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- [54] **HEATER FOR AN ELECTRIC FLAVOR-GENERATING ARTICLE**
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- [22] Filed: **Sep. 10, 1992**
- [51] Int. Cl.⁵ **A24F 1/22**
- [52] U.S. Cl. **131/194**
- [58] Field of Search **131/194**

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[57] ABSTRACT

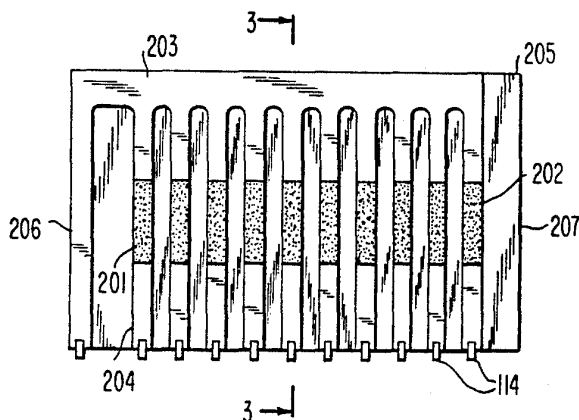
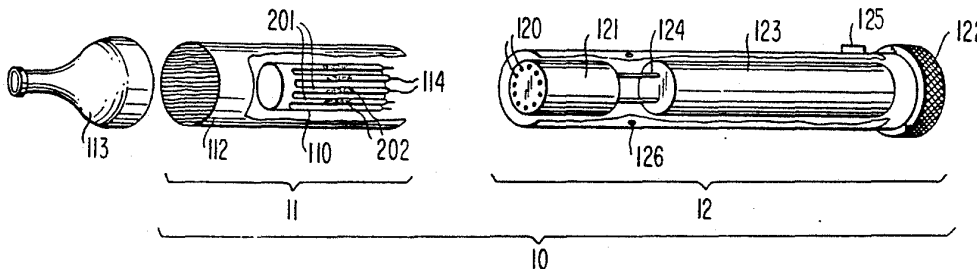
A smoking article is provided in which a flavor-generating medium is heated electrically to release an aerosol for inhalation by a consumer. The smoking article includes a heater having resistive heating elements printed on a flexible substrate. The heater can be manufactured by circuit board mass production techniques, and can be formed to fit inside an article of the same shape and size as a conventional cigarette. Alternatively, the heater comprises an array of heating elements onto which charges of flavor-generating medium are deposited. The heating elements are connected in a manner which allows the temperature increase in the heater to be concentrated in individually selected heating elements, and requires a minimal number of electrical conductors.

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57 Claims, 2 Drawing Sheets



RAI Strategic Holdings, Inc.
 Exhibit 2007
 Philip Morris Products, S.A. v. RAI Strategic Holdings, Inc.
 IPR2020-00919

FIG. 1

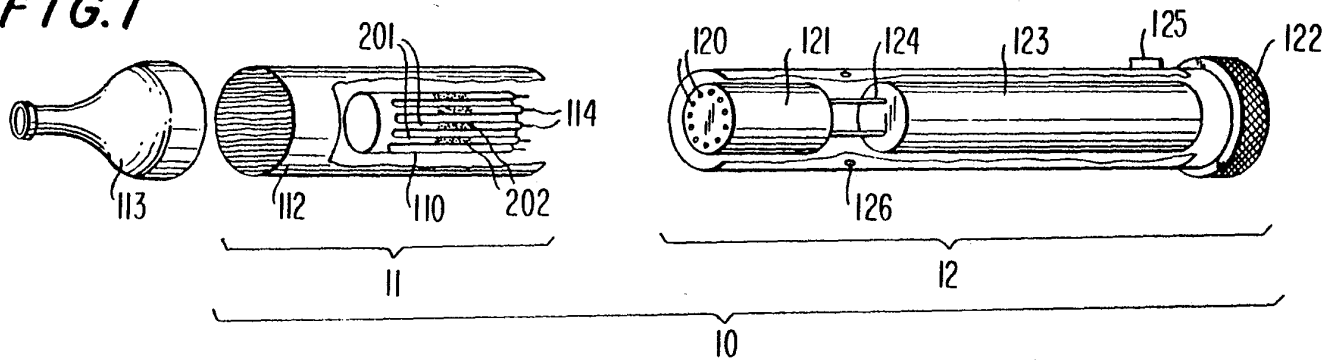
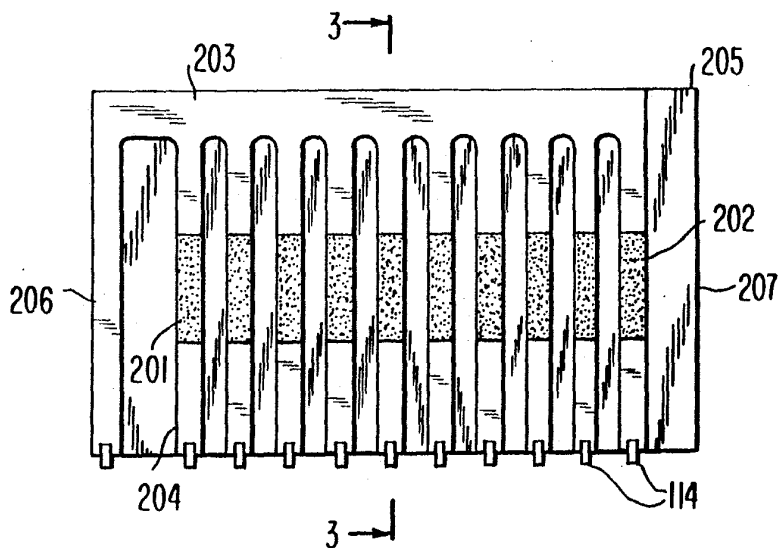


FIG. 2



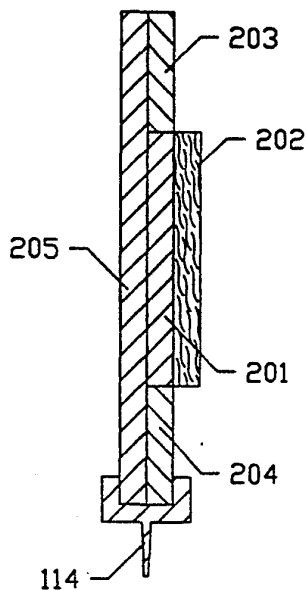
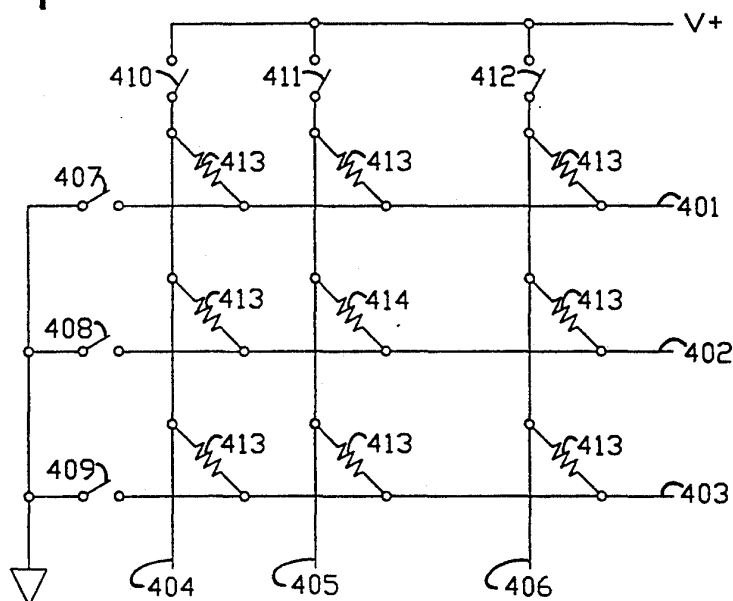


FIG. 3

FIG. 4



HEATER FOR AN ELECTRIC FLAVOR-GENERATING ARTICLE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to flavor-generating articles in which a flavor-generating medium, for example tobacco, is heated electrically to produce a flavor-containing aerosol for delivery to a consumer. More particularly, the invention relates to electrical resistance heaters for such articles.

2. Description of Related Art

Smoking articles utilizing electrical power for heating and thereby releasing flavor from tobacco and other compounds may have certain advantages over conventional smoking articles. For example, electrically-heated smoking articles produce the taste and sensation of smoking, but do not burn tobacco, and thus do not produce all the normal byproducts of tobacco combustion. Also, electrically-heated articles do not produce sidestream smoke.

One previous attempt to provide an electrically-heated smoking article involved heating an entire bed of flavor-generating materials, each time the consumer inhaled, using a single heating element. Another electrically-heated smoking article heated localized charges of flavor-generating material selectively, with a new charge being heated each time the consumer inhaled.

There have been various technical problems with electrically-heated articles. For example, if a large number of heating elements are provided for heating individual flavor-generating charges, the number of electrical connections necessary to supply power to the heating elements becomes large. This can increase the cost of the heater. Also, it may be difficult to mass-produce heaters having individually selectable heating elements. It may also be difficult to manufacture heaters of a suitable shape and size to fit into a smoking article similar in size to a conventional cigarette.

In view of the foregoing, it is an object of the invention to provide a heater which uses a minimal number of electrical connections to heat selectively any one of several individual flavor-generating charges.

It is another object of the invention to provide a heater which can be manufactured by mass-production techniques.

It is a further object of the invention to provide a heater which can be shaped into a configuration suitable for incorporation into a smoking article of the same shape and size as a conventional cigarette.

SUMMARY OF THE INVENTION

These and other objects of the invention are accomplished in accordance with the principles of the present invention by providing an electrical resistance heater manufactured by printing conductive and resistive materials on a flexible substrate. The heater can be manufactured using mass-production printed circuit techniques. The flexibility of the substrate allows the heater to be shaped into a tubular form suitable for incorporation into a smoking article of the same size and shape as a conventional cigarette.

The heater may include several heating elements which are connected in a two-dimensional array configuration. The two-dimensional array requires a minimum

number of electrical connections to selectively concentrate power on an individual heater element.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects of the invention will be apparent from the following detailed description, taken in connection with the accompanying drawings, in which like reference numerals refer to like parts throughout, and in which:

FIG. 1 is a partially fragmentary exploded cut-away perspective view of an embodiment of a smoking article including a heater according to the present invention;

FIG. 2 is a plan view of a preferred embodiment of a heater according to the present invention;

FIG. 3 is a cross-sectional view of the heater of FIG. 2 taken along lines 3—3; and

FIG. 4 is a schematic diagram of an alternative embodiment of a heater according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The heater of the present invention may be used in an electric flavor-generating article, which itself includes a source of electrical energy, electrical or electronic controls for delivering electrical energy from the source of electrical energy to the heaters in a controlled manner, and a flavor-generating medium in contact with the heater. When the heater heats the flavor-generating medium, flavor-containing substance—i.e., a vapor or aerosol, or mixture thereof, containing flavored vapors or aerosols or other vapor or aerosol components—is generated or released and can be drawn in by the consumer.

The flavor-generating medium can be any material that, when heated, releases a flavor-containing substance. Such materials can include tobacco, tobacco condensates or fractions thereof (condensed components of the smoke produced by the combustion of tobacco, leaving flavors and, possibly, nicotine), or tobacco extracts or fractions thereof, deposited on an inert substrate. These materials, when heated, generate or release a flavor-containing substance which can be drawn in by the consumer. Any of these flavor-generating media can also include an aerosol-forming material, such as glycerine or water, so that the consumer has the perception of inhaling and exhaling "smoke" as in a conventional cigarette. A particularly preferred material is a composition such as that described in commonly-assigned U.S. Pat. No. 4,981,522, hereby incorporated by reference in its entirety, which describes pelletized tobacco containing glycerine (as an aerosol-forming ingredient) and calcium carbonate (as a filler). As used in the present invention, the composition, instead of being formed into pellets, would be deposited as a coating (in conjunction with adhesion agents such as citrus pectin) onto heating elements.

The flavor-generating medium is divided into individual charges, each representing one puff of the article. It is possible to mimic a conventional cigarette by providing a number of charges of flavor-generating medium equal to an average number of puffs per cigarette, e.g., eight to ten puffs. Although the article does not decrease in length like a conventional cigarette as it is operated, it is possible to make the article in varying lengths, with different numbers of puffs. By providing individual charges for each puff, one reduces the total amount of flavor-generating medium that must be provided, as compared with a single larger charge that

would be electrically heated or reheated once for each of several puffs.

The portion of the flavor-generating article that contains the heaters and the flavor-generating medium is preferably a replaceable plug-in unit, so that when all of the charges have been heated, the spent plug-in unit can be discarded and a new one inserted. The controls and power source could be retained.

One embodiment of the smoking article 10 according to the invention is shown in FIGS. 1 and 2. Article 10 is the simplest form of article according to the present invention, and includes heater/flavor/mouthpiece section 11 and power/control section 12. Section 11 includes a heater 110, and heater 110 further includes a plurality of heater elements 201, each having deposited on its surface a quantity of flavor-generating medium 202. The heater configuration shown in FIG. 2 is illustrative only. Different possible heater configurations will be discussed below. Preferably, there is a segment of filter material 112, such as conventional cellulose acetate or polypropylene cigarette filter material, possibly in conjunction with paper-wrapped tobacco rod sections, at the mouth end of section 11, to provide appropriate filtration efficiency and resistance-to-draw to the article. In addition, mouthpiece 113 can optionally be included.

As shown in both FIGS. 1 and 2, there are ten heater elements 201 in section 11. There are also eleven contact pins 114 extending from section 11 remote from its mouth end—one common pin and ten pins connected to individual heater elements 201—that fit into eleven sockets 120 on section 12 to make electrical contact between heater 110 and power source 121, the nature of which will be discussed in more detail below.

A knurled knob 122 is provided at the remote end of section 12 to allow the consumer to select one of the heater elements 201. Knob 122 controls a single-pole ten position rotary switch 123 connected by wires 124 to sockets 120.

To operate article 10, the consumer selects a heater element 201 using knob 122 and presses momentary-on pushbutton switch 125 to complete the circuit and energize the selected heater 201 to initiate heating. Flavor-generating medium 202, thus heated, can release or generate a flavor-containing substance. The consumer draws in the flavor-containing substance along with air drawn through perforations 126 in the outer wrapper of sections 11 or 12, which could be conventional cigarette paper or tipping paper. Air may also enter through the end of section 12 remote from the mouth end through channels that may be provided for that purpose, carrying the air around power source 121 and around other internal components of section 12. It is important that the air enter section 11 at a point at which it can fully sweep heater 110 to carry the maximum amount of flavor-generating substance to the mouth of the consumer.

When all ten charges in section 11 have been heated, section 11 is spent, and can be unplugged from section 12. A new section 11 can then be plugged in. Section 12 as envisioned is reusable.

A more preferred embodiment of an article according to the present invention includes controls that automatically select which charge will be heated, initiate heating in response to a certain stimulus (for example, the user's inhalation), and control the duration of the heating of each flavor charge.

A preferred embodiment of heater 110 is shown in FIG. 2. The entire heater is constructed on a flexible substrate 205. FIG. 2 shows a linear arrangement of heating elements 201 with a single common connection 203 and a plurality of heater element connections 204. Heating elements 201 are deposited on substrate 205. A flavor-generating medium 202 (FIG. 3) is then deposited onto each heating element. Alternatively, electrically-resistive materials are mixed with a flavor-generating medium to form the heating elements. The mixture is then printed on the substrate.

Contact pins 114 or other suitable connecting means are provided to couple the heating elements to the power supply. Referring again to FIG. 1, sockets 120 may be provided to connect heater element connections 204 to control unit 12. Each time the consumer initiates a puff, control unit 12 provides power to one or more of heating elements 201. The powered heating element heats an unused charge 202 (FIG. 3) of a flavor-generating medium, thus releasing a flavor-containing aerosol.

Flexible substrate 205 typically is a non-conductive, heat resistant material, with a low dielectric constant. In addition to flexibility, the substrate must exhibit good thermal and mechanical strength characteristics. That is, the substrate must be able to withstand extremely high temperatures (upwards of the 400°–450° C. required to extract tobacco aerosol), without releasing undesired volatiles, melting, bubbling, or otherwise losing its structural integrity or its flexibility. Certain polyamide polymers have been found to remain stable and flexible under these extreme temperature conditions. Specifically, two polymers, Upilex® vended ICI and Kapton® vended DuPont, exhibited no decomposition or deformation even at temperatures upwards of 500° C. Certain fibrous materials have also proven suitable for use in this invention. They include Nomex® vended DuPont, pure cellulose paper and cloth, and paper coated with inorganic salt or sol-gel.

Common connection 203 and heating element connections 204 can be made of any low resistivity conductive material. In the preferred embodiment, the connections are formed of conductive ink which, for example, may include silver in a binder such as a polyester resin. Alternatively, the conductors may be formed of conductive epoxy.

Heater elements 201 are generally made of conductive ink with a resistance chosen such that, when a voltage is applied across common connection 203 and one of heating element connections 204, the temperature of the selected heating element rises sufficiently to release a flavor-containing aerosol from charge 202 of flavor-generating medium. The conductive ink contains an adhesive ingredient. This ingredient has two primary functions in the ink; first, cohesion of the different ingredients in the ink, and second, the adhesion of the ink to the surface of the substrate. It is important that the adhesive agent maintain dimensional integrity (i.e., it must exhibit resistance to shrinkage and creep) under high temperature gradients and high electric field stresses. It is also important that the adhesive agent be resistant to moisture. Epoxy resins are good adhesive agents towards metals, glass, ceramics, and plastics. Also, polyamide epoxy resins are thermally very stable and exhibit good adhesion properties toward polyamide substrates. It is also important that the agent be flexible. Modification of the rigidity of the cured resin can be accomplished by diluting the epoxy system with low concentrations of other, more flexible, resins. This

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