



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.06.2008 Bulletin 2008/23

(51) Int Cl.:
F21S 8/00 (2006.01) F21V 29/00 (2006.01)

(21) Application number: **06077117.7**

(22) Date of filing: **28.11.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(71) Applicant: **Obelux Oy**
00380 Helsinki (FI)

(72) Inventors:
• **Sipinen, Jyrki**
00200 Helsinki (FI)
• **Laakso, Vesa**
01640 Vantaa (FI)

(74) Representative: **Järveläinen, Pertti Tauno Juhani et al**
Heinänen Oy
Annankatu 31-33 C
00100 Helsinki (FI)

(54) **Low-power aircraft warning light**

(57) The present invention relates to a low-power aircraft warning light in which a LED component serving as a light source is integrated in a new and innovative manner to form part of the rest of the electronics and mechanics of the illuminator. The function of the aircraft warning light is to produce a light beam that is vertically narrow, e.g. a 10° beam, but horizontally wide, typically an angle of 360°. Aircraft warning lights are used as safety devices on tall structures, such as e.g. towers. Aircraft warning lights have to meet official requirements imposed by ICAO (International Civil Aviation Organization), FAA (Federal Aviation Administration) or some other corresponding organization.

In the implementation according to the invention, the required luminous intensity is achieved using a single high-power LED component. This is made possible by optimizing the thermal control of the high-power LED component as well as the illuminator's mechanical and optical properties and its properties regarding circuit technology so that the properties required of an aircraft warning light functioning as a safety device by official provisions are achieved as regards the luminous intensity and illumination pattern.

In the solution of the invention, an aircraft warning light as simple as possible in construction is achieved while thermal control of the LED component is very effectively implemented. As only one LED component is used, the number of other electronic components required is also reduced correspondingly. The light produced by the single LED component is directed by means of a sophisticated lens solution so as to produce a horizontally omnidirectional light beam that meets the official requirements imposed on an aircraft warning light.

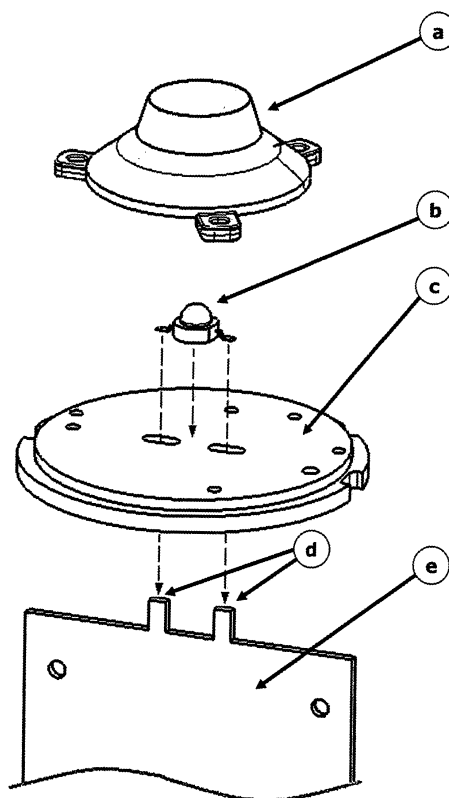


Fig. 1

Description

[0001] The present invention relates to a low-power aircraft warning light, in which a LED component serving as a light source is integrated with the rest of the electronic and mechanical structure of the illuminator in a new innovative manner. The function of an aircraft warning light is to produce a light beam that is vertically narrow, e.g. a beam of 10 degrees, but horizontally broad, typically with an angle of 360 degrees. Aircraft warning lights are used as safety devices on tall structures, such as e.g. towers. Aircraft warning lights have to meet official requirements imposed by ICAO (International Civil Aviation Organization), FAA (Federal Aviation Administration) or some other corresponding organization.

[0002] A problem with prior-art aircraft warning lights with a low luminous intensity, at least 10 candelas, is a relatively low efficiency in producing a horizontally omnidirectional light beam in relation to the power required by the device. Also, in prior-art aircraft warning lights the amount of electronics and LED components is fairly large. Most solutions use a large number of low-power LED components with no special arrangement for thermal control, whereas their operating range is designed to cover a relatively large range to produce the luminous power required to allow the effect of temperature to be taken into account. High-power LED components are also used in prior-art low-power aircraft warning light implementations, but it is to be noted that the lights are implemented using a plurality of LED components to produce an omnidirectional illumination pattern.

[0003] The aircraft warning light of the present invention is implemented using only one high-power LED semiconductor component as a light source.

[0004] In the implementation according to the invention, the required luminous intensity is achieved using a single high-power LED component. This is made possible by optimizing the thermal control of the high-power LED component as well as the illuminator's mechanical and optical properties and its properties regarding circuit technology so that the properties required of an aircraft warning light functioning as a safety device by official provisions are achieved as regards the luminous intensity and illumination pattern.

[0005] The light produced by the single LED component is directed by means of a sophisticated lens solution so as to create a horizontally omnidirectional light beam that meets the official requirements imposed on an aircraft warning light.

[0006] In the use of high-power LED components, the essential problem is how to provide as efficient heat control as possible. The heat generated by the semiconductor chip of the LED component has to be conducted as effectively as possible to the actual cooling element of the device. One of the most central challenges is how to keep the operating temperature of the high-power LED component constantly within a variation range as narrow as possible, so as to allow the current required by the

component to be kept at a low level and its luminous intensity to remain as stable as possible.

[0007] In prior-art solutions, heat conduction in the high-power LED component typically occurs via four contact surfaces, whose total thermal resistance affects the operation of the LED component as a light source. High-power LED components are generally mounted on an MCPCB (Metal-Core Printed Circuit Board) circuit board. Use of a MCPCB circuit board is also recommended by the leading LED component manufacturer in their instructions for thermal design. However, the use of a MCPCB circuit board adds a further contact surface affecting thermal control in the conduction of the heat produced by the high-power LED component to the cooling element of the device. A solution as described above is not completely optimal in respect of thermal control.

[0008] In prior-art solutions, the most critical surfaces regarding implementation of thermal control are the external contact surfaces of the LED component. Manufacturers of LED components use considerable product development resources for minimizing the thermal resistance of internal contact surfaces, and thus the methods used in equipment engineering to minimize the effect of external contact surfaces on thermal resistance are very central in thermal control.

[0009] Using the solution of the present invention, a considerably improved final result is achieved in the conduction of the heat of high-power LED components to the actual cooling element of the device [FIG. 1-c]. The solution of the invention also provides other advantages as compared to prior art.

[0010] On the basis of the properties listed below, it can be stated that the aircraft warning light implementation according to the present invention is of a completely new type.

[0011] In the implementation according to the present invention, the high-power LED component is not mounted on the MCPCB circuit board but directly on the cooling element of the device, so the solution comprises only three junctions associated with thermal conduction. This is made possible by using an innovative circuit board solution in which the LED component is integrated on the end [FIG. 1-d, FIG. 2-c] of the circuit board [FIG. 1-e, FIG. 2-e] containing the control electronics, so that the cooling element [FIG. 1-c] of the device can be placed between the LED component and the circuit board to achieve optimal thermal control. This eliminates one significant contact surface affecting the thermal resistance, i.e. the contact surface introduced in prior-art solutions with the generally used MCPCB circuit board.

[0012] It is obvious that the implementation according to the invention provides a considerable advantage for effective thermal control when high-power LED components are used. As an example, it can be stated that when the temperature increases 20 degrees, the luminous intensity in the case of certain LED components producing red light may decrease up to 20 percent.

[0013] Referring to the attached drawings, implemen-

tation of the aircraft warning light of the invention with a single high-power LED component is made possible by using a lens structure [FIG. 1-a, FIG. 2-a] specifically developed for this purpose, which lens structure very effectively directs the light produced by the LED component horizontally. Thermal control of the LED component is optimized by innovatively integrating it on the end of the circuit board [FIG. 1-d, FIG. 2-c], thus allowing a cooling element [FIG. 1-c] to be placed between the LED component and the circuit board so as to achieve optimal thermal control. The cooling element simultaneously serves in the illuminator as a structural component between the lens dome and the casing containing the electronic control unit. The LED component is glued onto the cooling element [FIG. 2-d] with thermally conductive glue and soldered fast to soldering points at the end [FIG. 1-d, FIG. 2-c] of the circuit board.

[0014] In the solution of the invention, the structure of the aircraft warning light is made as simple as possible while thermal control of the LED component is very effectively implemented. As only one LED component is used, the number of other electronic components required is also reduced correspondingly.

[0015] By using the solution of the invention, considerable cost savings in respect of materials are achieved in the manufacture of the aircraft warning light. The LED component does not require a separate circuit board, and the number of electronic components in the technical implementation of the illuminator circuit can be minimized. The power required by the aircraft warning light of the invention is lower by about a half as compared to other implementations of low-power aircraft warning lights.

[0016] The aircraft warning light implementation of the invention provides significant advantages in the implementation of a low-power aircraft warning light and it employs new types of solutions.

[0017] The following properties can be regarded as the most central advantages of the implementation of the invention as compared to prior-art implementations of low-power aircraft warning lights:

- 1) the number of LED components in the device is reduced to one.
- 2) with the lens solution used in the device, a horizontally omnidirectional light pattern of the aircraft warning light is achieved using a single optical lens.
- 3) the structure of the device makes it possible to implement the thermal control of the LED component in a manner as efficient as possible. The LED component is directly attached to the cooling element [FIG. 2-d].
- 4) a luminous intensity according to the norms defined in official regulations is achieved with a single high-power LED component and a smaller number of other electronic components.
- 5) the power required by the high-power LED component of the device in the implementation according to the invention is only about 1 W, which is sufficient

to produce a luminous intensity of about 15 candelas, which meets the official requirements imposed on low-power aircraft warning lights.

6) the power required by the device is lower by about a half as compared to other known implementations.

7) the number of electronic components in the device is as small as possible.

8) thanks to the vertically mounted circuit board and the rest of the structure, the glass dome of the illuminator is small.

9) the properties listed above allow the low-power aircraft warning light to be implemented in a structurally simpler form and in smaller size.

[0018] It is obvious to a person skilled in the art that different embodiments of the above-described invention are not exclusively limited to the examples presented above, but that they may be varied within the scope of the claims presented below.

Claims

1. Low-power aircraft warning light, in which the light source used is a LED (Light Emitting Diode) component, **characterized in that** it directs the light produced by the LED component vertically with a narrow beam of e.g. 10 degrees and horizontally with an omnidirectional angle of 360 degrees, using only one optical lens [FIG. 1-a] to direct the light, and the device contains only one LED component [FIG. 1-b, FIG. 2-b], which is attached directly to a cooling element [FIG. 1-c] and integrated on the edge of a transversely disposed circuit board containing the control electronics of the LED components [FIG. 1-d].
2. Aircraft warning light implementation according to claim 1, **characterized in that** the LED component is attached directly to the cooling element [FIG. 2-d].
3. Aircraft warning light implementation according to claim 1, **characterized in that** there is no circuit board between the LED component and the cooling element.
4. Aircraft warning light implementation according to claim 1, **characterized in that** the cooling element has openings opposite the legs of the LED component, through which openings the connection to the circuit board containing the control electronics can be made.
5. Aircraft warning light implementation according to claim 1, **characterized in that** the LED component and the circuit board containing the control electronics are placed on opposite sides of the cooling element.

6. Aircraft warning light implementation according to claim 1, **characterized in that** the LED component and the circuit board containing the control electronics are not connected to each other by wiring.

5

10

15

20

25

30

35

40

45

50

55

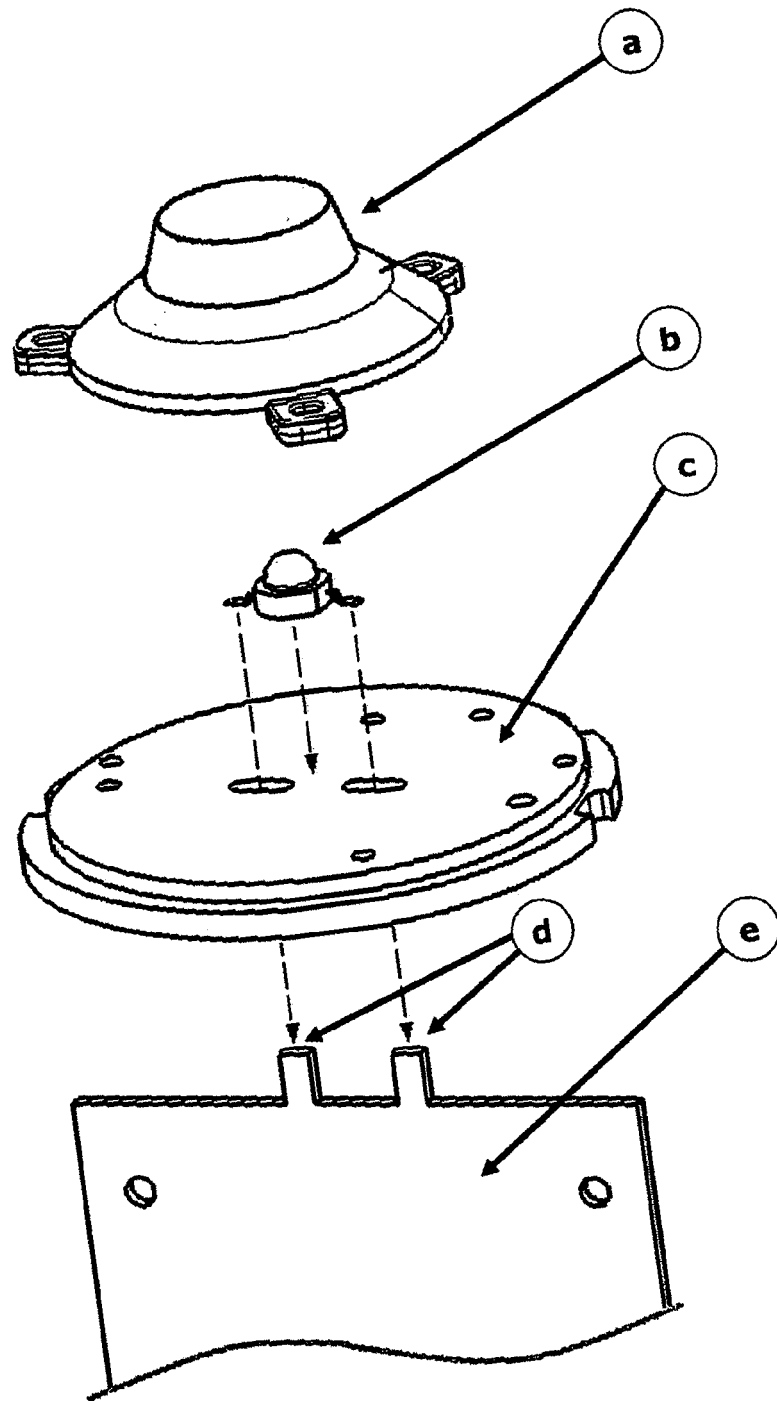


Fig. 1

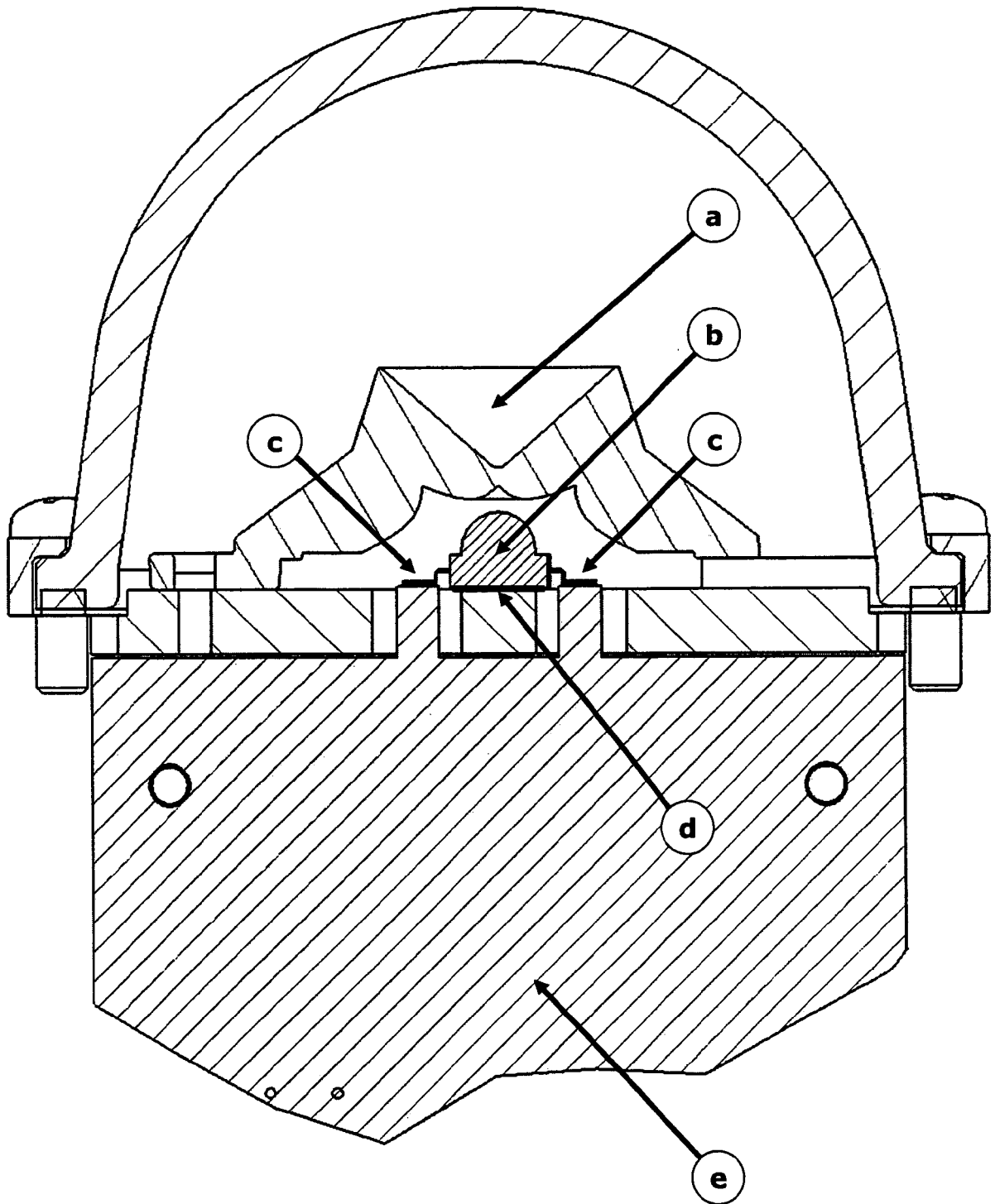


Fig. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 07 7117

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 666 305 A (ARROW ELECTRONICS IND CO LTD [JP]) 7 June 2006 (2006-06-07) * column 4, line 10 - column 6, line 49; figure 1 *	1-6	INV. F21S8/00 F21V29/00
A	DE 10 2004 001124 B3 (GOODRICH HELLA AEROSPACE LIGHT [DE]) 6 October 2005 (2005-10-06) * paragraph [0023] - paragraph [0026]; figure 2 *	1-6	
A	JP 2002 279802 A (EBARA CORP) 27 September 2002 (2002-09-27) * abstract; figures 1-3 *	1-6	
A	JP 07 153307 A (TOSHIBA LIGHTING & TECHNOLOGY) 16 June 1995 (1995-06-16) * abstract; figures 1,2 *	1-6	
A	JP 04 121901 A (STANLEY ELECTRIC CO LTD) 22 April 1992 (1992-04-22) * abstract; figure 1 *	1-6	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2005/117365 A1 (MENKE W K [US] MENKE W KENNETH [US]) 2 June 2005 (2005-06-02) * paragraph [0024] - paragraph [0034]; figures 1,2 *	1-6	F21S F21V G08G
A	WO 01/40703 A (PROCTER JEFFREY KENNETH [AU]) 7 June 2001 (2001-06-07) * page 4, line 3 - page 5, line 21; figure 4 *	1-6	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 April 2007	Examiner Schmid, Klaus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

2
EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 07 7117

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-04-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1666305 A	07-06-2006	JP 2006185890 A	13-07-2006
DE 102004001124 B3	06-10-2005	NONE	
JP 2002279802 A	27-09-2002	NONE	
JP 7153307 A	16-06-1995	NONE	
JP 4121901 A	22-04-1992	JP 8024001 B	06-03-1996
US 2005117365 A1	02-06-2005	US 2005122722 A1	09-06-2005
WO 0140703 A	07-06-2001	CA 2392285 A1	07-06-2001
		EP 1234141 A1	28-08-2002
		US 6667582 B1	23-12-2003