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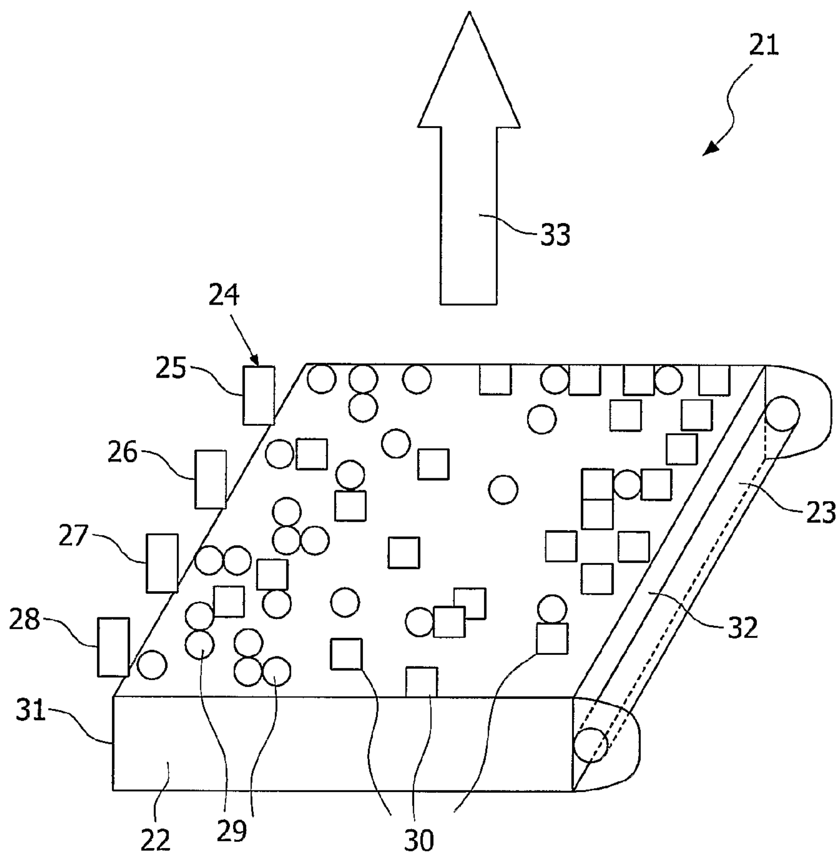
(54) Title: LAMP SYSTEM



(57) Abstract: The invention relates to a lamp system (21) with a first light source (23) which radiates light of a first chromaticity coordinate and with a second light source which radiates light of a second chromaticity coordinate, and with an optical component (22) for additively mixing the light of the two light sources (23, 24 to 28). According to the invention, the optical component (22) comprises an optical waveguide (22) with two different kinds of scattering centers (29, 30). The light can be mixed thereby as desired.

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

Lamp system

The invention relates to a lamp system with a first light source which radiates light of a first chromaticity coordinate and with a second light source which radiates light of a second chromaticity coordinate, and with an optical component for additively mixing the light of the two light sources.

Such a lamp system is known from DE 200 07 134 U1. A homogeneous mixing of the radiation of the light sources is achieved in that the lamp system radiates indirect light from all light sources at least partly. The directly emitted light of all light sources is incident on a deflection means, for example on a reflector, diffuser, or simply on the inner wall of the housing of the luminaire, whereby the radiation path is modified.

The invention accordingly has for its object to provide a simple possibility of light mixing.

This object is achieved by the characterizing features of claim 1. According to the invention, the optical component comprises an optical waveguide with two different scattering centers. First scattering centers scatter light from the first light source and second scattering centers scatter light from the second light source. Light can be mixed as desired in this manner.

Light mixing thus takes place by coupling-in into a planar optical waveguide. In such a waveguide, the light is totally reflected until it hits a scattering center, also denoted scattering point hereinafter. The scattering center may be on the surface of the planar optical waveguide or in the interior thereof.

A homogeneous luminance distribution is achieved in that the density of the scattering points varies. It increases with an increasing distance from the first light source, a fluorescent lamp in this case. If two light sources of different colors are at a distance from one another, mixing of the light of the light sources of different colors into a white, homogeneous light source now leads to the problem that the one color is indeed homogeneously coupled out by means of the difference in scattering point density, but the other color is inhomogeneously coupled out by this scattering point density. If two different scattering centers are introduced, the one kind of scattering center scattering only light from the first light source and the other one light from the second light source, a homogeneous distribution can be achieved, and in particular white light can also be coupled out. The second kind of scattering center may yet be formed by two sub-types if one of the light sources radiates light with two different wavelengths, such that the one sub-type scatters green by preference and the other one blue.

A possible effect by which such a color-selective scattering can be achieved is the so-called Mie scattering. The Mie theory states that the scattering behavior changes strongly when the particle size approximates the value of the wavelength to be scattered, or is smaller than the wavelength of the light to be scattered. In this case, the scattering coefficient depends on the size and shape of the scattering centers.

The invention will now be explained in more detail below with reference to an embodiment and to the drawing, in which:

Fig. 1 shows a planar optical waveguide with a light source in perspective view,

Fig. 2 shows the optical waveguide with the light source and a scattering center in lateral cross-section,

Fig. 3 shows the optical waveguide with the light source and a second scattering center in lateral cross-section,

Fig. 4 shows the optical waveguide with the light source and with scattering centers in perspective view,

Fig. 5 shows the optical waveguide with two different light sources arranged at a distance from one another and with scattering centers in perspective view, and

Fig. 6 shows the optical waveguide with two light sources and with different scattering centers in perspective view.

Fig. 1 shows a lamp system 1 with a planar optical waveguide 2 and a light source 3 which is constructed as a fluorescent lamp.

Fig. 2 shows the lamp system 1 with the optical waveguide 2 and the fluorescent lamp 3, which emits a light ray 4 that is passed on by a scattering center 5 into a space 6 that is to be illuminated. The scattering center 5, also denoted scattering point below, is provided at a surface 7 of the optical waveguide 2.

Fig. 3 shows the lamp system 1 with the optical waveguide 2 and the fluorescent lamp 3, which emits a second light ray 8 which is passed on by a scattering center 9 into the space 6 to be illuminated. The second scattering center 9 is arranged in an interior 10 of the optical waveguide 2.

Fig. 4 shows the lamp system 1 with the optical waveguide 2 and the fluorescent lamp 3. The optical waveguide 2 comprises scattering centers 5 and 9, wherein a density of these scattering centers 5, 9 varies. The scattering center density increases with an increase in distance to the fluorescent lamp 3. It is possible in this manner to distribute the blue-green light of the fluorescent lamp 3 homogeneously.

Fig. 5 shows the optical waveguide 2 with the fluorescent lamp 3 and a second light source 11, which is formed by four red light-emitting diodes or LEDs 12 to 15. Light rays 16 originate from the fluorescent lamp 3, and light rays 17 originate from the LEDs 12 to 15 of the light source 11. The inhomogeneous density distribution of the scattering points 5 and 9 leads to a homogeneous blue-green light distribution, but to an inhomogeneous red light distribution. The color red is inhomogeneously coupled out.

Fig. 6 shows a lamp system 21 with an optical waveguide 22, a fluorescent lamp 23, and a second light source 24 comprising several red LEDs 25 to 28, and two different scattering centers 29 and 30. The scattering centers 29 deflect substantially blue-green light rays of the fluorescent lamp 23. The density of the scattering centers 29 increases with their distance to the fluorescent lamp 23. The scattering centers 30 deflect substantially red light rays from the red LEDs 25 to 28 of the light source 24. The density of the scattering centers 30 increases as their distance to the light source 24 increases. The light sources 23 and 24 are arranged at two mutually opposed sides 31 and 32 of the optical waveguide 22. The arrangement and the density of the scattering centers 29 and 30 are accordingly chosen such that the optical waveguide 22 radiates white light in a direction 33.

LIST OF REFERENCE NUMERALS

1	lamp system
2	planar optical waveguide
3	fluorescent lamp
4	light ray
5	scattering center
6	space
7	surface
8	light ray
9	scattering center
10	interior
11	light source
12	LED
13	LED
14	LED
15	LED
16	light rays
17	light rays
18	
19	
20	
21	lamp system
22	optical waveguide
23	fluorescent lamp
24	second light source
25	red LED
26	red LED
27	red LED
28	red LED
29	scattering center
30	scattering center
31	lateral side
32	lateral side
33	direction

CLAIMS:

1. A lamp system (1, 21) with a first light source (3, 23) which radiates light (4, 8, 16) of a first chromaticity coordinate and with a second light source (11 to 15, 24 to 28) which radiates light (17) of a second chromaticity coordinate, and with an optical component (2, 22) for additively mixing the light (4, 8, 16, 17) of the two light sources (3, 11 to 15, 23, 24 to 28), characterized in that the optical component (2, 22) comprises an optical waveguide (2, 22) with scattering centers (5, 9, 29, 30) of two different kinds.

2. A lamp system as claimed in claim 1, characterized in that the optical waveguide (2, 22) is of planar construction.

3. A lamp system as claimed in claim 1, characterized in that the light from the light source (3, 11 to 15, 23, 24 to 28) can be coupled into the optical waveguide (2, 22).

4. A lamp system as claimed in claim 1, characterized in that the scattering center (5) is arranged on the surface (7) of the optical waveguide (2).

5. A lamp system as claimed in claim 1, characterized in that the scattering center (9) is arranged in the interior (10) of the optical waveguide (2).

6. A lamp system as claimed in claim 1, characterized in that a density of the scattering centers varies.

7. A lamp system as claimed in claim 6, characterized in that the density of the scattering centers increases with an increasing distance to the light source (3, 11 to 15, 23, 24 to 28).

8. A lamp system as claimed in claim 1, characterized in that the first light source (3, 23) comprises a fluorescent lamp (3, 23), and the second light source (11, 24) comprises a light-emitting diode (12 to 15, 25 to 28).

9. A lamp system as claimed in claim 8, characterized in that the fluorescent lamp (3, 23) radiates blue-green light.

10. A lamp system as claimed in claim 8, characterized in that the light-emitting diode (12 to 15, 25 to 28) radiates red light.

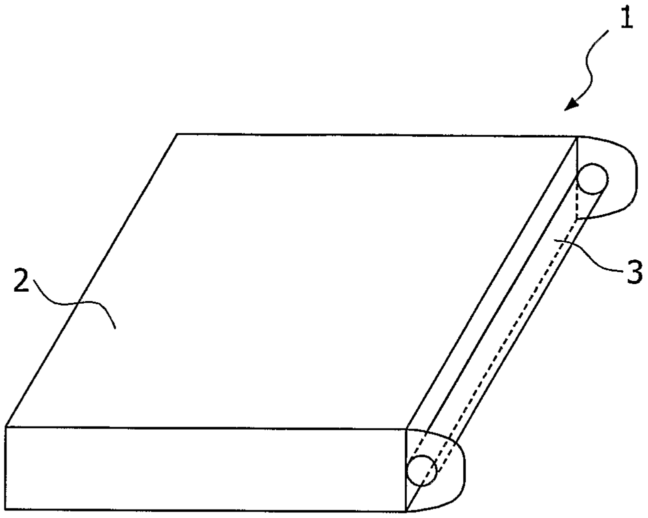

FIG. 1

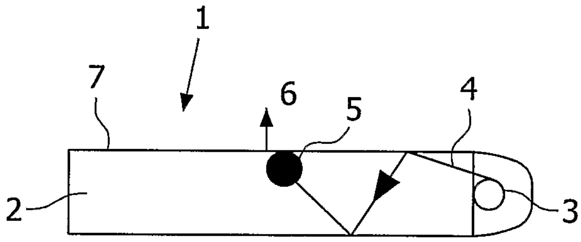

FIG. 2

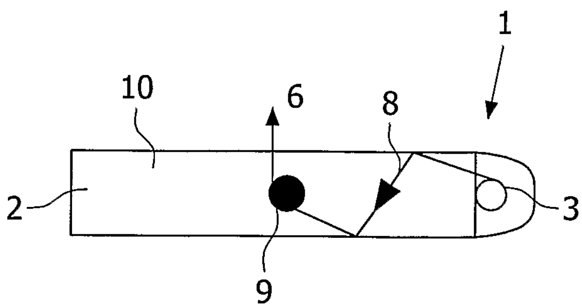

FIG. 3

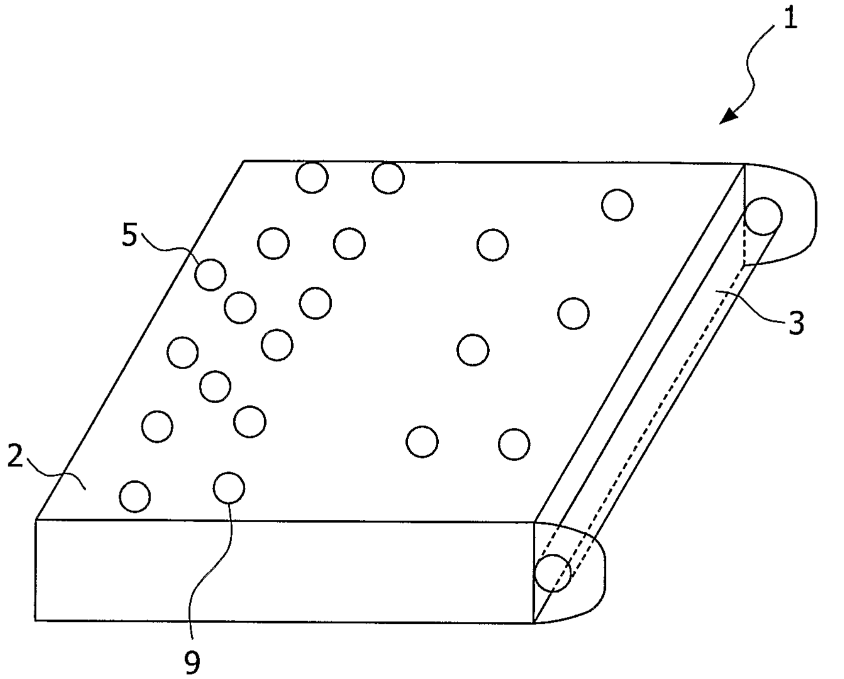

FIG. 4

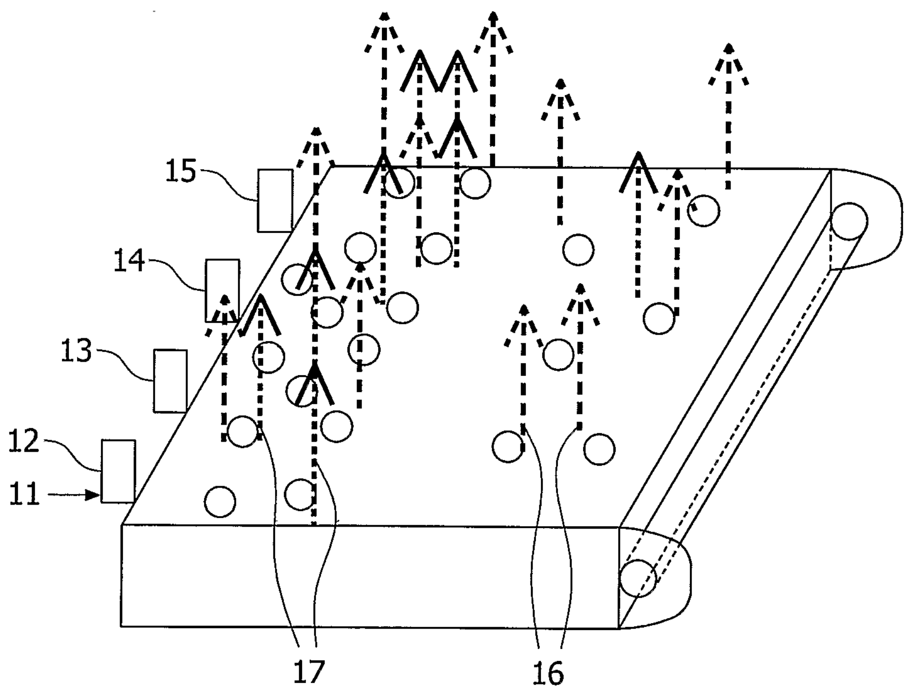

FIG. 5

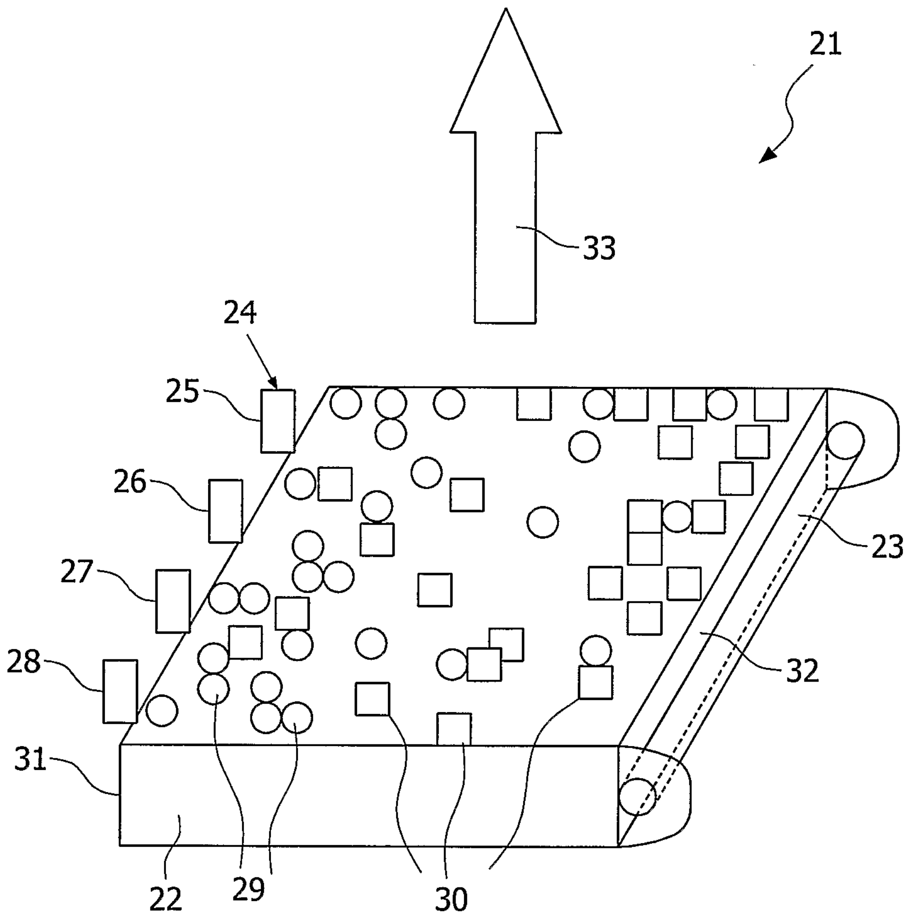

FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02B6/00

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 200 07 134 U (PATRA PATENT TREUHAND) 17 August 2000 (2000-08-17) cited in the application abstract; figures 1-3	1-10
Y	US 5 899 552 A (ARAI TAKAYUKI ET AL) 4 May 1999 (1999-05-04) abstract; figures 1-19	1-3,5, 8-10
Y	US 6 211 929 B1 (HIRAISHI FUMINORI ET AL) 3 April 2001 (2001-04-03) abstract; claims 1-10; figures 1-12	1-4,6,7

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

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 November 2004	02/12/2004

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IB2004/051652

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