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Datasheet for the decision of 21 May 2019

Case Number: T 1032/14 - 3.5.02

Application Number: 08857984.2

Publication Number: 2225914

IPC: H05B33/08

Language of the proceedings: EN

Title of invention:
Solid State Lighting Devices and Methods of Manufacturing the Same

Applicant:
Cree, Inc.

Relevant legal provisions:
EPC Art. 84, 56

Keyword:
Clarity and conciseness (no) - method features in device claim
Inventive step (no) - readily predictable drawback

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Case Number: T 1032/14 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 21 May 2019

Appellant: (Applicant)	Cree, Inc. 4600 Silicon Drive Durham, NC 27703 (US)
Representative:	Dummett Copp LLP 25 The Square Martlesham Heath Ipswich IP5 3SL (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 9 December 2013 refusing European patent application No. 08857984.2 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	R. Lord
Members:	F. Giesen
	R. Cramer

Summary of Facts and Submissions

I. The present appeal by the applicant, now appellant, lies from the decision of the Examining Division refusing European patent application No. 08857984.2 pursuant to Article 97(2) EPC.

II. In their statement of grounds of appeal dated 17 April 2014 the appellant requested that the impugned decision be set aside and that grant of a patent be ordered based on the main request or one of the first, second and third auxiliary requests, all filed with the statement of grounds of appeal. Oral proceedings were requested in case the Board could not accede to any of these requests.

III. In a communication pursuant to Article 15 of the Rules of Procedure of the Boards of Appeal (RPBA) accompanying summons to oral proceedings the Board made reference to document

D7: US 7,213,940 B1 (published on 8 May 2007),

which was introduced pursuant to Article 114(1) EPC, and informed the appellant of their preliminary opinion that *inter alia* the independent device claims according to all pending requests appeared to lack clarity and conciseness and that the independent method claim 7 of the first auxiliary request appeared not to involve an inventive step in view of D7 alone.

IV. In reply to the summons, the appellant with letter dated 18 April 2019 filed arguments in support of the patentability of the claims in view of D7 and a fourth auxiliary request and with letter dated 23 April 2019

announced that no representative for the appellant would be attending the oral proceedings.

V. Oral proceedings before the Board took place on 21 May 2019 in the absence of the duly summoned appellant pursuant to Rule 115(2) EPC.

VI. Claim 1 according to the **main request** reads as follows:

"*1. A lighting device, comprising:*

a first string and a second string of solid state lighting devices, each of said first and second strings comprising at least one solid state lighting device which emits light having x, y color coordinates which define a point which is within an area on a 1931 CIE Chromaticity Diagram enclosed by line segments connecting a first point having x, y coordinates of 0.32, 0.40, a second point having x, y coordinates of 0.36, 0.48, a third point having x, y coordinates of 0.43, 0.45, a fourth point having x, y coordinates of 0.42, 0.42, and a fifth point having x, y coordinates of 0.36, 0.38, and a third string of solid state lighting devices comprising at least one solid state lighting device which emits light having a dominant wavelength in the range of from about 600 nm to about 640 nm;

a power line; and

a power supply, the power supply configured to:

(1) supply a first fixed current through the first string of solid state lighting devices when line voltage is supplied to the power line;

(2) supply a second fixed current through the second string of solid state lighting devices when the line voltage is supplied to the power line; and

(3) supply a third current through the third string of solid state lighting devices,

wherein said first fixed current and said second fixed current are determined by:

(1) measuring a color output of the lighting device while supplying a first string initial current to said first string of solid state lighting devices, a second string initial current to said second string of solid state lighting devices and a third string initial current to said third string of solid state lighting devices;

(2) comparing the color output to a target range;

(3) adjusting the current supplied to at least one of the first string of solid state light emitters, the second string of solid state light emitters and the third string of solid state light emitters to bring the colour output within said target range, such that a first string final current is supplied to the first string of solid state light emitters, a second string final current is supplied to the second string of solid state light emitters and a third string final current is supplied to the third string of solid state light emitters; and

(4) permanently setting the current supplied to the first string of solid state lighting devices, such that if any line voltage is supplied to the power line, said first fixed current will be supplied to the first

string of solid state lighting devices, the first fixed current being equal to the first string final current, and permanently setting the current supplied to the second string of solid state lighting devices, such that if any line voltage is supplied to the power line, said second fixed current will be supplied to the second string of solid state lighting devices, the second fixed current being equal to the second string final current."

VII. Claim 1 of the **first auxiliary request** reads

"*1. A lighting device, comprising: [...]*

wherein said first fixed current and said second fixed current are determined by:

(1) measuring a color output of the lighting device while supplying a first string initial current to said first string of solid state lighting devices, a second string initial current to said second string of solid state lighting devices and a third string initial current to said third string of solid state lighting devices;

(2) comparing the color output to a target color range;

(3) adjusting the current supplied to the third string emitters to a third string final current such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the u' coordinate is within a predetermined u' coordinate range;

(4) comparing the color output to a target color range;

(5) adjusting the current supplied to the first string of solid state light emitters to a first string final current and/or adjusting the current supplied to the second string of solid state light emitters to a second string final current, such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the v' coordinate is within a predetermined v' coordinate range;

(6) permanently setting the current supplied to the first string of solid state lighting devices, such that if any line voltage is supplied to the power line, said first fixed current will be supplied to the first string of solid state lighting devices, the first fixed current being equal to the first string final current, and permanently setting a final current supplied to the second string of solid state lighting devices, such that if any line voltage is supplied to the power line, said second fixed current will be supplied to the second string of solid state lighting devices, the second fixed current being equal to the second string final current."

The omitted passage indicated by "[...]" is identical to the main request, here and in the following.

VIII. Claim 1 of the **second auxiliary request** has in addition to the features of claim 1 of the first auxiliary request, the features

"*wherein if the current supplied to said third string of solid state lighting devices cannot be adjusted to bring the u' coordinate of the color output within said*

predetermined u' range, then the lighting device is rejected, and if the current supplied to said first and second strings of solid state lighting devices cannot be adjusted to bring the v' coordinate of the color output within said predetermined v' range, then the lighting device is rejected."

IX. Claim 1 of the **third auxiliary request** reads

"1. A lighting device, comprising: [...]

wherein said first fixed current and said second fixed current are determined by:

(1) measuring a color output of the lighting device while supplying a first string initial current to said first string of solid state lighting devices, a second string initial current to said second string of solid state lighting devices and a third string initial current to said third string of solid state lighting devices;

(2) comparing the color output to a target color range;

(3) adjusting the current supplied to the third string of solid state light emitters to a third string final current such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the u' coordinate is within a predetermined u' coordinate range;

(4) comparing the lumen output to a target lumen range;

(5) proportionally adjusting the currents supplied to the strings of solid state light devices until the lumen output is within said target lumen range;

(6) adjusting the current supplied to the first string of solid state light emitters to a first string final current and/or adjusting the current supplied to the second string of solid state light emitters to a second string final current, such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the v' coordinate is within a predetermined v' coordinate range;

(7) comparing the lumen output to a target lumen range;

(8) proportionally adjusting the currents supplied to the strings of solid state light devices until the lumen output is within said target lumen range; and

(9) permanently setting the current supplied to the first string of solid state lighting devices, such that if any line voltage is supplied to the power line, said first fixed current will be supplied to the first string of solid state lighting devices, the first fixed current being equal to the first string final current, and permanently setting a final current supplied to the second string of solid state lighting devices, such that if any line voltage is supplied to the power line, said second fixed current will be supplied to the second string of solid state lighting devices, the second fixed current being equal to the second string final current,

wherein if the current supplied to said third string of solid state lighting devices cannot be adjusted to

bring the u' coordinate of the color output within said predetermined u' range, then the lighting device is rejected, if the current supplied to said first and second strings of solid state lighting devices cannot be adjusted to bring the v' coordinate of the color output within said predetermined v' range, then the lighting device is rejected, and if a minimum lumen output cannot be achieved then the lighting device is rejected.

X. The independent method claims 7 and 1 of the **first** and **fourth auxiliary requests**, respectively, are identical and read as follows:

"*A method of tuning a lighting device to provide a desired color output having u'v' coordinates within a target range on a 1976 CIE Chromaticity Diagram, the lighting device comprising a first string and a second string of solid state lighting devices, both of said first and second strings comprising at least one solid state lighting device which emits light having x, y color coordinates which define a point which is within an area on a 1931 CIE Chromaticity Diagram enclosed by line segments connecting a first point having x, y coordinates of 0.32, 0.40, a second point having x, y coordinates of 0.36, 0.48, a third point having x, y coordinates of 0.43, 0.45, a fourth point having x, y coordinates of 0.42, 0.42, and a fifth point having x, y coordinates of 0.36, 0.38, and a third string of solid state lighting devices comprising at least one solid state lighting device which emits light having a dominant wavelength in the range of from about 600 nm to about 640 nm, the method comprising:*

(1) measuring a color output of the lighting device while supplying a first string initial current to said

first string of solid state lighting devices, a second string initial current to said second string of solid state lighting devices and a third string initial current to said third string of solid state lighting devices;

(2) comparing the color output to said target range;

(3) adjusting the current supplied to the third string of solid state light emitters to a third string final current such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u',v' coordinates in which the u' coordinate is within a predetermined u' coordinate range;

(4) comparing the color output to said target range;

(5) adjusting the current supplied to the first string of solid state light emitters to a first string final current and/or adjusting the current supplied to the second string of solid state light emitters to a second string final current, such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the v' coordinate is within a predetermined v' coordinate range; and

(6) permanently setting the current supplied to the first string of solid state lighting devices, such that if any line voltage is applied to the power line, said first string final current will be supplied to the first string of solid state lighting devices, and permanently setting the current supplied to the second string of solid state lighting devices, such that if any line voltage is supplied to the power line, said

second string final current will be supplied to the second string of solid state lighting devices."

XI. The appellant's arguments, in as far as they are relevant for the present decision, are essentially as follows:

Document D7 did not disclose permanently setting the current but instead disclosed using current regulators, which did not fall within the meaning of the expression "permanently setting the current". The passage of D7, at column 17, lines 8 to 26 corroborated the distinction between permanently setting current vs. employing a current regulator. There was thus no suggestion in D7 to permanently set the current. This state of being permanently set represented a structural limitation of the device.

Reasons for the Decision

1. The appeal is admissible.

2. *Lack of clarity (Article 84 EPC) - main request and first to third auxiliary requests*

2.1 The device claims according to the main request and to the first to third auxiliary requests are structured such that a first block of features describes structural features of the respective lighting devices. A second block, starting with the phrase "wherein said first fixed current and said second fixed current are determined by" contains steps relating to a method of adjusting the lighting device's colour output.

These device claims are therefore "product-by-process" claims which attempt to define the lighting device in terms of its method of manufacture. Alternatively, it could be understood that these features define aspects of the intended manner of operation of the device.

2.2 A skilled person trying to construe the limitations of the claim is faced with the presence of a large number of features which appear to be non-limiting on the device or for which it is not immediately apparent in what way exactly they might limit it.

The presence in the claims of such a large number of non-limiting or at least not clearly limiting method steps results in the claims being neither clear nor concise. It is noted that the amendments made in the first to third auxiliary requests consist of adding yet more method steps to the device claim, such as rejecting the device or measuring its lumen output.

The appellant was informed of this preliminary opinion of the Board in the communication accompanying the summons but their reply did not contain any explicit argument or amendment dealing with it. The statement in the appellant's letter of 18 April 2019 that the permanent setting of the currents represents a "structural limitation" of the device might be considered as being pertinent in this context. It is however merely a statement, and is not accompanied by any arguments as to why this should be the case. Moreover, a great number of further method features remain unaddressed.

The Board therefore comes to the conclusion that claim 1 according to each of the main and first to third

auxiliary requests is neither clear nor concise, contrary to the requirements of Article 84 EPC.

3. *Lack of inventive step (Article 56 EPC) - fourth auxiliary request*

3.1 The Board had informed the appellant in the communication accompanying the summons to oral proceedings that the subject-matter of claim 7 of the first auxiliary request was considered not to involve an inventive step in view of D7 alone. Since claim 1 of the fourth auxiliary request is identical to that claim, the appellant had been given a chance to comment on this objection.

3.2 The Board considers the method of tuning a lighting device according to document D7, which forms part of the state of the art according to Article 54(2) EPC, to represent the closest prior art. The appellant did not contest this.

3.3 Document D7 discloses

a method of tuning a lighting device to provide a desired color output having x,y coordinates within a target range on a 1931 CIE Chromaticity Diagram, (column 16, lines 45 to 59)

the lighting device (Figure 8, column 20, lines 4 to 22) comprising a first string (42) and a second string (43) of solid state lighting devices (LED 16b), both of said first and second strings comprising at least one solid state lighting device which emits light having x, y color coordinates which define a point which is within an area on a 1931 CIE Chromaticity Diagram enclosed by line segments connecting a first point

having x, y coordinates of 0.32, 0.40, a second point having x, y coordinates of 0.36, 0.48, a third point having x, y coordinates of 0.43, 0.45, a fourth point having x, y coordinates of 0.42, 0.42, and a fifth point having x, y coordinates of 0.36, 0.38, (column 21, lines 38 to 59)

and a third string (41) of solid state lighting devices comprising at least one solid state lighting device (LED 16a) which emits light having a dominant wavelength in the range of from about 600 nm to about 640 nm, (column 21, lines 6 to 7)

3.4 The method according to claim 1 of the fourth auxiliary request therefore differs from that known from D7 in

- the desired color output having u'v' coordinates within a target range on a 1976 CIE Chromaticity Diagram,

- (1) measuring a color output of the lighting device while supplying a first string initial current to said first string of solid state lighting devices, a second string initial current to said second string of solid state lighting devices and a third string initial current to said third string of solid state lighting devices;

- (2) comparing the color output to said target range;

- (3) adjusting the current supplied to the third string of solid state light emitters to a third string final current such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram

having u', v' coordinates in which the u' coordinate is within a predetermined u' coordinate range;

- (4) comparing the color output to said target range

- (5) adjusting the current supplied to the first string of solid state light emitters to a first string final current and/or adjusting the current supplied to the second string of solid state light emitters to a second string final current, such that a color of a mixture of light emitted by the lighting device corresponds to a point on a 1976 CIE Chromaticity Diagram having u', v' coordinates in which the v' coordinate is within a predetermined v’ coordinate range; and

- (6) permanently setting the current supplied to the first string of solid state lighting devices, such that if any line voltage is applied to the power line, said first string final current will be supplied to the first string of solid state lighting devices, and permanently setting the current supplied to the second string of solid state lighting devices, such that if any line voltage is supplied to the power line, said second string final current will be supplied to the second string of solid state lighting devices.

3.5 Paraphrasing these distinguishing features, one intends to set the mixture of light emitted from the lighting device to be within a desired range, expressed on a standard diagram. To this end, first to third currents are applied to the three strings of LEDs, the colour output is measured and compared to the desired target colour output range. If it does not correspond to it,

the currents to the strings are adjusted such as to bring the actual output to the desired range, and then the string currents thus determined are permanently set.

3.6 The distinguishing features solve the technical problem of adjusting the colour output of a lighting device to lie within a target colour output represented in an alternative way.

3.7 The solution to this technical problem is obvious:

Bringing the colour output to a target range necessarily requires first measuring the actual light output of the device and comparing it to the target output range. This in turn requires necessarily applying a current to all three strings. Therefore, steps (1) and (2) are obvious.

D7 itself proposes in column 16, lines 45 to 49 to specify the colour output as coordinates in the 1931 CIE Chromaticity Diagram and discloses that the 1976 version is more suitable for representing perceived differences in colour, see column 13, lines 1 to 5. Specifying the target colour output as an area in a 1976 CIE Chromaticity Diagram is therefore merely a straightforward alternative already suggested by D7, see column 12, lines 55 to 58 and Figures 2 and 3.

If the colour output is not already within the target range in the 1976 CIE Chromaticity Diagram, it has to be shifted to that range. A skilled person is aware, from his common general knowledge, that the intensity of an LED depends on the current through it and that the resulting colour of a mixture of LED having different colours, such as the strings in D7, depends

on the relative intensities of the strings. This also explicitly follows from D7, column 16, lines 52 to 59, where D7 discloses that the colour output of the mixture of light of the lighting device as represented in a CIE Diagram can be adjusted by increasing or decreasing the currents through the individual strings. Thus, because D7 suggests adjusting the colour output of a lighting device, it clearly also suggests that the currents through the strings have to be adjusted to a value producing the desired output irrespective of the applied line voltage. It is furthermore, if not readily predictable, then immediately apparent when performing the adjustment process, that the red LED string (41) influences primarily the u' range and the blueish LED strings (42, 43) influence primarily the v' range. Therefore, the skilled person would most naturally try to navigate the 1976 CIE Chromaticity Diagram bringing the output to within a predetermined u' range by adjusting the third string current and bringing it to within a predetermined v' range by adjusting the first and/or second string currents, repeatedly comparing the actual output to the target output and further adjusting the currents if necessary. Therefore steps (3), (4) and (5) are obvious.

Since the lighting device is supposed to stay adjusted to a desired colour output, it is immediately obvious that the current settings found in the adjustment process must be kept as a set value. According to page 7, lines 7 to 16 of the original application documents "permanently setting" means that a specific current will pass through a given string despite any variance in the line voltage. According to the claim itself the result of permanently setting the current is that a fixed current is applied to the LED. According to D7 the current setting is achieved by the current

regulators. A skilled person understands that current regulators apply a current set to a specific value despite variations in the line voltage and thus represent one way of "permanently" setting the currents within the meaning of the claim. Therefore, step (6) is obvious.

Therefore D7 suggests each of these steps and also their combination.

3.8 The appellant argued that D7 did not disclose or suggest permanently setting the current but only regulating the currents, which implied that due to temperature variations or ageing the currents supplied to the LED strings would have to vary in value to produce the same colour output over the lifetime. Therefore, D7 did not disclose permanently setting the current.

The Board agrees that D7 discloses using current regulators (45 to 47), see column 20, lines 4 to 23. The very passage of the original disclosure of the present application cited by the appellant in support the above argument clearly lists among the techniques for permanently setting currents a "linear or pulse width modulated current regulated power supply", i.e. a current regulator. Thus, the passage cited in support of their argument in fact supports the Board's view.

Therefore, the method according to claim 1 of the fourth auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

3.9 Even if one were to accept *arguendo* that "permanently setting the current" was not disclosed in D7, the

appellant's conclusion that the method of claim 1 was therefore not obvious, would be incorrect.

The Board agrees that due to variations in temperature and ageing the colour output of the lighting device would vary over its lifetime, as was correctly pointed out by the appellant in their reply and as is already disclosed in D7, column 17, lines 8 to 25. If indeed the appellant chose to keep a fixed specific Ampère value of the final string currents despite this known effect, this would amount to accepting the deviation from a desired target colour output due to ageing and temperature.

Permanently setting the current, in the way the appellant wants the Board to understand the term, would therefore entail accepting a drawback that had already been identified, explained and overcome in the prior art document D7 without any surprising technical effect compensating for the drawback. Modifying the device according to D7 by merely accepting a readily predictable drawback that was already explained and overcome in D7 does not involve an inventive step.

In conclusion, the method according to claim 1 according to the fourth auxiliary request and also claim 7 of the first auxiliary request does not involve an inventive step in view of D7.

4. The Board therefore concludes that none of the requests is allowable, so that the appeal has to be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

U. Bultmann R. Lord

Decision electronically authenticated