



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.08.2019 Bulletin 2019/33

(51) Int Cl.:
A45D 2/00 (2006.01)

(21) Application number: **18155698.6**

(22) Date of filing: **08.02.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN

- **BRADA, Ype Bernardus**
5656 AE Eindhoven (NL)
- **ZJIROECHA, Nikolaj Vasiljevitsj**
5656 AE Eindhoven (NL)
- **VERHAGEN, Rieko**
5656 AE Eindhoven (NL)
- **COOMBS, James Howard**
5656 AE Eindhoven (NL)

(71) Applicant: **Koninklijke Philips N.V.**
5656 AE Eindhoven (NL)

(74) Representative: **Steenbeek, Leonardus Johannes et al**
Philips Intellectual Property & Standards
High Tech Campus 5
5656 AE Eindhoven (NL)

(72) Inventors:
• **SPOORENDONK, Wouter Hendrik Cornelis**
5656 AE Eindhoven (NL)

(54) **HAIR STYLING DEVICE**

(57) A hair styling device (S) comprising at least two treatment compartments (C1, C2, ...) for subjecting hair (H) to optical radiation. Preferably, in at least one treatment compartment (C1, C2, ...), the hair (H) is radiated from at least three different sides. The hair styling device (S) may comprise at least five treatment compartments, preferably at least ten treatment compartments (C1, C2, ...), and more preferably at least twenty-five treat-

ment compartments (C1, C2, ...), thereby forming an optical comb. Preferably, the treatment compartments (C1, C2, ...) are dimensioned to only allow hair (H) that is not more than ten layers thick, and preferably not more than five layers thick. Advantageously, the treatment compartments (C1, C2, ...) are made from a material (M) that can convey light. Preferably, the material (M) is shaped in such a way that that light is directed towards the hair (H).

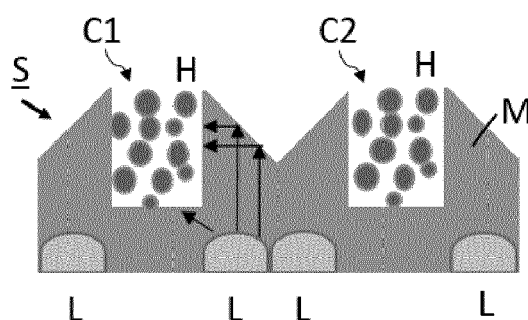


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a hair styling device for photo-thermal hair reshaping.

BACKGROUND OF THE INVENTION

[0002] WO2017153121 (Attorney's ref. 2016PF00294), incorporated herein by reference, discloses a hair styling device which comprises a pulse-driven light emitting diode (LED) or an array of LEDs configured to deliver optical energy to hair, wherein an output wavelength is in the range 400 - 900 nm, with good results in the range 400 - 650 nm, and preferably in the range 450 - 550 nm, a pulse width is in the range 50 - 300 ms, preferably between 50 and 200 ms, such as in the range 100 - 200 ms, or between 50 and 100 ms, a LED pulse driver circuit to drive the LED/s, a control system to control the LED pulse driver, particularly controlling pulse electrical parameters including voltage, pulse duration, and pulse duty cycle, a hair contacting interface configured to contact the hair and hold the hair in a preconfigured shape, e.g. planar, cylindrical, during pulsed light exposure provided by the LED, and an optical shield configured to block stray light during light exposure of hair.

SUMMARY OF THE INVENTION

[0003] It is, inter alia, an object of the invention to provide an improved hair styling device. The invention is defined by the independent claims. Advantageous embodiments are defined in the dependent claims.

[0004] Embodiments of the invention are based on the recognition that hairs stacked more than about 200µm away on top of each other do not receive enough light for photo-thermal reshaping. This results in that in a curler (or straightener) application, only those hairs that were within this about 200µm layer, will be curled (or straightened), while the other hairs will retain their original shape. A realistic amount of hairs to be treated at once, is a bundle of hair between 3 and 6 mm in diameter, which is about 15 - 30 times the maximum stacked cross-section hair should have in order to be reshaped.

[0005] To address this problem, one aspect of the invention proposes to divide the hair over multiple treatment compartments, to enable hair to be sufficiently radiated in each treatment compartment by optical radiation, preferably from an LED light source. Preferably, in at least one treatment compartment, the hair is radiated from at least three different sides. The hair styling device may comprise at least five treatment compartments, preferably at least ten treatment compartments, and more preferably at least twenty-five treatment compartments, thereby forming an optical comb. Preferably, the treatment compartments are dimensioned to only allow hair that is not more than ten layers thick, and preferably not

more than five layers thick. Advantageously, the treatment compartments (are made from a material that can convey light. Preferably, the material is shaped in such a way that light is directed towards the hair.

[0006] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figs. 1-4 show embodiments of the invention.

DESCRIPTION OF EMBODIMENTS

[0008] In an embodiment of the invention, the compartments have fixated dimensions and guide the light from the light source(s) homogeneously toward the hair. An exemplary embodiment is shown below. In this case there is single side illumination and two treatment compartments. The light is guide towards the treatment compartments where the hair is illuminated from at least 2 sides, and preferably from at least 3 sides.

[0009] In an embodiment of the invention, the dimensions of the treatment compartments will never allow more hairs than can be illuminated at once. Preferably, each treatment compartment will only allow hair that is not more than 10 layers thick, but to cope with natural dark hair, more preferably, each treatment compartment will only allow hair that is not more than 5 layers thick.

[0010] The shape of the treatment compartments' material is preferably developed in such way that light intensity is distributed (on all surfaces of the hair, preferably in a homogeneous way. For the treatment compartments, materials are used which can guide light, e.g. transparent glass or plastic. Advantageously, the material of the treatment compartments will guide the light of the light source(s) (e.g. LEDs) towards the hair. The light may be coupled into the treatment compartments material from any direction. Due to internal reflections of light in the light guide, the material will be heated (<100°C). In turn the hairs will catch this heat by conduction, lowering the optical specifications.

[0011] The hair styling device may have at least 5 treatment compartments, preferably at least 10 treatment compartments, more preferably at least 25 treatment compartments. Such embodiments could be called an optical comb. The more treatment compartments, the more hair can be reshaped in one go. Note, the amount of treatment compartments also depends on the depth of the treatment compartments. The deeper the treatment compartment, the fewer treatment compartments are needed.

[0012] For a straightener application, the hair styling device would just be a kind of optical comb in which heating and reshaping is done in the treatment compartments. For a curler application, the treatment compartments could be curved, or the hair can be curled directly afterwards in a subsequent element. For example, after

the hair has left the comb, it could be wound around a cylinder so as to set the curled shape while the hair is still above its glass transition temperature.

[0013] In an embodiment, pulsed LEDs are used to style hair. The output wavelength is preferably in the range between 400 and 900 nm, and more preferably in the range between 450 and 550 nm. The pulse width is preferably shorter than or equal to 200 ms, and more preferably shorter than or equal to 100 ms. To prevent the hair from being damaged, the output energy fluence on the hair surface is preferably in the range between 1 J/cm² and 10 J/cm², more preferably between 3 J/cm² and 7 J/cm², and most preferably between 4 and 6 J/cm².

[0014] In an embodiment, not only optical energy but also heat from the LEDs (e.g. heat from the LEDs' heat sinks, or heat derived from optical energy outside a wavelength band suitable for hair styling) is used to heat a contact surface that contacts the hair, so that less optical energy from the LEDs in a suitable wavelength band is needed to heat the hair to a temperature above its glass transition temperature needed for hair styling, as described in more detail in the earlier application EP17190265.3 (Attorneys' reference 2017PF02405), incorporated herein by reference. The optical radiation source (e.g. one or more LEDs) may be arranged for radiating hairs using one radiation flash having a duration of at least 0.1 s. Alternatively, the optical radiation source may be arranged for radiating hairs using at least two radiation flashes, an interval between subsequent flashes being smaller than 5 s, preferably smaller than 1 s, and more preferably smaller than 0.3 s.

[0015] In an embodiment, as described in more detail in the earlier application EP17190268.7 (Attorneys' reference 2017PF02407), incorporated herein by reference, the hair styling device comprises a sensor unit for measuring effects from radiating hair, and a feedforward control device for controlling the optical radiation source in dependence on a signal from the sensor unit. The optical radiation source (e.g. one or more LEDs) may produce a first flash having a first energy density that may be lower than required for photo-thermal hair reshaping, the optical radiation source being controlled to produce a subsequent flash in dependence on a sensor signal obtained in response to the first flash, which subsequent flash may have at least the first energy density. The sensor unit may include a sensor arranged before the optical radiation source in a hair flow direction. The hair styling device may comprise, along a direction in which the hair is guided, a first sensor, a first LED unit being controlled in dependence on a signal from the first sensor, a second sensor, and a second LED unit being controlled in dependence on a signal from the second sensor. The direction in which hair is guided through the hair styling device may determine which part of the optical radiation source will act as the first LED unit. The hair styling device may comprise a drive mechanism to move the hair along the optical radiation source at a speed controlled by the feedforward control device in dependence on the signal

from the sensor unit.

[0016] In an embodiment, as described in more detail in the earlier application EP17190269.5 (Attorneys' reference 2017PF02408), incorporated herein by reference, the hair styling device comprises a two-dimensional array of elements to bring hair at a styling temperature, the elements produce optical radiation energy. The elements may include one or more LEDs, and preferably a plurality of LEDs, in which case the LEDs are driven in clusters that may be of mutually different shapes and sizes. The hair styling device may comprise sensors to obtain an areal light absorption measurement opposed to the two-dimensional array of elements, and a control unit for individually controlling the elements in dependence of the measurement. The sensors may include LEDs that momentarily do not produce light.

[0017] Fig. 1 shows a first embodiment of a hair styling device S according to the invention. Hair H is treated in 2 treatment compartments C1, C2, formed from a compartment material M. LEDs L act as light source, and in this embodiment, the LEDs are embedded in the compartment material M. As is illustrated with regard to the light from the second LED L, the compartment material ensures that the light from the LEDs is used for treating the hair from multiple sides; in this embodiment, hair would receive light from the left side, from the bottom, and from the right side.

[0018] Fig. 2 shows a second embodiment of a hair styling device S according to the invention. The embodiment from Fig. 2 differs from that of Fig. 1 in that the LEDs L are not embedded in the compartment material M, and that LEDs L are also present to the left and to the right of the hair styling device.

[0019] Fig. 3 shows a third embodiment of a hair styling device S according to the invention. To optimize the light transfer, in this embodiment LEDs L are also placed between adjacent treatment compartments.

[0020] Fig. 4 shows a fourth embodiment of a hair styling device S according to the invention. The embodiment from Fig. 4 differs from that of Fig. 3 in that the hair styling device S now also has a cover C having LEDs L so as to also provide light from a fourth side to the hair H.

[0021] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In one embodiment, the light source is turned on and off (flash) to form a pulsed wave (PW) to vary the light output so that hair can receive required optical energy to increase temperature required for styling. Alternatively, the light source is turned on (not off) to form a continuous wave (CW), in combination with a suitable light source control to ensure that hairs are not overexposed to light energy by regulating the current flowing through the LEDs during operation to limit the light output. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the

presence of elements or steps other than those listed in a claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by means of hardware comprising several distinct elements, and/or by means of a suitably programmed processor. In the device claim enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims that do not refer to one another does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. A hair styling device (S), comprising:
 at least two treatment compartments (C1, C2, ...) for subjecting hair (H) to optical radiation.
2. A hair styling device (S) as claimed in claim 1, wherein in at least one treatment compartment (C1, C2, ...), the hair (H) is radiated from at least three different sides.
3. A hair styling device (S) as claimed in claim 1 or 2, comprising at least five treatment compartments.
4. A hair styling device (S) as claimed in claim 3, comprising at least ten treatment compartments (C1, C2, ...).
5. A hair styling device (S) as claimed in claim 4, comprising at least twenty-five treatment compartments (C1, C2, ...).
6. A hair styling device (S) as claimed in any of the preceding claims, wherein the treatment compartments (C1, C2, ...) are dimensioned to only allow hair (H) that is not more than ten layers thick.
7. A hair styling device (S) as claimed in claim 6, wherein the treatment compartments (C1, C2, ...) are dimensioned to only allow hair (H) that is not more than five layers thick.
8. A hair styling device (S) as claimed in any of the preceding claims, wherein the treatment compartments (C1, C2, ...) are made from a material (M) that can convey light.
9. A hair styling device (S) as claimed in claim 8, wherein the material (M) is shaped in such a way that light is directed towards the hair (H).

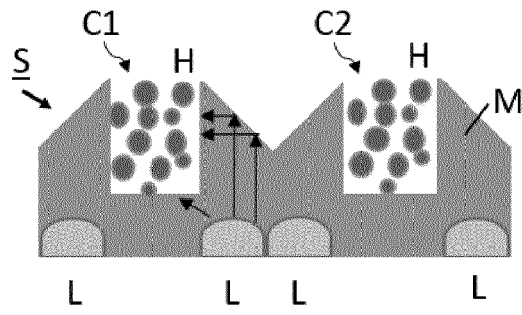


Fig. 1

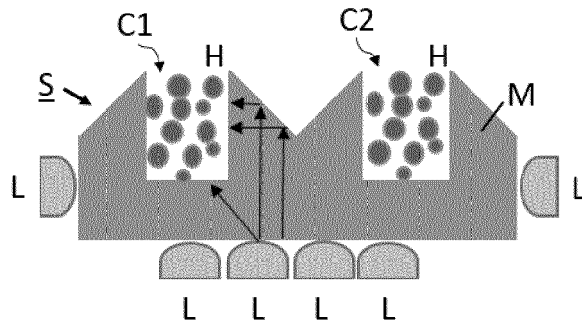


Fig. 2

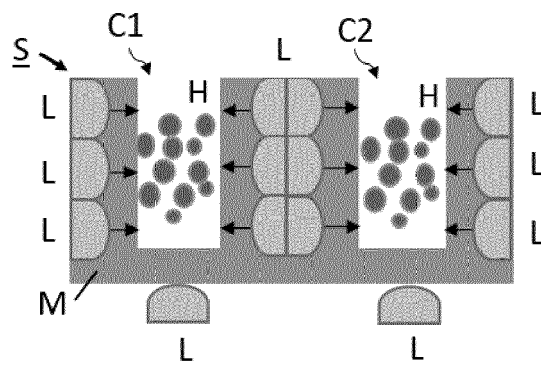


Fig. 3

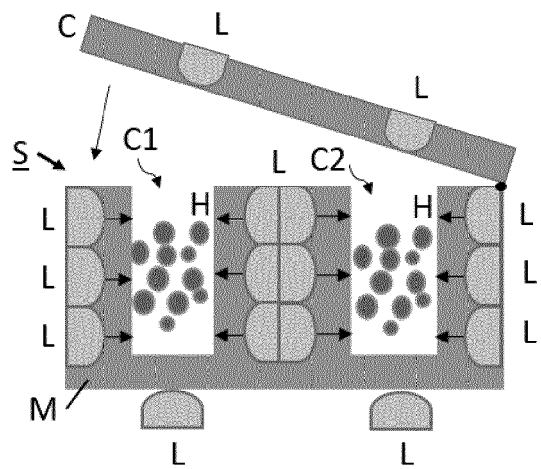


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 18 15 5698

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2013/190484 A1 (KONINKL PHILIPS NV [NL]) 27 December 2013 (2013-12-27) * page 4, line 8 - page 9; figures * -----	1-9	INV. A45D2/00
X	JP 2004 159727 A (KUWABARA SEIJI) 10 June 2004 (2004-06-10) * the whole document * -----	1-9	
X	CN 104 970 534 A (SIPLIED ZHANGJIAKOU CO LTD) 14 October 2015 (2015-10-14) * the whole document * -----	1-9	
			TECHNICAL FIELDS SEARCHED (IPC)
			A45D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 June 2018	Examiner Van Bastelaere, Tiny
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			

EPO FORM 1503 03.82 (P04C01)

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

EP 18 15 5698

5

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.

28-06-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013190484 A1	27-12-2013	BR 112014031578 A2	27-06-2017
		JP 2015528712 A	01-10-2015
		US 2015173482 A1	25-06-2015
		WO 2013190484 A1	27-12-2013

JP 2004159727 A	10-06-2004	NONE	

CN 104970534 A	14-10-2015	NONE	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2017153121 A [0002]
- EP 17190265 A [0014]
- EP 17190268 A [0015]
- EP 17190269 A [0016]