One or both of second and third light guides 604 and 605 may include light extractors adapted to extract light from the light guide assembly 600 through one or more of the surfaces 637 and 639. In some embodiments, such light extractors are adapted to illuminate one or more indicia at one or more of the surfaces 637 and 639.

One or more light sources may be disposed proximate one or more of the ends 612, 613, 618, 619, 628, and 629. In some embodiments, light sources are disposed proximate one or both of the first and second ends 618 and 619 of the second light guide 604, and light sources are disposed proximate one or both of the first and second ends 628 and 629 of the third light guide 605. The first light guide 602 may receive light substantially only from the second and third light guides 604 and 605 and not from any light sources disposed proximate the first and second ends 612 and 613 of the first light guide 602.

FIG. 7 is a perspective view of a light guide assembly 700 including a first light guide 702, a second light guide 704, a first optical coupling component 706 disposed between and attached to the first and second light guides 702 and 704, a third light guide 705, and a second optical coupling component 707 disposed between and attached to the first and third light guides 702 and 705. The first optical coupling component 706 is adapted to couple light between the first and second light guides 702 and 704, and the second optical coupling component 707 is adapted to couple light between the first and third light guides 702 and 705. In the embodiment illustrated in FIG. 7, the first, second and third light guides 702, 704 and 705, and the first and second optical coupling components 706 and 707 are coextensive over an entire length or over substantially the entire length of the light guide assembly 700. In some embodiments, the first and second light guides 702 and 704, and the first optical coupling component 706 are coextensive over a first region of the light guide assembly 700 extending along a portion of a length of the light guide assembly 700; and the first and third light guides 702 and 705, and the second optical coupling component 707 are coextensive over a second region of the light guide assembly 700 extending.
along a portion of a length of the light guide assembly 700. In some embodiments, the first and second
regions are the same, and in some embodiments, the first and second regions are different. In some
embodiments, the first and second regions overlap, and in some embodiments, the first and second
regions do not overlap.

The first optical coupling component 706 includes a plurality of locations 733 along a length of
the first optical coupling component 706 adapted to prevent optical coupling between the first and second
light guides 702 and 704. The second optical coupling component 707 includes a plurality of locations
735 along a length of the second optical coupling component 707 adapted to prevent optical coupling
between the first and third light guides 702 and 705. In some embodiments, locations 733 extend over less
than about half (or less than about one third, or less than about one fourth) of the length of the optical
coupling component 706 and locations 735 extend over less than about half (or less than about one third,
or less than about one fourth) of the length of the optical coupling component 707.

First light guide 702 includes opposing first and second ends 712 and 713 and includes light
extractor 708, which may correspond to any of the light extractors described elsewhere herein. Light
extractor 708 is adapted to extract light from the light guide assembly 700 through side 716 of the first
light guide 702. Second light guide 704 includes opposing first and second ends 718 and 719, and
includes sides comprising one or more flat surfaces 737. Third light guide 705 includes opposing first and
second ends 728 and 729, and includes sides comprising one or more flat surfaces 739. One or both of
second and third light guides 704 and 705 may include light extractors adapted to extract light from the
light guide assembly 700 through one or more of the surfaces 737 and 739. In some embodiments, such
light extractors are adapted to illuminate one or more indicia at one or more of the surfaces 737 and 739.

One or more light sources may be disposed proximate one or more of the ends 712, 713, 718,
719, 728, and 729. In some embodiments, light sources are disposed proximate one or both of the first
and second ends 718 and 719 of the second light guide 704, and light sources are disposed proximate one
or both of the first and second ends 728 and 729 of the third light guides. The first light guide 702 may
receive light substantially only from the second and third light guides 704 and 705 and not from any light
sources disposed proximate the first and second ends 712 and 713 of the first light guide 702.

FIG. 8A is a cross-sectional view of light guide assembly 800A including first and second light
guides 802 and 804 and including optical coupling component 806a disposed between and attached to
first and second light guides 802 and 804. The first and second light guides 802 and 804 may have the
same or different cross-sectional shapes and/or the same or different cross-sectional areas. The optical
coupling component 806a may be adapted to symmetrically or asymmetrically couple light between the
first and second light guides 802 and 804. In the illustrated embodiment, optical coupling component
806a is symmetrically disposed between the first and second light guides 802 and 804 with a thickness (y-
dimension) that does not vary (the thickness is constant or substantially constant) in the width direction
(x-direction) and symmetrically couples light between the first and second light guides 802 and 804. The
optical coupling component 806a may be continuous (e.g., corresponding to optical coupling component 406 of FIG. 4) or discontinuous (e.g., corresponding to optical component 306 of FIG. 3) in the length direction (z-direction). The optical coupling component 806 may include one or more locations (e.g., corresponding to locations 733 of FIG. 7) adapted to prevent optical coupling between the first and second light guides 802 and 804. One or both of first and second light guides 802 and 804 may include a light extractor configured to extract light through a side of the light guides as described elsewhere herein.

FIG. 8B is a cross-sectional view of light guide assembly 800B which corresponds to light guide assembly 800A except that optical coupling component 806a has been replaced with optical coupling component 806b which include a color selective filter 895, which may be any of the color selective filters described elsewhere herein. For example, color selective filter 895 may be a dyed polymer or a polymeric multilayer optical film.

FIG. 9 is a cross-sectional view of light guide assembly 900 including first and second light guides 902 and 904 and including optical coupling component 906 disposed between and attached to first and second light guides 902 and 904. The first and second light guides 902 and 904 may have the same or different cross-sectional shapes and/or the same or different cross-sectional areas. The optical coupling component 906 is adapted to asymmetrically couple light between the first and second light guides 902 and 904. The optical coupling component 906 has a height (y-dimension) that varies with the width direction (x-direction). The optical coupling component 906 may be continuous (e.g., corresponding to optical coupling component 406 of FIG. 4) or discontinuous (e.g., corresponding to optical component 306 of FIG. 3) in the length direction (z-direction). The optical coupling component 906 may include one or more locations (e.g., corresponding to locations 733 of FIG. 7) adapted to prevent optical coupling between the first and second light guides 902 and 904. One or both of first and second light guides 902 and 904 may include a light extractor configured to extract light through a side of the light guides as described elsewhere herein.

FIG. 10 is a top view of light guide assembly 1000 including first and second light guides 1002 and 1004 and including optical coupling component 1006 disposed between and attached to first and second light guides 1002 and 1004. The first and second light guides 1002 and 1004 may have the same or different cross-sectional shapes and/or the same or different cross-sectional areas. The optical coupling component 1006 is adapted to asymmetrically couple light between the first and second light guides 1002 and 1004. The optical coupling component 1006 includes spaced apart portions 1007 that have a length (z-dimension) that varies with the width direction (x-direction). The spaced apart portions 1007 has a height (y-dimension) that may be constant (e.g., corresponding to optical coupling component 806 of FIG. 8) or that may vary (e.g., corresponding to optical coupling component 906 of FIG. 9) in the width direction (x-direction). The optical coupling component 1006 is discontinuous in the length direction (z-direction) and includes locations 1033 adapted to prevent optical coupling between the first and second
light guides 1002 and 1004. One or both of first and second light guides 1002 and 1004 may include a
light extractor configured to extract light through a side of the light guides as described elsewhere herein.

FIG. 11 is a cross-sectional view of light guide assembly 1100 including first and second light
guides 1102 and 1104 and including optical coupling component 1106 disposed between and attached to
first and second light guides 1102 and 1104. The first and second light guides 1102 and 1104 have
different cross-sectional shapes and/or different cross-sectional areas. The optical coupling component
1106, which may correspond to any of the optical coupling components described elsewhere herein, may
be adapted to symmetrically or asymmetrically couple light between the first and second light guides
1102 and 1104 as described elsewhere herein. The first light guide 1102 has a circular or substantially
circular cross-section and the second light has a rectangular or substantially rectangular cross-section,
which, in the illustrated embodiment is a square or substantially square cross-section. Other cross-
sectional shapes can be substituted for the first and/or second light guides 1102 and 1104. One or both of
first and second light guides 102 and 1104 may include a light extractor configured to extract light
through a side of the light guides as described elsewhere herein.

FIG. 12 is a cross-sectional view of light guide assembly 1200 including first and second light
guides 1202 and 1204 and including optical coupling component 1206 disposed between and attached to
first and second light guides 1202 and 1204. One or both of the first and second light guides 1202 and
1204 can made as generally described in U.S. Patent Numbers 8,684,578 (Rudek et al.) and 8,459,854
(Rudek et al.). Optical coupling component 1206 is adapted to couple light between the first and second
light guides 1202 and 1204. First light guide 1202 includes a curved side 1252, an opposing flat side
1254, and first and second joining sides 1256 and 1257 connecting the curved side 1252 and the flat side
1254. Second light guide 1204 includes a curved light exit side 1262, a light directing side 1264, which is
flat in the illustrated embodiment, and first and second joining sides 1266 and 1267 connecting the curved
side 1262 and the light directing side 1264. Optical coupling component 1206, which may correspond to
any of the optical coupling components described elsewhere herein, is attached to the flat side 1254 and is
attached to the joining side 1267. Second light guide 1204 includes a light extractor 1208, which may
correspond to any of the light extractors described elsewhere herein, configured to extract light from the
light guide assembly 1200 though the curved light exit side 1262 of the second light guide 1204.

The light extractors may include a plurality on notches arranged along a length of the light guide.
The notches may have any suitable distribution and may be uniformly distributed or non-uniformly
distributed. In some embodiments, notches are arranged in pairs, or triplets, or quadruplets of notches
with a uniform spacing between the pairs, or triplets, or quadruplets. This is illustrated in FIG. 13 which
shows a top surface of light guide 1304 having a length, L, and having a light extractor 1308 including a
plurality of triplets 1378 of notches 1379 with a uniform pitch, P, between adjacent triplets and a gap, g,
between adjacent notches within a triplet. The notches 1379 have a width W.
In some embodiments, a light guide article of the present description includes a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides. The light guide article may satisfy any combination or any one or more, or all, of the following conditions: (i) the first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article, and one of the first and second light guides includes a light extractor, the light extractor disposed at least partially in the region, the light extractor configured to extract light from the article through a side of the light guide that includes the light extractor; (ii) the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm, or at least 3 cm, or at least 10 cm; (iii) the optical coupling provided by the optical coupling component is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide; and (iv) the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

The light guide assemblies of the present description may be made from an optically clear polymeric material or a glass, for example. Suitable polymeric materials include acrylates such as polymethyl methacrylate (PMMA), polycarbonate, and polyurethane, for example. Light guides or light guide assemblies having light extracting features can be made by injection molding, for example. Alternatively, the light guides or light guide assemblies can be made by first forming the light guides or light guide assemblies without light extracting features and then creating the light extracting features through a subsequent processing step. The light guides or light guide assemblies can be formed without light extractors, by extrusion or by molding, for example. The light extractors can then be formed by etching, laser ablation, or embossing, for example. A cladding layer may optionally be added to the light guide or light guide assemblies either before or after the light extracting structures are formed. The cladding material may be any material having a lower refractive index than the core of the light guide. As used herein, refractive index refers to the refractive index determined at a wavelength of 589 nm (sodium D line) unless specified differently. Suitable materials for the cladding layer include fluoropolymers, for example. In some embodiments, no cladding layer is added. In some embodiments, separate light guides are first formed and then attached together through an optical coupling component. In other embodiments, the first and second light guides and the optical coupling component are extruded simultaneously to form the light guide assembly. In some embodiments, the light guide assembly is monolithic.

Examples

Examples 1-5 and Comparative Examples C1-C2

A light guide assembly as illustrated in FIG. 1 was modeled. The first and second light guides 102 and 104 were each modeled as round light guides having a refractive index of 1.49, a 2.5 mm radius,
and a 1.2 m length. The optical coupling component 106 was modeled as a rectangular component having a refractive index of 1.49 and a thickness of 4mm, 3mm, 2mm, 1mm, and 0.5mm, respectively, for Examples 1-5. Light was injected into opposing ends of the first light guide 102 using light sources modeled as Light Emitting Diodes (LEDs) having Lambertian light emission. Light extractor 108 was modeled as a diffusive strip having Lambertian reflectance with 100% reflectivity and having an angular coverage of 18 degrees.

For comparison, individual round light guides having a length of 1.2 m and a radius of 2.5 mm and 3.54 mm, respectively, for Comparative Examples C1 and C2 were also modeled. The light extractor was modeled as in Examples 1-5 with an angular coverage of 18 degrees for both cases. LEDs with Lambertian light emission were used as light sources to inject light into opposing ends of the light guides. Uniformity of the extracted light was simulated using optical modeling. A detector was placed immediately underneath the second light guide 104 to receive extracted light. Results are shown in FIG. 14 which shows luminance versus position in mm along a length of the light guide assemblies with zero corresponding to the center position along the length. It can be seen from FIG. 14 that the uniformity is improved for each of Examples 1-5 compared to either Comparative Example C1 or C2.

Example 6 and Comparative Examples C3

A light guide assembly as illustrated in FIG. 12 was constructed using two mushroom rods having curved portions with diameters of 7 mm (Example 6). The rods were made by extrusion of PMMA (POQ66 available from Evonik Performance Materials GmbH, Essen, Germany) and had a refractive index of 1.49. Light extractor 1208 included a plurality of triplets of notches as illustrated in FIG. 13 with a pitch, P, of 9 mm between triplets and a spacing, g, of 1.5 mm between the notches within the triplets. The notches had a width, W, of 2.6 mm, an included angle of about 100 degrees, and a depth of about 129 micrometers. The notches were formed via laser ablation. The first and second light guides 1202 and 1204 were attached together using an optically clear adhesive having a refractive index of 1.47-1.49, a thickness of about 10 mils (250 micrometers), and a width of about 1 mm which extended along the length of the two light guides. The optically clear adhesive formed the optical coupling component 1206. The length, L, of the light guide assembly was about 1.2 m.

Two LEDs (OSRAM CN5M available from OSRAM Opto Semiconductors GmbH, Regensburg, Germany) were used to inject light into opposing ends of the first light guide 1202. For comparison (Comparative Example C3), two OSRAM CN5M LEDs were also used to inject light into opposing ends of a single light guide corresponding to second light guide 1204. The uniformity of light outputs through curved light exit side 1262 was determined for both Example 6 and Comparative Example C3 and are shown in FIG. 15 which shows the luminance as a function of location in mm along a length of the light guide articles from an end (0 mm) to a center (600 mm) of the article. It can be seen in FIG. 15 that Example 6 gave improved luminance uniformity compared to Comparative Example C3. The luminance,
which was normalized to a maximum value of 100 for both Example 6 and Comparative Example C3, showed high frequency oscillation due to the notches.

The following is a list of exemplary embodiments of the present description.

Embodiment 1 is an article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article, and wherein one of the first and second light guides includes a first light extractor, the first light extractor disposed at least partially in the region, the first light extractor configured to extract light from the article through a side of the first or second light guide.

Embodiment 2 is the article of embodiment 1, wherein the first light extractor comprises a plurality of discrete spaced apart light extraction features and at least one of the light extraction features is disposed in the region.

Embodiment 3 is the article of embodiment 1, wherein the region extends over a length of at least 1 cm.

Embodiment 4 is the article of embodiment 1, wherein the region extends over a length of at least 3 cm.

Embodiment 5 is the article of embodiment 1, wherein the region extends over a length of at least 10 cm.

Embodiment 6 is the article of embodiment 1, wherein the optical coupling component provides an optical coupling between the first and second light guides that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

Embodiment 7 is the article of embodiment 1, wherein the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 8 is the article of embodiment 1, wherein the optical coupling component is continuous over the region.

Embodiment 9 is the article of embodiment 1, wherein the optical coupling component is discontinuous over the region.

Embodiment 10 is an article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light
between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

Embodiment 11 is the article of embodiment 10, wherein at least one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide.

Embodiment 12 is the article of embodiment 11, wherein the first light extractor comprises a plurality of discrete spaced apart light extraction features.

Embodiment 13 is the article of embodiment 12, wherein at least one of the light extraction features is disposed in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 14 is the article of embodiment 11, wherein at least a portion of the first light extractor is disposed in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 15 is the article of embodiment 10, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 3 cm.

Embodiment 16 is the article of embodiment 10, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 10 cm.

Embodiment 17 is the article of embodiment 10, wherein the optical coupling component provides an optical coupling between the first and second light guides that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

Embodiment 18 is the article of embodiment 10, wherein the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 19 is the article of embodiment 10, wherein the optical coupling component is continuous over the length of at least 1 cm.

Embodiment 20 is the article of embodiment 10, wherein the optical coupling component is discontinuous over the length of at least 1 cm.

Embodiment 21 is an article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over at least a portion
of a length of the article, wherein one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide, and wherein the optical coupling component is adapted to optically couple the first and second light guides, the optical coupling primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

Embodiment 22 is the article of embodiment 21, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

Embodiment 23 is the article of embodiment 21, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 3 cm.

Embodiment 24 is the article of embodiment 21, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 10 cm.

Embodiment 25 is the article of embodiment 21, wherein the first light extractor is disposed at least partially in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 26 is the article of embodiment 25, wherein the first light extractor comprises a plurality of spaced apart light extraction features and at least one of the light extraction features is disposed in the region.

Embodiment 27 is the article of embodiment 21, wherein the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 28 is the article of embodiment 21, wherein the optical coupling component is continuous over a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 29 is the article of embodiment 21, wherein the optical coupling component is discontinuous over a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 30 is the article of embodiment 21, wherein the optical coupling is a function of at least one of a first phase of a first light propagating in the first light guide and a second phase of a second light propagating in the second light guide.
Embodiment 31 is the article of embodiment 21, wherein the optical coupling is substantially independent of both a first phase of a first light propagating in the first light guide and a second phase of a second light propagating in the second light guide.

Embodiment 32 is an article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over at least a portion of a length of the article, wherein one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide, and wherein the optical coupling component is adapted to optically couple the first and second light guides, the optical coupling component having at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 33 is the article of embodiment 32, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

Embodiment 34 is the article of embodiment 32, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 3 cm.

Embodiment 35 is the article of embodiment 32, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 10 cm.

Embodiment 36 is the article of embodiment 32, wherein the first light extractor is disposed at least partially in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 37 is the article of embodiment 36, wherein the first light extractor comprises a plurality of spaced apart light extraction features and at least one of the features is disposed in the region.

Embodiment 38 is the article of embodiment 32, wherein the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 39 is the article of embodiment 32, wherein the optical coupling component is continuous over a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

Embodiment 40 is the article of embodiment 32, wherein the optical coupling component is discontinuous over a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.
Embodiment 41 is an article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article,

wherein one of the first and second light guides includes a first light extractor, the first light extractor disposed at least partially in the region, the first light extractor configured to extract light from the article through a side of the first or second light guide,

wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm, and

wherein the optical coupling component provides an optical coupling that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

Embodiment 42 is the article of embodiment 41, wherein the optical coupling component has at least one location along a length of the optical coupling component adapted to prevent optical coupling.

Embodiment 43 is the article of any of embodiments 1 to 42, wherein the first and second light guides are coextensive over substantially an entire length of the article.

Embodiment 44 is the article of any of embodiments 1 to 42, wherein the first, the second light guides and the optical coupling component are coextensive over at least half of an entire length of the article.

Embodiment 45 is the article of any of embodiments 1 to 42, wherein the first light guide, the second light guides and the optical coupling component are coextensive over substantially the entire length of the article.

Embodiment 46 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the first light extractor is substantially continuous.

Embodiment 47 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the first light extractor is discontinuous.

Embodiment 48 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the first light extractor is adapted to illuminate one or more indicia at a surface of the first or second light guides.

Embodiment 49 is the article of embodiment 48, wherein the surface is flat.

Embodiment 50 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the light extracted from the article has a substantially uniform intensity over at least half on an entire length of the article.
Embodiment 51 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the first light guide includes the first light extractor and the side.

Embodiment 52 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the second light guide includes the first light extractor and the side.

Embodiment 53 is the article of any of embodiments 1, 11, 21, 32, or 41, wherein the first light guide includes the first light extractor and the second light guide includes a second light extractor.

Embodiment 54 is the article of any of embodiments 1 to 42, wherein the optical coupling component is adapted to asymmetrically couple light between the first and second light guides.

Embodiment 55 is the article of embodiment 54, wherein at least a portion of the optical coupling component has a height or a length that varies in a width direction of the article.

Embodiment 56 is the article of embodiment 55, wherein the optical coupling component has a height that varies in a width direction of the article along substantially an entire length of the optical coupling component.

Embodiment 57 is the article of any of embodiments 1 to 42, wherein the optical coupling component has a height that substantially constant in a width direction of the article along substantially an entire length of the optical coupling component.

Embodiment 58 is the article of any of embodiments 1 to 42, further comprising a third light guide adjacent the second light guide and substantially parallel to the first and second light guides.

Embodiment 59 is the article of embodiment 58, further comprising a second optical coupling component disposed between and attached to the second and third light guides, wherein the second light guide, the third light guide and the second optical coupling component are coextensive over at least a portion of a length of the second light guide.

Embodiment 60 is the article of any of embodiments 1 to 42, further comprising a light source disposed proximate a first end of the first light guide and configured to inject light into the first end of the first light guide.

Embodiment 61 is the article of embodiment 60, further comprising a second light source disposed proximate a first end of the second light guide and configured to inject light into the first end of the second light guide.

Embodiment 62 is the article of embodiment 61, wherein the first light source is configured to produce light having a first color, and the second light source is configured to produce light having a second color.
Embodiment 63 is the article of embodiment 62, wherein the first and second colors are the same.

Embodiment 64 is the article of embodiment 63, wherein the first and second colors are white.

Embodiment 65 is the article of embodiment 62, wherein the first and second colors are different.

Embodiment 66 is the article of any of embodiments 1 to 42, wherein one of the first and second light guides has a substantially circular cross-section and the other of the first and second light guides has a substantially rectangular cross-section.

Embodiment 67 is the article of any of embodiments 1 to 42, wherein both of the first and second light guides have a substantially circular cross-section.

Embodiment 68 is the article of any of embodiments 1 to 42, wherein the first and second light guides have substantially the same shapes.

Embodiment 69 is the article of any of embodiments 1 to 42, wherein the first light guide has a first cross-section and the second light guide has a substantially same second cross-section.

Embodiment 70 is the article of any of embodiments 1 to 42, wherein the first light guide has a first cross-section and the second light guide has a second cross-section different from the first cross-section.

Embodiment 71 is the article of any of embodiments 1 to 42, wherein at least one of the first and second light guides has a curved side and an opposing flat side, wherein the optical coupling component is attached to the flat side.

Embodiment 72 is the article of any of embodiments 1 to 42, wherein at least one of the first and second light guides has a curved light exit side, a flat light directing side, and a joining side connecting the light exit side to the light directing side, wherein the optical coupling component is attached to the joining side.

Embodiment 73 is the article of any of embodiments 1 to 42, wherein the optical coupling component comprises a color selective filter.

Embodiment 74 is the article of embodiment 73, wherein the color selective filter comprises a dyed polymer.

Embodiment 75 is the article of embodiment 73, wherein the color filter comprises a polymeric multilayer optical film.
Descriptions for elements in figures should be understood to apply equally to corresponding elements in other figures, unless indicated otherwise. Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations can be substituted for the specific embodiments shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific embodiments discussed herein. Therefore, it is intended that this disclosure be limited only by the claims and the equivalents thereof.
What is claimed is:

1. An article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article, and wherein one of the first and second light guides includes a first light extractor, the first light extractor disposed at least partially in the region, the first light extractor configured to extract light from the article through a side of the first or second light guide.

2. The article of claim 1, wherein the first light extractor comprises a plurality of discrete spaced apart light extraction features and at least one of the light extraction features is disposed in the region.

3. The article of claim 1, wherein the region extends over a length of at least 1 cm.

4. The article of claim 1, wherein the optical coupling component provides an optical coupling between the first and second light guides that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

5. The article of claim 1, wherein the optical coupling component includes at least one location along a length of the optical coupling component adapted to prevent optical coupling.

6. An article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

7. The article of claim 6, wherein at least one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide.

8. The article of claim 7, wherein at least a portion of the first light extractor is disposed in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

9. The article of claim 6, wherein the optical coupling component provides an optical coupling between the first and second light guides that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.
10. An article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over at least a portion of a length of the article, wherein one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide, and wherein the optical coupling component is adapted to optically couple the first and second light guides, the optical coupling primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.

11. The article of claim 10, wherein the first light extractor is disposed at least partially in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

12. An article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over at least a portion of a length of the article, wherein one of the first and second light guides includes a first light extractor configured to extract light from the article through a side of the first or second light guide, and wherein the optical coupling component is adapted to optically couple the first and second light guides, the optical coupling component having at least one location along a length of the optical coupling component adapted to prevent optical coupling.

13. The article of claim 12, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm.

14. The article of claim 12, wherein the first light extractor is disposed at least partially in a region of the article where the first light guide, the second light guide and the optical coupling component are coextensive.

15. An article comprising a first light guide, a second light guide, and an optical coupling component disposed between and attached to the first and second light guides and adapted to couple light between the first and second light guides, wherein the first light guide, the second light guide and the optical coupling component are coextensive over a region of the article extending along at least a portion of a length of the article, wherein one of the first and second light guides includes a first light extractor, the first light extractor disposed at least partially in the region, the first light extractor configured to extract light from the article through a side of the first or second light guide,
wherein the first light guide, the second light guide and the optical coupling component are coextensive over a length of at least 1 cm, and

wherein the optical coupling component provides an optical coupling that is primarily a function of at least one of a first amplitude of a first light propagating in the first light guide and a second amplitude of a second light propagating in the second light guide.
## INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. F21S8/10  F21V8/00

ADD.

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

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

- F21S
- G02B

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 practicable, search terms used)

- EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2013/044497 A (SAKAMOTO MITSUHIDE [JP] ET AL) 21 February 2013 (2013-02-21) figure 15</td>
<td>1, 2, 6-8, 10-12, 14, 15</td>
</tr>
<tr>
<td>X</td>
<td>FR 2 995 976 A (VALEO VISION [FR]) 28 March 2014 (2014-03-28) figure 11</td>
<td>1, 6, 10, 12, 15</td>
</tr>
</tbody>
</table>

* 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 another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
  - "P" document published prior to the international filing date but later than the priority date claimed
  - "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  - "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  - "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  - "A" document member of the same patent family

Date of the actual completion of the international search

27 October 2016

Date of mailing of the international search report

10/11/2016

Name and mailing address of the ISA

European Patent Office, P.B. 5018 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Jones, Julian

Form PCT/ISA/210 (second sheet) (April 2005)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 5845025 A</td>
<td>01-12-1998</td>
<td>AU 7677794 A</td>
<td>22-03 - 1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2153595 AI</td>
<td>21-07 - 1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0678106 AI</td>
<td>25-10 - 1995</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 0788426 AI</td>
<td>13-08 - 1997</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP H08506189 A</td>
<td>02-07 - 1996</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 5845025 A</td>
<td>01-12 - 1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 5856384 A</td>
<td>05-01 - 1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W0 9415995 AI</td>
<td>21-07 - 1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W0 9606735 AI</td>
<td>07-03 - 1996</td>
</tr>
<tr>
<td>US 2013044497 Al</td>
<td>21-02-2013</td>
<td>CN 102405373 A</td>
<td>04-04 - 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP 2578920 Al</td>
<td>10-04 - 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HK 1165532 Al</td>
<td>31-10 - 2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KR 20120047840 A</td>
<td>14-05 - 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SG 184799 AI</td>
<td>29-11 - 2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TW 201142209 A</td>
<td>01-12 - 2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2013044497 Al</td>
<td>21-02 - 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W0 2011148420 Al</td>
<td>01-12 - 2011</td>
</tr>
<tr>
<td>FR 2995976 Al</td>
<td>28-03-2014</td>
<td>EP 2901074 Al</td>
<td>05-08-2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FR 2995976 Al</td>
<td>28-03-2014</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2015533713 A</td>
<td>26-11-2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 2015233539 Al</td>
<td>20-08-2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>W0 2014048848 Al</td>
<td>03-04-2014</td>
</tr>
</tbody>
</table>