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**Datasheet for the decision
of 14 June 2012**

Case Number: T 2146/10 - 3.2.03

Application Number: 99969780.8

Publication Number: 1047904

IPC: F21K 7/00, H01L 25/075

Language of the proceedings: EN

Title of invention:
Lighting system

Applicant:
Koninklijke Philips Electronics N.V.

Headword:
-

Relevant legal provisions:
EPC Art. 56, 123(2)

Keyword:
"Inventive step (yes)"
"Amendment - added subject-matter (no)"

Decisions cited:
-

Catchword:
-



Case Number: T 2146/10 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 14 June 2012

Appellant:
(Applicant)

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Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 15 April 2010
refusing European patent application
No. 99969780.8 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: U. Krause
Members: G. Ashley
I. Beckedorf

Summary of Facts and Submissions

- I. This appeal arises from the decision of the examining division to refuse European patent application EP-A-99 969 780.8 for lack of inventive step.
- II. The decision was posted by the examining division on 15 April 2010. The appellant (the applicant) filed notice of appeal on 24 June 2010, paying the appeal fee on the same day; a statement containing the grounds of appeal was filed on 25 August 2010.
- III. In accordance with Rule 100(2) EPC, the Board issued a preliminary opinion concerning inventive step and Article 123(2) EPC. In response, the appellant filed, with the letter of 12 June 2012, an amended set of claims and description pages.
- IV. Requests

The appellant requests that the decision under appeal be set aside and a patent be granted on the basis of the set of claims and description pages filed with the letter dated 12 June 2012 together with figures of the application as originally filed. Should the Board be considering an adverse decision, oral proceedings are requested.

V. Claims

(a) Claim 1 reads as follows:

"1. A lighting system (1; 101) for producing white light, which lighting system comprises at least three

light-emitting diodes (6,7,8; 106,107,108), each one of the light-emitting diodes emitting, in operation, visible light in a preselected wavelength range, said three light-emitting diodes (6,7,8; 106,107,108) comprise a blue light-emitting diode (6; 106), a blue-green light emitting diode (7; 107) and a red light-emitting diode (8; 108), the lighting system (1;101) further includes at least a fourth light-emitting diode (9; 109) which, in operation, emits visible light in a further wavelength range,

characterized in that

the maximum of the spectral emission of the blue light-emitting diode (6; 106) lies in the wavelength from 460 to 490 nm, the maximum of the spectral emission of the blue-green light-emitting diode (7; 107) lies in the wavelength range from 510 to 530 nm, and the maximum of the spectral emission of the red light-emitting diode (8; 108) lies in the wavelength range from 610 to 630 nm, and the maximum of the spectral emission of the fourth light-emitting diode lying in the further wavelength range from 575 to 605 nm."

(b) Dependent claims:

Dependent claims 2 to 6 define preferred embodiments of the lighting system of claim 1. In particular, claim 3 as considered by the examining division reads as follows:

"3. A lighting system as claimed in claims 1 or 2, wherein the relative spectral contribution of the blue light-emitting diode is smaller than 0.2 resulting in a

luminous efficacy of the lighting system (1; 101) greater than 40 lm/W."

Present claim 3 has been re-worded:

"3. A lighting system as claimed in claims 1 or 2, wherein the relative spectral contribution of the blue light-emitting diode is smaller than 0.2 and a luminous efficacy of the lighting system (1; 101) is greater than 40 lm/W."

VI. Prior Art

The following documents referred to by the examining division are of relevance for this decision:

D1: DE-A-39 16 875

D2: EP-A2-0 838 866.

VII. Arguments of the Examining Division and Submissions of the Appellant

(a) Inventive Step

The closest prior art was seen by both the examining division and the appellant as being D2, which discloses a lighting system based on four LEDs and calculates the theoretical wavelength ranges required for producing white light.

The examining division regarded the objective problem to be solved as, how to put the teaching of D2 into practice using commercially available LEDs. Selecting LEDs to implement the model of D2 from the limited

number that were commercially available at the priority date, even taking into consideration the desire to achieve the optimum combination of luminous efficiency (η) and colour rendering index (R_a), was considered by the examining division merely to be a matter of trial and error following routine design procedures, and hence did not involve an inventive step.

The appellant submitted that optimising two parameters (η and R_a) on the basis of four different wavelength ranges goes beyond routine work and experimentation, and hence the claimed lighting system has an inventive step.

It was argued by the appellant that, whilst two of the ranges of claim 1 correspond to two of the ranges of D2, there is no disclosure in D2 of the claimed ranges of 575 to 605 nm and 510 to 530 nm. A skilled person wishing to reproduce the D2 lighting system has no incentive to keep the specification of two LEDs constant, while changing the specifications of the other two. In addition, D2 requires a blue LED in the range 440 to 450 nm for the purpose of improving R_a , hence an LED emitting in this range would also be included.

(b) Article 123(2) EPC

The examining division commented *obiter* in Annex II of the decision that the subject-matter of dependent claim 3 was contrary to Article 123(2) EPC.

The appellant addressed this point by redrafting claim 3.

Reasons for the Decision

1. The appeal is admissible.
2. Inventive Step (Article 56 EPC)
 - 2.1 Document D2 discloses a lighting system of the type defined in claim 1 and is described in the introduction to the application as being the starting point for the invention (see page 1, lines 6 to 18 and page 2, lines 15 to 23).
 - 2.2 The lighting system of D2 is for producing white light and comprises four LEDs. The following table compares the combination of LEDs defined in claim 1, the combination disclosed in D2, and those LEDs said to be commercially available at the priority date of the application (see page 1, line 28 to page 2, line 10 of the application, and D1, column 3, lines 42 to 45). The maximum of the spectral emission of the LEDs lies in the wavelengths ranges (nm) indicated.

Claim 1	Document D2	Commercially Available LEDs
	1) 440 - 450	430 - 490 (blue)
1) 460 - 490	2) 455 - 505	
2) 510 - 530		500 - 525 (blue-green; only half-efficient)
	3) 555 - 565	565 green (see D1)
3) 575 - 605		565 - 605 (yellow)
4) 610 - 630	4) 610 - 620	590 - 630 (red)

2.3 From the above comparison, the claimed lighting system differs in that there are LEDs in the ranges 510 to 530 nm and 575 to 605 nm.

2.4 The emission spectra of the LEDs of the lighting system of D2 are based on theoretical calculations, whereas the combination of claim 1 provides a means of producing white light based on commercially available LEDs (see page 2, lines 15 to 23 of the application).

The examining division thus regarded the objective problem to be solved as how to put the teaching of D2 into practice using commercially available LEDs. The invention also seeks, using the commercially available LEDs, to achieve the optimum combination of luminous efficiency (η) and colour rendering index (R_a), bearing in mind that an increase in η is accompanied by a

reduction in R_a , and visa versa (page 2, lines 21 to 23 of the application). Determining a combination of known LEDs to achieve these aims is thus the objective problem to be solved.

- 2.5 Faced with this problem, the skilled person is aware that there are commercially available blue LEDs that would provide spectra for the ranges 440 to 450 nm and 455 to 505 nm of D2. According to D1 there was also, at the time of filing the application, a green LED with a wavelength of 565 nm (indeed the application at page 2, lines 6 to 7, acknowledges that yellow LEDs in the range 565 to 605 nm were known). A red LED is also available for the range 610 to 620 nm).

Wishing to implement the four ranges of D2, the obvious route for the skilled person would be to choose blue LEDs (430 to 490) for the ranges 440 to 450 nm and 455 to 505 nm respectively. A yellow / green LED of 565 nm is available for the third range (555 to 565 nm) and a red LED can be used for the range 610 to 620 nm. The skilled person thus has four commercially available LEDs with which he can reproduce the theoretical ranges of D2.

- 2.6 However, this is not the approach adopted in the application. There is no mention in claim 1 of a blue LED corresponding to the lower range of 440 to 450 nm in D2. There is also no requirement for an LED in the range 555 to 565 nm as taught in D2, but instead a blue-green LED and a yellow LED having ranges 510 to 530 nm and 575 to 605 nm respectively are used.

As argued by the appellant, starting from the disclosure of D2, such a combination requires some inventive input and is more than the result of mere trial and error. In particular, there is no hint to omit the blue LED corresponding to the range 440 to 450 nm, when such an LED is commercially available, and to replace a green 565 nm LED by the combination of a blue-green and a yellow LED, the former of which only has half the efficiency of its blue equivalent (page 2, lines 2 to 4 of the application).

The claimed combination of LEDs provides a light source for white light that has good colour rendering, together with a relatively high luminous efficiency, and with respect to the disclosure of D2 has an inventive step.

3. Article 123(2) EPC

3.1 Dependent claim 3 before the examining division defined a blue light-emitting diode having a relative spectral contribution smaller than 0.2 resulting in a luminous efficacy of the lighting system greater than 40 lm/W. The appellant argued that basis for this claim was provided by the table presented on page 6 of the application.

3.2 The examining division held the view *obiter* that the required luminous efficiency is not automatically achieved when the contribution of the blue LED is less than 0.2, since it also depends on the contributions of the red, blue-green and yellow LEDs, hence dependent claim 3 did not meet the requirements of Article 123(2) EPC.

- 3.3 Present claim 3 has been reworded to define the lighting system of claim 1 having a blue light-emitting diode with a relative spectral contribution smaller than 0.2 and a luminous efficacy greater than 40 lm/W.
- 3.4 Table 1 shows three examples for which the blue LED has a contribution less than 0.2 and the luminous efficiency is greater than 40 lm/W. Limiting the claimed lighting system to these two criteria does not therefore infringe Article 123(2) EPC.
4. Since the claims of the appellant's request have been held to meet the requirements of Articles 56 and 123(2) EPC, it is not necessary to hold oral proceedings.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the examining division with the order to grant a patent on the basis of
 - a) claims 1 to 6, filed with the letter of 12 June 2012;
 - b) description pages 1 to 8, filed with the letter of 12 June 2012;
 - c) figures 1 to 3 of the application as originally filed.

The Registrar:

The Chairman:

D. Hampe

U. Krause