

Description**Background and Summary of the Invention**

Light emitting diodes (LEDs) are becoming increasingly widely used in automobile design because of their longer lives and lower cost compared to the incandescent bulbs they replace. Present day automotive designers are specifying LEDs not only for indicator lamps and alphanumeric lights but also for high power illumination lamps such as center high mounted stop lights. LED stop lights require very high brightness, but often only over a very limited viewing angle. Figure 1 shows the current U.S. federal standard for LED center high mounted stop light brightness in candela as a function of viewing angle.

In order to be cost competitive with incandescent bulbs, an LED stop light must contain only a minimum number of individual LED lamps. The number of individual lamps can only be minimized if each lamp extracts substantially all of the light flux from the LED chip and concentrates the light within the useful viewing angle. Light flux outside of the viewing angle is wasted and might have been available to increase brightness within the viewing angle. Commercially available indicator lamps, which are designed according to the principles of imaging optics and standard manufacturing techniques, fail to concentrate sufficient light flux within the narrow required viewing angle. The imaging optics design constraint that the emitting surface is imaged onto the viewing plane makes design of a cost effective LED illumination lamp using imaging optics very difficult.

An alternative design approach known as non-imaging optics has been used successfully in the design of high efficiency solar collectors. An additional degree of design freedom is available in non-imaging optics since there is no requirement that the emitting surface be imaged onto the viewing plane. An informative discussion of non-imaging optics may be found in the textbook "The Optics Of Nonimaging Concentrators" by W. T. Welford and R. Winston. Specific examples of the use of non-imaging optics in solar collectors may be found in the U.S. patents (e.g., U.S. Patents 3,923,381 and 3,957,031) issued to Dr. Roland Winston.

According to the present invention there is provided a light flux extractor cup and light source assembly (a lamp) as specified in claim 1 hereinafter.

Light flux extractor cups are known, e.g. JP-A-59 61 082 and IBM Technical Disclosure Bulletin, vol 9, no. 7, December 1966, pp.947-8, but they do not have the particular geometrical form for the cup, for concentrating the light.

In accordance with the illustrated preferred embodiments of the present invention, the inventors have used the concepts of non-imaging optics to provide a high efficiency LED illumination lamp that is well adapted for use in an external automobile light such as a stop light. The lamp, which produces a very bright output over a preselected limited viewing angle, consists of two primary stages plus an optional lens stage. The first stage is a flux extractor which supports the LED and concentrates the three dimensional light flux into a desired angle, such as $\pm 45^\circ$, relative to the optical axis. The second stage is a light pipe which continues the concentration to a final desired viewing angle. By using this second stage, instead of continuing the flux extractor's compound parabolic shape, the inventors have greatly simplified manufacturing and improved the cost and reliability of the lamp. One of a number of lenses may be used to increase the apparent illuminated area of the lamp or to allow a decrease in the physical height of the lamp.

In an alternative preferred embodiment of the present invention, a diffusant may be used to scatter the LED light. A bulk diffusant may be located within the structure of the lamp itself or a diffusing layer may be positioned over the lamp. The diffusant operates to increase the apparent size of the illuminated area, to decrease the brightness of the lamp and to increase the flux divergence to an approximately Lambertian distribution at the diffusant surface.

Brief Description of the Drawings

Figure 1 shows the U.S. federal specification for the brightness of an LED automobile center high mounted stop light as a function of viewing angle.

Figure 2 shows a prior art LED lamp designed according to the principles of imaging optics.

Figure 3 shows various design parameters that are important to the design of an LED illumination lamp.

Figure 4 shows an LED illumination lamp that is constructed in accordance with a preferred embodiment of the present invention.

Figure 5 is an exploded view of the LED illumination lamp shown in Figure 4.

Figure 6 is a detail view of the flux extractor shown in Figure 4.

Figures 7A-B show a number of lenses that may be used in the lamp shown in Figure 4.

Figures 8A-C show the use of diffusant with the lamp shown in Figure 4.

Figure 9 shows a center high mounted stop light constructed as an array of the lamps shown in Figure 4.

Detailed Description of the Preferred Embodiments

Figure 1 shows the current U.S. federal specification for the brightness, in candela, of an LED automobile center high mounted stop light as a function of horizontal and vertical viewing angle. The required brightness is at a maximum within 5° of the optical axis and decreases as the angle increases. Light flux beyond 10° above the optical axis, 5° below the optical axis, or 10° to either side of the optical axis is not required and is, therefore, wasted.

Figure 2 shows a schematic cross section of a prior art LED indicator lamp, such as the Hewlett-Packard Company model HLMP-3570 ultrabright LED lamp, that is constructed according to the principles of imaging optics. Since this device is not optimized for extracting and concentrating a maximum amount of light flux, a significant portion of the total LED chip light flux either exits the lamp at high angles from the optical axis or is reflected back into the LED chip and absorbed.

Figure 3 shows a number of the design parameters that are important in the construction of an LED illumination lamp. Modern LED chips may be fabricated from GaAs, GaAsP, AlGaAs or other compounds and may use either absorbing or transparent substrates. Many of these chips are capable of emitting a Lambertian distribution of light flux from most, if not all, of the chip surfaces. To minimize input electrical power (P_{in}) and to optimize efficiency, the lamp should extract and concentrate substantially all of the light flux rather than just that portion emitted by the LED top surface. In order to meet brightness and angular viewing requirements, such as those shown in Figure 1, light flux of a certain brightness (B) is concentrated within a specified viewing angle (θ_v). In many applications the lamp must provide an illuminated surface having a given area (A) and a specified uniformity of brightness. In addition, it is often necessary to limit the overall height (h) of the lamp because of physical mounting constraints. In a typical illumination application there is no requirement that the LED chip surface be imaged onto the viewing plane.

As shown in Figure 3, an optimal LED illumination lamp would concentrate all of the light flux from the LED chip to create a maximum brightness, B , within the desired viewing angle, θ_v , and zero brightness elsewhere. The sine-brightness equation,

$$(A_c B_c)(\sin^2 \theta_{c_v}) \geq (A_v B_v)(\sin^2 \theta_{v_v}),$$

relates the area (A_c), brightness (B_c) and viewing angle (θ_{c_v}) at the LED chip to the area (A_v), brightness (B_v) and viewing angle (θ_{v_v}) at the lamp viewing plane.

Figure 4 shows an LED illumination lamp 1 that is constructed in accordance with a preferred embodiment of the present invention using the principles of non-imaging optics. The lamp 1 is effective to conserve brightness ($B_c = B_v$) and to maximize intensity by cutting off the flux at a desired angle (θ_{v_v}). An LED chip 3 sits within a flux extractor cup 5 which is fabricated within a lead frame 7. A bond wire 9 connects the anode of the LED chip 3 to an anode lead 11. The cathode of the LED chip 3 is electrically connected to a cathode lead 13 by conductive epoxy adhesion to the interior surface of the cup 5. Leads 11 and 13 are electrically isolated from each other. The lead frame 7 is fabricated in a conventional manner from a sheet of nickel plated copper. A stripe of silver may be deposited on the sheet in order to allow formation of the cup 5 as is more fully described with reference to Figure 6. The lead frame 7, after formation of the cup 5, has a thickness of approximately 8.89×10^{-2} cm (.035 inch). The leads 11, 13 may be bent and cut to a given length as desired.

Figure 5 shows an exploded view of the lamp 1 shown in Figure 4. A light pipe 21 is formed by the conical wall 23 of a second stage 27. The bottom opening of the light pipe 21 is slightly larger than the top of the cup 5 to minimize blocking any light exiting the cup 5 caused by misalignment during assembly. The oversize should be kept as small as possible to avoid uniformity problems in the light flux from the lamp 1. The lead frame 7 is attached to the stage 27 by connection of lugs 31, 33 into holes 35, 37 to ensure that the light pipe 21 and the cup 5 are aligned along the optical axis 25. An adhesive may be used to secure lead frame 7 to stage 27 and to minimize light leakage at the interface. A cutout 39 in the wall 23 allows connection of the bond wire 9 from the LED chip 3 to the lead 11.

The second stage 27 may be fabricated from a metallizable plastic such as XHTA-150 which is a commercially available thermoplastic copolymer manufactured by Rohm & Haas Co. The wall 23 is coated with a highly reflective metal such as aluminum or silver and is polished to a bright finish to provide a specularly reflecting surface. The light pipe 21 is 2.06 cm (0.813 inches) high and the contour of the wall 23 approximates a straight line and is defined by the following table which gives radius (in inches) versus depth

	Depth, cm (& inches)	Radius, cm (& inches)
	0 (0)	.7478 (.2944)
	.5019 (.1976)	.5890 (.2319)
5	.8778 (.3456)	.4717 (.1857)
	1.105 (.4349)	.4023 (.1584)
	1.267 (.4987)	.3533 (.1391)
	1.394 (.5488)	.3147 (.1239)
	1.500 (.5905)	.2830 (.1114)
10	1.591 (.6263)	.2553 (.1005)
	1.670 (.6575)	.2304 (.0907)
	1.740 (.6849)	.2078 (.0818)
	1.801 (.7090)	.1869 (.0736)
	1.554 (.7301)	.1674 (.0659)
	1.901 (.7484)	.1496 (.0589)
15	1.940 (.7639)	.1331 (.0524)
	1.974 (.7771)	.1181 (.0465)
	2.003 (.7886)	.1049 (.0413)
	2.028 (.7986)	.0940 (.0370)
	2.049 (.8067)	.0853 (.0336)
20	2.064 (.8127)	.0790 (.0311)
	2.075 (.8169)	.0752 (.0296)
	2.079 (.8186)	.0737 (.0290)

A lamp 1 may be constructed as shown in Figure 4 without the addition of the lens 41 shown in Figures 4 and 5 and the light pipe 21 may be air filled for ease of manufacturing and improved thermal performance although the epoxy provides a better optical match to the LED chip 3. One disadvantage of such a lens-less design is that the total height, h , of the lamp 1 is kept relatively large. Addition of the lens 41 to the lamp 1 allowed the total height to be decreased from 7.62 cm (three inches) to 2.065 cm (0.813 inch) with substantially no change in brightness, B_v , and area, A_v , and at a constant viewing angle, θ_{v_1} , of $\pm 7.5^\circ$.

Figure 5 shows the immersion lens 41 which may be used with the lamp 1 to decrease total height. Lens 41 is fabricated from an epoxy having an index of refraction of $n = 1.53$ and is available commercially from Essex Polytech Company as "PT" epoxy. The lens 41 has a radius of curvature of 1.016 cm (0.4 inch) and extends above the top of the second stage 27 a distance of .305 cm (0.12 inch).

The entire lamp 1 may easily be constructed with reference to Figures 4 and 5 by performing the following steps:

1. Attach LED chip 3 inside cup 5 and attach bond wire 9 from the chip 3 to lead 11.
2. Attach lead frame 7 to the second stage 27 with the optical axes aligned.
3. Inject epoxy into the light pipe 21 and the cup 5 and cure.
4. Inject epoxy into a mold cup having the desired shape for lens 41.
5. Attach the mold cup to the top of the second stage 27 ensuring that the optical axes of the lens 41 and the light pipe 21 are aligned.
6. Cure the epoxy in the mold cup so that the lens 41 is attached to the epoxy within the light pipe 21 without a reflective interface.
7. Remove the mold cup and finish the surface of lens 41, if desired.

A lamp 1 was constructed as described above using a 16 mil square by 10 mil high absorbing substrate AlGaAs red LED chip 3. The total height of the lamp 1 was approximately 2.54 cm (one inch) and the total diameter was 2.159 cm (0.85 inch). Light flux generated by the LED chip 3 was three-dimensional (4 pi steradian) and the viewing angle relative to the optical axis at the plane of connection of the cup 5 to the second stage 27 was $\pm 60^\circ$. The viewing angle, θ_{v_1} , at the viewing plane at the surface of the lens 41 was $\pm 7.5^\circ$ and the illuminated area, A_v , was 1.81 cm² (0.28 square inches). The electrical input power, P_{in} , to the LED chip 3 was 300 milliwatts and the brilliance, B_v , of the lamp 1 was 2.4×10^4 candela/meter² (for an intensity of 4.3 candela).

Figure 6 shows a detailed cross-sectional view of the cup 5 shown in Figures 4 and 5. The cup 5 is formed within the lead frame 7 as described above and may be silver coated to provide a specularly reflecting inner surface 49. Light emitted by the LED chip 3 exits the cup 5 within a cup viewing angle θ_{c_1} about the optical axis 25. The cup 5 includes four separate sections 61, 63, 65, 67 which are axially symmetric about the optical axis 25. Formation of these four sections is described only with respect to the left half of the cup 5 shown in Figure 6. Formation of an actual three-dimensional cup 5 could be accomplished by rotation of this planar representation about the optical axis 25. The LED chip 3 is attached to a flat bottom section 61 of the cup 5 using

Carbon Black Content	0%	0.1%	0.2%	1.25%
Heat Distortion Temp.	101.5	96.2	96.5	99.8
Tg (DMA)	139	141	137	140
Notched Izod 23 °C	50.5	50.7	51.4	47
Impact Strength 0 °C	42.9	42.7	43.2	37
Impact Strength 30 °C	29.7	28.3	28.5	26
Flex Modulus	17.700	17.600	17.600	18.190
Flex Strength	718	680	677	699

From the above, it can be seen that physical properties are not materially affected by the presence of carbon black at the levels employed here.

Claims

1. A polymeric composition comprising units derived from the ring-opening metathesis-catalyst polymerization of one or more norbornene-type monomers and containing carbon black, characterized in that said polymerization has been carried out in the presence of from 0.05 to 25 parts, per 100 parts of monomer by weight, of carbon black which contains less than 0.3% oxygen.
2. A polymeric composition as claimed in claim 1, further characterized in that the composition contains from 0.5 parts to 25 parts by weight of the carbon black.
3. A polymeric composition as claimed in claim 2, further characterized in that the carbon black is thermal carbon black or acetylene carbon black.
4. A polymeric composition as claimed in claims 1 or 2, further characterized in that the carbon black has been prepared by a partial combustion process and has been subjected to a heat treatment to remove oxygenated impurities.
5. A polymeric composition as claimed in any of the preceding claims, further characterized in that the monomer or monomers from which the polymeric units are derived are dicyclopentadiene, norbornene, norbornadiene, a trimer or higher oligomer of dicyclopentadiene, or an unsubstituted or substituted alkyl derivative of tetracyclododecene or tetracyclododecadiene.
6. A process for making a polymeric composition as claimed in any of claims 1 to 5, by polymerizing one or more norbornene-type monomers by a ring-opening metathesis-catalyst polymerization, characterized in that the monomer or monomers are polymerized in the presence of carbon black that has been prepared by a thermal decomposition process and which contains less than 0.3% oxygen, the amount of carbon black present being from 0.05 parts to 25 parts by weight per 100 parts of the norbornene-type monomer.
7. A process as claimed in claim 6, further characterized in that the monomer or monomers are dicyclopentadiene, norbornene, norbornadiene, a trimer or higher oligomer of dicyclopentadiene, or an unsubstituted or substituted alkyl derivative of tetracyclododecene or tetracyclododecadiene.
8. A process as claimed in claim 6 or 7, further characterized in that the polymerization of the monomer or monomers is carried out by reaction injection molding.

Patentansprüche

1. Polymere Zusammensetzung, enthaltend von der Ringöffnungsmetathese-Katalysatorpolymerisation von einem oder mehreren Monomeren vom Norbornen-Typ hergeleitete Einheiten und enthaltend Ruß, **dadurch gekennzeichnet**, daß die Polymerisation in Gegenwart von 0,05 bis 25 Gewichtsteilen, pro 100 Gewichtsteilen des Monomeren, Ruß durchgeführt wird, der weniger als 0,3 % Sauerstoff enthält.
2. Polymere Zusammensetzung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Zusammensetzung von 0,5 bis 25 Gewichtsteile an Ruß enthält.



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6. A process for making a polymeric composition as claimed in any of claims 1 to 5, by polymerizing one or more norbornene-type monomers by a ring-opening metathesis-catalyst polymerization, characterized in that the monomer or monomers are polymerized in the presence of carbon black that has been prepared by a thermal decomposition process and which contains less than 0.3% oxygen, the amount of carbon black present being from 0.05 parts to 25 parts by weight per 100 parts of the norbornene-type monomer.
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2. Polymere Zusammensetzung nach Anspruch 1, **dadurch gekennzeichnet**, daß die Zusammensetzung von 0,5 bis 25 Gewichtsteile an Ruß enthält.



a light source (3) attached in a location centred on said cup's optical axis (25) to said flat portion (61) and extending into the cup (5),

the cup having an interior surface (49) that is specularly reflective such that a substantial portion of the light emitted by the light source in any direction is directed within a solid cup angle (θ_1),

characterised in that a cross-section of said cup (5) in a plane including said optical axis (25) comprises a circular portion (63), a lower parabolic portion (65) and an upper parabolic portion (67) which are defined as follows:

the flat portion of the cup and the light source defining within the cup a virtual cylindrical surface (53) having a base coincident with said flat portion and a height parallel to the optical axis substantially equal to the height of the light source;

the circular portion (63) extending from the flat portion (61) to a lower point (73) located at an intersection with a projection of the cup angle (θ_1) through a nearest edge point (55) of a top surface (59) of said virtual cylindrical surface the circular portion having a constant radius and a center at the nearest edge point;

the lower parabolic portion (65), extending from the lower point (73) to an upper point (75) located at an intersection with a projection of the top surface (59) of said virtual cylindrical surface (53), the lower parabolic portion (65) having a vertex at the lower point (73), an axis projecting through the nearest edge point (55) and the lower point (73), and a focus at the nearest edge point (55); and

the upper parabolic portion (67), extending from the upper point (75) to a top point (77) located at an intersection of a projection of the cup angle (θ_1) with a line drawn through a farthest edge point (57) of the top surface (59) of said virtual cylindrical surface and the corresponding lower point (73') on the opposite side of the optical axis, the upper parabolic portion having a focus located at the farthest edge point (57) and an axis parallel to the axis of the lower parabolic portion.

2. An assembly according to claim 1, wherein the cup angle (θ_1) is between $+45^\circ$ and $+90^\circ$.
3. An assembly according to claim 1 or 2, wherein the light source (3) is a LED.
4. An assembly according to any of claims 1 to 3 having an interior surface (49) that is coated with a layer of silver.
5. An assembly according to any of claims 1 to 4, comprising:
 - a support frame (7) connected to the flux extractor cup (5); and
 - a contoured second stage (27), alignable to the optical axis by attachment to the frame (7), for receiving the light from the cup at an entrance aperture and for directing the light within a viewing angle (θ_v) which is less than the cup angle (θ_1);

wherein the second stage (27) entrance aperture is slightly larger than the cup exit aperture such that transition between the cup contour and the second stage (27) contour is smooth and light loss at the transition is small.
6. An assembly according to claim 5, wherein the second stage (27) includes one or more mounting lugs (31,33) for connection with associated receptors (35,37) in the lead frame such that the lead frame and second stage are thereby attached and the cup and the second stage are thereby aligned along the optical axis.
7. An assembly according to claims 5 or 6 wherein the contour of the second stage (27) is parabolic.
8. An assembly according to claims 5 or 6, wherein the contour of the second stage (27) is substantially straight and aligned with the exit contour of the cup.
9. An assembly according to any of claims 5 to 8, wherein:
 - the viewing angle (θ_v) is less than $+10^\circ$.
10. An assembly according to any of claims 5 to 9 wherein the second stage (27) is air filled and the lamp further comprises a lens (41) attached to the second stage (27) and aligned with the optical axis (25).
11. An assembly according to any of claims 5 to 10, further comprising an optically transmissive light pipe (21) within the second stage (27).



12. An assembly according to claim 11, wherein the light pipe (21) comprises a solid filling the second stage (27) and the cup (5).
13. An assembly according to claim 12, wherein an upper surface of the light pipe (21) is formed into a lens (41) aligned with the optical axis (25).
14. An assembly according to any of claims 11 to 13, further comprising diffusant particles located within the light, pipe (21) such that light striking a particle is scattered.
15. An assembly according to claim 14, wherein the diffusant particles comprise titanium dioxide.
16. An assembly according to claim 13, wherein the lens (41) surface is roughened such that the roughened surface (115) scatters light.
17. An assembly according to claim 13, further including a matte finish (115) on the lens (41) surface such that the matte finish (115) scatters light.
18. An assembly according to claim 16, further comprising a prism lens (91) connected to and over the lens (41), such that the viewing angle (θ_v) is increased in a first direction.
19. An assembly according to claim 16, further comprising a fly's eye lens (101) connected to and over the lens (41), such that the viewing angle (θ_v) is increased in first and second orthogonal directions.

Patentansprüche

1. Eine Lichtquellenanordnung, mit folgenden Merkmalen:
 einer Flußextraktionsschale (5), die um deren optische Achse (25) rotationssymmetrisch ist und einen flachen Abschnitt (61) hat, der am Boden der Schale (5) und normal zur optischen Achse angeordnet ist,
 einer Lichtquelle (3), die an einem Ort, der bezüglich der optischen Achse (25) der Schale mittig angeordnet ist, an dem flachen Abschnitt (61) angebracht ist, und die sich in die Schale (5) erstreckt,
 wobei die Schale eine innere Oberfläche (49) hat, die derart spiegelnd reflektierend ist, daß ein wesentlicher Anteil des Lichts, das durch die Lichtquelle in irgendeine Richtung emittiert wird, innerhalb eines festen Schalenwinkels (θ_s) gerichtet ist,
 dadurch gekennzeichnet,
 daß ein Querschnitt der Schale (5) in einer Ebene, die die optische Achse (25) einschließt, einen kreisförmigen Abschnitt (63), einen unteren parabolischen Abschnitt (65) und einen oberen parabolischen Abschnitt (67) einschließt, die wie folgt definiert sind:
 der flache Abschnitt der Schale und die Lichtquelle definieren innerhalb der Schale eine virtuelle zylindrische Oberfläche mit einer Basis, die mit dem flachen Abschnitt zusammenfällt, und mit einer Höhe parallel zu der optischen Achse, die im wesentlichen gleich der Höhe der Lichtquelle ist;
 der kreisförmige Abschnitt (63) erstreckt sich von dem flachen Abschnitt (61) zu einem unteren Punkt (73), der an einer Schnittstelle mit einer Projektion des Schalenwinkels (θ_s) durch einen nächsten Kantenpunkt (55) einer oberen Oberfläche (59) der virtuellen zylindrischen Oberfläche angeordnet ist, wobei der kreisförmige Abschnitt einen konstanten Radius und einen Mittelpunkt an dem nächsten Kantenpunkt hat;
 der untere parabolische Abschnitt erstreckt sich von dem unteren Punkt (73) zu einem oberen Punkt (75), der an einer Schnittstelle mit einer Projektion der oberen Oberfläche (59) der virtuellen zylindrischen Oberfläche (53) angeordnet ist, wobei der untere parabolische Abschnitt (65) einen Scheitelpunkt an dem unteren Punkt (73), eine Achse, die sich durch den nächsten Kantenpunkt (55) und den unteren Punkt (73) erstreckt, und einen Brennpunkt beim nächsten Kantenpunkt (55) hat; und
 der obere parabolische Abschnitt (67) erstreckt sich von dem oberen Punkt (75) zu einem oben liegenden Punkt (77), der an einer Schnittstelle mit einer Projektion des Schalenwinkels (θ_s) mit einer Linie angeordnet ist, die durch den entferntesten Kantenpunkt (57) der oberen Oberfläche (59) der virtuellen zylindrischen Oberfläche und durch den entsprechenden unteren Punkt (73') auf der gegenüberliegenden Seite der optischen Achse gezogen ist, wobei der obere parabolische Abschnitt ein Brennpunkt, der bei dem entferntesten Kantenpunkt (57) angeordnet ist, und eine Achse hat, die parallel zu der Achse des unteren parabolischen Abschnitts ist.
2. Eine Anordnung nach Anspruch 1, bei der der Schalenwinkel (θ_s) zwischen + 45 Grad und + 90 Grad ist.



3. Eine Anordnung gemäß Anspruch 1 oder 2, bei der die Lichtquelle (3) eine LED ist.
4. Eine Anordnung gemäß irgendeinem der Ansprüche 1 bis 3, die eine innere Oberfläche (49) aufweist, die mit einer Schicht aus Silber bedeckt ist.
5. Eine Anordnung gemäß irgendeinem der Ansprüche 1 bis 4, die folgende Merkmale aufweist:
einen Tragerahmen (7), der mit der Flußextraktionsschale (5) verbunden ist; und
eine profilierte zweite Stufe (27), die mit der optischen Achse durch Befestigung an dem Rahmen (7) ausrichtbar ist, zum Empfangen des Lichts von der Schale an einer Eintrittsöffnung und zum Leiten des Lichtes innerhalb eines Sichtwinkels (θ_1), der kleiner ist als der Schalenwinkel (θ_1);
wobei die Eintrittsöffnung der zweiten Stufe (27) etwas größer ist als die Schalenausgangsöffnung derart, daß ein Übergang zwischen der Schalenkontur und der Kontur der zweiten Stufe (27) weich ist, und daß der Lichtverlust bei dem Übergang gering ist.
6. Eine Anordnung gemäß Anspruch 5, bei der die zweite Stufe (27) eine oder mehrere Befestigungsnasen (31, 33) zum Verbinden mit zugeordneten Aufnahmevorrichtungen (35, 37) in dem Anschlußleitungsrahmen derart einschließt, daß der Anschlußleitungsrahmen und die zweite Stufe dadurch befestigt werden, und die Schale und die zweite Stufe dadurch entlang der optischen Achse ausgerichtet werden.
7. Eine Anordnung gemäß Anspruch 5 oder 6, bei der die Kontur der zweiten Stufe (27) parabolisch ist.
8. Eine Anordnung gemäß Anspruch 5 oder 6, bei der die Kontur der zweiten Stufe (27) im wesentlichen gerade und mit der Ausgangskontur der Schale ausgerichtet ist.
9. Eine Anordnung gemäß irgendeinem der Ansprüche 5 bis 8, bei der der Sichtwinkel (θ_1) kleiner als + 10 Grad ist.
10. Eine Anordnung gemäß irgendeinem der Ansprüche 5 bis 9, bei der die zweite Stufe (27) mit Luft gefüllt ist, und die Lampe ferner eine Linse (41) umfaßt, die an der zweiten Stufe (27) befestigt ist und mit der optischen Achse (25) ausgerichtet ist.
11. Eine Anordnung gemäß irgendeinem der Ansprüche 5 bis 10, die ferner eine optisch durchlässige Licht-
röhre (21) innerhalb der zweiten Stufe (27) umfaßt.
12. Eine Anordnung gemäß Anspruch 11, bei der die Lichtröhre (21) einen Festkörper umfaßt, der die zweite Stufe (27) und die Schale (5) füllt.
13. Eine Anordnung gemäß Anspruch 12, bei der eine obere Oberfläche der Lichtröhre (21) zu einer Linse (41) gebildet ist, die mit der optischen Achse (25) ausgerichtet ist.
14. Eine Anordnung gemäß irgendeinem der Ansprüche 11 bis 13, die ferner Diffusoreinrichtungspartikel umfaßt, die innerhalb der Lichtröhre (21) derart angeordnet sind, daß Licht, das einen Partikel trifft, gestreut wird.
15. Eine Anordnung gemäß Anspruch 14, bei der die Diffusoreinrichtungspartikel Titandioxid umfassen.
16. Eine Anordnung gemäß Anspruch 13, bei der die Oberfläche der Linse (41) derart aufgeraut ist, daß die aufgeraute Oberfläche (115) Licht streut.
17. Eine Anordnung gemäß Anspruch 13, die ferner einen feinkörnigen Abschluß (115) auf der Oberfläche der Linse (41) derart einschließt, daß der feinkörnige Abschluß (115) Licht streut.
18. Eine Anordnung gemäß Anspruch 16, die ferner eine Prismalinse (91) umfaßt, die mit oder über der Linse (41) derart verbunden ist, daß der Sichtwinkel (θ_1) in eine erste Richtung erhöht wird.
19. Eine Anordnung gemäß Anspruch 16, die ferner eine Fliegenaugenlinse (101) umfaßt, die mit oder über der Linse (41) derart verbunden ist, daß der Sichtwinkel (θ_1) in eine erste und eine zweite orthogonale Richtung erhöht wird.



Revendications

1. Montage de source de lumière comprenant:
 - une coupe d'extraction de flux (5) qui présente une symétrie de rotation autour de l'axe optique (25) de celle-ci, et qui comporte une partie plate (61) située au fond de la coupe (5), et normale à l'axe optique,
 - une source de lumière (3) fixée, en un emplacement centré sur ledit axe optique de la coupe (25), sur ladite partie plate (61), et s'étendant dans la coupe (5),
 - la coupe ayant une surface intérieure (49) qui est réfléchissante de façon spéculaire, de sorte qu'une partie sensible de la lumière émise par la source de lumière dans une direction quelconque est dirigée à l'intérieur d'un angle solide de la coupe (θ_1),
 - caractérisé en ce qu'une coupe transversale de ladite coupe (5), dans un plan comportant ledit axe optique (25), comprend une partie circulaire (63), une partie parabolique inférieure (65) et une partie parabolique supérieure (67), qui sont définies comme suit:
 - la partie plate de la coupe et la source de lumière définissant à l'intérieur de la coupe une surface cylindrique virtuelle (53), ayant une base coïncidant avec ladite partie plate, et une hauteur parallèle à l'axe optique, sensiblement égale à la hauteur de la source de lumière;
 - la partie circulaire (63) s'étendant depuis la partie plate (61), vers un point inférieur (73) situé à l'intersection avec la projection de l'angle de coupe (θ_1), passant par le point du bord le plus proche (55) de la surface supérieure (59) de ladite surface cylindrique virtuelle, la partie circulaire ayant un rayon constant et un centre situé sur le point du bord le plus proche;
 - la partie parabolique inférieure (65), s'étendant depuis le point inférieur (73), vers un point supérieur (75) situé à l'intersection avec la projection de la surface supérieure (59) de ladite surface cylindrique virtuelle (53), la partie parabolique inférieure (65) ayant un sommet sur le point inférieur (73), un axe se projetant passant par le point inférieur (73), un axe se projetant passant par le point de bord le plus proche (55) et le point le plus bas (73), et un foyer sur le point de bord le plus proche (55); et
 - la partie parabolique supérieure (67), s'étendant depuis le point supérieur (75), vers un point haut (77), situé à l'intersection de la projection de l'angle de coupe (θ_1) avec une ligne tracée passant par le point de bord le plus éloigné (57) de la surface supérieure (59) de ladite surface cylindrique virtuelle, et par le point le plus bas correspondant (73') situé du côté opposé de l'axe optique, la partie parabolique supérieure ayant un foyer située au point de bord le plus éloigné (57), et un axe parallèle à l'axe de la partie parabolique inférieure.
2. Montage selon la revendication 1, dans lequel l'angle de coupe (θ_1) est compris entre $+ 45^\circ$ et $+ 90^\circ$.
3. Montage selon la revendication 1 ou 2, dans lequel la source de lumière (3) est une diode électroluminescente.
4. Montage selon l'une quelconque des revendications 1 à 3, ayant une surface intérieure (49) qui est recouverte d'une couche d'argent.
5. Montage selon l'une quelconque des revendications 1 à 4, comprenant:
 - un châssis de soutien (7) connecté à la coupe d'extraction de flux (5); et
 - un second étage profilé (27), pouvant être aligné avec l'axe optique par fixation au châssis (7), pour recevoir la lumière provenant de la coupe par une ouverture d'entrée, et pour diriger la lumière à l'intérieur d'un angle d'observation (θ_2) qui est inférieur à l'angle de la coupe (θ_1);
 - dans lequel l'ouverture d'entrée du second étage (27) est légèrement plus grande que l'ouverture de sortie de la coupe, de façon que la transition entre le profil de la coupe et le second étage (27) soit régulière, et que les pertes lumineuses soient faibles à la transition.
6. Montage selon la revendication 5, dans lequel le second étage (27) comporte une ou plusieurs pattes de montage (31, 33) destinées à la connexion avec des récepteurs associés (35, 37) situés dans le châssis principal, telles que le cadre principal et le second étage soient fixés par ce moyen, et que la coupe et le second étage soient alignés par ce moyen le long de l'axe optique.
7. Montage selon les revendications 5 ou 6, dans lequel le profil du second étage (27) est parabolique.
8. Montage selon les revendications 5 ou 6, dans lequel le profil du second étage (27) est sensiblement rectiligne et aligné avec le profil de sortie de la coupe.



9. Montage selon l'une quelconque des revendications 5 à 8, dans lequel:
l'angle d'observation (θ_r) est inférieur à $+ 10^\circ$.
- 5 10. Montage selon l'une quelconque des revendications 5 à 9, dans lequel le second étage (27) est rempli d'air, et la lampe comprend en outre une lentille (41) fixée au second étage (27), et alignée avec l'axe optique (25).
11. Montage selon l'une quelconque des revendications 5 à 10, comprenant en outre un tube optiquement transmetteur de lumière (21), situé à l'intérieur du second étage (27).
- 10 12. Montage selon la revendication 11, dans lequel le tube de lumière (21) comprend un solide remplissant le second étage (27) et la coupe (5).
13. Montage selon la revendication 12, dans lequel la surface supérieure du tube de lumière (21) est formée dans une lentille (41), alignée avec l'axe optique (25).
- 15 14. Montage selon l'une quelconque des revendications 11 à 13, comprenant en outre des particules diffusantes situées à l'intérieur du tube de lumière (21), telles que la lumière qui frappe une particule soit dispersée.
- 20 15. Montage selon la revendication 14, dans lequel les particules diffusantes comprennent du dioxyde de titane.
16. Montage selon la revendication 13, dans lequel la surface de la lentille (41) est rendue rugueuse, de façon que la surface rendue rugueuse (115) disperse la lumière.
- 25 17. Montage selon la revendication 13, comportant en outre un fini mat (115) sur la surface de la lentille (41), de façon que le fini mat (115) disperse la lumière.
18. Montage selon la revendication 16, comprenant en outre une lentille prismatique (91) connectée à et située sur la lentille (41), telle que l'angle d'observation (θ_r) soit augmenté dans une première direction.
- 30 19. Montage selon la revendication 16, comprenant en outre une lentille en oeil de mouche (101) connectée à et située sur la lentille (41), telle que l'angle d'observation (θ_r) soit augmenté dans une première et une seconde directions orthogonales.

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