United States Patent

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[54] ELECTRICAL CONTACT MEANS FOR HAIR CURLER HAVING ELONGATED ANNULAR HEATER

7 Claims, 4 Drawing Figs.

[52] U.S. Cl. .... **219/222,** 132/33 R, 132/39, 219/505
[51] Int. Cl. **A45d 2/36,** H05b 1/02, H05b 3/12
[50] Field of Search 219/222–226, 241, 242, 210, 301, 504, 505; 132/33, 36, 39

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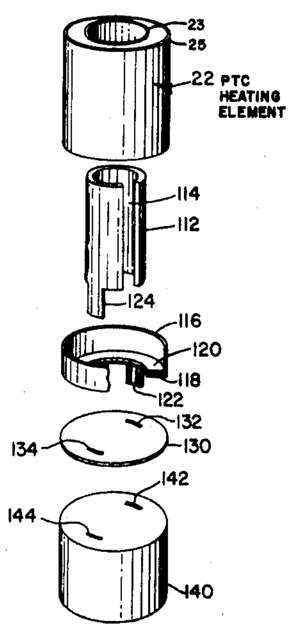
ABSTRACT: A hair curler employing a heater element formed of a conductive crystalline polymer is disclosed. The polymer, loaded with conductive particles, such as carbon black, has a positive temperature coefficient (PTC) of resistance characteristic and combines a fast warmup time with a slow cooldown time due to the phase change of amorphous polymer to crystalline upon cooling, yet does not become molten due to the sharp rise in resistance at temperatures above an anomaly temperature which limits the heat generation at elevated temperatures. Since the polymer retains its shape, no special sealing means is required to confine it as in prior art fusible wax devices. The heater element is an elongated annulus coated with conductive material on inner and outer peripheral surfaces. A sheet of conductive material is rolled into a cylinder and pressed into the bore of the annulus with a terminal extending therefrom. A sleeve of conductive material is placed about the annulus and a terminal attached to the sleeve to complete electrical connection. The outer shell of the curler extends over the terminal to provide a protected environment.



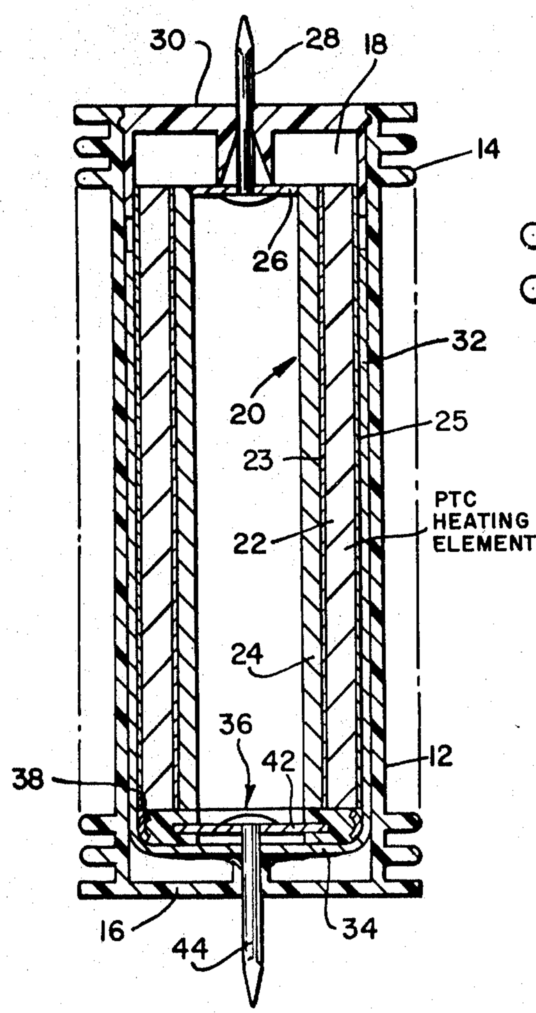


FIG. 1

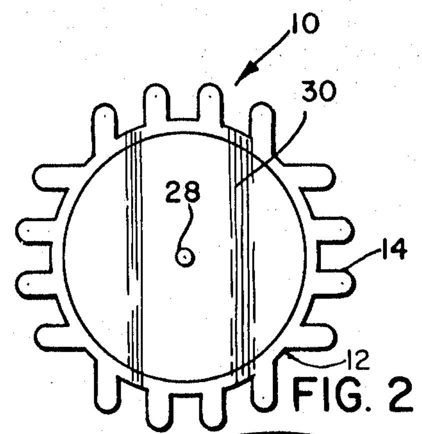


FIG. 2

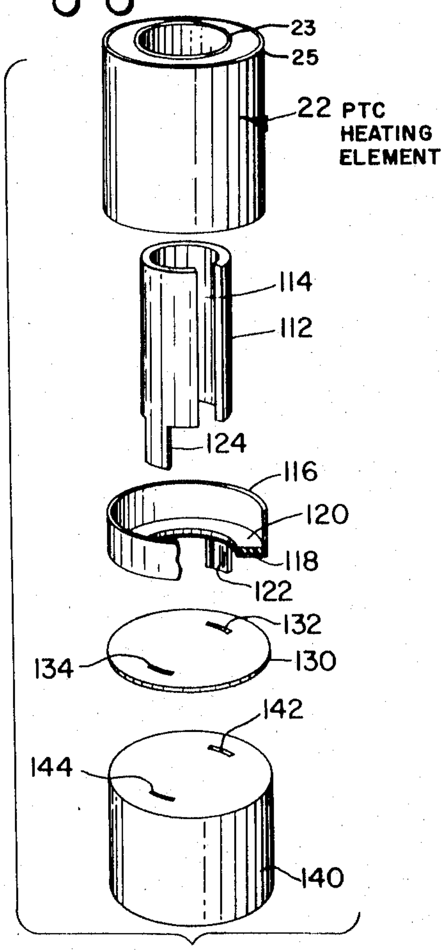


FIG. 3

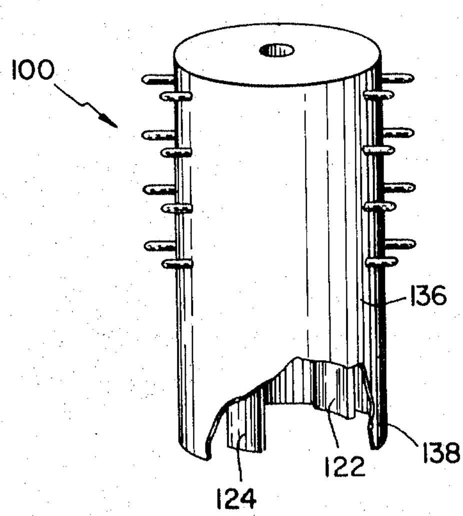


FIG. 4

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ELECTRICAL CONTACT MEANS FOR HAIR CURLER HAVING ELONGATED ANNULAR HEATER

BACKGROUND OF INVENTION

The invention relates to hair curlers, and more particularly, to electrically heated hair curlers.

Electrically heated hair curlers have found wide market acceptance in recent years. In general, these curlers comprise an outer cylindrical shell of a suitable polymer provided with a plurality of fingers extending outwardly from the outer peripheral surface of the shell for grasping hair wound about the shell. These curlers are heated to a desired temperature, then taken by the user who trains hair about the periphery. The hair is generally kept in contact with the curler for a short period of time to effect curling of the hair. Various ways have been used to heat the curlers but all have certain disadvantages. One type of curler employs, mounted within the shell, a housing which contains a fusible wax. The curler is placed in heat transfer relation with a heating element until the wax melts and is then removed from the heat source and is ready for use. However, since the wax is changed to a liquid, special precautions must be taken to insure a good seal. Further, the time which is required for the curler to be heated is longer than desirable due to the relatively low heat conductivity of the wax. The wax-filled device does, however, offer the advantage of being an excellent heat storage means due to the latent heat released during phase change of the wax from liquid to solid upon cooling. Attempts have been made to avoid the above disadvantages by using a resistance element in the curler both as the heater and as the heat storage means. This avoids the liquid sealing problem but the warmup time for the device is still excessive since a relatively massive resistance element must be employed in order to store the heat for the required time after deenergization. Still another disadvantage is that both of the above types require current-controlling devices, such as thermostats. Further, heat distribution along the surface of the curler for both types is relatively nonuniform with a concomitant nonuniform degree of curling for different sections of hair.

Thus, it is an object of the invention to obviate the disadvantages of the prior art curlers mentioned above.

Another object of the invention is the provision of a hair curler heater which combines the functions of various components used in prior art devices.

Yet another object is the provision of a simple, reliable, rugged hair curler device, one which provides uniform heating with no hot or cold spots. Another object is the provision of a hair curler heater which has an extremely fast warmup time along with the characteristic of maintaining its heat for a prolonged period. Yet another advantage is the provision of a hair curler device which needs no thermostats yet provides close temperature control. Another object is the provision of structure which permits the location of electrical terminals in one end of the curler and in a recessed protected environment.

Briefly, the present invention meets the above objects by providing a hair curler which employs a generally cylindrical tubular heating element located within an outer shell in heat transfer relation therewith. The heating element is coated on the inner and outer peripheral surfaces with electrically conductive material electrically insulated from one another. An inner conductor comprising an axially slit tubular cylinder is pressed into the bore of the heating element and an outer conductor comprising a tubular cylinder is received around the outer peripheral surface of the heating element and is held tightly thereagainst. Terminals extend from the inner and outer conductors through an electrically insulating disc. The outer shell extends axially beyond the terminals forming a recessed area for them.

In the accompanying drawings, in which one of the various possible embodiments, of the invention is illustrated:

FIG. 1 is a cross section of a hair curler device employing an elongated annular PTC heating element;

FIG. 2 is top plan view of the FIG. 1 device;

FIG. 3 shows a blown apart perspective of a portion of a second embodiment of the invention utilizing another electrical contacting means, the curler outer shell not being shown to aid in clarity of illustration; and

FIG. 4 shows a perspective of the second embodiment partly broken away to show recessed terminals.

Dimensions of certain of the parts as shown in the drawings may have been modified and/or exaggerated for the purposes of clarity of illustration.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

The heater of the present invention is made out of conductive-filled polymer having a positive temperature coefficient of resistance above an anomaly or threshold temperature. The heater is connected to line voltage so that current flows therethrough causing I^2R heating. When the temperature rises above the anomaly point, there is a sudden and marked increase in resistance to effectively cut off the current through the heater. Thus, this self-limiting of current eliminated the need for a thermostat or similar control employed by prior art devices. Among the other advantages the present invention offers is that extremely fast warmup time is obtained while storing the heat for an extended period of time since the polymer acts as a heater, heat exchanger and heat sink or heat storage means. Not only does the PTC characteristic serve to limit current but it offers another unexpected advantage. The prior art teaches that a PTC characteristic in conductive polymers is caused by a difference in thermal expansion between the polymer material and the conductive filler, that is, if the polymer has a greater thermal coefficient of expansion than the conductive-filler particles, this would give rise to a PTC effect. At the temperature is raised, the polymer expands more than the conductive particles, thus spreading the conductive particles apart. See, for instance, U.S. Pat. Nos. 2,978,665 and 3,243,753. However, this is not a complete explanation since many materials, such as polyvinylchloride and polystyrene do not exhibit a marked PTC effect even through the thermal coefficient of expansion of the polymer is greater than that of the conductive particle.

In the present invention material is utilized in which, rather than being primarily dependent upon rates of thermal expansion, the PTC effect appears related to the phase change in polymers having crystalline structure. When a crystalline-type polymer, such as polyethylene, is loaded with carbon particles, such as carbon black, the carbon black is distributed unevenly in the polymer even with extensive mixing. Such material also includes amorphous regions and it happens that most of the carbon particles are found in these amorphous regions. The carbon particles form large aggregates separated by crystalline regions with the separation being in the order of several hundred angstroms. Thus the polymer contains a few chains of carbon particles forming a continuous chain through the material but the bulk of such chains will be broken up by crystalline regions of polyethylene. Electron tunneling can occur fairly readily through thin films of crystalline polymer so that carbon chains broken up by crystalline regions can have conductivities approaching those of uninterrupted carbon chains. As temperature rises, the carbon black masses separate due to the greater thermal expansion coefficient of the polymer, increasing the difficulty of electron tunneling between carbon masses which offsets the increased electron tunneling effect due to temperature rise while the crystalline regions remain intact. At temperatures below roughly 90° C., the resistance level is relatively flat. When the temperature rises to the crystalline melting point, the carbon masses become separated by amorphous regions in which electron tunneling is very limited, thus causing high resistance of the material. Further increase of temperature causes the polymer to become semimolten which permits the strained carbon masses to expand in the polymer and form a partial network of carbon through the material resulting in an increase in conductivity.

Thus use of PTC polymeric resistance material not only permits combining of several functions mentioned above but also utilizes the extra heat-storage capabilities associated with the phase change. That is, changing of the crystalline polymeric composition to the amorphous phase upon heating stores latent heat associated with the phase change which is released upon cooling to make a very efficient heat-storage device.

Referring now to the drawings, particularly FIGS. 1 and 2, numeral **10** indicates generally a hair curler made in accordance with the invention and comprises and outer, generally cylindrical, shell **12** of any suitable synthetic resin having a plurality of fingers **14** distributed over the outer peripheral surface of the shell and extending therefrom to facilitate holding of hair thereon. Shell **12** is formed with a closed end **16** and an open end **18** to permit passage therethrough of a heater assembly **20**. Assembly **20** includes an elongated annular heating element **22** formed of a conductive-filled polymer having a positive temperature coefficient of resistance above an anomaly or threshold temperature. In order to provide optimum and reliably electrical contact with this polymeric composition, the inner and outer peripheral surfaces of element **22** are coated with a conductive material layers **23** and **25** respectively, such as electroless nickel and tin, which are electrically insulated from one another and cooperate with sleeve members in close physical connection therewith. Reference may be had to coassigned and copending application Ser. No. 6,093 filed Jan. 27, 1970, for further details on the method used to apply the conductive coatings to the polymer. Sleeve **24**, formed of a good electrically conductive material, such as copper, and being of a size and sufficiently thick so that when inserted into the bore of element **22**, is firmly biased against the inside surface thereof. This serves both to make electrical contact with the conductive coating and also to support the coating and prevent it from peeling upon continual cycling of energization. A cap **26** is attached to sleeve **24** at one end thereof by conventional means, such as by soldering, and a pin **28**, attached as by soldering, extends therefrom. It will be understood that cap **26** could be formed integrally with sleeve **24** if so desired. Pin **28** extends through an aperture provided in cap **30** which is received in and closes the open end of shell **12**. Sleeve **32**, also of good electrically conductive material, is placed about the outer periphery of element **22** in tight physical contact therewith and is formed over at **34** as by crimping to enclose header **36**. Header **36** comprises an outer rim **38** of any convenient material, such as aluminum, surrounding an annulus **40** of dielectric material, such as polymer, which in turn supports shelf **42**. Pin **44** extends from shelf **42** and is attached thereto by any convenient means, such as welding. To enhance the electrical connection between pin **44** and sleeve **32**, solder may be placed on surface **34** around the pin location or alternatively, shelf **42** could be electrically connected to rim **38** (not shown).

Element **22** is formed from a polymer material filled with conductive particles and having a PTC effect. The polymer is of a type having crystalline structure, such as a polyolefine, which gives rise to the PTC characteristic, as well as providing the heat storage capabilities associated with the phase change from the crystalline phase to the amorphous phase. A unique advantage that this material offers is that the current, and hence heat generation, is limited by the marked increase in resistance before the material melts. That is, the elongated annulus **22** still maintains its configuration so that there is no need for providing elaborate sealing means as in the case of devices using fusible waxes. Yet the advantages derived from the phase change are utilized. The material is chosen so that using line voltage, resistance will approach the level shown in FIG. 3 by the dashed lines. At this point, heat generation matches heat dissipation with very little change in temperature. Reference may be had to coassigned and copending application Ser. No. 6,086, filed Jan. 27, 1970 for further details on the composition of the polymer material and how it is made.

Combining the heating and heat storing functions by means of the PTC polymeric element results in a very fast warmup time along with the slow-cooling characteristics of the wax-filled devices.

Referring now to FIGS. 3 and 4, another embodiment of the invention is shown. In the FIGS. 1 and 2 embodiment, the electrical connections to the curler are made from opposite ends through pins **28**, **44**. In some cases it is preferred to have both electrical terminals in the same end of the curler. As seen in FIG. 3, sleeve member **112** of suitable electrically conductive material, such as copper, is provided with an axial slit **114** all along its length. This may conveniently be formed by rolling a sheet of material into a cylindrical shape. This configuration is conducive to a tighter fit of the sleeve when it is pressed into the bore of elongated annulus **22**. As in the FIGS. 1 and 2 embodiment, the annulus **22** is coated in the inner and outer surface with a conductive coating to facilitate electrical connection therewith. Sleeve **116**, also of electrically conductive material, such as copper, is tightly fitted on the outer surface of annulus **22** to effect electrical connection therewith. The sleeve is formed with an inwardly extending radial flange **118** on which is placed a washer **120** of electrically insulative material. Terminal **122** is attached to sleeve **116** in any suitably manner, such as by soldering, and cooperates with terminal **124** formed on sleeve **112**. A disc **130** of electrically insulative material formed with apertures **132**, **134** therein for reception of terminals **122**, **124** respectively is provided, and shell **136**, similar to shell **12** of FIGS. 1 and 2, is pressed over the assembly. As seen in FIG. 4, shell **136** has a skirt portion **138** to provide a recessed portion for terminals **122** and **124**. Skirt **138** also fits over base **140** on which the curler is mounted. Terminals **122** and **124** are received in receptacles **142** and **144** which are connected to line voltage. It will be understood that more than one base **140** may be provided on a unitary support, if desired.

Thus the use of a polymer PTC heater for a hair curler results in a very fast warmup time, yet also has a very favorably cooldown time. It further obviates the need for additional thermostats to limit the current since the PTC characteristic effectively limits the current flow when the operating temperature has been reached. Additionally, the polymer is rugged and not subject to damage upon dropping, is extremely uniform in heating along its surface, and is readily shaped using conventional polymer-forming techniques. Structure is also provided which conveniently permits location of the terminals on one end of the curler and which recesses the terminals in a protected environment.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

I claim:

1. An electrically heated hair curler comprising a generally cylindrical outer shell of polymeric material; a generally cylindrical tubular polymeric resistive heating element having an electrically conductive coating on inner and outer peripheral surfaces, the coatings being electrically insulated from one another, the heating element being located within the outer shell in good heat transfer relation therewith;

an inner conductor formed from a generally tubular cylinder of electrically conductive material pressed into the bore of the heating element and in electrical connection with the coating on the inner peripheral surface of the heating element;

a first terminal formed integrally with the inner conductor and extending axially therefrom beyond an end of the heating element;

an outer conductor formed from a generally tubular cylinder of electrically conductive material received around the outer peripheral surface and held tightly thereagainst and in electrical connection with the coating on the outer peripheral surface of the heating element, the outer and inner conductors being electrically insulated from one another;

a second terminal attached to the outer conductor and extending axially therefrom beyond the end of the heating element and aligned with the first terminal; and

a circular disc of electrically insulative material secured to an end of the outer shell and provided with terminal apertures placed so that the first and second terminals pass through respective terminal apertures.

2. A hair curler according to claim 1 in which the inner conductor is of greater thickness than the outer conductor and extends substantially along the length of the heating element.

3. A hair curler according to claim 2 in which the inner conductor is slit along its axial length.

4. A hair curler according to claim 1 in which the outer conductor is formed with an inwardly extending radial flange and the second terminal extends from the inner portion of the flange.

5. A hair curler according to claim 4 in which a washer of electrically insulative material is interposed between the flange and the heating element.

6. A hair curler according to claim 1 in which the outer shell extends axially beyond the first and second terminals and the disc.

7. An electrically heated hair curler comprising a generally cylindrical outer shell of polymeric material; a generally cylindric tubular heating element having an electrically conductive coating on inner and outer peripheral surfaces, the coatings being electrically insulated from one another, the heating element being located within the outer shell in good heat-transfer relation therewith;

an inner conductor formed for a generally tubular cylinder of electrically conductive material and having an axially extending slit pressed into the bore of the heating element and in electrical connection with the coating on the inner peripheral surface of the heating element;

an outer conductor formed of electrically conductive material received on the outer peripheral surface and held tightly thereagainst and in electrical connection with the coating on the outer peripheral surface of the heating element, the outer and inner conductors being electrically insulated from one another; and

terminal means attached to the inner and outer conductors to provide electrical connection therewith.

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