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(54) **HAIR IRON AND METHOD OF TEMPERATURE CONTROL**

(57) The temperature of a hair iron (100) is controlled to prevent damage to hair being ironed by the hair iron (100). Whilst the hair iron (100) is being applied to the hair, the controller determines a temperature change of one or more plates (102) of the hair iron (100) over a time period starting from an initial application of the hair iron (100) to the hair being ironed. If the temperature change of the one or more plates (102) is larger than a threshold, the controller reduces the power supplied to the one or more plates (102).

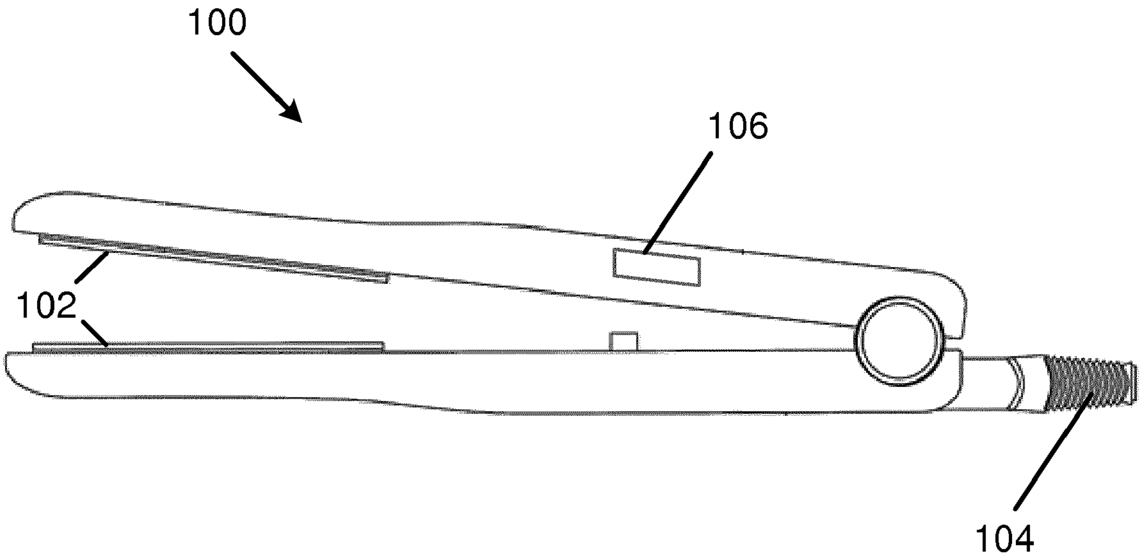

Figure 1

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Description

Technical Field

[0001] The present disclosure relates to a hair iron and a method of controlling the temperature of a hair iron to prevent damage to hair being ironed by the hair iron.

Background

[0002] Hair irons generally include any tools that change the appearance of a person's hair through the application of heat. For example, curling irons are used to make the hair curly, straightening irons (or flat irons) are used to make the hair straight and crimping irons are used to create crimps of the desired size in the hair. Most hair irons today use electric heating, with power being supplied to heat the hair iron heating elements. The heating elements, or plates, of the hair iron are heated to high temperatures during use. The application of the high temperature plates to a person's hair during use is known to cause (temporary or permanent) damage to the hair.

Summary

[0003] According to a first aspect disclosed herein, there is provided a method of controlling the temperature of a hair iron to prevent damage to hair being ironed by the hair iron, the method comprising: whilst the hair iron is being applied to the hair, determining a temperature change of one or more plates of the hair iron over a time period starting from an initial application of the hair iron to the hair being ironed; and if the temperature change of the one or more plates is larger than a threshold, reducing the power supplied to the one or more plates.

[0004] In an example, the method comprises reducing the power supplied to the one or more plates by an amount based on the determined temperature change.

[0005] In an example, the threshold is based on an expected temperature change of the one or more plates due to the hair being ironed containing an amount of moisture.

[0006] In an example, the method comprises: if the temperature change of the one or more plates is less than the threshold, determining a temperature change of the one or more plates over a second time period starting from the initial application of the hair iron to the hair; and if the temperature change of the one or more plates over the second time period is larger than a threshold, reducing the power supplied to the one or more plates.

[0007] In an example, the method comprises preventing power from being supplied to the one or more plates if the determined temperature change is larger than a second threshold.

[0008] According to a second aspect disclosed herein, there is provided a hair iron comprising: one or more plates; at least one temperature sensor configured to monitor a temperature of at least one of the one or more plates whilst the hair iron is being applied to the hair; and a controller configured to: determine a temperature change of at least one of the one or more plates of the hair iron over a time period starting from an initial application of the hair iron to the hair being ironed; and reduce the power supplied to the one or more plates if the temperature change of the one or more plates is larger than a threshold.

[0009] In an example, the controller is configured to reduce the power supplied to the one or more plates by an amount based on the determined temperature change.

[0010] In an example, the hair iron is configured such that the threshold is based on an initial temperature of the one or more plates of the hair iron.

[0011] In an example, the hair iron is configured such that the threshold is based on an expected temperature change of the one or more plates due to the hair being ironed containing an amount of moisture.

[0012] In an example, the controller is configured to: determine a temperature change of the one or more plates over a second time period starting from the initial application of the hair iron to the hair if the temperature change of the one or more plates is less than the threshold; and reduce the power supplied to the one or more plates if the temperature change of the one or more plates is larger than a threshold.

[0013] In an example, the controller is configured to prevent power from being supplied to the one or more plates if the determined temperature change is larger than a second threshold.

[0014] In an example, the hair iron is at least one of: a hair straightening iron; a hair crimping iron; and a hair curling iron.

Brief Description of the Drawings

[0015] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically an example hair iron;

Figure 2 shows schematically an example control system for controlling the temperature of the hair iron; and

Figure 3 shows an example method for controlling the temperature of a hair iron to prevent damage to hair being ironed by the hair iron.

Detailed Description

[0016] Hair irons, or "hot combs", are designed to temporarily change the shape and/or texture of the hair through the application of heat to the hair. For example, hair straighteners are used to achieve a straightened effect by applying high temperature plates (e.g. at 250°C) to the hair. The heat applied to the hair by the high temperature plates breaks down the hydrogen bonds in the hair and temporarily prevents the hair from taking a natural curly form. However, the high temperatures to which the hair is exposed can cause short or long term damage to the hair. For example, the short term damage caused by hair straighteners can make the hair frizzier and curlier, causing the hair to appear thin and dull. Long term damage, known as "heat damage", is irreversible, requiring heat damaged hair to be cut off.

[0017] A cause of temporary or permanent damage to the hair is the deterioration of the hair structure due to the large difference in temperature between the hair being ironed and the heating elements (plates) of the hair iron. This problem of heat damage is particularly compounded by applying the hot plates to wet or damp hair.

[0018] Figure 1 shows schematically an example hair iron 100. The hair iron 100 has one or more heating plates or other heating elements 102. The plates 102 may be made of or coated with, for example, PTFE (polytetrafluoroethylene), ceramic, tourmaline, titanium, silicone, etc. The plates 102 may consist of a single layer of material, e.g. a single layer of ceramic. Alternatively, the plates 102 may consists of multiple layers of the same or different material(s), e.g. a ceramic-coated metal plate.

[0019] The hair iron 100 has a power supply 104. The power supply 104 may be, for example, an internal power supply 104 such as a single use or rechargeable battery. Alternatively or additionally, the power supply 104 may be a mains power supply in which case the hair iron 100 comprises a connection to the mains power supply. The one or more plates 102 are operatively coupled to the power supply 104 such that power may be supplied to the one or more plates 102.

[0020] The hair iron 100 may have a user interface 106. The user interface 106 may be a display in the form of a screen for receiving inputs from a user. Additionally or alternatively, the user interface 106 may have a control panel or actuator which can be operated by the user, e.g. by using one or more buttons, sliders, switches and/or dials of the control panel.

[0021] Figure 2 shows schematically an example control system for controlling the temperature of the hair iron 200. The hair iron 200 has a controller 202, such as a processor, operatively coupled to the user interface 204. The controller 202 is also operatively coupled to the power supply 206 such that the power being supplied to the one or more plates 208 of the hair iron 200 can be controlled. The hair iron 200 also has at least one temperature sensor 210 for monitoring the temperature of one or more of the one or more plates 208. The at least one temperature sensor 210 is operatively coupled to the controller 202 to provide the controller 202 with temperature measurements of the one or more plates 208.

[0022] In examples described herein, the temperature of a hair iron 100 is controlled to prevent damage to hair being ironed by the hair iron 100. Whilst the hair iron 100 is being applied to the hair, a temperature change of at least one of the one or more plates 102 of the hair iron 100 is determined over a time period starting from an initial application of the hair iron 100 the hair being ironed. That is, each time the hair iron 100 is applied to the hair during use, a temperature change over the time period is determined. For example, when the hair iron 100 is removed from the hair, e.g. the user removes the hair iron 100 when completing a stroke of the hair iron 100 through their hair, and then reapplied to the hair, a temperature change is determined from the time of reapplying the hair iron 100. If the temperature change of the one or more plates 102 is larger than a threshold, the power supplied to the one or more plates 102 is reduced.

[0023] For example, the temperature of the one or more plates 102 may be monitored by one or more temperature sensors whilst the hair iron 100 is being applied to the hair. Each plate 102 may be monitored by a respective temperature sensor.

[0024] In some specific examples, the time period may be less than one second, e.g. half a second or so. In some cases it may be desirable to reduce the power supplied to the one or more plates 102 if a large difference in temperature is detected upon the immediate application of the hair iron 100. This may indicate that the hair iron 100 is being applied to relatively very wet hair.

[0025] In other examples, the time period may be one second or more than one second. That is, the time period may be set such that the power is only reduced if the temperature change occurs over a longer time period. This may indicate that only an isolated patch of hair was damp. That is, the temperature of the one or more plates may return to close to the initial temperature when applied to drier hair. The time period may be configured by the user. Alternatively, the time period may be predetermined by the manufacturer of the hair iron 100.

[0026] In examples, the time period may be based on the initial temperature of the one or more plates 102 of the hair iron 100. For example, the higher the initial temperature of the one or more plates 102 of the hair iron 100, the smaller the time period over which the temperature change is determined. When the initial temperature is relatively high, e.g. at 250°C, it is desirable to reduce the temperature as quickly as possible. Alternatively, the lower the initial temperature of the one or more plates 102 of the hair iron 100, the smaller the time period over which the temperature change is determined. For example, a large temperature change at a lower temperature change may indicate that the hair is relatively very wet as cooler, drier hair would not cause a large temperature change.

[0027] In examples, the power supplied to the one or more plates 102 is reduced by an amount based on the determined temperature change. For example, the amount may be proportional to the determined temperature change. That is, the higher the temperature change, the more the power is reduced from being supplied to the one or more plates 102. A large temperature change indicates that the hair is relatively very wet. In such a case it may be desirable to reduce the power supplied by a large amount quickly.

[0028] In alternative or additional examples, the amount of power supplied to the one or more plates 102 is reduced based on the initial temperature of the one or more plates 102. For example, the higher the initial temperature of the one or more plates 102, the more the power supplied to the one or more plates 102 is reduced by. When damp or wet hair is subjected to high temperatures it is likely to become damaged. Therefore upon detection of a relatively large temperature change indicative of damp or wet hair, it is desirable to reduce the temperature to which the hair is subjected.

[0029] In examples, the threshold is based on an initial temperature of the one or more plates 102 of the hair iron 100. For example, the higher the initial temperature of the one or more plates 102, the smaller the threshold for which the determined temperature change must be higher in order to cause a reduction in power supplied to the one or more plates 102. That is, a smaller threshold may be beneficial when the initial temperature is relatively high so that the reduction of power is triggered more quickly. This advantageously prevents the one or more plates 102 from having to be cooled down by a large amount before the power is reduced, which in turn minimizes the damage to the hair. For example, if the initial temperature of the one or more plates 102 is 200°C, the change in the threshold temperature may be 10°C. The change in the threshold temperature may be greater or less than 10°C.

[0030] In alternative examples, the higher the initial temperature of the one or more plates 102, the larger the threshold which the determined temperature change must exceed in order to cause a reduction in power to the one or more plates 102. This may prevent the power being reduced when the one or more plates 102 are applied to dry hair that happens to be cooler than the one or more degrees by a large amount, e.g. due to environmental factors.

[0031] In yet further examples, the threshold may be based on the time period over which the temperature change is determined. For example, the threshold may be greater for greater time periods. This may account for small fluctuations in the determined temperature that are not caused by damp or wet hair. In another example, the threshold may be smaller for greater time periods. Advantageously, this may result in the detection of a damp or wet patch of hair amongst an otherwise dry head of hair.

[0032] In examples, the threshold may be based on both the initial temperature of the one or more plates 102 and the time period over which the temperature change is to be determined.

[0033] In examples, the threshold is based on an expected temperature change of the one or more plates 102 due to the hair being ironed containing an amount of moisture. For example, empirical data may show that the temperature of the one or more plates 102 of the hair iron 100 change by (approximately) 20°C in (approximately) half a second when applied to damp or wet hair. The threshold may then be set at this temperature such that the power reduction occurs when the hair iron 100 is applied to damp or wet hair. In another example, the data may show that damp or wet hair is damaged if the one or more plates 102 are subjected to a change in temperature of more than 15°C over a time period of one second. The threshold may then be set at 15°C. Advantageously, the power may be reduced when conditions known to result from damp or wet hair are detected.

[0034] In examples, if the temperature change of the one or more plates 102 is less than the threshold, a temperature change of the one or more plates 102 is determined over a second time period starting from the initial application of the hair iron 100 to the hair; and if the temperature change of the one or more plates 102 over the second time period is larger than a threshold, the power supplied to the one or more plates 102 is reduced. For example, the section(s) of hair that have been e.g. straightened by the hair iron 100 may have been dry during the first time period. However, sections of damp or wet hair may be straightened during the second time period.

[0035] That is, if the temperature of the one or more plates 102 does not change by more than the threshold over the (first) time period, the temperature of the one or more plates 102 is monitored for a second time period (e.g. the temperature is continuously monitored from the initial application). The threshold to cause a reduction in power after monitoring for the second time period may be smaller than, equal to, or greater than the threshold to cause a reduction in power after monitoring for the (first) time period.

[0036] In examples, power is prevented from being supplied to the one or more plates 102 if the determined temperature change is larger than a second threshold. Advantageously, the hair is prevented from being exposed to relatively high temperatures if the hair is extremely wet.

[0037] That is, if the temperature change over the (first) time period or the second time period is above the second threshold, the hair iron 100 is switched off. The second threshold may be based on a temperature change known to cause damage to damp or wet hair. Alternatively, the second threshold may be based on a temperature change indicative of the hair iron 100 being applied to a substance other than the user's hair, e.g. fabric. This advantageously prevents damage to the hair iron 100 and/or the substance. This may also reduce the risk of the substance catching fire.

[0038] In examples, the at least one temperature sensor monitors the temperature of the one or more plates 102 whilst the hair iron 100 is being applied to the hair. The controller determines a temperature change of the one or more plates 102 of the hair iron 100 over a time period starting from an initial application of the hair iron

100 to the hair being ironed. If the temperature change of the one or more plates 102 is larger than a threshold, the controller reduces the power supplied to the one or more plates 102.

[0039] In examples, the controller may reduce the power supplied to the one or more plates 102 by an amount based on the determined temperature change.

[0040] In examples, the threshold is based on an initial temperature of the one or more plates 102 of the hair iron 100.

[0041] In examples, the threshold is based on an expected temperature change of the one or more plates 102 due to the hair being ironed containing an amount of moisture.

[0042] In examples, if the controller determines that the temperature change of the one or more plates 102 is less than the threshold, the controller determines a temperature change of the one or more plates 102 over a second time period starting from the initial application of the hair iron 100 to the hair. If the temperature change of the one or more plates 102 is larger than a threshold, the controller reduces the power supplied to the one or more plates 102.

[0043] In examples, if the determined temperature change is larger than a second threshold, the controller prevents power from being supplied to the one or more plates 102, e.g. by switching off the hair iron 100.

[0044] In examples, the hair iron 100 is at least one of: a hair straightening iron, a hair crimping iron, and a hair curling iron.

[0045] Figure 3 shows an example method for controlling the temperature of a hair iron 100 to prevent damage to hair being ironed by the hair iron 100.

[0046] The method starts at Step S02. At Step S04, the controller determines a temperature change of the one or more plates 102 of the hair iron 100 over a time period starting from an initial application of the hair iron 100 to the hair being ironed.

[0047] At Step S06, the controller determines if the determined temperature change is greater than a threshold. If the determined temperature change is less than the threshold, the method reverts back to S04.

[0048] At Step S08, the controller determines if the determined temperature change is greater than a second threshold.

[0049] At Step S10, the controller reduces the power supplied to the one or more plates 102 if the determined temperature change is less than the second threshold but greater than the (first) threshold. Alternatively, if the determined temperature change is greater than the (first) threshold at Step S06, the controller may immediately reduce the power being supplied to the plates 102 instead of continuing to Step S08.

[0050] At Step S12, the power is prevented from being supplied to the one or more plates 102 if the determined temperature change is greater than the second threshold.

[0051] The method ends at Step S14.

[0052] The controller and its components as shown in Figure 2 are represented as a schematic block diagram for the purposes of explaining the functionality of the controller only. Hence, it is understood that each component of the controller is a functional block for performing the functionality ascribed to it herein. Each component may be implemented in hardware, software, firmware, or a combination thereof. Additionally, although described as separate components of the controller, some or all of the functionality may be performed by a single piece of hardware, software, or firmware.

[0053] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0054] Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

[0055] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A method of controlling the temperature of a hair iron (100) to prevent damage to hair being ironed by the hair iron (100), the method comprising:

whilst the hair iron (100) is being applied to the hair, determining a temperature change of one or more plates (102) of the hair iron (100) over a time period starting from an initial application of the hair iron (100) to the hair being ironed; and
if the temperature change of the one or more plates (102) is larger than a threshold, reducing the power supplied to the one or more plates (102).

2. A method according to claim 1, comprising reducing the power supplied to the one or more plates (102) by an amount based on the determined temperature change.

3. A method according to claim 1 or claim 2, wherein the threshold is based on an initial temperature of the one or more plates (102) of the hair iron (100).

4. A method according to any of claims 1 to 3, wherein the threshold is based on an expected temperature change of the one or more plates (102) due to the hair being ironed containing an amount of moisture.

5. A method according to any of claims 1 to 4, comprising:

if the temperature change of the one or more plates (102) is less than the threshold, determining a temperature change of the one or more plates (102) over a second time period starting from the initial application of the hair iron (100) to the hair; and
if the temperature change of the one or more plates (102) over the second time period is larger than a threshold, reducing the power supplied to the one or more plates (102).

6. A method according to any of claims 1 to 5, comprising:

preventing power from being supplied to the one or more plates (102) if the determined temperature change is larger than a second threshold.

7. A hair iron (100) comprising:

one or more plates (102);
at least one temperature sensor (210) configured to monitor a temperature of at least one of the one or more plates (102) whilst the hair iron (100) is being applied to the hair; and
a controller (2020 configured to:

determine a temperature change of at least one of the one or more plates (102) of the hair iron (100) over a time period starting from an initial application of the hair iron (100) to the hair being ironed; and
reduce the power supplied to the one or more plates (102) if the temperature change of the one or more plates (102) is larger than a threshold.

8. A hair iron (100) according to claim 7, the controller (202) being configured to reduce the power supplied to the one or more plates (102) by an amount based on the determined temperature change.

9. A hair iron (100) according to claim 7 or claim 8, configured such that the threshold is based on an initial temperature of the one or more plates (102) of the hair iron (100).

10. A hair iron (100) according to any of claims 7 to 9, configured such that the threshold is based on an expected temperature change of the one or more plates (102) due to the hair being ironed containing an amount of moisture.

11. A hair iron (100) according to any of claims 7 to 10, the controller (202) being configured to:

determine a temperature change of the one or more plates (102) over a second time period starting from the initial application of the hair iron (100) to the hair if the temperature change of the one or more plates (102) is less than the threshold; and
reduce the power supplied to the one or more plates (102) if the temperature change of the one or more plates (102) is larger than a threshold.

12. A hair iron (100) according to any of claims 7 to 11, the controller (202) being configured to prevent power from being supplied to the one or more plates (102) if the determined temperature change is larger than a second threshold.

13. A hair iron (100) according to any of claims 7 to 12, wherein the hair iron (100) is at least one of:

- a hair straightening iron;
- a hair crimping iron; and

- a hair curling iron.

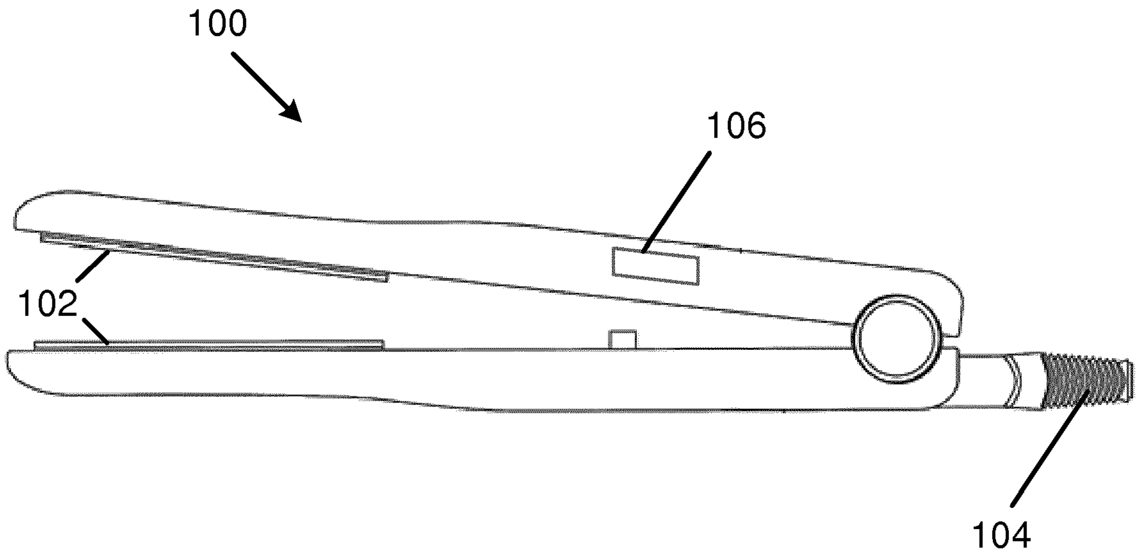

Figure 1

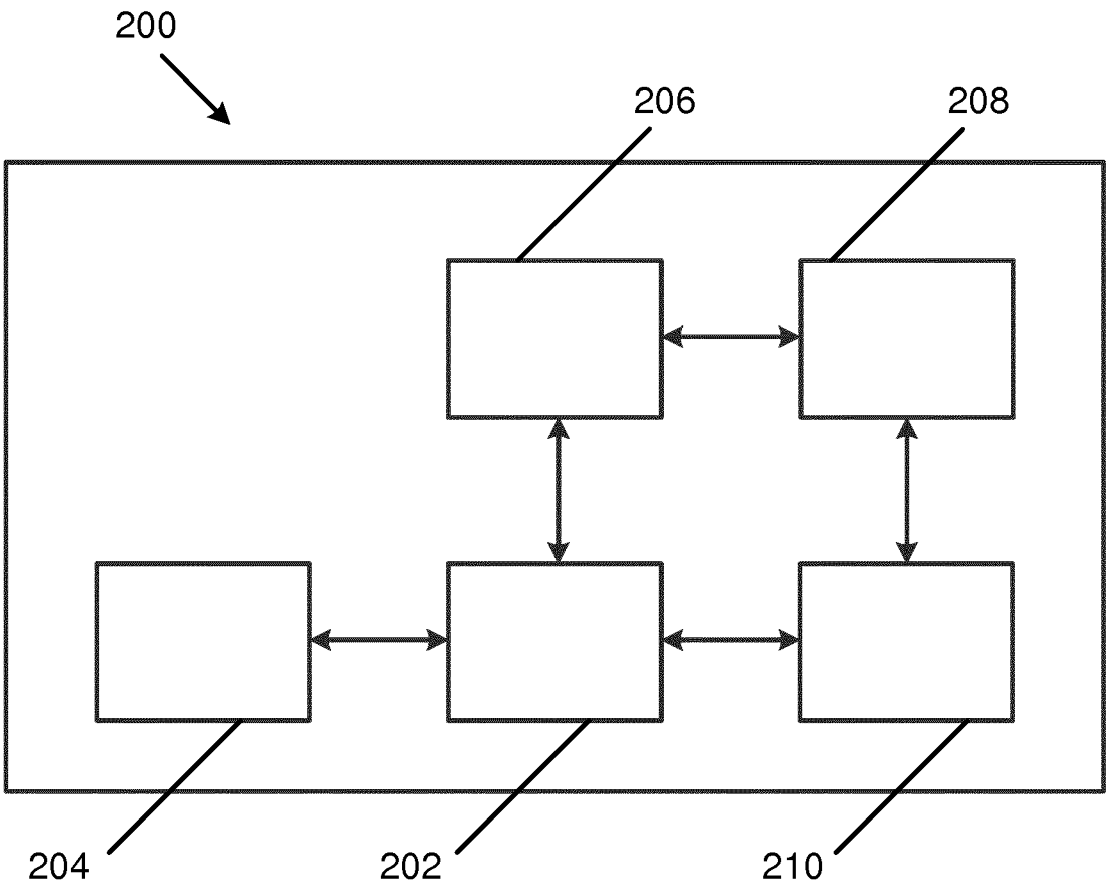

Figure 2

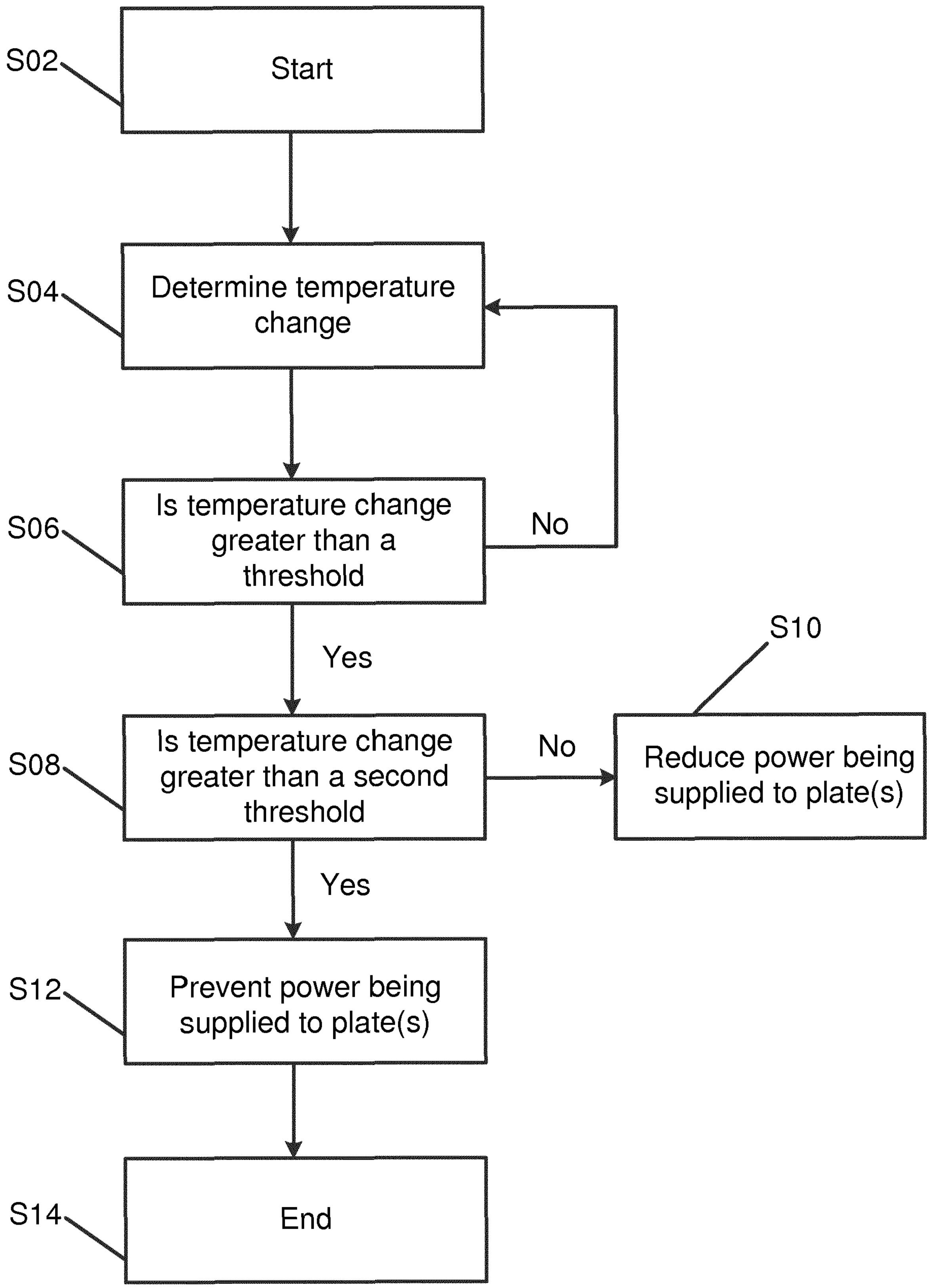
S02
Start
S04
Determine temperature change
S06
Is temperature change greater than a threshold
No
Yes
S08
Is temperature change greater than a second threshold
No
S10
Reduce power being supplied to plate(s)
Yes
S12
Prevent power being supplied to plate(s)
S14
End

Figure 3

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 4511

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	US 2012/312320 A1 (HUMPHREYS JAMES D [CA] ET AL) 13 December 2012 (2012-12-13) * paragraph [0023] - paragraph [0071]; claims 1, 5, 11-16; figures 1-5 * * paragraph [0002] * -----	1-13	INV. A45D1/28 A45D6/20
X	KR 2016 0148469 A (MUKAI TAKASHI [JP]) 26 December 2016 (2016-12-26) * paragraph [0018] - paragraph [0021]; figures 1-6 * -----	1-13	

TECHNICAL FIELDS SEARCHED (IPC)

A45D

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	4 April 2018	Ehrsam, Sabine

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 17 20 4511

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
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04-04-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82