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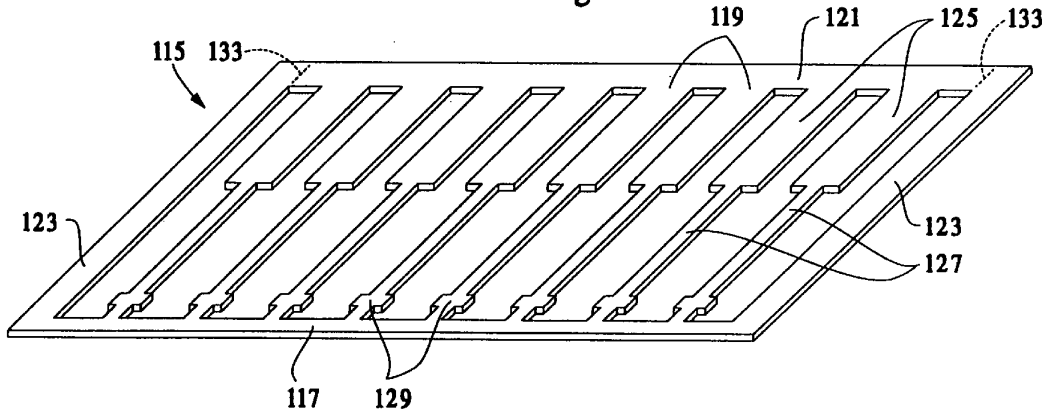
(54) **Method and apparatus for manufacturing a heater assembly for use in an electric smoking system**

(57) A heater assembly (89) for a smoking system is formed by cutting a sheet of resistive material to form a sheet (115) of resistive material connected to one another at at least one end (117,121), and forming that

material into a cylindrical shape. The heater elements may be bowed inwards towards the centerline and to the tight. The edges of the heating elements may electropolished to smooth them and the sheet is formed into

a cylindrical shape before cutting to form the heater elements.

Fig. 7



## Description

[0001] This invention relates to smoking systems in which cigarettes are used with lighters, and in particular to the manufacture of heaters for use in lighters.

[0002] An electrical smoking article is described in our United States Patent No. 5,060,671, which is hereby incorporated by reference in its entirety. That patent described a smoking article which is provided with a disposable set of electrical heating elements. A charge of tobacco flavor medium containing, for example, tobacco or tobacco-derived material is deposited on each of the heating elements. The disposable heater/flavor unit is mated to a source of electrical energy such as a battery or capacitor, as well as to control circuitry to actuate the heating elements in response to a puff by a smoker on the article or in response to the depression of a manual switch. The circuitry is designed so that at least one, but less than all of the heating elements are actuated for any one puff, and so that a predetermined number of puffs, each containing a pre-measured amount of tobacco flavor substance, eg, an aerosol containing tobacco flavors or a flavored tobacco response, is delivered to the smoker. The circuitry also preferably prevents the actuation of any particular heater more than once, to prevent overheating of the tobacco flavor medium thereon.

[0003] With such articles, the heater is thrown away with the spent remainder of tobacco material. Also, the electrical connections between the heaters and the battery must be able to endure repeated release and reconnection as flavor units are replaced.

[0004] In our copending, United States Patent Application Serial No. 07/666,926, filed March 11, 1991, now abandoned in favor of Continuing Application Serial No. 08/012,799, filed February 2, 1993, an electrical smoking article is disclosed that has reusable heating elements and a disposable portion for tobacco flavor generation. The disposable portion preferably includes a flavor segment and a filter segment, attached by a tipping paper or other fastening arrangement. Certain operational difficulties are, however, associated with reusable heating elements, particularly in that residual aerosol tends to settle the condense on the heating elements and other permanent structural components of the article. The present invention aims to provide improvements in lighter and heater elements.

[0005] According to the invention, there is provided a method for manufacturing an integrated heater assembly for use in a smoking system for delivering a flavored tobacco response to a smoker, comprising the steps of:

cutting a sheet of resistive material to form a plurality of heater elements connected to one another at at least one end; and  
forming the sheet into a cylindrical shape.

[0006] The invention also provides apparatus for man-

ufacturing an integrated heater assembly for use in a smoking system for delivering a flavored tobacco response to a smoker, comprising:

5 cutting means for cutting a sheet of resistive material to form a plurality of heater elements connected to one another at at least one end; and  
forming means for forming the sheet in to a cylindrical shape.

10 [0007] The invention further provides a lighter for use in combination with a removable cigarette in a smoking system that delivers a flavored tobacco response to a smoker, the lighter comprising:

15 a heater fixture for receiving, through a first end, a removable cigarette, the heater fixture having means for providing a flow of air to at least a portion of the cigarette; and

20 a plurality of electrical heater elements disposed in the heater fixture, each of the heater elements having a surface for being disposed adjacent a surface of the portion of the cigarette to which the flow of air is provided; and

25 means for individually activating the plurality of heating elements such that a predetermined quantity of flavored tobacco response is generated in the cigarette,

30 wherein, when a smoker draws on a cigarette inserted in the lighter, air flows transversely into the cigarette. A system embodying the invention has the advantage that condensation of aerosol onto heating elements and other structural components of a lighter is minimized.

35 [0008] Embodiments of the invention may have the further advantage of providing improved aerosol and flavor delivery to the smoker.

40 [0009] In accordance with a preferred embodiment of the invention, the lighter includes a heater fixture for receiving, through a first end, a removable cigarette. The heater fixture has means for providing a transverse flow of air to at least a portion of the cigarette. A plurality of electrical heater elements are disposed in the heater fixture. Each of the heater elements has a surface for being disposed adjacent a surface of the portion of the cigarette to which the traverse flow of air is provided. Means are provided for activating one or more of the plurality of electrical heating means such that a predetermined quantity of flavored tobacco response is generated in the cigarette. The transverse flow of air is generated when a smoker draws on a cigarette inserted in the lighter.

45 [0010] Embodiments of the invention in its various aspects will now be described, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a smok-

ing system embodying the invention;

Figure 2 is a partially broken, schematic perspective view of a smoking system embodying the invention;

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Figure 3A is a side, cross-sectional view of a heater fixture of the system of figure 2.

Figure 3B is an end view of taken at section 3B-3B of Figure 3A;

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Figure 4A is a schematic perspective view of a cigarette for use with a lighter embodying the invention;

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Figure 4B is a side cross-sectional view taken at section 4B-4B of Figure 4A;

Figure 5 is a schematic assembly view of a heater fixture made according to the method of the invention;

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Figure 6 is a perspective view of a heater assembly made according to the method of the invention;

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Figure 7 is an outline of a heater assembly made according to the method of the invention;

Figure 8 is a perspective view of a portion of a heater made according to an embodiment of the invention;

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Figure 9 is a perspective view of a pin assembly made according to an embodiment of the invention;

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Figure 10A is a schematic, side cross-sectional view of a spacer embodying the invention;

Figure 10B is a schematic view taken at section 10B-10B of Figure 10A;

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Figure 10C is a schematic view taken at section 10C-10C of Figure 10A;

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Figure 11A is a schematic, side cross-sectional view of a base

Figure 11B is a schematic view taken at section 11B-11B of Figure 11A;

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Figure 11C is a schematic view taken at section 11C-11C of Figure 11A;

Figure 12A is a schematic, perspective view of a combined spacer base member;

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Figure 12B is a schematic, side cross-sectional

view taken at section 12B-12B of Figure 12A;

Figure 12C is a schematic view taken at section 12C-12C of Figure 12A;

Figure 12D is a schematic view taken at section 12D-12D of Figure 12A;

Figure 13 is an end view of a ring;

Figure 14A is a schematic, perspective view of a cap;

Figure 14B is a schematic, side cross-sectional view taken at section 14B-14B of Figure 12A;

Figure 14C is a schematic view taken at section 14D-14D of Figure 14A;

Figure 14D is a schematic view taken at section 14D-14D of Figure 14A;

Figure 15A is a schematic side view of a heater sleeve;

Figure 15B is an end view taken at section 15B-15B of Figure 15A;

Figures 16 and 17 are schematic side cross-sectional views of portions of a smoking system showing air flow paths in the smoking system;

Figure 18 is a schematic circuit diagram showing circuitry;

Figure 19 is a schematic, cross-sectional side view of a further smoking system;

Figure 20 is a schematic, cross-sectional side view of a further heater fixture;

Figure 21 is a schematic perspective view of an apparatus for manufacturing a centre portion of a disposable cigarette of the smoking system in Figure 19;

Figure 22 is a schematic, cross-sectional side view of a peripheral draw embodiment of a smoking system;

Figure 23 is a schematic circuit diagram showing further circuitry; and

Figure 24 is a schematic circuit diagram of a timing network of the control circuit of Figure 23.

### Detailed Description

**[0011]** A smoking system 21 is seen with reference to Figures 1 and 2. The smoking system 21 includes a cigarette 23 and a reusable lighter 25. The cigarette 23 is adapted to be inserted in and removed from an orifice 27 at a front end 29 of the lighter 25. The smoking system 21 is used in much the same fashion as a conventional cigarette. The cigarette 23 is disposed of after one or more puff cycles. The lighter 25 is preferably disposed of after a greater number of puff cycles than the cigarette 23.

**[0012]** The lighter 25 includes a housing 31 and has front and rear portions 33 and 35. A power source 37 for supplying energy to heating elements for heating the cigarette 23 is preferably disposed in the rear portion 35 of the lighter 25. The rear portion 35 is preferably adapted to be easily opened and closed, such as with screws or with snap-fit components, to facilitate replacement of the power source 37. The front portion 33 preferably houses heating elements and circuitry in electrical communication with the power source 37 in the rear portion 35. The front portion 33 is preferably easily joined to the rear portion 35, such as with a dovetail joint or by a socket fit. The housing 31 is preferably made from a hard, heat-resistant material. Preferred materials include metal-based or, more preferably, polymer-based materials. The housing 31 is preferably adapted to fit comfortably in the hand of a smoker and, in a presently preferred embodiment, has overall dimensions of 10.7 cm by 3.8 cm by 1.5 cm.

**[0013]** The power source 37 is sized to provide sufficient power for heating elements that heat the cigarette 23. The power source 37 is preferably replaceable and rechargeable and may include devices such as a capacitor or, more preferably, a battery. In a presently preferred embodiment, the power source is a replaceable, rechargeable battery (actually four nickel cadmium battery cells connected in series) with a total, non-loaded voltage of approximately 4.8 to 5.6 volts. The characteristics required of the power source 37 are, however, selected in view of the characteristics of other components in the smoking system 21, particularly the characteristics of the heating elements. U.S. Patent No. 5,144,962 describes several forms of power sources useful in connection with the smoking system of the present invention, such as rechargeable battery power sources and quick-discharging capacitor power sources that are charged by batteries, and is hereby incorporated by reference.

**[0014]** A substantially cylindrical heating fixture 39 for heating the cigarette 23, and, preferably, for holding the cigarette in place relative to the lighter 25, and electrical control circuitry 41 for delivering a predetermined amount of energy from the power source 37 to heating elements (not seen in FIGS. 1 and 2) of the heating fixture are preferably disposed in the front 33 of the lighter. In the presently preferred embodiment, the heating fix-

ture 39 includes eight radially spaced heating elements 43, seen in FIG. 3A, that are individually energized by the power source 37 under the control of the circuitry 41 to heat eight areas around the periphery of the cigarette 23 to develop eight puffs of a flavored tobacco response. While other numbers of heating elements 43 may be provided, eight heater elements are preferred, at least because there are nominally eight puffs on a conventional cigarette and because eight heater elements lend themselves to electrical control with binary devices.

**[0015]** The circuitry 41 is preferably activated by a puff-actuated sensor 45, seen in FIG. 2, that is sensitive either to pressure changes or air flow changes that occur when a smoker draws on the cigarette 23. The puff-actuated sensor 45 is preferably disposed in the front 33 of the lighter 25 and communicates with a space inside the heater fixture 39 and near the cigarette 23 through a passageway 47 extending through a spacer 49 and a base 50 of the heater fixture and, if desired, a puff sensor tube (not shown). A puff-actuated sensor 45 suitable for use in the smoking system 21 is described in U.S. Patent No. 5,060,671, the disclosure of which is incorporated by reference, and is in the form of a Model 163PC01D35 silicon sensor, manufactured by the MicroSwitch division of Honeywell, Inc., Freeport, Ill., which activates an appropriate one of the heater elements 43 as a result of a change in pressure when a smoker draws on the cigarette 23. Flow sensing devices, such as those using hot-wire anemometry principles, have also been successfully demonstrated to be useful for activating an appropriate one of the heater elements 43 upon detection of a change in air flow.

**[0016]** An indicator 51 is preferably provided on the exterior of the lighter 25, preferably on the front 33, to indicate the number of puffs remaining on a cigarette 23 inserted in the lighter. The indicator 51 preferably includes a seven-segment liquid crystal display. In the presently preferred embodiment, the indicator 51 displays the digit "8" when a light beam emitted by a light sensor 53, seen in FIG. 2, is reflected off of the front of a newly inserted cigarette 23 and detected by the light sensor. The light sensor 53 is preferably mounted in an opening 55 in the spacer 49 and the base 50 of the heater fixture 39, seen, for example, in FIG. 3A. The light sensor 53 provides a signal to the circuitry 41 which, in turn, provides a signal to the indicator 51. The display of the digit "8" on the indicator 51 reflects that the preferred eight puffs provided on each cigarette 23 are available, i.e., none of the heater elements 43 have been activated to heat the new cigarette. After the cigarette 23 is fully smoked, the indicator displays the digit "0". When the cigarette 23 is removed from the lighter 25, the light sensor 53 does not detect the presence of a cigarette 23 and the indicator 51 is turned off. The light sensor 53 is modulated so that it does not constantly emit a light beam and provide an unnecessary drain on the power source 37. A presently preferred light sensor

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