

INDUCTION HEATED HAIR STYLING APPLIANCES AND THE HEATING UNIT THEREFOR

Field of the Invention

[0001] The present invention generally heated brush. More particularly, the present invention relates to a heated brush for hair styling and a heating unit for heating up the heated brush.

Background

[0002] Hair styling often requires heating up hair to style it. Depending on the used, different hair styling appliances have different ways of heating up. For example, curling tongs and hair straightening device, such devices requires electrical power to continuously heating up the heating elements thereon. Most commonly, the electrical power is supplied through a power cord/wire connected thereto. Such power cord/wire often get in the users' way when they operate these appliances.

[0003] Another hair styling appliance includes thermal brush that is commonly used in conjunction with a hair blower/dryer. The hair blower/dryer serves as a heat source to heat up hair as well as the thermal brush operationally. It is recognized that ordinary users may face challenges to operate several appliances simultaneously. Further, such appliances do not retain heat within the appliances itself; as soon as the hair blower stops blowing heated air to the thermal brush, it cools down very quickly.

Summary

[0004] There is a desire to provide user a cordless and handheld appliance that is easy and convenience to use. Preferably, the cordless and handheld is easy to operate, fast heating up,

[0005] In one aspect of the present invention, there is provided a heated hair-styling appliance for styling hair. The hair-styling appliance comprises a heated head having an outer shell covering at least part of the surface thereof, and an inner heat source core disposed within the inner part of the heating head, a handle attached to a distal end of the heating head. The hair-styling appliance works in conjunction with an independent induction-heating unit to heat up the inner heat source core, wherein the heat source core supplies heat to heat up the outer shell for styling hair after it is being heated.

[0006] In one embodiment, the handle is detachable from the heating head.

[0007] In another embodiment, wherein the outer shall is made up of heat conductive material. Possibly, the outer shell is cover by a thermal insulation layer, such as ceramic coating or any thermal insulation material. In yet another embodiment, the inner heat source core is made up of a thermal conducting material, such as ferrous metal.

[0008] In a further embodiment, the hair-styling appliance is a thermal brush. The thermal brush may have the outer shell covered with a thermal insulation layer, and bristles are formed on the thermal insulation layer.

[0009] In yet a further embodiment, the hair-styling appliance is a curling tong or a hair-straightening iron. The heating head may further define an aperture, wherein the aperture provides access into the inner part of the heating head.

[0010] Further, the heating head further comprises a sensor port adapted for coupling with a sensor plug of the independent heating unit to detect. It may further comprise a temperature sensor disposed in the inner part of the heating head and electrically connected to the sensor port, wherein the temperature sensor is operable to send signals to the independent heating unit through the sensor port coupling with a sensor plug of the independent heating unit.

[0011] Yet, the hair styling appliance may further comprise an identifier attaching for identifying a type of the hair styling appliance through the independent heating unit. The identifier may be a resistor connecting to the sensor port, wherein each type of the hair styling appliances can be identified through one fixed resistance value

[0012] In another aspect of the present invention, there is provided a hair styling appliance comprises an induction heating unit having a container, the container defines a well that is surrounded by a induction coil winding, the induction coil winding is connected to a circuitry operationally generates electromagnetic induction within the well through the coil winding and the aforesaid hair-styling appliance. The hair-styling appliance is heated up within the well through the electromagnetic induction for usage.

[0013] In yet a further aspect of the present invention, there is provided an induction heating unit for heating up a hair styling appliance. The induction heating

unit comprises a container defining a well that is surrounded by an induction coil winding, a controller electrically connected to the induction coil winding to operationally control a heating power; and a sensor plug disposed at the bottom on the well, the sensor plug adapted for coupling with a sensor socket on the hair styling appliance to detect at least temperature of the hair styling appliance through a temperature sensor. The controller operationally controls a heating power based at least on the temperature detected through the temperature sensor.

[0014] In one embodiment, the temperature sensor is disposed on the sensor plug. In an alternative embodiment, the temperature sensor is disposed on the hair styling appliance and electrically connected to the sensor socket, whereby the controller is operable to receive signals from the temperature sensor when the sensor socket is coupled with the sensor plug.

[0015] In a further embodiment, the temperature sensor may be a negative temperature coefficient (NTC) thermistor or a thermocouple device. Further, the sensor plug comprises a multi-channel plug.

[0016] In another embodiment, the controller further detects a type of hair styling appliance when the sensor socket is coupled with the sensor plug through an identifier electrically connected to the sensor socket.

[0017] In yet a further aspect, there is provided a method of heating a hair styling appliance through an induction heating unit. The method comprises placing a hair styling appliance into an induction heating unit with a sensor socket on the hair styling appliance coupled with a sensor plug disposed on the induction heating unit; detecting temperature of the hair styling appliance through a temperature sensor; and

controlling a heating power based at least on the temperature detected through the temperature sensor.

[0018] In one embodiment, the method further comprises detecting a type of the hair styling appliance through an identifier connected to the sensor socket of the hair styling appliance, wherein the controller operationally the heating power based on the type of the appliance detected.

Brief Description of the Drawings

[0019] Preferred embodiments according to the present invention will now be described with reference to the figures accompanied herein, in which like reference numerals denote like elements;

[0020] **FIG. 1A** illustrates an overall appearance of a heating unit in accordance with one embodiment of the present invention;

[0021] **FIG. 1B** illustrates the heating unit of **FIG. 1A**, with a portion of the housing cut out, exposing the components mounted within the heating unit;

[0022] **FIG. 1C** illustrates an induction-heating pot in accordance with another embodiment of the present invention;

[0023] **FIG. 1D** illustrates a sensing rod in accordance with one embodiment of the present invention;

[0024] **FIG. 2A** illustrates a schematic diagram of the circuitry of the heating unit in accordance with one embodiment of the present invention;

[0025] FIG. 2B illustrates a control panel of a heating unit in accordance with one embodiment of the present invention;

[0026] FIG. 3 shows an operation flow of the induction-heating unit of FIG. 1A in accordance with one embodiment of the present invention;

[0027] FIG. 4 illustrates a thermal hairbrush in accordance with one embodiment of the present invention; FIG. 5A illustrates a thermal hairbrush in accordance with another embodiment of the present invention;

[0028] FIG. 5B illustrates a thermal hairbrush in accordance with an alternative embodiment of the present invention;

[0029] FIG. 5C illustrates a thermal brush in accordance with yet another embodiment of the present invention;

[0030] FIG. 6 illustrates a curling iron in one embodiment of the present invention; and

[0031] FIG. 7 illustrates a hair-straightening appliance in accordance with one embodiment of the present invention;

[0032] FIG. 8 illustrates schematically a configuration of temperature measurement assembly in accordance with one embodiment of the present invention;

[0033] FIG. 9A illustrates temperature measurement assembly in accordance with an alternative embodiment of the present invention;

[0034] FIG. 9B illustrates a temperature measurement assembly in yet another alternative embodiment of the present invention; and

[0035] FIG. 9C illustrates schematically a temperature measurement assembly in accordance with a further embodiment of the present invention.

Detailed Description

[0036] Embodiments of the present invention shall now be described in detail, with reference to the attached drawings. It is to be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

[0037] FIG. 1A illustrates an overall appearance of a heating unit **100** in accordance with one embodiment of the present invention. The heating unit **100** is adapted to heat up a thermal brush (not shown in FIG. 1A). Preferably, the heating unit **100** is adapted with induction heating assembly for heating up the thermal brush placing therein. The heating unit **100** includes a housing **101** for accommodating components therein. An upper portion of the housing **101** incorporates a well **103** adapted for loading the heated brush. The size and depth of the well **103** is catered to be large enough for loading multiple sizes thermal brushes. The heating unit **100** is adapted for heating up thermal brush that generally adapted with handle. It is also desired that the well is adapted to receive only the brush portion of the thermal brush, while exposing the handle for outside of the heating unit for handling. Accordingly, a thermal brush can easily be placed into the well **103** so that the heated brush can be heated through the heating unit **100** for subsequent usage. Further, the thermal brush, regardless of the sizes, can be effortlessly placed or dropped the heated brush into the

well **103** at any orientations while the heating unit is heating up the heated brush within the cavity of the well **103**. A control panel **105** can be disposed on an external surface of the housing **101**. The control panel **105** may further include a button **106** and a display screen **107** for providing the necessarily operation control. The button **106** may be an on/off switch, or multi-triggering button for controlling the operation of the heating unit.

[0038] It is understood that an induction heating unit is desired in this embodiment as it offers quick heat up time and it allows the hair styling appliances to be reheated with minimal or no downtime. However, other heating unit may be desired without departing from the scope of the present invention.

[0039] **FIG. 1B** illustrates the heating unit **100** of **FIG. 1A**, with a portion of the housing **101** cut out, exposing the components mounted under the housing **101**. The heating unit **100** comprises two parts, an upper part that includes the well **103**, and a bottom part that accommodates the circuitry of the heating unit **100**.

[0040] The upper part of the heating unit **100** includes the well **103**, a winding roller **111** and a coil **112**. The winding roller **111** is an inner cylinder adapted to wrap around the circular surface of the well **103** within housing **101**. The winding roller **111** facilitates a means for supporting the coil **112**, such that the coil of wire, preferably copper wire, can be disposed around the perimeter of the winding roller **111**.

[0041] The coil **112** is electrically connected to the circuitry of the heating unit **100**, which is mounted beneath the upper part of the heating unit **100**. The circuitry comprises a PCB board **114** and components adapted for driving the coil **112** to generate the electromagnetic induction to heat up the heated brush. Beneath the PCB

board 114, there is further provided a heat sink 116 attached to the components that operationally produce heat. In another embodiment, the heating unit 100 may further provide a fan for increase the heat dissipation efficiency.

[0042] FIG. 1C illustrates an induction-heating pot 150 in accordance with another embodiment of the present invention. The induction heating pot 150 has a similar configuration as that of the induction-heating unit 100. The induction heating pot 150 further comprises a guiding pole 152 extending upwardly from the bottom of the well. The guiding pole 152 has a tapered end and along the length of the guiding pole 152, there is provided a thermal sensor 155. The induction heating pot 150 works in conjunction with a thermal brush or hair-styling appliances adapted with a corresponding slot configured for receiving the guiding pole 152. Preferably, the guiding pole 152 is supported through a flexible member allowing the guiding pin to be able to swivel in all direction.

[0043] FIG. 1D illustrates a sensing rod 180 in accordance with one embodiment of the present invention. The sensing rod 180 has substantially the same functions the guiding pole 152 of FIG. 1C, i.e. providing a sensor for sensing the temperature of the thermal brush that is placed within the unit for heating. The sensor is a contact type of sensing device. The sensing rod 180 comprises a base 182, a flexible rod 184, a sensor tip 186 and a wire 188. The base 182 is provided for supporting the entire sensing rod 180 and to attach it within the well of the heating unit. The flexible rod 184 is attached the base 182 at one end, and extending upwardly at another free end. The sensor tip 186 is attached at the free end of the flexible rod 184 and the wire 188 is electrically connected to the sensor tip 186 and extending

downwardly within the cavity of the rod, through the base of the well and electrically connecting to the heating unit's controller.

[0044] The sensor tip **186** is being made in round shape for easily coupling with the thermo brush. It can also be made in any other shape that corresponds to the configurations of the thermal brush for easy and effortless coupling. Preferably, the sensor tip **186** is made up of material that is would not be heated up during the operation of the heating unit. For example, aluminium can be selected for the sensor tip **186** on an induction-heating unit.

[0045] The flexible rod **184** can be made up of any flexible material, such as silicon, or even spring. It is desired that rod **184** can be band in omni-directions, which standing still upright when it is left untouched.

[0046] When in used, the thermal brush or the associated hair styling apparatus is placed within the well of the induction-heating unit with the sensing rod **180** couples with the thermal brush. Correspondingly, the thermal brush has a coupling means for receiving the sensing rod **180** for sensing temperature of the thermal brush. Specifically, the inner core of the thermal brush. It is desired that the sensing rod **180** and the coupling means are configured in any such way that user may effortlessly insert the thermal brush into the well of the induction-heating unit for heating. In one embodiment, the thermal brush includes an aperture on the top of the brush, wherein coupling and inserting the sensing rod **180** into the aperture allowing the sensing rod **180** to come into contact with the inner core of the thermal brush in order to sense the temperature of the thermal brush.

[0047] **FIG. 2A** illustrates a schematic diagram of the circuitry of the heating unit in accordance with one embodiment of the present invention. The circuitry **300** includes a microcontroller **302**, an insulated gate bipolar transistor (IGBT) driver **304**, one or more IGBT **306**, a power source **310**, an interface panel **314**, sensors **316**, and optionally a fan **320**. The power supply **310** operationally supplies power to the entire heating unit. It may be a multi-voltage power supply. Depending on the design and specification, the power supply may further include a switch mode power supply (SMPS) circuit, to transforms the DC bus voltage into several different DC low voltage outputs.

[0048] The microcontroller **302** is adapted for controlling the entire operations and processes of the induction-heating unit. The microcontrollers **302** suitable for the induction heating equipment can be any suitable microcontroller available in the market.

[0049] The IGBT **306** is the main power component and is provided to drive the coil **308** that are winded around the well of the induction heater. The IGBT **306** is driven by the IGBT driver **304** that provides a voltage transfer interface between the microcontroller **302** and the IGBT **306**. It is well known in the art that, when desire, the IGBT **306** can be replaced several bipolar transistors.

[0050] The microcontroller is further connected to the interface panel **314** for receiving control input from user and display some operating status to the user. The interface panel **314** may include switches and a display panel. User may control the operations of the induction heater through the switches provided on the control panel,

and monitor the operating status through the display panel. The interface panel **314** may further include LED lights for showing the operating status.

[0051] The sensors **316** include a thermal sensor for detecting the temperature within the well of the induction heater, or more specifically the temperature of the thermal brush heated therein. These sensors detect the necessary operating status automatically, and the microcontroller **302** responds according. For example, the sensor can be placed at the bottom of the well as a switch, and when a thermal brush is placed within the well and triggers the sensor, the induction heating unit would recognize so in order to carrying out further operation. This can prevent that the induction heating being turned on unintentionally without any thermal brush presents therein. In another embodiment, the sensor can be used to detect the presence of the thermal brush to automatically trigger the induction-heating unit to heat up the thermal brush as it is placed within the well of the heating unit.

[0052] For safety purpose, it would be desired that the thermal sensor be provided for detecting the heating condition. Preferably, the thermal sensor is adapted to be able to detect at least the temperature of the thermal brush. When the thermal brush is detected overheating, the induction-heating unit will cut off automatically. For example, when a heated thermal brush that has not been cooled down is placed within well, the induction heater may overheat the thermal brush. Accordingly, it is desired that the temperature of the thermal brush that is placed within the well can be detected before the induction heating operation starts.

[0053] The thermal sensor may be a thermopile, or thermopile infrared sensor or the like. It may also be thermocouples or the like. Most preferably, the thermal sensor is able to detect the temperature of the thermal brush contactlessly.

[0054] The induction-heating unit may further adapt with the fan **320** to dissipate heat during the heating operation. The heat generating components may further attach with heat sink to work in conjunctions with the fan to effectively dissipate the heat operationally.

[0055] It is understood to a skilled person that the above circuitry is illustrated by way of example only, not limitations. There are many other suitable configurations that can be adapted for the induction-heating unit. Preferably, the induction-heating unit shall be able to heat up the heated element of the thermal brush to a desired working temperature suitable for practical hair styling. The thermal sensor can be adapted to control or cut off heating to prevent overheating.

[0056] The induction heater is heated by controlling the coil power. To control it, a synchronous signal is needed to be detected.

[0057] For safety protection, the induction may provide an overvoltage (OV) and overcurrent (OC) detection means. Operationally, when the induction heater is running, it may generate an over voltage or a high level of voltage noise created by the repeatedly switching (i.e. on/off) IGBT **306**, which may damage the IGBT **306**. A potentiometer OV may be facilitated to the microcontroller **302** to regulate the voltage. When current flowing through the IGBT **306** is higher than the expected current, the IGBT **306** can also be damaged. A current transformer can be adapted to prevent OC.

[0058] **FIG. 2B** illustrates a control panel **350** of the heating unit in accordance with one embodiment of the present invention. The control panel **350** provides buttons **352** that allow various controls on the heating unit to heat up various type of hair styling apparatus that can also be provided in various sizes, which require different temperature controls. The hair styling appliances may include thermal brushes (TB), curling iron (CI), hair-straightening clamps (HS) and etc. The sizes available may be labeled large (L), medium (M) and small (S), or the like. Such various controls are desired because different hair styling appliances with different sizes may require different heating level and time. Each time when a hair styling appliances is being heated up, user may require to select both the type of hair styling appliances and the size of the appliances. An LED light **354** maybe provided adjacent to the respective buttons **352** to indicate what have been selected.

[0059] **FIG. 3** shows an operation flow of the induction-heating unit of **FIG. 1A** in accordance with one embodiment of the present invention. The operation starts with pressing a power switch to turn on the induction-heating unit at step **352**. At this stage, the induction-heating unit is placed at a standby mode. At step **354**, the thermal brush can be inserted into the well of the induction-heating unit. Once the thermal brush is placed in the induction-heating unit, the induction-heating unit will detect the presence of the thermal hairbrush at step **356**. The presence of thermal hairbrush will trigger a thermal sensor to detect whether the temperature of the thermal hairbrush is detected to be higher than a predefined level. If the detected temperature is higher than the predefined level, the induction-heating unit will not function to heat up the thermal hairbrush. Such detection is provided to prevent overheating. If the detected temperature is below the predefined level, the LED light indicator may light up to

indicate that the induction-heating unit is ready for operation. At step 358, the user may press a start button to start heating up the thermal hairbrush. At step 360, the induction-heating unit may determine the heating time require. The time determination may be based on the temperature detected at step 356, or it triggers the sensor to detect the temperature again after the start button is pressed. The thermal hairbrush is being heated up in step 362, and once the heating operation is completed at step 364, users may remove the thermal hairbrush from the induction-heating unit at step 366 for hair styling.

[0060] FIG. 4 illustrates a thermal hairbrush 400 in accordance with one embodiment of the present invention. The thermal hairbrush 400 is adapted with a capability of storing and self-releasing heat without any power source or external heat source. The thermal hairbrush 400 is adapted for heating up through induction heating unit, and once heated up it can be used immediately out from the induction-heating unit. The thermal hairbrush 400 has a brush head 402 with a brush handle 404 thereto for allowing users to handle the thermal hairbrush 400. The brush head 402 is shown in a preferred embodiment as a round vented brush of a generally elongated cylindrical shape. However, one skilled in the art should appreciate that the thermal hairbrush 400 may be used with a round brush, a cylindrical shaped brush, a flat hairbrush, a paddle brush, a spinning brush, a half round brush, a vent brush with a specific configuration adapted to suit the present application. When in use, user may hold on to the brush handle 404 and place it into the well of the induction-heating unit of FIG. 1A. Once it is heated, the heated thermal hairbrush 400 may assist with curling the hair being brushed with the heat emitted therefrom. The advantage of the thermal hairbrush 400 is: once heated, it can be use immediately. It also does not require external power

source to heat it up, therefore, no cable is adapted thereon, therefore, it is easier to handle.

[0061] Referring back to the **FIG. 4**, the brush head **402** may be formed in a variety of diameters. Relatively narrow diameters are especially effective for creating curls while conversely relatively larger diameters create looser curls. The brush head **402** extends about half way on the heated hairbrush **400** from an end to about a midpoint on the thermal hairbrush **400**. The brush head **402** has a length suitable to comb or style hair in a comfortable manner and further to have an adequate number of bristles **406** disposed in surrounding fashion thereon. As illustrated by the thermal hairbrush **400**, the bristles **406** are extended from the inner side of the brush head **402**.

[0062] The brush head **402** has an outer shell **408** that is disposed around the brush head **402** in concentric relation to the brush head **402**. The outer shell **408** further defines through holes **408**, through which, the bristles **406** extend outwardly from the inner space of the brush head **402**.

[0063] Still referring to **FIG. 4**, the thermal hairbrush **400** is being shown with a cut out portion exposing the inner part of the brush head **402** and the constructions of the outer shell **408**. Generally, the outer shell **408** is adapted as a heat retainer. The outer shell **408** is made up of two layers **412**, **414**. The layer **412** is made up of thermal insulation material and the layer **414** is made up of thermally conductive material. For layer **412**, materials such as ceramic material, polymer may be adapted. In an alternative embodiment, it may also be a thin layer of thermally insulation coating coated on top of the layer **414**. The layer **414** on the other hand, is made up of thermally conductive material such as metal, copper, aluminum, or any other thermally

conductive material known in the art. Through the cut out portion, it can be seen that the thermal brush **400** further comprises a heat source core **420**, of which, the bristles are extended therefrom. Preferably, the heat source core **420** is also made up of heat conducting materials. More preferably, the heat source core **420** can be made up of ferrous metals or alloys. The preferred materials for the heat source core **420** shall be easily heated up through induction heating, and preferably, the material used is able to retain heat as long as possible. The heat source core **420** may further be coated with heat retaining coating, such as ceramic coating.

[0064] Operationally, the thermal brush **400** is placed in an induction-heating unit, such as the one illustrated in **FIG. 1A**. Once the induction-heating unit is turned on, the thermal brush **400** is being heated up through electromagnetic induction. More specifically, the conducting materials, i.e. the outer shell **408** and the heat source core **420** will be heated up to a desired temperature. The induction heating may be stopped through a timer, and once the time is up and the thermal brush **400** is heated up, it is ready to be used. When in use on hair, the outer shell **408** heats up the hair directly because it is in direct contact with hair. The thermally conductive layer **414**, which is heated up by the induction-heating unit, releases the heat through the thermal insulation layer **412** slowly. The thermal insulation layer **412** serves as a thermal retainer for holding the heat onto the thermally conductive layer **414** as long as possible.

[0065] Similarly, once the heat source core **420** is heated up by the induction heating unit, it serves as a heat source to the thermal brush **400** for supplying heat continuously to heat up the outer shell **408** as it loses heat to the ambient operationally.

[0066] In yet another embodiment, the thermal insulation material can be a layer of insulating coating, for example, ceramic coating. Such insulation material can also be applied onto the heat source core **420**, in accordance with another embodiment of the present invention.

[0067] **FIG. 5A** illustrates a thermal hairbrush **500** in accordance with another embodiment of the present invention. The thermal hairbrush **500** comprises a brush head **502** with a brush handle **504** attached thereto at one end. The brush head **502** has an outer shell **508** that disposed around the brush head **502** in concentric relation to the brush head **502**. The outer shell **508** is formed by two layers, a sleeve **510** and a metal layer **512**. The metal layer **512** is an inner cylinder defining an inner cavity. The metal layer is made up of thermal conductive material, such as copper, aluminum or the like. Preferably, it is made up of a material that can be heated up through induction heater. The sleeve **510** is an outer layer wrapping around the metal layer **512**. Bristles **514** of the thermal hairbrush **500** are extending directly from the sleeve **510**. The sleeve **510** together with the bristles **514** are made up of thermal insulation material, for example, nylon.

[0068] Within the cavity of the inner cylinder, the brush head **502** is further provided with a heat source core **520** disposed along the concentric axis of the brush head **502**. In this embodiment, the heat source core **520** is configured as a solid component, though it is possible to make the heat source core **520** with a hollow cylinder. Similarly, the heat source core **520** is made up of thermal conducting material; more preferably, it is made up of material that can be heated up through induction heating.

[0069] As shown in **FIG. 5A**, the heat source core **520** is disposed within the cavity spaced apart from the sleeve **510**. In another embodiment, it is possible that the heat source core **520** can be made as an inner cylinder disposed beneath the metal layer **512**, with or without space. In yet a further embodiment, the heat source core **520** may also be covered by a thermal insulating material (i.e. between the metal layer **512** and the heat source core **520**) aims for slowing down the heat transfer from the heat source core **520** to the metal layer **512**.

[0070] Operationally, the thermal hairbrush **500** is heated up with a same or substantially the same way as the thermal hairbrush **400**, and as the thermal hairbrush **500** does not have holes on the outer shell as the thermal hairbrush **400**, it is expected that the heat can be retained longer within the thermal hairbrush **500**.

[0071] Although, the outer shells shown above are completely surrounding the respective brush head, alternatively the outer shells may only surround a radial portion of the brush head such as three quarters of the brush head, half of the brush head or a quarter of the brush head.

[0072] Further, the brush heads of the thermal hairbrushes illustrated above are fixed to the handle. In other embodiments, these thermal hairbrushes may be adapted with the brush head detachable from the handle, when desire. In such case, the handle may adapt a quick release latch for securing the brush head onto the handle.

[0073] **FIG. 5B** illustrates a thermal brush in accordance with an alternative embodiment of the present invention. The thermal brush is substantially the same as the thermal brush **500** except that the heat source core **520** is made a hollow core and the top of the thermal brush is adapted with an aperture leading up to the hollow space

of the hollow core. Such configuration allows the thermal brush to be placed into the induction heating pot through inserting the guiding pole **152** into a hollow space of the hollow heat source core **520** as shown in **FIG. 5B**. Preferably, the thermal sensor **155** is made slightly bigger than the diameter of the guiding pole **152** to give a tight fit when it is inserted into the heat source core of the thermal brush. Such configuration allows the thermal sensor to effectively measure the temperature of at least the heat source core **520**.

[0074] The guiding pole **152** can further be adapted as a sensor to detect the presence of the brush in the well of the heating unit as the guiding pole **152** is inserted into the thermal brush.

[0075] **FIG. 5C** illustrates a thermal brush **570** in accordance with yet another embodiment of the present invention. The thermal brush **570** has exactly the same exterior configuration as the thermal brush **500** of **FIG. 5A**, i.e. it comprises a brush head **572** attaching to a brush handle **574**. The brush head **572** has an outer shell **578** disposed around the brush head **572** covering with bristles **577**. Under the outer shell **578** wrapped a cylinder **575** that made up of heat conductive material, more preferably, induction heatable material. Two extreme ends of the cylinder are respectively disposed with a heat core **576** with a direct contact with the cylinder. Both heat cores are disposed in the inner part of the thermal brush. The one on the top distal end of the thermal brush is covered by a cap. The cap is preferably made by heat insulated material to minimize heat from dissipating from the top. The heat core **576** is also made up of heat conductive material, more preferably, induction heatable material. The two heat cores **576**, similar to the heat source core **520**, is provided in the thermal brush is operable to supply heat continuously after it is being heated up. Accordingly,

it places no limitation on the shapes and sizes required for the heat cores **576** as long as they are able to function as a heat reservoir to store heat and able to supply the heat graduatedly to the cylinder. It is further understood that one of the heat core **576** would be sufficient to deliver the heat required, but two may work better in supplying the heat more consistently.

[0076] It is also understood to a skilled person that there can be many variations to configure the heat core **576**, for example, the heat core may be a hollow body or a solid piece that fills up the inner part of the brush head. It is well understood that the more material provided, more heat can be stored, but it also compromises the weight. It is therefore desired that any configurations of the hair styling appliances according to the present invention shall consider the balance with the heat storage capacity and the appliances' weight. But it imposes no limitations on the configurations and designs on the appliances.

[0077] Still referring to **FIG. 5C**, the cap for covering the heat core **576** on the top may further define an aperture, and correspondingly, the heat core **576** defines a channel **579**. The channel **579** is provided for receiving a sensor that when inserted, gets into direct contact with the heat core **576** so that the temperature of the heat core can be measured.

[0078] **FIG. 6** illustrates a curling iron **600** in one embodiment of the present invention. The curling iron **600** comprises a handle **602** and an heating rod **604** attached to the handle **602**. The curling iron **600** further has a clamp **606** pivoted at the proximal end of the handle **602** with a clamping plate **607** covers a portion of the

heating rod **604**, and a actuator **608** on the other side of the pivot projecting over the handle **602**.

[0079] In **FIG. 6**, the front end of heating rod **604** is cut out to show the inner configurations of the heating rod **604**. As shown, the heating rod **604** includes a heat source core **612** and a heating shell **614**. The heating shell **614** forms the outer shell of the heating rod **604**. When in used, it is directly contacting the hair to style the hair. The heating shell **614** may be coated with a layer of thermal insulating material for prolonging the heating process. The heat source core **612** is a concentric tubular component that disposed within the heating shell in a telescopic manner. When possible, a space may be provided between the heat source core **612** and the heating shell.

[0080] It is to be noted that the curling iron **600** does not require any power source to operate, therefore, no cord is attached thereto.

[0081] **FIG. 7** illustrates a hair-straightening appliance **700** in accordance with one embodiment of the present invention. The hair-straightening appliance **700** includes two opposing tongs **702** that are being hinged together at one distal end. Opposite the hinge, the opposing tongs **702** holds a heating plate **704** on each tong **702**. The heating plate **704** is removable from the tong **702**. The heating plate can be a flat panel for straightening hair, or a profiled panel defining zigzag profile for crimping hair.

[0082] As shown in **FIG. 7**, the front end of the lower tong **702** is cut out to show the inner configurations of the hair-straightening appliance **700**. As shown, the

tong **702** has a heat source core **712** disposed beneath the heating plate **704** with a space apart.

[0083] It is understood that the hinge of the two opposing tongs **702** can be configured at the middle, i.e. class 2 lever, in accordance with another embodiment of the present invention.

[0084] When in used, the curling iron **600** and the hair-straightening appliance **700** illustrated above can be placed into an induction-heating unit for heating up. Once it is heated up to a desired temperature, it can be remove from the induction-heating unit for immediate usage. The outer plate or shell directly heats up the hair as it is in direct contact with the hair. The inner core, which was also heated up through the induction heating unit, dissipates it heat slowly to the outer plate or shell, thereby prolonging the heating capability.

[0085] **FIG. 8** illustrates schematically a configuration of temperature measurement assembly in accordance with one embodiment of the present invention. The temperature measurement assembly comprises a sensor plug **802** and a sensing port **804**. The temperature measurement assembly is adapted on a thermal brush adapting two heat cores **806** that are disposed at the two ends of the brush head similar to that of **FIG. 5C**. The sensor port **804** can be simply an opening defining at the top end of the thermal brush to expose the heat core **806**. The heat core **806** may further defines a small depression for receiving the sensor plug **802**. The sensor plug **802** has a thermal sensor **810** disposed on its tip in a manner that when the sensor plug **802** is inserted into the brush head through the sensing port **804**, the thermal sensor **810** is in contact with the heat core **806**. The thermal sensor **810** can be any thermocouple, such

as a K-type thermocouple device electrically connected to the control circuitry or PCB board of the heating unit. Such configuration allows the thermal sensor **810** to operationally come into contact with the one of the thermal core **806** of the thermal head to measure the temperature of the thermal core **806**. Once the temperature of the thermal core **806** is obtained, the temperature of the outer conductive shell that is in contact with the two thermal cores can be estimated through the control circuitry the heating unit.

[0086] In a further embodiment, the temperature measurement assembly may further comprise a sensor to detect the present of brush as the sensor plug **802** is inserted into the sensing port **804**. The sensor can simply be two open-circuit terminals on the sensor plug **802**, and a jumper disposed at the opening of the sensor port **804**, and when the sensor plug **802** is inserted into the sensing port **804**, the jumper closes the two terminals to indicate that a thermal brush is inserted into the heating unit.

[0087] It is apparent to a skilled person that by knowing at least the size and material of the heat core **806** to be measured, the temperature of the outer conductive shell can be readily estimated. It is presumed that the outer conductive shell is at least at the same or lower temperature than the heat core **806**.

[0088] **FIG. 9A** illustrates temperature measurement assembly in accordance with an alternative embodiment of the present invention. The assembly, too, is adapted on a thermal brush adapting two heated cores **906** that are disposed at the two ends of the brush head similar to that of the **FIG. 5C**. The temperature measurement assembly comprises a port **904** and a plug **902**, and a sensor **903**. Both port **904** and the sensor

903 are disposed on the brush head while the plug **902** is disposed on the heating unit and electrically connected to the control circuitry or PCB board of the heating unit.

[0089] In this embodiment, the sensor **903** is strategically attached to one of the heat cores **906** and electrically connected to the port **904**. The sensor **903** can be any thermal sensor, such as a negative temperature coefficient (NTC) thermistor, or the like. The port **904** provides a socket for receiving the plug **902**. The port **904** and the plug **902** may be a multi-channel connector adapted for electrically coupling to each other, which allows the sensor **903** to send signals to the control circuitry when the plug **902** is plugged into the port **904**. The multi-channel connector can be a phone-connector, TRS/TRRS connectors or the like.

[0090] **FIG. 9B** illustrates a temperature measurement assembly in yet another alternative embodiment of the present invention. The temperature measurement assembly is substantially the same as that of the **FIG. 9A** except that the sensor **915** is disposed on the heat conducting shell of the brush head directly, rather than the heat core, so that the temperature of the heat conducting shell can be measured directly.

[0091] **FIG. 9C** illustrates a temperature measurement assembly of a further embodiment of the present invention. The temperature measurement assembly comprises a sensor **922**, a multi-channel socket **924** and an identifier **926**. Similarly, the multi-channel socket **924** is adapted to couple with a corresponding plug mounted on within the heating unit. The sensor **922** and the identifier **926** are electronically connected to the respective terminal of the multi-channel socket **924**. The sensor **922** is attached to a heat core **928** of a hair styling appliance to detect the temperature thereof. The identifier **926** is provided to indicate the type of appliance that is inserted into the

heating unit. The identifier 926 can be any device that provides a signal to differentiate one appliance to another automatically. It allows the heating unit to identify the type of appliance and thereby provide the appropriate heating power to heat up the appliance.

[0092] In one implementation, a fix value resister may be adapted to identify the type of appliance to be heated. For example, a resister value of $1K\Omega$ can be used to indicate that the appliance is a 30mm thermal brush, and $2K\Omega$ to indicate that the appliance is a curling iron, and etc. Accordingly, by detecting the resistance value of the respective resistor, the heating unit is able to identify the type of the associate appliance. In this embodiment, the fix value resister is chosen because it is a very low cost and it is relatively straightforward to implement. It is readily understood to a skilled person that many other means, such as RFID tag and etc., are possible without departing from the scope of the invention.

[0093] Besides detecting the type of appliances, it is well understood to a skilled person that the identifier 926 can further be used as a presence sensor.

[0094] In an alternative embodiment, the temperature measurement assembly may comprise two or more sensors disposed within various locations of the brush head so that the temperatures of the various locations of the brush head can be taken.

[0095] While specific embodiments have been described and illustrated, it is understood that many changes, modifications, variations, and combinations thereof could be made to the present invention without departing from the scope of the invention.

Claims

1. An induction heating unit for heating up a hair styling appliance, the induction heating unit comprising:

a container defining a well that is surrounded by an induction coil winding,

a controller electrically connected to the induction coil winding to operationally control a heating power; and

a sensor plug disposed at the bottom on the well, the sensor plug adapted for coupling with a sensor socket on the hair styling appliance to detect at least temperature of the hair styling appliance through a temperature sensor,

wherein the controller operationally controls a heating power based at least on the temperature detected through the temperature sensor.

2. The induction heating unit according to claim 1, wherein the temperature sensor is disposed on the sensor plug.

3. The induction heating unit according to claim 1, wherein the temperature sensor is disposed on the hair styling appliance and electrically connected to the sensor socket, whereby the controller is operable to receive signals from the temperature sensor when the sensor socket is coupled with the sensor plug.

4. The induction heating unit according to claim 1, wherein the temperature sensor is a negative temperature coefficient (NTC) thermistor.

5. The induction heating unit according to claim 1, wherein the temperature sensor is a thermocouple device.

6. The induction heating unit according to claim 1, wherein the sensor plug comprises a multi-channel plug.

7. The induction heating unit according to claim 1, wherein the controller further detects a type of hair styling appliance when the sensor socket is coupled with the sensor plug through an identifier electrically connected to sensor socket.

8. A method of heating a hair styling appliance through an induction heating unit, the method comprising:

placing a hair styling appliance into an induction heating unit with a sensor socket on the hair styling appliance coupled with a sensor plug disposed on the induction heating unit;

detecting temperature of the hair styling appliance through a temperature sensor;

controlling a heating power based at least on the temperature detected through the temperature sensor.

9. The method according to claim 8, further comprising detecting a type of the hair styling appliance through an identifier connected to the sensor socket of the hair styling appliance, wherein the controller operationally the heating power based on the type of the appliance detected.