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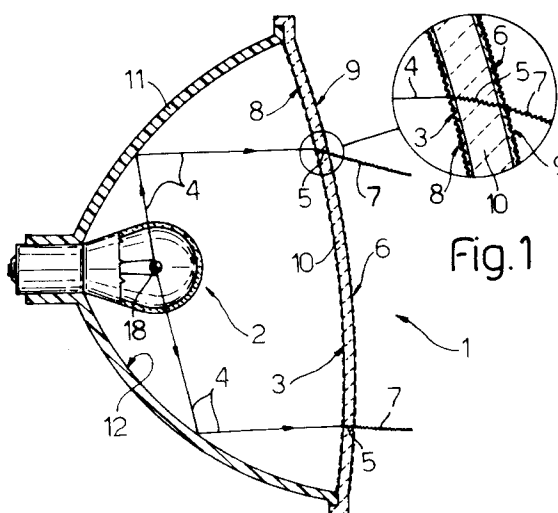
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Lighting device, in particular for use on motor vehicles.

The device comprises a source for generating light radiation and is capable of emitting a light flux having predetermined characteristics into an area outside the device itself; such a device also comprises first diffraction means (3) arranged so as to be struck by the light radiation (4) emitted by the abovementioned source and capable of emitting a first flux of diffracted rays (5) and second diffraction means (6) arranged so as to be struck by said first flux (5) and capable of emitting a second flux of diffracted rays (7); the second diffraction means (6) are set so as to correct and modify the characteristics of the rays of the first light flux (5) so that the characteristics of the second light flux (7) correspond to the abovementioned predetermined characteristics.



The present invention relates to a lighting device which is particularly suitable for use in the production of a motor vehicle headlight.

As is known, the distribution of the light flux emitted by certain lighting devices, for example motor vehicle headlights, must meet specific requirements in order to allow proper lighting and must conform to the provisions laid down by the various standards and regulations.

The distribution of the light flux (with respect to both the direction of the rays emitted and their intensity) into the area outside the lighting device is currently obtained using various prism means, which, as a result of total reflection and refraction, modify the direction of the light rays incident on the means themselves; in certain cases these prisms are formed directly on the walls which delimit the front of the lighting device.

Devices of this type have proved to be somewhat complex in terms of structure as a result of the large number of parts from which they are made up and of the shape of some of these parts; furthermore they take up a lot of space and additional, particularly tricky, operations are needed to mount them on the car bumper.

In order to control the light flux emitted by motor vehicle headlights, holographic optics have also been proposed; two different optics of this type are described in USA Patents No. 4,713,738 and No. 4,722,037.

The first of these patents describes a headlight comprising a reflector, inside which is located a light source and on the surface of which is located a holographic optic element, so that the light emitted by said source is incident on the abovementioned element and comes from it, simultaneously diffracted and reflected towards the area outside the lighting device.

The second patent describes a motor vehicle lighting device fitted with two different sources of monochromatic light and with a transparent wall on which a holographic optic element is located; this element is set so as to exert a different diffractive action on the two light fluxes emitted by each of the sources, in such a way that the flux emitted by one of these sources exits the device in one direction while that emitted by the other source exits the device in a different direction.

The optical devices fitted with the holographic elements of the type described have certain drawbacks. If they are to operate using white light, as is the case in the device of the first-mentioned patent, the light flux emitted by the device undergoes significant angular dispersion and the optical efficiency is considerably reduced; with the device of the second patent, not only are the drawbacks mentioned above present, there is the additional disadvantage that it can only be properly used with

monochromatic light.

The object of the present invention is to produce a lighting device, in particular for use on motor vehicles, which does not have the drawbacks mentioned above and with which it will be possible to obtain a predetermined distribution in space of the light flux emitted by said device.

This object is achieved by means of a lighting device, in particular for use on motor vehicles, which comprises a source for generating light radiation and is capable of emitting a light flux having predetermined characteristics into an area outside the device, characterised in that it comprises first diffraction means arranged so as to be struck by the light radiation emitted by said source and capable of emitting a first flux of diffracted rays and second diffraction means arranged so as to be struck by said first flux and capable of emitting a second flux of diffracted rays, said second diffraction means being set so as to correct and modify the characteristics of said rays of said first light flux so that the characteristics of said second light flux correspond to said predetermined characteristics.

In order to give a clearer idea of the structure of the lighting device of the present invention and of the way in which it works, a more detailed description will now be given by way of an example with reference to the attached drawings in which:

- Figure 1 shows a diagrammatic vertical section of a motor vehicle headlight produced according to the concept of the present invention;
- Figures 2 and 3 respectively show diagrammatic sections of a lamp and of an LED constructed according to the concept of the present invention;
- Figures 4 and 5 show alternative embodiments of the lamp and of the emitter shown in Figures 2 and 3;
- Figure 6 shows an end section of an optical fibre which can make up the lighting device according to the concept of the present invention;
- Figures 7 and 8 show diagrammatic vertical sections of other embodiments of a motor vehicle headlight constructed according to the invention;
- Figures 9 and 10 respectively show vertical diagrammatic sections of a lamp and of an LED corresponding to various embodiments of the invention;
- Figure 11 shows a vertical diagrammatic section of a further embodiment of a motor vehicle headlight.

The lighting device of the invention is particularly suitable for use in the production of a motor vehicle headlight, as has been shown in some of

the attached figures; however, it also lends itself to use in the production of devices designed for other uses and, in particular, in the production of lamps or light radiation emitters, as is shown in some of the attached figures.

With reference firstly to Figure 1, which diagrammatically shows a motor vehicle headlight, the lighting device is capable of emitting a light flux into the area 1 outside said device; the latter comprises a source for generating light radiation 2, for example an incandescent lamp, first diffraction means 3, which are arranged so as to be struck by the flux of light radiation 4 emitted by the source 2 and which are capable of emitting a first flux of diffracted light rays 5; the device further comprises second diffraction means 6, arranged so as to be struck by the first flux of rays 5 and so as to emit, in turn, a second flux of diffracted rays 7.

According to the invention, the second diffraction means 6 are set so as to correct and modify the characteristics of the rays of the light flux 5 exiting the first diffraction means 3, so that the characteristics of the light flux 7 exiting the lighting device correspond to predetermined characteristics.

According to the invention the second diffraction means 6 are basically set so as to correct, in a way which will be described below, the distribution of the light flux. In the lighting systems proposed, the residual chromatic dispersion of the light flux does not interfere with visual perception.

Advantageously, the first and second diffraction means 3 and 6 are located on corresponding surfaces 8 and 9 of at least one transparent front wall 10 of the device, which wall is located between the source and the area outside 1, in such a way that the abovementioned means lie in succession along the path of the light fluxes 4, 5 and 7 which originate from the source 2. Advantageously and for this purpose, the headlight 1 comprises a reflector 11, the surface 12 of which can reflect the light radiation emitted by the source 2 towards the diffraction means 3 and 6.

The transparent front wall to which the diffraction means 3 and 6 are attached can advantageously be the wall 15 of a bulb (Figure 2) or of a light radiation emitter of the LED type, shown respectively in Figures 2 and 3. In this case the first and the second diffraction means 3 and 6 can be located on the inner side and on the outer side of the abovementioned wall respectively. Alternatively, according to a variant embodiment shown in Figures 4 and 5, the first diffraction means 3 can be located on the outer surface of the wall 15, while the second diffraction means 6 can be located on the inner surface of the wall 16 of a cap attached to the bulb or to the emitter; advantageously, in the embodiments of Figures 2 and 4, the bulb can be

fitted with a suitable reflecting screen 17, which is capable of diverting the light flux generated by the filament 18 of the bulb towards the diffraction means 3 and 6.

According to the same inventive concept, a lighting device may be produced using an optical fibre, of the type shown in Figure 6 and referenced 19, as the light radiation source. In this case the diffraction means 3 are located on the inner surface of a wall 20 of a cap which closes off the emitting section 21 of the optical fibre, whereas the second diffraction means 6 are located on the outer surface of said cap.

According to the embodiment shown in Figure 7, the first diffraction means 3 are located on the outer surface of a part of the wall 15 of a bulb 22, whereas the second diffraction means 6 are located on the inner surface of the wall 10 which closes off the device from the front.

According to the invention, the first diffraction means 3, or the second diffraction means 6, can be located on a reflecting surface of the device, as has been shown in Figures 8, 9, 10 and 11. According to the embodiment shown in Figure 8, the first diffraction means 3 are located on the surface 12 of the reflector 11, whereas the second diffraction means 6 are located on the inner surface 8 of the front wall 10 of the device, between the source 2 and the area outside 1.

In this embodiment the light flux 4 emitted by the source 2 is diffracted by the first diffraction means 3 and simultaneously reflected by the surface 12 of the wall 11; the flux 5 exiting the diffraction means 3 is directed towards the second diffraction means 6, to give rise to the flux 7 exiting towards the area outside 1.

According to the embodiments shown in Figures 9 and 10, the reflecting surface on which the first diffraction means 3 are located is the surface 25 of a portion of the wall 15 of a bulb (Figure 9) or of an LED (Figure 10); in these devices the second diffraction means 6 are instead located on the outer surface of the portion of wall 15 which delimits the lighting device at the front.

In this case the light flux 4 generated by the light source 18 is diffracted by the diffraction means 3 and reflected by the surface 25 of the wall 15, thereby generating the flux 5, which is in turn diffracted by the second diffraction means 6 so as to generate the exiting flux 7.

According to the embodiment shown in Figure 11, the first diffraction means 3 are located on the outer surface of a portion of the wall 15 of the bulb 22, whereas the second diffraction means 6 are located on the surface 12 of the wall 11 of the reflector; advantageously in this case, the front portion of the wall 15 is screened off by means of a suitable screen 26. In this case also, the flux 4

generated by the radiation source is diffracted by the first means 3 so as to give rise to the flux 5 which is in turn diffracted by the second means 6 to give rise to the flux 7 exiting the device.

The diffraction means 3 and 6 advantageously comprise diffractive projections arranged in a predetermined configuration. These projections may be formed directly on the surfaces on which the diffraction means themselves are located, or else, according to an alternative version, these diffractive projections are formed or recorded on a support attached to the abovementioned surfaces.

The diffraction means can be of the type with phase modulation or else of the type with amplitude modulation. These means advantageously comprise holograms, which can be of the "computer generated holograms" type. The diffractive reliefs of the diffraction means 3 and 6 or the holograms which form part of the means themselves can be obtained using any known technique, for example, using a multilevel process of the type with binary diffractive optics; replication can be carried out using microelectronics, by means of direct moulding or by means of the process known as "embossing", or by moulding by means of any other known technique used in the replication of diffractive optics.

The element supporting the diffraction means 3 and 6 can be a plastic film or can be a suitable layer of material deposited on a surface of the device and on which diffractive reliefs are subsequently cut. The hologram 2 can be recorded on a sheet of plastic or on a layer of a suitable material which has been deposited on a surface of the device, for example of vitreous material. These sheets of material can advantageously be attached to the surfaces of the device using a suitable adhesive and they can be covered with a suitable protective layer, the refractive index of which is suitably selected in order to obtain a high efficiency for said device.

So that the second diffraction means 6 can perform the function for which they are designed, i.e. that of correcting and modifying the characteristics of the rays of the light flux incident thereon in order to obtain a diffracted light flux having predetermined characteristics, and, in particular, having a completely negligible angular dispersion, the design of the diffractive reliefs or of the holograms of the second diffraction means 6 needs to be suitably selected and it needs to correlate closely with the corresponding design of the diffraction means 3. Known computer-aided techniques can be used to obtain such a result.

According to the invention the first and/or second diffraction means 3 and 6 may comprise a plurality of holograms arranged next to one another; each of these is capable of generating a

corresponding flux of diffracted rays and the design of each of the abovementioned holograms is selected so that the flux resulting from the superimposition of the different fluxes has predetermined optical characteristics.

In all the embodiments described, selection of the specific design of the diffraction means 3 and 6 can also be used to effect suitable chromatic control of the flux 7 exiting the device of the invention. This is because the action exerted by these diffraction elements also depends on the wavelength of the rays incident on them: it is therefore possible to obtain a light flux exiting the device which is of a predetermined colour or which has a desired chromatic distribution within the flux itself.

It is clear that modifications and variations may be made to the embodiments described in the present invention, with regard both to shape and to the arrangement of the different elements of the devices described, without departing from the scope of said invention.

Claims

1. Lighting device, in particular for use on motor vehicles, which comprises a source for generating light radiation and is capable of emitting a light flux having predetermined characteristics into an area outside said device, characterised in that it comprises first diffraction means (3) arranged so as to be struck by the light radiation (4) emitted by said source and capable of emitting a first flux of diffracted rays (5) and second diffraction means (6) arranged so as to be struck by said first flux (5) and capable of emitting a second flux of diffracted rays (7), said second diffraction means (6) being set so as to correct and modify the characteristics of said rays of said first light flux (5) so that the characteristics of said second light flux (7) correspond to said predetermined characteristics.
2. Device according to Claim 1, characterised in that said second diffraction means (6) are set so as to correct the angular dispersion of the rays of said first light flux (5).
3. Device according to Claim 1 or 2, characterised in that said first (3) and second (6) diffraction means are located on corresponding surfaces (8, 9) of at least one transparent front wall (10) of said device, which wall is located between said source and said area outside, in such a way that said means lie in succession along the path of the light rays emitted by said source towards said area.

4. Device according to Claim 3, characterised in that said transparent front wall (10) is a wall which closes off said device from the front.
5. Device according to Claim 3, characterised in that said transparent front wall (10) is the wall (15) of a bulb or of an LED.
6. Device according to Claim 3, characterised in that said wall is the transparent wall of a cap (20) located on the emitting section (21) of an optical fibre (19).
7. Device according to Claim 3, characterized in that said first diffraction means (3) are located on a surface of a wall (15) of a bulb or of an LED and said second diffraction means (6) on a surface of a transparent cap (16) attached to said bulb or to said emitter.
8. Device according to Claim 3, characterised in that said first diffraction means (3) are located on the surface of a wall (15) of a bulb (22) and said second diffraction means (6) are located on the surface of a wall (10) which closes off the device from the front.
9. Device according to Claim 1 or 2, characterised in that said first diffraction means (3) are located on a reflecting surface (12) of the device and said second diffraction means (6) are located on a front wall (10) of the device which wall is located between said source and said area outside, said reflecting surface (12) being capable of reflecting the diffracted rays from said first diffraction means (3) towards said second diffraction means (6).
10. Device according to Claim 9, characterised in that said reflecting surface (12) is the surface of the reflector (11) of a motor vehicle headlight.
11. Device according to Claim 9, characterised in that said reflecting surface (12) is a surface (25) of a portion of wall (15) of a bulb or of an LED and said front wall is the portion of wall which delimits the bulb at the front.
12. Device according to Claim 1, characterised in that said first diffraction means (3) are located on a surface of a bulb or of an LED and said second diffraction means (6) are located on a surface (12) of a reflector, inside which said bulb or said emitter is housed.
13. Device according to one of the preceding claims, characterized in that said diffraction means (3, 6) comprise diffractive projections arranged in predetermined configurations.
14. Device according to Claim 13, characterised in that said diffractive projections are formed directly on said surfaces on which the means themselves are located.
15. Device according to Claim 13, characterized in that said diffractive projections are formed or recorded on a support attached to said surfaces.
16. Device according to one of the preceding claims, characterized in that said diffraction means (3, 6) are of the type with phase modulation, and have any profile which can give a high efficiency value.
17. Device according to one of Claims 1 to 16, characterized in that said diffraction means (3, 6) are of the type with amplitude modulation.
18. Device according to one of the preceding claims, characterized in that said diffraction means (3, 6) comprise holograms.
19. Device according to Claim 18, characterized in that said holograms are of the "computer generated holograms" type.
20. Device according to Claim 18, characterized in that said holograms are of the "Kinoform" type.
21. Device according to one of Claims 17 to 19, characterized in that said first and/or second diffraction means (3, 6) comprise a plurality of holograms arranged next to one another, each of said holograms being capable of generating a corresponding flux of diffracted rays, the design of each of said holograms being selected so that the flux resulting from the superimposition of said fluxes has said predetermined characteristics.

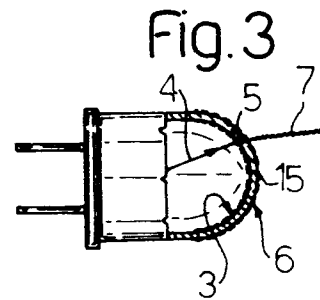
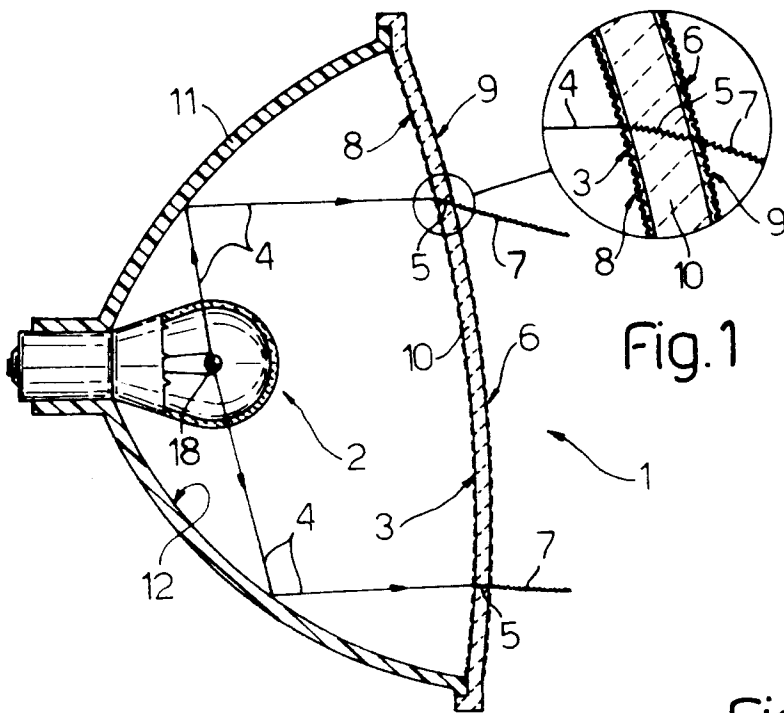


Fig. 5

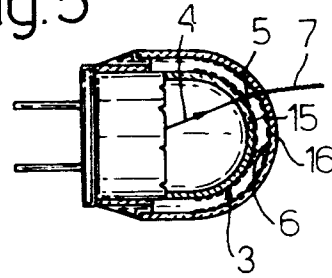


Fig. 2

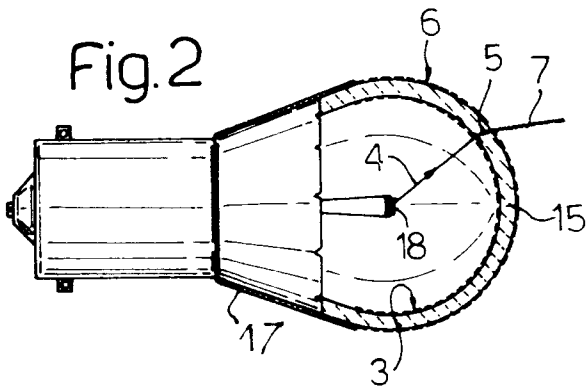


Fig. 4

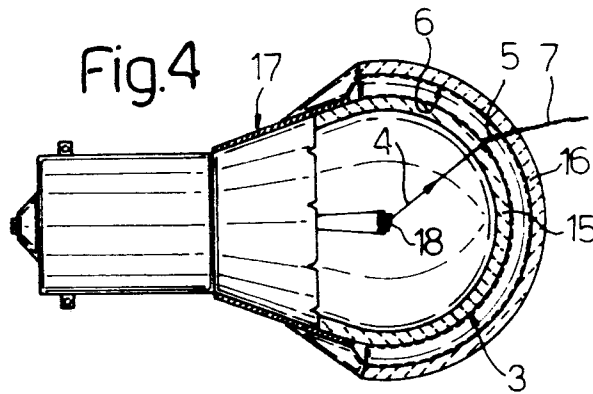


Fig. 6

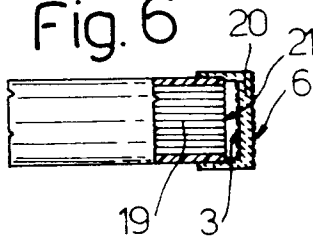


Fig. 9

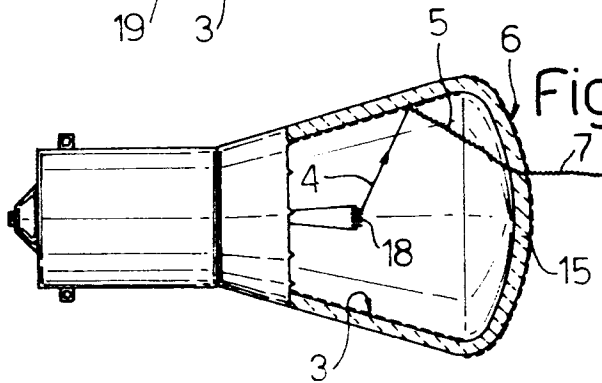


Fig. 10

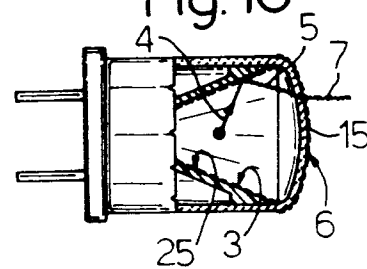


Fig.7

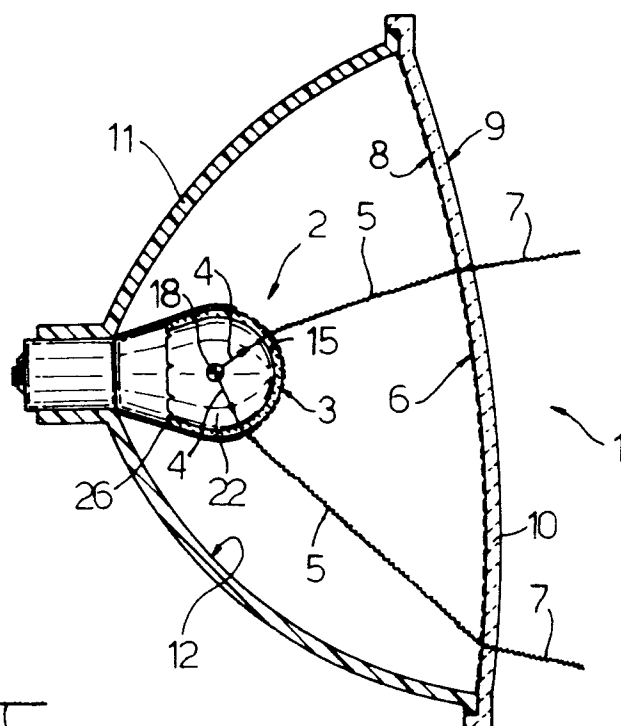


Fig.8

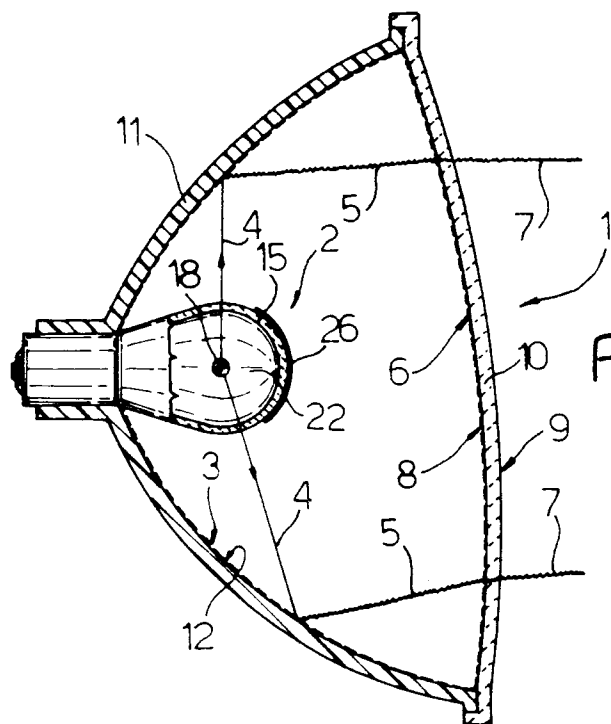
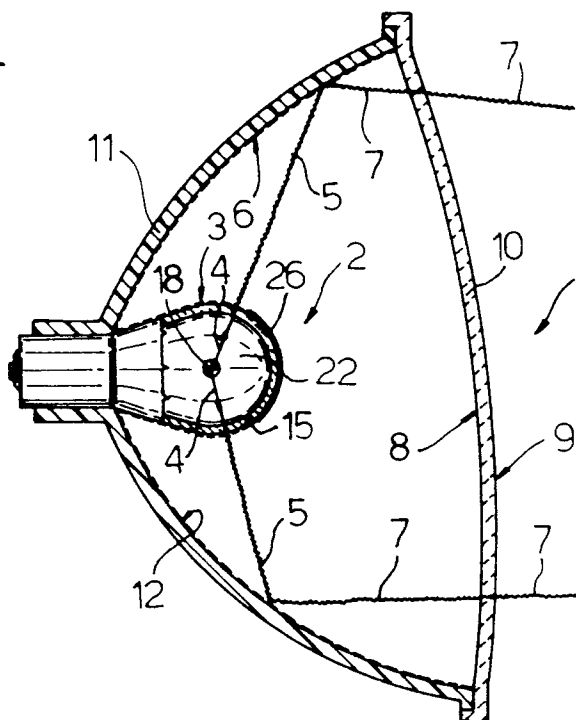


Fig.11





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 1868

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 420 195 (CANON KABUSHIKI KAISHA) * page 4, line 27 - line 29 * * page 6, line 17 - line 23; claim 2; figure 5 * ---	1,2,18	F21M3/05
A	US-A-4 536 833 (DAVIS) * abstract; figures 1,3 * ---	1,3,4, 18,21	
A	PATENT ABSTRACTS OF JAPAN vol. 16, no. 208 (M-1249)18 May 1992 & JP-A-40 034 804 (SANYO ELECTRIC CO LTD) 5 February 1992 * abstract * ---	1	
A	GB-A-2 240 390 (NISSAN MOTOR COMPANY LIMITED) * claim 1; figures 1,2 * -----	18,21	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			F21M G02B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 1 December 1993	Examiner Martin, C
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