It is therefore desirable to provide an improved hairstyling device, improved methods of operating a hairstyling device, and/or improved run times of hairstyling devices between charges.

Summary

According to an ~~aspect~~ example of the present disclosure, there is provided a cordless hairstyling device comprising a heatable hair contact member having a hair contact-able surface, the hair contact member being operable to apply heat to a tress of hair of a user via the hair contactable surface; at least one sensor configured to sense a change in state of the device from a first stationary state to a second moving state; and a controller configured to, in response to the at least one sensor sensing a change in state from the first state to the second state, causing the hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

In one aspect, the present disclosure refers to a cordless hairstyling device, the device comprising: a heatable hair contact member having a hair contact-able surface, the hair contact member being operable to apply heat to a tress of hair of a user via the hair contactable surface; at least one sensor configured to sense a change in state of the device from a first stationary state to a second moving state; and a controller configured to, in response to the at least one sensor sensing a change in state from the first state to the second state, cause the hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

In ~~embodiment~~examples, heating of the hair contact member only commences when a user moves the device, and the device will be at the desired operating temperature by the time the user starts to style their hair using the device. Conventional hair styling devices begin to heat when switched on, and dump heat when they come into contact with a tress of hair. The controlled heating claimed in the present ~~invention~~disclosure is more efficient, and results in less damage to hair. In ~~embodiment~~examples, if the device is switched on but is not moving, the controller does not cause the hair contact member to heat, thereby saving battery power and improving the run time of the device. This is more efficient, than, for example, immediately causing the hair contact member to heat to the desired operating temperature when the device is switched on. The device may not be at the required operating temperature until the moment immediately before a user begins to style their hair. This may improve the run time of the device as causing the hair contact members to be held at the operating temperature for a longer time, when the device is not being used to style the hair, will drain the charge of the device faster.

In ~~embodiment~~examples, the controller is configured to cause the hair contact member to start heating when the at least one sensor senses the state change.

In ~~embodiment~~examples, the controller causes the hair contact member to start heating immediately when the sensor senses that the user has moved the device, thereby allowing the hair contact member to heat gradually as the user moves the device towards the roots of their hair to begin styling.

In ~~embodiment~~examples, the controller is configured to cause the hair contact member to start heating after a pre-determined time delay.

In ~~embodiment~~examples, when the sensor senses that the user has moved the device, the hair contact member initially remains at room temperature, but heats rapidly to the operating temperature as the hair contact member approaches the roots of the user's hair. This further improves the run time of the device, as the hair contact members will remain at room temperature for a longer period of time prior to heating.

In ~~embodiment~~examples, the controller is configured to cause the hair contact member to heat at a pre-determined rate.

In ~~embodiment~~examples, the pre-determined rate is set by the manufacturer, and may be based on a predicted time that it will take for a user to move the device to the root of their hair. By causing the hair contact member to heat at a pre-determined rate, the controller may cause the hair contact member to only reach the pre-determined operating temperature immediately before a user begins to style their hair. This avoids the need for the hair contact members to be held at a high temperature when a user is not styling their hair. This further improves the run time of the device.

In ~~embodiment~~examples, at least one of the predetermined amount of time; pre-determined rate; pre-determined time-delay; and pre-determined operating temperature is initially set to a default value.

In ~~embodiment~~examples, at least one of the pre-determined amount of time, the pre-determined rate, the pre-determined time delay and the pre-determined operating temperature is set by the manufacturer, based on predicted desired user values and/or known safe values. For example, the pre-determined operating temperature may be a known appropriate temperature for curling and/or straightening hair. This helps to ensure that the device performs well, or optimally for a user from first use.

In ~~embodiment~~examples, the at least one sensor is configured to output signals dependent on movement of the hairstyling device, and the controller is configured to; receive the output signals from the at least one sensor, identify one or more user operation parameters associated with how a user operates the device; and adapt, on the basis of the one or more identified user parameters, at least one of the: pre-determined amount of time; pre-determined rate; pre-determined time-delay; and the pre-determined operating temperature.

In ~~embodiment~~examples, the sensor may output a signal indicating that the user is curling or straightening their hair, and the controller may adapt the operating temperature to be

appropriate for this action. This improves the performance of the device and the user experience by ensuring that the operating temperature is appropriate for the action that is being performed. This assists in avoiding damage to the user's hair by ensuring that the device is being used at an appropriate operating temperature. In ~~embodiment~~examples, the sensor senses that the user takes a significantly longer or shorter amount of time to move the device to the roots of their hair. The controller may adapt the heating rate, or for example, incorporate/increase or eliminate/reduce a time delay. This both improves the user experience, by ensuring that the hair contact member is at the required operating temperature when the user begins to style their hair, and improves the run time of the device by avoiding the hair contact member from being held at a high temperature for longer than necessary.

In ~~embodiment~~examples, the controller is configured to identify one or more user operation parameters specific to multiple users, and the adaption is performed on the basis of the user specific operation parameters.

The device may be used by multiple users at different times. Different users may use the device for different styling actions, which may require different operating temperatures, and may take different amounts of time to move the device to the roots of their hair. It may therefore be appropriate for the controller to cause heating of the device to different temperatures, at different rates for the different users, in order to improve user experience and efficiency of the device. To facilitate this, the controller may identify different operating parameters for the different users.

In ~~embodiment~~examples, the identified one or more user operation parameters comprise one or more of temporal parameters; spatial parameters; and thermal parameters.

In ~~embodiment~~examples, the at least one sensor is configured to sense a change in state of the device from the second moving state to the first stationary state, and the controller is configured to, in response to the at least one sensor sensing a change in state from the second state to the first state, prohibit heating of the hair contact member, thereby allowing the hair contact member to cool below the pre-determined operating temperature. In ~~embodiment~~examples, the at least one sensor is configured to sense when the hair contact member is not in contact with a tress, and the controller is configured to, in response to the at least one sensor sensing that the hair contact member is not in contact with a tress, prohibit heating of the hair contact member, thereby allowing the hair contact member to cool below the pre-determined operating temperature.

In ~~embodiment~~examples, the sensor senses when a user has finished styling their hair and has returned the device to the stationary state. In response to receiving a signal from the sensor, the controller may stop causing the hair contact member to heat or may prohibit heating of the hair contact member. This ensures that the hair contact member is not held at the operating temperature for longer than necessary, thereby improving run time of the device. In ~~embodiment~~examples, the controller causes the hair contact member to be held at a standby temperature until the device is switched off by the user. This ensures that the hair contact member can efficiently be caused to heat to the operating temperature if the user moves the device and wishes to continue styling their hair.

In ~~embodiment~~examples, the at least one sensor comprises a touch sensor configured to sense when a user has picked up the device, and the controller is configured to, in response to the touch sensor sensing that the device is not being held by the user, prevent the hair contact member from heating to the pre-determined operating temperature.

In ~~embodiment~~examples, if the device is moving but the touch sensor senses that the device is not being held by a user, the controller prevents the hair contact member from heating. This provides a safety check, ensuring that if the device has been unintentionally moved, for example, if it has been knocked off a surface by a user, the hair contact member will not heat to the pre-determined operating temperature. In other words, in ~~embodiment~~examples, the hair contact member will only heat to the pre-determined operating temperature when the device is being used by a user for styling their hair.

In ~~embodiment~~examples, the at least one sensor comprises an inertial measurement unit, IMU sensor, configured to sense when the device is in the second moving state. In ~~embodiment~~examples, the IMU sensor is configured to sense when the device has been returned to the first, stationary state.

In ~~embodiment~~examples, the at least one sensor comprises a proximity sensor, configured to sense when styling of a tress has started, and/or when styling of a tress has finished.

In ~~embodiment~~examples, the device comprises at least one other sensor configured to sense one or more environmental conditions, and the controller is configured to cause heating of the hair contact member to the pre-determined operating temperature further on the basis of the sensed environmental conditions. In ~~embodiment~~examples, the environmental conditions comprise temperature and/or humidity of a room in which the device is being operated.

Humidity levels and/or the temperature of the room in which the device is being used may affect the appropriate operating temperature of the device. For example, at a high

humidity level, a higher operating temperature may be required. By adapting the pre-determined operating temperature on the basis of the environmental conditions in which the device is being used according to ~~embodiment~~examples, user experience is improved, ensuring that the hair contact members are at the optimum operating temperature.

In ~~embodiment~~examples, the pre-determined operating temperature is user-configurable.

A user may wish to override the pre-determined operating temperature set by the controller, for example, if they intend to use the device for different styling behaviour. Similarly, a user may wish to override the pre-determined heating rate set by the controller, for example, if they intend to use the device for different styling behaviour. User experience may be improved by allowing this option to control the operating characteristics of the device.

In ~~embodiment~~examples, the device comprises a hair straightener. In ~~embodiment~~examples, the device comprises a hair curler. A user can use the straightener to perform a curling or straightening action, and may use the device differently, requiring different operating temperatures and/or heating rates for these different actions.

In ~~embodiment~~examples, the device comprises a heating element operable to heat the hair contact member, and the controller is configured to control the heating element to cause the heating element to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

In ~~embodiment~~examples, the hair contact member is operable to apply heat to a tress of hair via the hair-contactable surface by the movement of the contact member along the tress of hair between a hair-root end of the tress and a hair-tip end of the tress.

According to an ~~aspect~~ example of the present disclosure, there is provided a method of operating a cordless hairstyling device, the method comprise generating a sensor signal in response to a user moving the device from a first stationary state to a second moving state, at a controller, processing the sensor signal to determine that the device is in use, and in response to determining that the device is in use, causing a heatable hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

In another aspect, the present disclosure refers to a method of operating a cordless hairstyling device, the method comprising: generating a sensor signal in response to a user moving the device from a first stationary state to a second moving state; at a controller, processing the sensor signal to determine that the device is in use and in response to determining that the device is in use, causing a heatable hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

According to an ~~aspect~~ example of the present disclosure, there is provided a computer program product comprising a set of instructions, which, when executed by a computerized device, cause the computerized device to perform a method of facilitating use of a cordless hairstyling device, the method comprising generating a sensor signal in response to a user moving the device from a first stationary state to a second moving state; at a controller processing the

sensor signal to determine that the device is in use; and in response to determining that the device is in use, causing a heatable hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

In another aspect, the present disclosure refers to a computer program comprising a set of instructions, which, when executed by a computerized device, cause the computerized device to perform a method of facilitating use of a cordless hairstyling device, the method comprising: gnerating a sensor signal in response to a user moving the device from a first stationary state to a second moving state; at a controller, processing the sensor signal to determine that the device is in use; and in response to determining that the device is in use, causing a heatable hair contact member to heat to a pre-determined operating temperature by a pre-determined amount of time after the detected state change.

It will of course be appreciated that features described in relation to one aspect of the present ~~invention~~disclosure may be incorporated into other aspects of the present ~~invention~~disclosure. For example, a method of the ~~invention~~disclosure may incorporate any of the features described with reference to an apparatus of the ~~invention~~disclosure and *vice versa*.

Brief description of the drawings

Embodiments of the present disclosure will now be described by way of example only with reference to the accompanying drawings, of which:

Figure 1A is a perspective view of a cordless hairstyling device with arms in an open position, according to embodiments;

Figure 1B is a perspective view of the cordless hairstyling device of Figure 1A with arms in a closed position, according to embodiments;

Figure 2 is a schematic diagram of a hairstyling device according to embodiments; and

Figure 3 is a flowchart showing a method of operating a cordless hairstyling device, according to embodiments.

Detailed Description

Figures 1A and 1B show perspective views of a hairstyling device 100 according to embodiments. The hairstyling device 100, and/or components thereof, may be used to implement the methods described herein. In the embodiments shown in Figures 1A and 1B, the hairstyling device 100 comprises a hair straightener.

The hairstyling device 100 comprises a first arm 110 and a second arm 120, which are joined together at one end by a hinge 130. The hairstyling device 100 comprises a heatable hair contact member. In the embodiments shown in Figure 1A and 1B, each arm 110, 120 comprises a heatable hair contact member in the form of a heatable plate 115, 125. In embodiments, one or both of the heatable plates 115, 125 are heatable, e.g. by a heating element (not shown). In some embodiments, one or both of the heatable plates 115, 125 comprises a resistive plate. Such resistive plates may be heated directly, e.g. without requiring a separate heating element. Each heatable plate 115, 125 is operable to apply heat to a tress of hair of a user via a hair-contactable surface 116, 126. The hair-contactable surfaces 116, 126 are