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**Datasheet for the decision
of 20 January 2023**

Case Number: T 2897/18 - 3.4.01

Application Number: 08731957.0

Publication Number: 2130405

IPC: H05B33/08

Language of the proceedings: EN

Title of invention:

COLOR VARIATIONS IN A DIMMABLE LIGHTING DEVICE WITH STABLE
COLOR TEMPERATURE LIGHT SOURCES

Applicant:

Signify Holding B.V.

Headword:

Colour variations in a dimmable lighting device / Signify
Holding

Relevant legal provisions:

EPC Art. 56

RPBA 2020 Art. 13

Keyword:

Amendment after summons - exceptional circumstances (yes)
Inventive step - common general knowledge - (no) - obvious
modification



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Case Number: T 2897/18 - 3.4.01

D E C I S I O N
of Technical Board of Appeal 3.4.01
of 20 January 2023

Appellant: Signify Holding B.V.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 4 June 2018
refusing European patent application No.
08731957.0 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman P. Scriven
Members: P. Fontenay
C. Almberg

Summary of Facts and Submissions

- I. In their decision to refuse the application, the Examining Division held that the subject-matter of claims 1 and 11 of the main request, and of auxiliary requests 1 and 2, was not new in the sense of Article 54(1) and (2) EPC over document:
- D2: WO-A-2006/067521.
- II. They also considered that claims 1 and 10 of auxiliary request 2 were unclear, contrary to Article 84 EPC, due to the inconsistent terminology used in the claims; and the reference, insofar as claim 1 was concerned, to device features defined in terms of method steps.
- III. The applicant appealed the decision. They requested that the decision be set aside and that a patent be granted on the basis of a main request or, in the alternative, one of the first to fourth auxiliary requests. All requests were new, submitted for the first time with the statement of grounds.
- IV. Arguments supporting the novelty and inventive step with regard to documents D1 to D4, cited in the course of the examination proceedings, were developed. It was, in particular, stressed that none of the cited documents disclosed an embodiment in which the first and second drive currents were varied using pulse width modulation (PWM) with a frequency above a point that avoids any perceptible flicker in the light output of

the first and second light sources. In particular, starting from D3 (US-A-2005/0253533), which was regarded by the appellant as reflecting the closest prior art, it would not have been obvious, in order to increase the quality of the light output during dimming, to use PWM and to define the frequency above a certain threshold to avoid flicker.

- V. In a communication under Article 15(1) RPBA 2020, the appellant was informed of the Board's preliminary opinion.

- VI. Objections were raised against the clarity of claim 10 of the main request. Although it was directed to a "method of varying a color temperature of the lighting device according to any of the preceding claims", it included method steps reproducing functionalities of the lighting device, as defined in independent claim 1, thus suggesting that the claim was actually not directed to the use of the lighting device but to its internal functioning.

- VII. Claim 10 further appeared to define added subject-matter, contrary to Article 123(2) EPC. Original claim 10 referred to a method implemented in a lighting device. It did not contain any reference to the use of the latter and nor did the original application. Similar objections applied to the method claims of auxiliary requests 1 to 4.

- VIII. It was acknowledged that neither D2 nor D3 (US-A-2005/0253533) disclosed that the first drive current

and the second drive current were varied using pulse width modulation with a frequency above a point that avoids any human perceptible flicker in the light output of the first light source and the second light source. All in all, it was considered that the claimed solution would have been obvious considering the teaching of either D2 or D3. D3, in particular, explicitly envisaged controlling the light output in order to simulate the flame of a candle (paragraph [0161]), thus suggesting selecting the modulation frequency according to the effects to be achieved.

- IX. While the objection of lack of inventive step starting from D2 elaborated on the Examining Division's objection, the other objections were new, raised *ex officio* and for the first time by the board.

- X. The comments and objections regarding clarity and added subject-matter applied also to claim 1 of auxiliary request 1. It was further observed that the auxiliary requests 2 to 4 were not convergent and that their admission into the appeal proceedings accordingly might be questionable.

- XI. In reply to the Board's communication, the appellant filed a new main request and a new auxiliary request (defined as first auxiliary request). The new requests, if admitted, were to replace all the former requests.

- XII. The new requests differed from the requests filed with the statement of grounds, firstly, in their limited number; secondly, in that the method claims had been

abandoned; and, thirdly, in that the requests were convergent in terms of scope of protection.

- XIII. The appellant reiterated its view that D3 defined the closest prior art. The signals resulting from pulse width modulation in D2 were not used, as such, to control the first and second light sources. For this reason, D2 was less relevant.
- XIV. With regard to claim 1 of the main request, the appellant defined the objective technical problem as improving the comfort of a human user by improving the quality of the light output.
- XV. In the appellant's view, the claimed device did not result in an obvious manner from D3. It was stressed, firstly, that the problem definition contained no hint that it is caused by the lighting loads being fed with PWM currents. Secondly, and contrary to the Board's assumption, D3 led away from the claimed invention. Flames move at a low frequency. Starting from the embodiment in D3 aimed at simulating flame effects, the skilled person would have been prompted to lower the frequency even further until it reached the limit of 0Hz. Such an implementation would have been straightforward for the skilled person, since it only required placing a capacitor in parallel with the resistor R5, thus smoothing the digital PWM input signal to a steady DC voltage. This solution would have provided both a lighting intensity directly related to the dimmer output and produced a constant light intensity, devoid of any disturbing fluctuations.

XVI. At oral proceedings before the Board the new main and auxiliary requests were admitted into the appeal proceedings. The main request and first to fourth auxiliary requests filed with the statement of grounds of appeal were withdrawn.

XVII. At oral proceedings, the appellant argued, with regard to claim 1 of the auxiliary request, that the added feature aimed at avoiding radio frequency interference. While it was conceded that this problem was a known one in the field of electrical engineering and that it was also known that it could be solved by randomly modifying the frequencies of the currents at the source of the interference, the inventive contribution, in the context of the invention, resided in applying this known technique to PWM drive signals. This was neither disclosed nor suggested by any of the documents cited in the course of the examination proceedings.

XVIII. Claim 1 of the main request reads:

A lighting device (400, 402) comprising:
- two input terminals to receive a dimmer signal (Vdim) from a dimmer (412) and alternating current (AC) power, wherein the dimmer signal (Vdim) indicates a dimming level;
- a phase angle detector to detect phase angles of the dimmer signal (Vdim) to determine the dimming level;
- a first light source (406) having a stable first color temperature;
- a second light source (408) having a stable second color temperature;

- a light source driver (418), coupled to the first light source (406) and the second light source (408) and to the input terminals to supply a first drive current to the first light source (406) and a second drive current to the second light source (408); and

- a light source driver controller (416), coupled to the light source driver (418), to cause the light source driver (418) to vary the first and second drive currents in response to changes in the dimming level indicated by the dimmer signal (V_{dim}), wherein varying the first and second drive currents varies a color temperature of the lighting device (400, 402), characterized in that the first drive current and the second drive current are varied using pulse width modulation with a frequency above a point that avoids any human perceptible flicker in the light output of the first light source (406) and the second light source (408).

XIX. Claim 1 of the auxiliary request differs (apart from an erroneous reference sign) in that it contains, at the end, the further limitation:

...

wherein the pulse width modulation frequency is varied to spread the spectrum of the fundamental and harmonic switching frequencies.

Reasons for the Decision

Main request and auxiliary request - Admission

Article 13(1) RPBA 2020

1. The method claims, objected to by the Board in its communication, were deleted. The objections raised under Articles 84 and 123(2) EPC are thus devoid of object.
2. Independent claim 1 according to the auxiliary request differs from claim 1 of the main request in that it incorporates an additional limitation as to the pulse width modulation frequency being varied. The requests are thus convergent in terms of scope of protection. The doubts expressed by the Board in its communication with regard to the admission of former auxiliary requests 2 to 4 are obsolete.
3. It follows that the amendments in the claims of the main request and auxiliary request overcome the issues raised by the Board in its communication. They *prima facie* do not give rise to new ones. The admission of both requests serves procedural economy in that it permits focus on the main issue, that is, whether the claimed subject-matter would have been obvious to a person skilled in the art, having regard to documents D3, or D2 (Article 56 EPC). The admission of both requests into the appeal proceedings further serves procedural economy in that it prompts the conditional withdrawal of the previously pending main and auxiliary requests 1 to 4 against which the Board, in its preliminary opinion, had raised multiple objections.

Article 13(2) RPBA 2020

4. The main request and the auxiliary request address the clarity and added matter objections that were raised for the first time by the board in its communication against the method claims in all the then pending requests. The appellant elaborated on the issue of inventive step, emphasising why, in their view, document D2 did not qualify as closest prior art and why D3 actually led away from the claimed subject-matter.
5. These new requests and the accompanying comments constitute constructive attempts to remedy the situation or to convince the board of the lack of significance of the objections it raised for the first time in its communication.

Conclusion on the admission of new main request and auxiliary request

6. The main request and auxiliary request, together with the appellant's arguments, solve the issues raised by the board in its communication or are sufficiently pertinent for at least questioning their merits (Article 13(1) RPBA 2020). The circumstances are exceptional in the sense of Article 13(2) RPBA 2020 in that the appellant faced new objections and addressed them successfully without raising new ones. The main request and auxiliary request are, therefore, admitted into the proceedings (Article 13 RPBA 2020).

Main request - Novelty (Article 54 EPC)

7. Document D2 discloses a lighting device with variable colour temperatures. It comprises two light sources configured to emit light at a respective first and a second colour temperature (page 4, lines 15-18). The colour temperature of the lighting device is changed in response to changing dimming levels. A light source driver and a drive source driver controller cooperate to vary drive currents to the light sources in response to the average voltage generated by the dimmer. The overall colour temperature of the light emitted may increase from the first colour temperature to the second colour temperature depending on the average voltage delivered by the dimmer (page 5, second paragraph; page 7, line 23 - page 8, line 14). In a preferred embodiment, the system may be used in conjunction with light emitting diodes (LEDs) (page 4, lines 5-14) and may include a pulse width modulated (PWM) dimmer (page 7, lines 3-8).
8. D3 discloses a lighting device having light sources with multiple colour temperatures to vary the intensity (brightness), colour, colour temperature, or temporal characteristics of an LED-based light source in response to changing dimming levels (paragraphs [0011], [0096]). The driver may drive the LEDs using pulse width modulation techniques (paragraph [0100]). It is further envisaged to have recourse to dimmer circuits that provide a duty cycle-controlled, i.e. phase modulated signals (paragraphs [0095], [0120]).
9. By varying the drive currents in different relative amounts, the intensity, colour, or colour temperature of the lighting device can be changed in response to dimming level changes. In an embodiment, the light

generated by the LED-based lighting source in response to dimmer operation can approximate the variable lighting characteristics of an incandescent source (paragraph [0104]).

10. Neither D2 nor D3 discloses a variation of the drive currents using pulse width modulation with a frequency above a point that avoids any humanly perceptible flicker in the light output of the first and second light sources.
11. The other documents cited in the course of the examination proceedings are less relevant.
12. The claimed lighting device is, therefore, new in the sense of Article 54 EPC.

Main request - Inventive step (Article 56 EPC)

13. Document D3 belongs to the field of the invention, that is, the field of lighting devices incorporating dimming functionalities. Like the invention, D3 addresses the general problem of changing the colour temperature on the basis of a control signal generated by the dimmer. In a preferred embodiment, these changes are directed at reproducing the behaviour of an incandescent source. Concretely, document D3 discloses all the features of the preamble of claim 1 in combination (see section novelty, above).
14. The claimed subject-matter differs thus from the teaching of D3 by the characterising feature of the claim according to which the first drive current and the second drive current are varied using pulse width modulation with a frequency above a point that avoids

any humanly perceptible flicker in the light output of the first light source and the second light source.

15. A high enough frequency of the PWM signal guarantees that the repeated on-off sequences of the light output resulting from PWM drive signals are not perceived by the human visual apparatus.
16. As put forward by the appellant, the objective technical problem may be defined as how to improve the comfort of a human user by improving the light quality of the light output.
17. In the light of the explicit reference in paragraph [32] of the published application to the alternative embodiment of the PWM frequency being lowered, for dimming levels approaching 100%, to perceptible levels simulating the flicker of a candle, the term "comfort" is construed in the context of the claimed invention as referring, *a contrario*, to situations in which the user will not notice any fluctuation in the light output. This encompasses situations in which such fluctuation would neither be consciously perceived by the human eyes nor unconsciously by affecting the user's well-being.
18. The appellant's view that this problem contains no hints towards it being caused by the using of PWM currents to the lighting loads is rejected. Both D3 and common general knowledge prove otherwise.
19. D3 does not contain any explicit indication as to what might constitute optimal lighting conditions for human comfort. In paragraph [0161], D3, however, comprises an explicit reference to an embodiment aimed at approximating flame effects, where the flicker rate may

even be modified according to specific conditions of the environment (windy, still, moderate...) to be reproduced. The skilled person would have derived from paragraph [0009] that flicker was the result of low PWM frequencies being applied to LEDs. Contrary to incandescent light sources, which comprise filaments with high thermal inertia, LEDs stop emitting light during periods of voltage interruption, thus generating fluctuations in the light output that, for low frequencies are perceptible.

20. Moreover, The Board has no doubt that the phenomenon of "persistence of vision", incidentally also known as "flicker fusion", which is an effect in which an intermittent light source appears completely steady to the average human observer, belonged to common general knowledge in the field of lighting sources. The skilled person would, therefore, have associated flicker effects like those depicted in D3 to simulate a flame with low frequency PWM drive signals. They would have recognised that the objective problem to be solved, as put forward by the appellant, related to the low PWM frequency of the drive currents.

21. The identification of the cause for the user's discomfort also entails a clear message as to the measure to be taken in order to improve the situation. If the light output becomes disturbing due to perceivable variations of the light output, the skilled person, realising that this is due to the phenomenon of persistence of vision being less effective because of the low frequency PWM drive signals, would, as a straightforward measure, have increased the PWM frequency (while maintaining the same duty cycle).

22. In this respect, the view that D3 would have led away from the invention is also rejected. Firstly, it is recalled, on a general note, that the existence of a straightforward solution to a given problem does not necessarily imply, that an alternative (claimed) solution to the same problem would not have been obvious. A technical problem may well have a plurality of obvious solutions.
23. Secondly, the argument that D3 would have led the skilled person, in a straightforward manner, to decrease the PWM frequency to zero so as to generate, instead of PWM drive signals, smoothed DC drive signals is also not persuasive. As observed by the appellant, this approach would entail modifying the circuit of D3 by incorporating a capacitor in parallel to the resistance R5. In the Board's judgement, the need to adapt the circuit of D3 reveals, *a contrario*, the flaw in the appellant's reasoning. The circuit of D3 is simply not adapted to generate DC drive signals. The argument that the skilled person would have been taught to reduce further the PWM frequency has no concrete basis, since a reduction of frequency would have led to variations of the light output becoming more obvious and disturbing as the successive on/off periods, for a given duty cycle, became longer. In the absence of any explicit pointer in D3 to modifying the circuits of D3 to generate DC drive signals, the appellant's argument amounts to mere speculation.
24. As a consequence, the claimed device is not inventive in the sense of Article 56 EPC.

Auxiliary request - Added subject-matter (Article 123(2) EPC)

25. Claim 1 of the auxiliary request includes the additional limitation that the pulse width modulation frequency is varied to spread the spectrum of the fundamental and harmonic switching frequencies. The sole basis for the amendment is to be found in the last but one sentence of paragraph [32] in the original application.

26. Paragraph [32] reads (with emphasis in bold added by the board):

*(32) [...] The drive currents can be varied using, for example, pulse width modulation (PWM) to vary the average value of drive currents I_A and I_B over time. When using PWM, the control signals V_s control respective switches that control the respective supply of drive currents I_A and I_B . The PWM frequency can be increased to a point that avoids any human perceptible flicker in the light output of light source bank 404. **In at least one embodiment, the PWM frequency can be varied to spread the spectrum of the fundamental and harmonic switching frequencies to minimize radio frequency interference.** In at least one embodiment, the PWM frequency can also correspond to the dimming level signal DL so that, for example, as the dimming level approaches 100%, the PWM frequency is set to intentionally allow human perception of flickering of one or more light sources in light source bank 404 to simulate, for example, the flicker of a candle.*

27. While, at first sight, the added feature, which follows the mention of the PWM frequency being increased beyond a lower threshold to avoid a perceptible flicker, seems to define a special implementation of that particular embodiment, the last sentence in this paragraph contradicts this interpretation. Although using the same introductory terms "In at least one embodiment" as those used to introduce the added feature, this last embodiment refers to the second branch of the alternative, intended at lowering the PWM frequency.
28. This means that that the terms "In at least one embodiment" in the sentence introducing the added feature do not necessarily refer to the embodiment regarding the PWM frequency being above a lower threshold to avoid a perceptible flicker. The terms seem to refer, rather, to the previous sentences referring to varying the drive currents using PWM. The teaching of paragraph [32] is thus ambiguous and does not constitute a sufficient basis under Article 123(2) EPC for the recited combination of features.
29. In the absence of any other basis for the claimed combination of features, the subject-matter of claim 1 defines added subject-matter, contrary to Article 123(2) EPC.

Auxiliary request - Inventive step (Article 56 EPC)

30. For the sake of completeness and independently of the above finding with regard to added subject-matter, it is noted that the added feature does not affect the board's conclusion as to inventive step.

31. The skilled person was well aware that periodic currents generate electromagnetic radiation of corresponding fundamental and harmonic frequencies which might interfere with neighbouring electrical devices.
32. Both the problem addressed by the added feature in claim 1 and its solution were well known in the field of electrical engineering. This was acknowledged by the applicant. It is further confirmed by the fact that the added feature is mentioned only in passing in paragraph [32] of the original application, without elaborating on the concrete means actually required to reduce it to practise.
33. The appellant's view, according to which the inventive idea resided in applying the claimed technique to PWM drive signals, is not persuasive.
34. The skilled person was aware that the radio frequencies which are affected by the drive currents are those which are present in the spectrum of the periodic current signals. This general principle applies independently of the type of modulation used to generate the signals. In this respect, the explicit reference, in the claim, to PWM signals is irrelevant, with respect to both the problem to be solved and its solution, as long as the drive signals are periodic.
35. The subject-matter of claim 1 would thus have been obvious in view of document D3 and common general knowledge. It is thus not inventive (Article 56 EPC).
36. With no allowable claim request on file, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



D. Meyfarth

P. Scriven

Decision electronically authenticated