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(54) **SMOKING ARTICLE**

(57) A smoking article (10) is provided and has opposed lighting and mouth ends (14, 18). A mouth end portion is disposed at the mouth end (18) and a heat generation portion is disposed about the lighting end (14). An outer wrapping material (75) is wrapped at least about the heat generation portion and extends toward the mouth end portion, to define a cylindrical rod. An aerosol-generating portion is disposed within the outer wrapping material (75) and between the heat generation and mouth end portions. The aerosol-generating portion is configured to generate an aerosol in response to heat received from the heat generation portion. The aerosol-generating and heat generation portions are further configured to cooperate to distribute heat received by the aerosol-generating portion from the heat generation portion, so as to prevent scorching of the outer wrapping material (75). An associated method is also provided.

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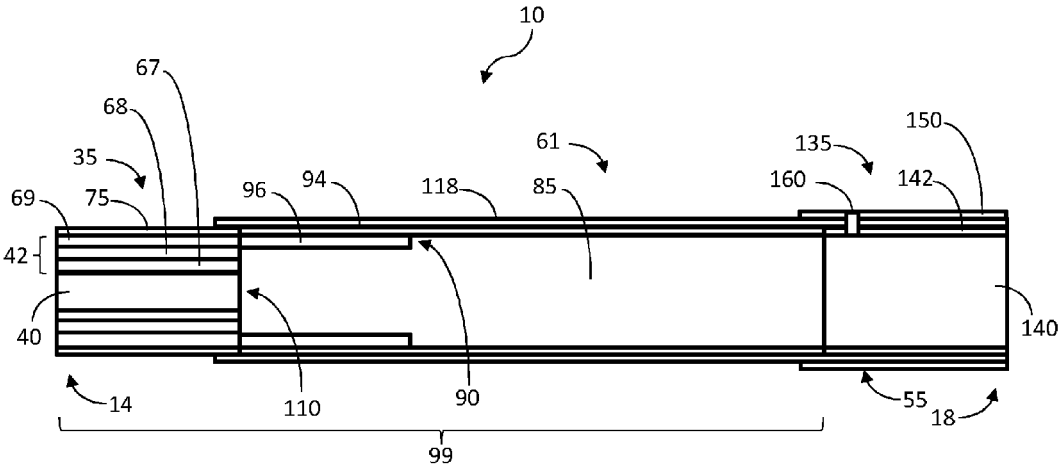
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FIG. 1

Description

BACKGROUND

Field of the Disclosure

[0001] The present disclosure relates to products made or derived from tobacco, or that otherwise incorporate tobacco, and are intended for human consumption; and more particularly, to segmented-type smoking articles that yield aerosols having considerably reduced quantities of incomplete combustion and pyrolysis products relative to tobacco products that produce smoke by burning tobacco.

Disclosure of Related Art

[0002] Popular smoking articles, such as cigarettes, have a substantially cylindrical rod-shaped structure and include a charge, roll or column of smokable material, such as shredded tobacco (e.g., in cut filler form), surrounded by a paper wrapper, thereby forming a so-called "smokable rod", "tobacco rod" or "cigarette rod." Normally, a cigarette has a cylindrical filter element aligned in an end-to-end relationship with the tobacco rod. Preferably, a filter element comprises plasticized cellulose acetate tow circumscribed by a paper material known as "plug wrap." Preferably, the filter element is attached to one end of the tobacco rod using a circumscribing wrapping material known as "tipping paper." It also has become desirable to perforate the tipping material and plug wrap, in order to provide dilution of drawn mainstream smoke with ambient air. Descriptions of cigarettes and the various components thereof are set forth in Tobacco Production, Chemistry and Technology, Davis et al. (Eds.) (1999). A traditional type of cigarette is employed by a smoker by lighting one end thereof and burning the tobacco rod. The smoker then receives mainstream smoke into his/her mouth by drawing on the opposite end (e.g., the filter end or mouth end) of the cigarette. Through the years, efforts have been made to improve upon the components, construction and performance of smoking articles. See, for example, the background art discussed in US Pat. No.7,753,056 to Borschke et al.

[0003] Certain types of cigarettes that employ carbonaceous fuel elements have been commercially marketed under the brand names "Premier" and "Eclipse" by R. J. Reynolds Tobacco Company. See, for example, those types of cigarettes described in Chemical and Biological Studies on New Cigarette Prototypes that Heat Instead of Burn Tobacco, R. J. Reynolds Tobacco Company Monograph (1988) and Inhalation Toxicology, 12:5, p. 1-58 (2000). Additionally, a similar type of cigarette recently has been marketed in Japan by Japan Tobacco Inc. under the brand name "Steam Hot One."

[0004] Various types of smoking products incorporating carbonaceous fuel elements for heat generation and aerosol formation recently have been set forth in the patent literature; and several patent documents provide a historical perspective of the technology related to smoking products that deliver aerosols having chemical compositions that are relatively simple compared to that of mainstream smoke produced by burning tobacco. See, for example, the types of smoking products and associated technologies proposed in U.S. Pat. Nos. 7,647,932 to Cantrell et al.; 7,836,897 to Borschke et al.; 8,469,035 to Banerjee et al.; 8,464,726 to Sebastian et al.; 8,616,217 to Tsuruizumi et al; 8,678,013 Crooks, et al.; and 8,915,255 to Poget et al.; US Pat. Pub. Nos. 2012/0042885 to Stone et al.; and 2013/0133675 to Shinozaki et al.; PCT WO Nos. 2012/0164077 to Gladden et al.; 2013/098380 to Raether et al.; 2013/098405 to Zuber et al.; 2013/098410 to Zuber et al.; 2013/104914 to Woodcock; 2013/120849 to Roudier et al.; 2013/120854 to Mironov; WO 2013/162028 to Azegami et al. and 20132/1600112 to Saleem et al.; EP 1808087 to Baba et al. and EP 2550879 to Tsuruizumi et al.

[0005] It would be highly desirable to provide smoking articles that demonstrate the ability to provide to a smoker much of the enjoyment of conventional cigarette smoking, without delivering aerosol that incorporates considerable quantities of incomplete combustion and pyrolysis products.

BRIEF SUMMARY OF THE DISCLOSURE.

[0006] The above and other needs are met by aspects of the present disclosure which, in one aspect, provides an elongate smoking article having a lighting end and an opposed mouth end, wherein such a smoking article comprises a mouth end portion disposed at the mouth end, and a heat generation portion disposed about the lighting end. An outer wrapping material is wrapped at least about the heat generation portion and extends toward the mouth end portion, so as to define a cylindrical rod. An aerosol-generating portion is disposed within the outer wrapping material and between the heat generation portion and the mouth end portion, wherein the aerosol-generating portion is configured to generate an aerosol in response to heat received from the heat generation portion, and wherein the aerosol-generating portion and the heat generation portion are further configured to cooperate to distribute heat received by the aerosol-generating portion from the heat generation portion, so as to prevent scorching of the outer wrapping material.

[0007] As such, aspects of the present disclosure provide a smoking article, and in particular, a rod-shaped or elongate smoking article, such as a cigarette. The smoking article includes a lighting end (i.e., an upstream end) and a mouth end (i.e., a downstream end), each positioned at opposite ends thereof. The smoking article also includes an aerosol-generating system that comprises: (i) a heat generation region, portion, or segment, and (ii) an aerosol-generating region, portion, or segment located downstream from the heat generation segment. The heat generation segment incorporates a relatively short

(longitudinally-extending) heat source or fuel element (i.e., a heat generation element); comprised of a material such as, for example, a relatively clean burning carbonaceous material. The aerosol-generating segment most preferably includes a substrate region, and in certain embodiments the substrate region incorporates pellets or beads formed from tobacco that are disposed within a substrate cavity. Alternatively, for example, the substrate region incorporates material that includes reconstituted type tobacco (e.g., a shredded cast sheet type of material). The substrate cavity or substrate region where the substrate material is located is preferably circumscribed along the longitudinally extending length of the smoking article by a metal foil (e.g., heat conducting) layer or strip laminated to a paper-type wrapping material. A substrate that is comprised, at least in part of tobacco, acts as a carrier and source of aerosol-forming materials.

[0008] In certain aspects, the present disclosure provides an elongate smoking article that comprises a mouth end segment, region, or portion disposed at the mouth end, and a tobacco rod segment, region, or portion (or other suitably configured segment) disposed between the lighting end and the mouth end portion. An aerosol-generating system is located as a segment disposed between the heat generation segment and the mouth end portion. That is, the aerosol-generating segment is longitudinally disposed adjacent to a heat generation portion or segment disposed at the lighting end; and those two segments are in a heat exchange relationship such that heat produced by combustion of components of the heat generation segment acts upon aerosol forming components of the aerosol-generating segment, and results in the production of aerosol. The longitudinally extending outer surfaces of the heat generation and aerosol-generating segments are circumscribed by an outer wrapping material so as to provide a rod that is in turn attached to the mouth end segment. A layer of heat conductive material is disposed beneath the outer wrapping material so as to provide an outer internal surface of the aerosol-generating segment. The heat conductive layer most preferably overlies the outer longitudinal surface of heat generation segment in the region thereof adjacent to the aerosol-generating segment; and the heat conductive layer optionally can overlie the outer longitudinal surface of the tobacco rod segment in the region thereof adjacent the aerosol-generating segment. Certain materials within the aerosol-generating segment generate aerosol upon the action of and in response to heat produced by a burning fuel element of the heat generation segment.

[0009] In certain aspects, the fuel element or heat source of the heat generation segment may incorporate a material that may be characterized as a carbonized or pyrolyzed material derived from the carbonization or pyrolysis of cotton material. In this regard, it may be preferable and/or desirable for the fuel element/heat source to be ignited and remain burning (i.e., smoldering), but without emitting a flame, during consumption of the smoking article, while producing sufficient heat for actuating the aerosol-generating segment to produce the aerosol. As such, aspects of the present disclosure may be directed to, for example, a fuel element/heat source configured or arranged to facilitate ready ignition or lightability thereof. In some instances, existing fuel elements/heat sources comprised of conventional materials may be optimized to produce the desired ignition/lightability characteristics for the smoking article. In other instances, other substances, such as additives (i.e., test carbons or cotton linters) and/or catalysts may be included in existing fuel elements/heat sources comprised of conventional materials in order to enhance the ignition/lightability characteristics thereof. Representative aspects of such fuel elements / heat sources are disclosed, for example, in U.S. Patent Application Serial No. 14/755,205 to Nordskog et al.

[0010] In certain aspects, the substrate region (aerosol-generating system) incorporates a form of tobacco that forms tobacco smoke exhibiting desirable sensory attributes. For example, the substrate region can be comprised of a mixture of: (i) pellets or beads comprised of tobacco, which pellets and beads act as carriers for an aerosol forming material, such as glycerin (i.e., the aerosol forming material may be included or otherwise incorporated into the beads/pellets or brought into contact with the beads/pellets and sealed thereto by a gelling agent/sealant for maintaining the integrity of the aerosol forming material with the bead/pellet until exposed to heat during use); and (ii) a form of tobacco that forms tobacco smoke exhibiting desirable sensory attributes. Alternatively, for example, the substrate region can be comprised of a mixture of: (i) pieces or parts of a cast sheet type of reconstituted tobacco material that act as carriers for an aerosol forming material, such as glycerin; and (ii) a form of tobacco that forms tobacco smoke exhibiting desirable sensory attributes. In particular aspects, the substrate region/aerosol-generating system, discretely or in cooperation with the heat generation segment, may be configured to more uniformly or efficiently transfer and distribute the heat directed from the heat generation segment to the substrate region/aerosol-generating system. Preferably, such increased uniformity or efficiency in the transfer and distribution of the heat directed from the heat generation segment to the substrate region/aerosol-generating system also advantageously reduces, minimizes or eliminates scorching of the outer wrapping material of the smoking article. In addition, such increased uniformity or efficiency in the transfer and distribution of the heat directed from the heat generation segment to the substrate region/aerosol-generating system may also reduce scorching of the substrate region/aerosol-generating system itself, or at least facilitate a reduction or minimization of adverse sensory effects, caused by scorching of the substrate, on the aerosol inhaled and experienced by the user.

[0011] The present disclosure thus includes, without limitation, the following embodiments:

Embodiment 1:An elongate smoking article having a lighting end and an opposed mouth end, wherein said smoking article comprises a mouth end portion disposed at the mouth end; a heat generation portion disposed about the lighting end; an outer wrapping material wrapped at least about the heat generation portion and extending toward the mouth end portion, so as to define a cylindrical rod; and an aerosol-generating portion disposed within the outer wrapping material and between the heat generation portion and the mouth end portion, the aerosol-generating portion being configured to generate an aerosol in response to heat received from the heat generation portion, the aerosol-generating portion and the heat generation portion being further configured to cooperate to distribute heat received by the aerosol-generating portion from the heat generation portion, so as to prevent scorching of the outer wrapping material.

Embodiment 2: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion comprises a rod member having a length and a maximum diameter, and wherein the rod member has a surface area greater than a surface area of a right cylinder having a length and a maximum diameter equal to the length and the maximum diameter, respectively, of the rod member.

Embodiment 3: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion comprises a fluted rod member.

Embodiment 4: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the fluted rod member defines a channel extending longitudinally therethrough.

Embodiment 5: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the fluted rod member is extruded from a mixture including milled tobacco, calcium carbonate, binder, glycerin, water, and flavoring.

Embodiment 6: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion comprises an aerosol-generating element wrapped by a wrapping material disposed between the aerosol-generating element and the outer wrapping material.

Embodiment 7: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the wrapping material is elected from the group consisting of a paper-foil sheet laminate, a paper-foil-paper sheet laminate, a paper-foil-tobacco sheet laminate, a non-woven graphite sheet, a graphene sheet, a graphene-foil sheet laminate, a graphene-foil-paper sheet laminate, a paper-graphene sheet laminate, a graphene ink imprinted on a paper sheet, a graphene ink imprinted on a foil sheet, carbon nanotubes engaged with a paper sheet or a foil sheet, fullerenes engaged with a paper sheet or a foil sheet, and graphene engaged with a paper sheet or a foil sheet.

Embodiment 8: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the graphene ink is imprinted according to a continuous pattern or a discontinuous pattern on the paper sheet or the foil sheet.

Embodiment 9: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the paper sheet comprises a tobacco wrapping paper sheet, and wherein the tobacco sheet comprises an extruded tobacco sheet, a cast tobacco sheet, or a reconstituted tobacco sheet.

Embodiment 10: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the foil sheet comprises a continuous foil sheet or discrete foil strips.

Embodiment 11: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a tobacco portion disposed within the outer wrapping material, and between the heat generation portion and the aerosol-generating portion.

Embodiment 12: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a tobacco portion disposed within the outer wrapping material, and between the aerosol-generating portion and the mouth end portion

Embodiment 13: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a non-woven graphite sheet or a non-woven composite sheet of graphite and graphene wrapped about a portion of the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

Embodiment 14: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the non-woven graphite sheet is laminated with the outer wrapping material.

Embodiment 15: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a metallic foil sheet laminated with

the outer wrapping material via an adhesive material therebetween, the adhesive material including therein a portion of aluminum hydroxide, and the metallic foil sheet being wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

Embodiment 16: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the outer wrapping material includes therein a portion of aluminum hydroxide, a portion of magnesium hydroxide, or a portion of calcium carbonate.

Embodiment 17: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a glass fiber sheet wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

Embodiment 18: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a heat conductive material engaged with the outer wrapping material, the heat conductive material being disposed within the outer wrapping material and extending to wrap radially at least partially about the heat generation portion and longitudinally from the heat generation portion to the aerosol-generating portion.

Embodiment 19: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the heat conductive material comprises a conductive ink imprinted on the outer wrapping material, a metallic layer deposited on a selected portion of the outer wrapping material, graphene engaged with the outer wrapping material, or a carbon material engaged with a selected portion of the outer wrapping material.

Embodiment 20: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion is comprised of a material selected from the group consisting of a cast sheet of a tobacco material in cut filler form, a sheet of a reconstituted tobacco material in cut filler form, cut filler tobacco material treated with glycerin, aerosol-forming beads, a ceramic material including glycerin, a cast sheet of a non-tobacco material in cut filler form, a glass fiber mat including a tobacco-derived nicotine substance, a foil sheet having an aerosol forming material applied thereto, gathered paper including a tobacco-derived nicotine substance, a non-tobacco material including a tobacco-derived nicotine substance, and combinations thereof.

Embodiment 21: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the cut filler tobacco material treated with glycerin includes between about 5% and about 25% glycerin. **Embodiment 22:** The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion includes a first portion and a second portion, the first portion and the second portion serially disposed between the heat generation portion and the mouth end portion.

Embodiment 23: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion includes a first portion and a second portion, the first portion of the aerosol-generating portion being comprised of a different material than the second portion of the aerosol-generating portion.

Embodiment 24: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion includes a first portion and a second portion, the first and second portions being mixed together to form a single aerosol-generating element.

Embodiment 25: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion comprises a porous ceramic rod member defining at least one conduit extending longitudinally therethrough.

Embodiment 26: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the porous ceramic rod member includes an aerosol former, flavoring, or tobacco extract engaged therewith.

Embodiment 27: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol former comprises glycerin and the tobacco extract comprises tobacco derived nicotine.

Embodiment 28: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the porous ceramic rod member defines a plurality of longitudinally-extending open channels angularly spaced apart about an outer surface thereof.

Embodiment 29: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion is comprised of aerosol-forming beads serially disposed in relation to the heat generation portion, and includes a non-tobacco plug member disposed between the beads

and the mouth end portion.

Embodiment 30: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the aerosol-generating portion comprises a plurality of rod members extending in parallel with each other, the rod members being comprised of a tobacco material, a non-tobacco material, or a ceramic material..

Embodiment 31: The article of any preceding or subsequent embodiment, or combinations thereof, wherein the heat generation portion includes a heating element comprised of a carbonized material or a pyrolyzed material, including an ignitability-enhancing material selected from the group consisting of carbon, cotton linters, glass microspheres, a catalyst, and combinations thereof.

Embodiment 32: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising an overwrap material wrapped at least about the outer wrapping material wrapped at least about the heat generation portion, the overwrap material being embossed so as to be at least partially spaced apart from the outer wrapping material.

Embodiment 33: The article of any preceding or subsequent embodiment, or combinations thereof, further comprising a thermochromic ink material interacted with the outer wrapping material, the thermochromic ink being configured to provide a visual indicium is response to the outer wrapping material exceeding a temperature threshold.

[0012] These and other features, aspects, and advantages of the present disclosure will be apparent from a reading of the following detailed description together with the accompanying drawings, which are briefly described below. The present disclosure includes any combination of two, three, four, or more features or elements set forth in this disclosure or recited in any one or more of the claims, regardless of whether such features or elements are expressly combined or otherwise recited in a specific embodiment description or claim herein. This disclosure is intended to be read holistically such that any separable features or elements of the disclosure, in any of its aspects and embodiments, should be viewed as intended, namely to be combinable, unless the context of the disclosure clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Having thus described the disclosure in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 schematically illustrates a longitudinal cross-sectional view of a representative smoking article, according to one aspect of the disclosure;

FIG. 2 schematically illustrates a longitudinal cross-sectional view of a representative deconstructed smoking article, according to another aspect of the disclosure;

FIG. 3 schematically illustrates a longitudinal cross-sectional view of a representative deconstructed smoking article, according to yet another aspect of the disclosure; and

FIGS. 4 and 5 schematically illustrate aerosol-generating substrate elements, according to alternate aspects of the disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0014] The present disclosure now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all aspects of the disclosure are shown. Indeed, the disclosure may be embodied in many different forms and should not be construed as limited to the aspects set forth herein; rather, these aspects are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

[0015] FIG. 1 illustrates a representative smoking article 10 in the form of a cigarette, according to one aspect of the present disclosure. Preferably, the smoking article 10 has the overall size, shape and general appearance of a filtered cigarette. The smoking article 10 has a rod-like shape, and includes a lighting end 14 and a mouth end 18. At the lighting end 14 is positioned a longitudinally-extending, generally cylindrical, heat generation segment 35. The heat generation segment 35 includes a heat source 40 circumscribed by insulation 42, which most preferably is coaxially encircled by an outer wrapping material 45. The heat source 40 preferably is configured to be activated by direct ignition of the lighting end 14. That is, the heat source or fuel element is designed to be lit so as to burn or smolder, and hence produce heat. The smoking article 10 also includes a filter segment 55 located at the opposing end (i.e., mouth end 18), and an aerosol-generating segment 61 that is located in between the filter segment and the heat source.

[0016] The heat generation segment 35 most preferably includes a combustible fuel element 40 that has a generally cylindrical shape and incorporates a combustible carbonaceous material. Such combustible carbonaceous materials generally have high carbon content. Preferred carbonaceous materials are comprised predominantly of carbon, typically have carbon contents of greater than about 60 percent, generally greater than about 70 percent, often greater than about 80 percent, and frequently greater than about 90 percent, on a dry weight basis. Such combustible fuel elements can incorporate components other than combustible carbonaceous materials (e.g., tobacco components, such as

powdered tobaccos or tobacco extracts; flavoring agents; salts, such as sodium chloride, potassium chloride and sodium carbonate; heat stable graphite fibers; iron oxide powder; glass filaments; powdered calcium carbonate; alumina granules; ammonia sources, such as ammonia salts; and/or binding agents, such as guar gum, ammonium alginate and sodium alginate). A representative fuel element, for example, has a length of about 12 mm and an overall outside diameter of about 4.2 mm. A representative fuel element can be extruded or compounded using a ground or powdered carbonaceous material, and has a density that is greater than about 0.5 g/cm^3, often greater than about 0.7 g/cm^3, and frequently greater than about 1 g/cm^3, on a dry weight basis.

[0017] Layered insulation 42 can be comprised of glass filaments or fibers. The insulation 42 can act as a jacket that assists in maintaining the heat source 40 firmly in place within the smoking article 10 (i.e., disposed between the heat source and the outer wrapping material so as to secure the heat source within the outer wrapping material). Preferably, the insulation is provided in the form of a non-woven mat of glass filaments. The insulation 42 can be provided as a multi-layer component, for example, including an inner layer or mat 67 of non-woven glass filaments, an intermediate layer of reconstituted tobacco paper 68, and an outer layer of non-woven glass filaments 69. These layers may be concentrically oriented or each overwrapping and/or circumscribing the heat source in a continuous overlapping manner.

[0018] Preferably, both ends of the heat generation segment 35 are open to expose at least the heat source 40 and insulation 42 at the lighting end 14. The heat source 40 and the surrounding insulation 42 can be configured so that the length of both materials is co-extensive (i.e., the ends of the insulation 42 are flush with the respective ends of the heat source 40, and particularly at the downstream end of the heat generation segment). Optionally, though not necessarily preferably, the insulation 42 can extend slightly beyond (e.g., from about 0.5 mm to about 2 mm beyond) either or both ends of the heat source 40. Moreover, heat and/or heated air produced when the lighting end 14 is ignited during use of the smoking article 10 can readily pass through the heat generation segment 35 during draw by the smoker on the mouth end 18, through the heat source 40 itself (i.e., through a longitudinal channel extending through the heat source 40) and/or longitudinally through the insulation 42.

[0019] Preferably, an outer wrapping material 75 circumscribes the insulation 42 over the longitudinally extending outermost surface of the lighting end 14 of the smoking article 10. That outer wrapping material 75 typically is a paper wrapping material, such as, for example, the type of paper wrapping materials used to as the circumscribing wrapping materials of the insulation regions of the heat source segments of the cigarettes marketed under the trade names "Premier" and "Eclipse" by R. J. Reynolds Tobacco Company. As such, the "outer wrapping material 75" may also be referred to as the "outer wrapping paper 75" to indicate such aspects, but without limiting the outer wrapping material 75 to a paper wrapping material.

[0020] The heat generation segment 35 preferably is positioned with one end disposed at or very near the extreme lighting end 14, and is axially aligned in an end-to-end serial relationship with a downstream aerosol-generating segment 61, preferably abutting one another, and preferably with no barrier (other than open air-space) therebetween. The close proximity of the heat generation segment 35 to the lighting end 14 provides for direct ignition of the heat source 40 of the heat generation segment 35.

[0021] The cross-sectional shape and dimensions of the heat generation segment 35, prior to burning during use, can vary. Preferably, the cross-sectional area of the fuel element / heat source 40 makes up about 10 percent to about 35 percent, often about 15 percent to about 25 percent of the total cross-sectional area of the heat generation segment 35; while the cross-sectional area of the outer or circumscribing region (comprising the insulation 42 and relevant outer wrapping materials) makes up about 65 percent to about 90 percent, often about 75 percent to about 85 percent of the total cross-sectional area of the heat generation segment 35. For example, for a cylindrical smoking article 10 having a circumference of about 24 mm to about 26 mm, a representative fuel element / heat source 40 has a generally circular cross-sectional shape with an outer diameter of about 2.5 mm to about 5 mm, often about 3 mm to about 4.5 mm.

[0022] The components of the heat generation segment can vary. One component of the heat generation segment is the fuel element. Suitable fuel elements typically comprise carbonaceous materials that possess high carbon contents, and also can include ingredients such as graphite and/or alumina. Carbonaceous fuel elements include those types of components and configurations that have been incorporated within those cigarettes commercially marketed under the trade names "Premier," "Eclipse" and "Steam Hot One." Additionally, representative types of heat generation segments, fuel element features, and representative components, designs and configurations thereof, as well as manners and methods for producing those heat generation segments and fuel elements therefor, are set forth in U.S. Pat. Nos. 4,714,082 to Banerjee et al.; 4,756,318 to Clearman et al.; 4,881,556 to Clearman et al.; 4,989,619 to Clearman et al.; 5,020,548 to Farrier et al.; 5,027,837 to Clearman et al.; 5,067,499 to Banerjee et al.; 5,076,297 to Farrier et al.; 5,099,861 to Clearman et al.; 5,105,831 to Banerjee et al.; 5,129,409 to White et al.; 5,148,821 to Best et al.; 5,156,170 to Clearman et al.; 5,178,167 to Riggs et al.; 5,211,684 to Shannon et al.; 5,247,947 to Clearman et al.; 5,345,955 to Clearman et al.; 5,461,879 to Barnes et al.; 5,469,871 to Barnes et al.; 5,551,451 to Riggs; 5,560,376 to Meiring et al.; 5,706,834 to Meiring et al.; 5,727,571 to Meiring et al.; 7,836,897 to Borschke et al.;

8,617,263 to Banerjee et al. and 8,678,013 to Crooks; and U.S. Pat. App. Pub. Nos. 2005/0274390 to Banerjee et al.; 2007/0215168 to Banerjee et al.; 2012/0042885 to Stone et al.; 2013/0269720 to Stone et al.; and 2015/0083150 to Conner et al. See also, the types of fuel element configurations and components thereof that are described in U.S. Pat. No. 4,819,655 to Roberts et al. and U.S. Pat. App. Pub. No. 2009/0044818 to Takeuchi et al.

[0023] Certain fuel elements can contain high carbon content carbonaceous material that is obtained from cotton-containing fiber (e.g., cotton linters) that have been carbonized or pyrolyzed. For descriptions of cotton linter materials that have been carbonized or pyrolyzed, and manners and methods that those materials have been incorporated into smoking articles, carbonized smoking materials, and fuel elements, see for example, U.S. Pat. Nos. 4,219,031 to Rainer et al.; 4,920,990 to Lawrence et al.; 5,007,440 to Robinson et al.; 5,060,673 to Lehman; 5,129,409 to White et al.; 5,211,684 to Shannon et al.; and 8,119,555 to Banerjee et al. The fuel element of the heat generation segment most preferably is circumscribed or otherwise jacketed by insulation, or other suitable material. The insulation can be configured and employed so as to support, maintain and retain the fuel element in place within the smoking article. The insulation may additionally be configured such that drawn air and aerosol can pass readily therethrough. Suitable insulation assemblies have been incorporated within those types of cigarettes commercially marketed under the trade names "Premier," "Eclipse" "Steam Hot One." Examples of insulation materials, components of insulation assemblies, configurations of representative insulation assemblies within heat generation segments, wrapping materials for insulation assemblies, and manners and methods for producing those components and assemblies, additionally are set forth in U.S. Pat. Nos. 4,807,809 to Pryor et al.; 4,893,637 to Hancock et al.; 4,938,238 to Barnes et al.; 5,027,836 to Shannon et al.; 5,065,776 to Lawson et al.; 5,105,838 to White et al.; 5,119,837 to Banerjee et al.; 5,247,947 to Clearman et al.; 5,303,720 to Banerjee et al.; 5,345,955 to Clearman et al.; 5,396,911 to Casey, III et al.; 5,546,965 to White; 5,727,571 to Meiring et al.; 5,902,431 to Wilkinson et al.; 5,944,025 to Cook et al.; 8,424,538 to Thomas et al.; 8,464,726 to Sebastian et al. and 8,678,013 Crooks et al.

[0024] A longitudinally extending, generally cylindrical aerosol-generating segment 61 is located downstream from the heat generation segment 35. The aerosol-generating segment 61 includes a substrate element 85 comprising a material that is itself an aerosol-forming agent or aerosol-forming substance, or otherwise acts as a carrier for an aerosol-forming agent or material (not shown). For example, the aerosol-generating segment can include a reconstituted tobacco material that includes processing aids, flavoring agents, and/or glycerin. The foregoing components of the aerosol-generating segment can be disposed within, and circumscribed by, a wrapping material 90. The wrapping material 90 can be configured to facilitate the transfer of heat from the lighting end 14 of the smoking article 10 (e.g., from the heat generation segment 35) to components of the aerosol-generating segment 61. That is, the aerosol-generating segment and the heat generation segment can be configured in a heat exchange relationship with one another, wherein such a heat exchange relationship can be facilitated by the wrapping material 90. The heat exchange relationship is such that sufficient heat from the heat source 40 is supplied to the aerosol-generating segment 61 to volatilize aerosol-forming material (i.e., associated with the substrate element 85) for aerosol formation and generation. In some instances, the wrapping material 90 may be a discrete component in relation to the outer wrapping material 75, or may be engaged with the outer wrapping material 75 in various manners. In other instances, the wrapping material 90 may comprise an insulating material for insulating the substrate element 85 from the outer wrapping material 75. For example, the wrapping material 90 may comprise a glass fiber mat having a thickness of between about 50 μm and about 500 μm.

[0025] In one aspect of the present disclosure, the heat exchange relationship is achieved by serially positioning the heat generation and aerosol-generating segments 35, 61 in proximity to one another. In some instances, those segments may be serially arranged in end-to-end contact with each other. A heat exchange relationship also can be achieved by extending a heat conductive material from the vicinity of the heat source 40 into and/or around the region occupied by the aerosol-generating segment 61. For example, in one aspect, a representative wrapping material 90 for the substrate element 85 can include heat conductive elements or properties for conducting heat from the heat generation segment 35 to the aerosol-generating segment 61 (and/or maintaining the heat in interaction with the aerosol-generating segment 61 along a length thereof), in order to provide for the volatilization of the aerosol forming components contained therein (i.e., in association with the substrate element 85). In other aspects, the representative wrapping material 90 and/or the outer wrapping material 75 may include heat conductive properties for dissipating heat not directed from the heat generation segment 35 to the aerosol-generating segment 61, and/or for uniformly or more consistently distributing heat between the heat generation segment 35 and the aerosol-generating segment 61, while still providing for the volatilization of the aerosol forming components contained in the aerosol-generating segment 61 or associated with the substrate element 85. Such a wrapping material 90 can be provided by a laminated paper/foil sheet, for example, comprised of an outer layer 94 of a paper-type material sheet and an inner layer 96 of a heat conductive metallic foil sheet. The metal foil sheet 96 can, for instance, extend from a region downstream from the heat source 40, and along at least a portion of the length of the aerosol-generating segment

61. The metal foil / inner layer 96 laminate can be associated with the outer layer 94 in the form of one or more discrete, longitudinally-extending strips affixed to the outer layer 94, or in the form of a continuous sheet that cooperates with the outer layer 94 to circumscribe the noted region overlapping the heat generation and aerosol-generating segments 35, 61.

[0026] In aspects of the disclosure implementing the wrapping material 90, the heat conductive provision thereof may be accomplished in various manners. Generally, the wrapping material 90, in the form of a laminated paper/foil sheet, may have a typical length (i.e., along the aerosol-generating segment 61) of between about 8 mm and about 50 mm for a representative smoking article of the type described herein. The laminated paper/foil sheet can be perforated, etched, embossed or primed, for example, to enhance ease of manufacturing. In some instances, the thickness of the foil used in the laminate can be varied or increased/decreased as necessary or desired, for example, between about 0.0001 inches and 0.005 inches, in order to alter performance of the laminated paper/foil sheet and/or to reduce visual scorching of the paper sheet portion (i.e., outer layer 94) of the laminate and/or the outer wrapping paper 75 wrapped about the wrapping paper 90 and/or the aerosol-generating segment 61.

[0027] The laminated paper/foil sheet can be formed in different manners. For example, a heat conductive ink (in some instances, a heat conductive metallic ink) may be used to print on the paper portion such that the printed ink forms a foil layer (sheet or strip) on the paper portion (and/or may be at least partially absorbed into/integrated with the paper portion). Such a heat conductive ink may include, for example, carbon, graphite, graphene, silver, or any other suitable heat or thermally conductive material or combinations thereof, to conduct heat along the paper portion, with the conducted heat, in turn, heating the substrate element to generate an aerosol therefrom. Preferably, such heat conductive inks can be printed according to a continuous pattern or a discontinuous pattern on foil sheets or conventional cigarette papers, with basis weights of the cigarette paper ranging from about 20 gsm to about 100 gsm.

[0028] In other instances, a heat or thermally conductive material such as, for example, a metallic foil (i.e., silver), a conductive carbon material (i.e., graphene), or any other suitable heat conductive material or combinations thereof, may be deposited on or otherwise attached in various configurations (i.e., discrete strip, full sheet, complete coating, etc.) to a conventional cigarette paper, e.g., using a "island placement" or selective deposition/engagement technology, for example, to facilitate ease of manufacturing and to enhance functionality. In any instance, the implementation of the laminated paper/foil sheet as the wrapping paper 90 may, in some cases, dissipate or redirect heat produced by the heat generation segment 35 to reduce scorching of the outer wrapping paper 75 and/or other components of the smoking article. As such, the elimination of scorching may improve the taste or sensory perception of the generated aerosol to the user. That is, scorched materials may impart an undesirable taste or sensory perception to the generated aerosol, and reduction, minimization, or elimination of such scorching may, for example, improve the taste of the aerosol to the user, and remove undesirable visual effects caused by such scorching. Accordingly, aspects of the present disclosure involve arrangements for more completely and efficiently directing and distributing the heat generated by the heat generation segment 35 and directed to the aerosol-generating segment 61, without scorching the substrate element 85, the outer wrapping paper 90, or other components that contribute to or otherwise affect the aerosol drawn and experienced by the user. In addition, since the aerosol-generating segment 61 may, in some instances, include glycerin or other leachable substances, the various aspects of the wrapping material 90 disclosed herein may also be directed to preventing or minimizing leaching of the glycerin or other leachable substances from the aerosol-generating segment 61 to the outer wrapping paper 75. That is, aspects of the present disclosure may include a wrapping material 90 configured to prevent or minimize discoloration of the outer wrapping paper 75 which may be caused by glycerin or another leachable substance leaching from the aerosol-generating segment 61.

[0029] In some aspects, the wrapping paper 90 may comprise a cigarette paper / foil / tobacco paper in a tri-laminate sheet form, wherein such a tri-laminate sheet configuration may further facilitate improvement in the taste or sensory perception of the generated aerosol experienced by the user, for example, by reducing, minimizing or eliminating scorching or charring of particular components of the smoking article, and by directing more of the heat toward the aerosol-generating segment61. The tobacco paper/sheet composition may vary and can be comprised of and include different ratios, for example, of burley tobacco, flue cured tobacco, oriental tobacco, or any other suitable type of tobacco or combinations thereof. The tobacco inclusion in the tobacco paper/sheet may be up to about 85% tobacco, and the tobacco paper/sheet may have a basis weight ranging from about 20 gsm to about 100 gsm. In some instances, the tri-laminate form of the wrapping paper 90 may be comprised of tobacco paper / foil / tobacco paper, as necessary or desired. In other instances, a bi-laminate of tobacco paper / foil may be implemented, wherein the tobacco sheet can be laminated to an aluminum or other heat-conductive foil having a thickness ranging from about 0.0005 inches to about 0.002 inches, wherein such a bi-laminate sheet may exhibit a basis weight of between about 60 gsm and about 100 gsm.

[0030] According to yet further aspects, wrapping paper 90 may be configured as any of a paper-foil sheet laminate, a paper-foil-paper sheet laminate, a paper-foil-tobacco sheet laminate, a non-woven graphite sheet, a non-woven graphite and graphene composite sheet, a

graphene sheet, a graphene-foil sheet laminate, a graphene-foil-paper sheet laminate, a paper-graphene sheet laminate, a graphene ink imprinted on a paper sheet, a graphene ink imprinted on a foil sheet, carbon nanotubes engaged with a paper sheet or a foil sheet, fullerenes engaged with a paper sheet or a foil sheet, and graphene engaged with a paper sheet or a foil sheet. In such instances, for example where graphene comprises one of the outer layers of the laminate, it may be desirable for the graphene layer of the laminate to provide the initial layer of the laminate closest to the substrate element 85. In other instances, for example, in the case of a graphene-foil sheet laminate, it may be desirable for the foil sheet layer of the laminate to provide the initial layer of the laminate closest to the substrate element 85, while the graphene layer functions as a heat shield between the substrate element 85 and the outer wrapping material 75, or the order could be reversed, wherein the graphene layer of the laminate is the initial layer of the laminate closest to the substrate element 85, while the foil sheet layer functions as a heat shield between the substrate element 85 and the outer wrapping material 75. In instances where the wrapping paper 90 comprises a heat conducting layer and a paper sheet or foil sheet, an insulating layer or thermal layer may be disposed therebetween.

[0031] In aspects implementing the imprinting, for example, of a graphene ink, the ink may be applied using a variety of printing processes such as, for instance, gravure printing, flexographic printing, off-set printing, screen printed, ink-jet printing, or other appropriate printing method, in order to provide varying thicknesses, patterns, surface coverage, and composition gradients.

[0032] In other aspects, a graphene foil or graphene conductive sheet can be placed between the cigarette paper (i.e., the outer wrapping material 75) and the aluminum foil (i.e., the foil sheet layer associated with the wrapping paper 90) to create a paper/graphene/foil laminate structure encompassing the outer wrapping material 75 and the wrapping paper 90. In such an instance, the graphene portion could be entirely encased (i.e., between inner and outer layers) to prevent or minimize material transfer or migration therefrom during product manufacturing and usage, which may also prevent or minimize any leaching of glycerin from the substrate element 85 to the outer wrapping material 75. One skilled in the art will appreciate, however, that the wrapping material 90 configured to accomplish the purposes herein may be structured and composed in many different manners in addition to the various configurations disclosed herein, and that these exemplary configurations are not intended to be limiting in this regard.

[0033] The outer wrapping paper 75 is generally configured to wrap around the heat generation segment 35 and to extend longitudinally (downstream) so as to wrap about the aerosol-generating segment 61 and along at least a portion of the length thereof. In so being engaged to wrap about the noted components of the smoking article, the outer wrapping paper 75 also extends over the interface between the heat generation segment 35 and the aerosol-generating segment 61 and, as such, may also desirably exhibit no scorching or minimal scorching propensities (as well as anti-leaching propensities). As such, in some aspects of the present disclosure, the outer wrapping paper 75 may be treated with, interacted with, or otherwise exposed to, for example, calcium carbonate ($CaCO_3$), aluminum hydroxide, magnesium hydroxide, and/or combinations thereof as fillers in the paper matrix of the outer wrapping paper 75 at least as anti-scorching agents.

[0034] One skilled in the art will also appreciate that the wrapping paper 90 and/or the outer wrapping material 75, when wrapped about the appropriate components of the smoking article, may have the opposing ends thereof (i.e., the angularly overlapping ends forming a longitudinally extending seam along the smoking article) sealed together, for example, by an adhesive material. Accordingly, in some aspects of the disclosure, the adhesive material may also include a filler such as, for example, calcium carbonate ($CaCO_3$), aluminum hydroxide, magnesium hydroxide, and/or combinations thereof, in order to reduce, minimize or eliminate scorching or charring of the adhesive material and/or the outer wrapping material 75 along the longitudinally-extending seam of the outer wrapping material 75 wrapped about the components of the smoking article.

[0035] The substrate element 85 forming part of the aerosol-generating segment 61 can incorporate tobacco. More particularly, if incorporating tobacco, the substrate element 85 can be comprised of a blend of flavorful and aromatic tobaccos, for example, in cut filler form. Those tobaccos, in turn, can be treated with an aerosol-forming material and/or at least one flavoring agent. The substrate element 85 can also be comprised of a processed tobacco (e.g., a reconstituted tobacco manufactured using cast sheet or papermaking types of processes) in cut filler form. Certain cast sheet constructions may include about 270 mg to about 300 mg of tobacco per 10 mm of linear length of the cast sheet. In other instances, the substrate element 85 can be comprised of a mixture of formed tobacco pellets. In particular aspects of the disclosure, the substrate element 85 comprised of a form of tobacco, in turn, can be treated with, or processed to incorporate, an aerosol-forming material and/or at least one flavoring agent, as well as a burn retardant (e.g., diammonium phosphate, other similar type of salt, and/or other suitable burn retardant materials). The inclusion of the burn retardant material in the substrate element may be configured to prevent ignition of the material forming the substrate and/or to prevent scorching of the substrate element by the heat-generation segment. Additionally, the metallic inner layer or surface 96 of the wrapping material / outer layer 94 of the aerosol-generating segment 61 can act as a carrier for aerosol-forming material, tobacco components and/or at least one flavoring agent.

[0036] As used herein, the term "tobacco pellets" is

meant to include beads, pellets, or other discrete small units of tobacco that has been formed, shaped, compressed, extruded, or otherwise fashioned into a desired shape. For example, tobacco pellets can be formed using a so-called marumarizing process. Tobacco pellets may have smooth, regular outer shapes (e.g., spheres, cylinders, ovoids, etc.) and/or they may have irregular outer shapes. In one example, the diameter of each tobacco pellet may range from less than about 1 mm to about 2 mm. The tobacco pellets may at least partially fill a substrate cavity of a smoking article, as described herein. That is, the substrate element 85 may take the form of pellets or other loose objects that occupy a space within the aerosol-generating segment 61 adjacent to and downstream of the heat generation segment 35. In one example, the volume of the substrate cavity may range from about 500 mm^3 to about 700 mm^3 (e.g., a substrate cavity of a smoking article where the cavity diameter is about 7.5 to about 7.8 mm, and the cavity length is about 11 to about 15 mm, with the cavity having a generally cylindrical geometry). In one example, the mass of the tobacco pellets within the substrate cavity may range from about 200 mg to about 500 mg. For example, the tobacco pellets can be employed so as to fill the appropriate section of the aerosol-generating segment 61 (e.g., the cylindrical region within the wrapping material thereof and bound by the ends of the heat generation segment 35 and the filter segment 55) at a packing density of about 100 to about 400 mg/cm^3.

[0037] The configuration and arrangement of the substrate element 85 can vary according to various aspects of the present disclosure. In one aspect, the substrate element 85 may be formed as a monolithic or integrated structure via, for instance, an extrusion, molding, or casting process. In some preferred aspects, the monolithic substrate element 85 may include tobacco or products of tobacco. For example, in one aspect, the monolithic substrate element 85, formed in an extrusion process, may include glycerin, milled tobacco, calcium carbonate, binder, flavorings, and water. More particularly, on a dry weight basis, the extrudate material may comprise about 37.86% milled tobacco, about 39.82% calcium carbonate, about 1.00% binder such as carboxymethyl cellulose (CMC) or cellulose gum, and about 21.32% glycerin and flavoring (with ~20% being glycerin).

[0038] Monolithic substrate elements 85 formed by an extrusion, molding, or casting process can have different final forms and shapes, wherein the form / shape may facilitate improved heat transfer from the heat generation segment 35 and/or more efficient and effective distribution of heat to the substrate element 85 instead of other proximal components of the smoking article so as to reduce, minimize, or eliminate scorching or charring thereof. For example, an extruded substrate element 85 may have the form and configuration of a monolithic fluted rod member 300 (see, e.g., FIG. 4). That is, the rod member may include a plurality of angularly spaced-apart lobes 310 about the circumference of the rod member, with adjacent lobes defining a longitudinally-extending open channel 320 therebetween. In some instances, the fluted rod member may further define one or more conduits 330 extending longitudinally through a central portion of the cross section thereof, or through one or more of the lobes. The locations, dimensions and/or configurations of the open channels and/or the conduits can be varied, as necessary or desired, to obtain particular performance characteristics. For example, one effect of the open channels and/or is to increase the exposed surface area as compared to a solid cylindrical rod member which, in turn, has such effects as increased cigarette yield (i.e., increased operational life) and decreased pressure drop along the smoking article (i.e., less resistance to draw).

[0039] The effective diameter (i.e., the maximum outside diameter) of the fluted rod member can vary, for example, from about 5.8 mm to about 7.3 mm. In order to incorporate the fluted rod member into the aerosol-generating segment 61, the larger diameter extrusion may be wrapped, for example, with a paper/foil laminate or paper/foil/paper laminate, while the smaller diameter extrusion may be wrapped, for example, with a single layer of glass fiber mat and then further overwrapped with either a paper/foil laminate or a paper/foil/paper laminate, prior to the aerosol-generating segment being wrapped with the outer wrapping material 75 (though any of the configurations of the wrapping material 90 disclosed herein may be implemented as necessary or desired). The increased surface area of the fluted rod member would result in less surface area of the rod member in contact with the wrapping disposed between the rod member and the outer wrapping material 75 which, in turn, causes less heat to be transferred to the outer wrapping material 75 during use of the smoking article. The internal conduits may further provide additional surface area of the rod member that is heated by the heat generation segment, and may serve to draw some of the heat away from the outermost surfaces of the fluted rod member (i.e., the outermost portions of the lobes). As such, visual scorching of the outer wrapping material 75 may be reduced. In addition, the increased surface area of the fluted rod member as compared to a solid cylindrical rod member, which increase in surface area may be further enhanced by the additional conduit(s), may provide additional capacity (i.e., proportional to the surface area of the substrate element 85) of the aerosol forming material incorporated into the substrate element 85 and exposed to the heat from the heat generation segment 35, as well as a reduction in the draw required to be imparted to the smoking article by the user. Accordingly, such a smoking article may exhibit an enhanced service life as compared to a smoking article incorporating a solid cylindrical substrate element 85.

[0040] In the alternative to either a paper/foil laminate or a paper/foil/paper laminate forming an overwrap of the substrate element 85 directly, or with a single layer of glass fiber mat disposed therebetween, a tobacco paper bi-laminate or tri-laminate could be used as the overwrap.

In such instances, should the overwrap experience heat from the heat generation segment sufficient to char or scorch the overwrap, the initial layer of the overwrap laminate may preferably comprise a tobacco paper. In such a manner, the scorching or charring of the tobacco paper layer may provide a tobacco flavor to the formed aerosol, and thus have little or no adverse effect upon the taste or sensory perception of the formed aerosol. More particularly, a tobacco paper, such as a cast sheet or extruded tobacco paper, can be laminated to a paper/foil bi-laminate to form a paper/foil/tobacco paper tri-laminate, with the tobacco paper providing the initial layer of the laminate closest to the substrate element 85. Such a tri-laminate arrangement may be applied, for example to both tobacco-containing and non-tobacco substrate elements and may, for example, facilitate improved adhesion along the seam formed by wrapping the tri-laminate about the substrate element (i.e., the seam would be formed between the tobacco paper and the cigarette paper forming the outer layer of the tri-laminate), and may add positive aspects to the taste and/or sensory perception characteristics of the aerosol experienced by the user. One skilled in the art, in appreciation of the inventive aspects of the present disclosure, will also appreciate that the paper/foil/tobacco paper tri-laminate of the type disclosed herein can also be applied to any of the various tobacco-containing or tobacco-free substrate elements and aerosol-generating segments set forth in the present disclosure.

[0041] In another aspect of the present disclosure, the substrate element 85 may take the form of a plurality of solid cylindrical rod members 400 (see, e.g., FIG. 5) extending in parallel to each other from the interface of the heat generation segment 35 and the aerosol-generating segment 61. Such solid cylindrical rod members may be formed using an extrusion process, or by molding or casting, as appropriate, and may be comprised of, for example, glycerin, milled tobacco, calcium carbonate, binder, flavorings, and water. In some instances, a solid cylindrical rod member may have a diameter of about 2.9 mm, wherein a plurality of such rods may be bundled or stacked for insertion into the aerosol-generating segment 61 as the substrate element 85. The collective solid cylindrical rod members can subsequently be overwrapped in a similar manner, under similar conditions, as the fluted rod member configuration disclosed herein

[0042] In still other aspects, the material composition used for the extruded rods, namely, for example, glycerin, milled tobacco, calcium carbonate, binder, flavorings, and water, may instead be used to form a flat sheet having a thickness of between about 0.3 mm to about 1.7 mm. In some instances, the sheet can also be formed by an extrusion process (or molded or cast, as appropriate), wherein the sheet is then dried to form the substrate material. The dried sheet can then be deconstructed, for example, by cutting the sheet into strips, or shredding the sheet. The cut/shredded portions of the formed sheet may then be stacked or gathered, and deposited in the aerosol-generating segment 61 as the substrate element 85, in a manner similar to cut filler tobacco (i.e., deposited instead of, but in a similar manner to, cut filler tobacco).

[0043] In some aspects, the substrate element 85 may be comprised, for example, of cast sheets including a tobacco material. Such cast sheets can be formed in a process whereby a selected tobacco-containing mixture is cast, dried, and cut into strips or shredded. In some instances, the cut strips or shredded portions of the cast sheet can be mixed with other cut fillers (i.e., a traditional cut filler tobacco, with or without an additional aerosol former) to provide desired taste and sensory perception of the user, as well as to facilitate the manufacturing process. In one example, the selected tobacco-containing mixture may be characterized as a pectin release mixture comprising, for example, (on a dry weight basis) about 66.60% milled tobacco, about 3.75% diammonium phosphate, about 4.65% ammonium hydroxide, and about 25% glycerin and flavoring. To process the pectin release mixture, the milled tobacco, diammonium phosphate, ammonium hydroxide, and water may be heated to about 160°F for about 1.5 hours, for example, to improve or enhance sensory qualities of the resulting mixture. The glycerin and flavorings may then be added to the remainder of the mixture upon cooling following the heating step. The resulting mixture may then be used to form the cast sheet.

[0044] In another example, the selected tobacco-containing mixture may be characterized as a non-ammoniated mixture comprising, for example, (on a dry weight basis) about 65.62% milled tobacco, about 4.50% sodium alginate, about 1.13% sodium hydroxide or other pH adjuster, about 25% glycerin, and about 3.75% wood pulp. To process the non-ammoniated mixture, the milled tobacco, sodium alginate, and water may heated to about 160°F for about 1.5 hours, for example, to improve or enhance sensory qualities of the resulting mixture. Hydrated wood pulp, the binder, glycerin and flavorings may then be added to the remainder of the mixture upon cooling following the heating step. The resulting mixture may then be used to form the cast sheet.

[0045] In another example, the selected tobacco-containing mixture may be characterized as a tobacco-containing reconstituted material comprising, for example, (on a dry weight basis) about 51.8% tobacco pulp, about 4.2% wood pulp, about 22.0% concentrated tobacco extract, and about 22.0% glycerin and flavorings. A sheet may be formed from the tobacco-containing reconstituted material in a similar manner to conventional reconstituted sheet. For example, water soluble elements are first removed from the tobacco pulp lamina and the remaining tobacco pulp concentrated to about 25% solids content. The wood pulp may then be added to the tobacco pulp to form a base sheet that can vary in basis weight from between about 120 grams per square meter (gsm) to about 240 gsm. Glycerin is then mixed with concentrated tobacco derived nicotine (TDN) extract (i.e., in a 1:1 ratio) and added to the base sheet. The formed base

sheet can then be dried, and cut into strips or shredded. Similar to cast sheets, the cut strips or shredded reconstituted sheets can be mixed with other cut fillers (i.e., a traditional cut filler tobacco, with or without an additional aerosol former) (i.e., a traditional cut filler tobacco, with or without an additional aerosol former).

[0046] In another example, the selected tobacco-containing mixture may be characterized as a traditional cut filler tobacco material with elevated glycerin content. In such instances, the cut filler tobacco can be loaded or interacted with between about 5% and about 30% glycerin. The cut filler tobacco material with elevated glycerin content can subsequently be used as the primary substrate (i.e., the substrate material forming the substrate element), or can be mixed with cast sheet material, such that the resulting mixture forms the substrate material of the substrate element. Based on amount of glycerin necessary or desired, the glycerin can be applied to the cut filler tobacco, for example, as a casing for cutting (i.e., applied to individual strips of tobacco), as a top dressing, or as both. Such cut filler tobacco with elevated glycerin content can be, for example, mixed with various cast sheets, reconstituted sheets, and/or tobacco beads, as necessary or desired, to form the substrate material for the substrate element 85. In such instances of a substrate element 85 having elevated glycerin levels, it may be desirable to include overwrapping of the substrate element 85 that will minimize or eliminate any leaching of the incorporated glycerin onto the outer wrapping material 75.

[0047] In yet another example, the selected tobacco-containing mixture may be characterized as a non-tobacco material. For example, a cast sheet used to form a substrate element, an extruded substrate element, or a substrate element in bead (marumerized) form, may include calcium carbonate, rice flour, a binder, diammonium phosphate, glycerin, flavorings, tobacco derived nicotine (TDN), and water. More particularly, such a non-tobacco cast sheet may be comprised of, for instance, about 41.25% calcium carbonate, about 13.75% rice flour, about 6% ammonium alginate, about 5.5% wood pulp, about 3.5% diammonium phosphate, and about 30% glycerin. In addition, tobacco derived nicotine (TDN), certain acids (i.e., levulinic acid and/or citric acid), and flavorings can be incorporated in the glycerin. An extruded substrate element, or a substrate element in bead (marumerized) form can be comprised of, for example, about 51.94% calcium carbonate, about 17.15% rice flour, about 1% TDN, about 1% carboxymethyl cellulose (CMC), about 0.66% levulinic acid, about 0.44% lactic acid, about 20% glycerin, and about 9.41% flavorings. In some instances, the cast sheet may be processed into cut strips, shredded, or processed into cut filler form. In other instances, if the substrate element 85 includes beads, the beads may be positioned to abut the heat generation segment, to be adjacent to the heat generation segment, or to be closest to the heat generation segment. In those instances, a selected component may be implemented opposite to the heat generation segment from the beads, in order to secure the beads in place. For example, such a selected component could include, a folded paper filter material or other non-tobacco paper plug.

[0048] In another example of a substrate element 85 formed of a non-tobacco material, tobacco derived nicotine (TDN), glycerin (i.e., an aerosol former), and flavorings can be added to an extruded ceramic substrate of relatively high porosity (i.e., a high porosity extruded ceramic rod member). In such instances, the ceramic rod member may be extruded so as to define one or more longitudinally-extending channels (i.e., open channels or slots disposed about the outer surface and/or conduits extending through the central portion of the rod member). In a similar manner to the fluted rod member previously disclosed, the increased surface area of the ceramic rod member (i.e., due to the open channels about the surface thereof) would result in less surface area of the rod member in contact with the wrapping disposed between the rod member and the outer wrapping material 75 which, in turn, causes less heat to be transferred to the outer wrapping material 75 during use of the smoking article. The internal conduits may further provide additional surface area of the rod member that is heated by the heat generation segment, and may serve to draw some of the heat away from the outermost surfaces of the fluted ceramic rod member (i.e., the outermost portions of the lobes). As such, visual scorching of the outer wrapping material 75 may be reduced. In addition, the increased surface area of the fluted ceramic rod member as compared to a solid cylindrical rod member, which increase in surface area may be further enhanced by the additional conduit(s), may provide additional capacity (i.e., proportional to the surface area of the substrate element 85) of the aerosol forming material incorporated into the substrate element 85 and exposed to the heat from the heat generation segment 35, as well as a reduction in the draw required to be imparted to the smoking article by the user. Accordingly, such a smoking article may exhibit an enhanced service life as compared to a smoking article incorporating a solid cylindrical substrate element 85. In addition, the open channels / conduits may provide less resistance to draw.

[0049] In some aspects of the present disclosure, the substrate element 85 may be segmented (i.e., the substrate element 85 may include a plurality of serially-disposed components or a plurality of components disposed in parallel), or may include combinations of two or more substrate materials. For example, the substrate element may comprise a combination of cast sheet and/or reconstituted sheet, each shredded or cut into strips, mixed with cut filler tobacco treated with glycerin. The cut filler tobacco can have various levels of glycerin ranging, for example, from about 5% to about 25%. In another example, cast sheet, shredded or cut into strips, may be mixed with tobacco-containing beads. In addition to an extruded substrate element being wrapped with glass fiber mat,

the extruded substrate element 85 may alternatively be wrapped with tobacco paper or a laminate including a tobacco paper layer, wherein the substrate element 85 may be comprised of, for example, a bundle of smaller diameter rod members arranged in parallel, or strips of a cast sheet, extruded sheet or reconstituted tobacco sheet processed in a similar manner to cut filler tobacco, or rolled together to form a substantially cylindrical substrate element.

[0050] In addition to the components disclosed herein, the substrate element 85 may be comprised of many different combinations of such components. In particular aspects, such components may also be additionally selected from the group consisting of, for example, a glass fiber mat having a TDN / glycerin (B3) solution applied thereto, a porous ceramic element having an aerosol former such as glycerin applied thereto, a cast sheet including a pectin release material, a non-ammoniated cast sheet, a non-tobacco cast sheet, a gathered or shredded foil sheet having an aerosol former applied thereto or strips formed therefrom, a non-tobacco product such as gathered paper treated with an extract such as TDN, beads, or gathered carbon or non-carbon paper.

[0051] The components of the aerosol-generating segment can vary. The aerosol-generating segment incorporates components that can be vaporized, aerosolized or entrained in air drawn through the smoking article during use. Most preferably, those components, separately or in combination, provide sensory and organoleptic effects, such as aroma, flavor, mouth feel, visible aerosol sensations, and the like. Examples of components of the aerosol-generating segment that are drawn into the mouth of the smoker during draw include water (e.g., as water vapor), visible aerosol forming materials (e.g., glycerin), various volatile flavors (e.g., vanillin or menthol), volatile components of tobacco (e.g., nicotine), and the like.

[0052] A preferred aerosol-forming material produces a visible aerosol upon the application of sufficient heat thereto, or otherwise through the action of aerosol forming conditions brought about by components of the smoking article. A highly preferred aerosol-forming material produces a visible aerosol that can be considered to be "smoke-like." A preferred aerosol-forming material is chemically simple, relative to the chemical nature of the smoke produced by burning tobacco. A preferred visible aerosol-forming material is a polyol, and exemplary preferred aerosol forming materials include glycerin, propylene glycol, and mixtures thereof. If desired, aerosol forming materials can be combined with other liquid materials, such as water. For example, aerosol forming material formulations can incorporate mixtures of glycerin and water, or mixtures of propylene glycol and water. See, for example, the various aerosol forming materials referenced in U.S. Pat. Nos. 4,793,365 to Sensabaugh, Jr. et al.; 5,101,839 to Jakob et al. and 8,678,013 Crooks, et al.; as well as PCT WO 98/57556 to Biggs et al.

[0053] The materials that can be used to provide the substrates for the aerosol-forming materials within the aerosol-generating region can vary. Suitable substrate elements and associated aerosol-forming materials have been incorporated within those types of cigarettes commercially marketed under the trade names "Premier," "Eclipse" "Steam Hot One." The substrate element can incorporate tobacco of some form, normally is composed predominantly of tobacco, and can be provided by virtually all tobacco material. For example, in some embodiments, at least a portion of the overall substrate material is employed in an essentially traditional filler form (e.g., as cut filler). Suitable substrate materials, and substrate formulations incorporating aerosol-forming materials (including cast sheet and paper type reconstituted tobacco materials), also are set forth in U.S. Pat. Nos. 4,793,365 to Sensabaugh et al.; 4,893,639 to White; 5,099,861 to Clearman et al.; 5,101,839 to Jakob et al.; 5,105,836 to Gentry et al.; 5,109,122 to Clearman et al.; 5,159,942 to Brinkley et al.; 5,203,355 to Clearman et al.; 5,271,419 to Arzonico et al.; 5,327,917 to Lekwauwa et al.; 5,396,911 to Casey, III et al.; 5,533,530 to Young et al.; 5,588,446 to Clearman; 5,598,868 to Jakob et al.; 5,715,844 to Young et al.; 6,378,528 to Beeson et al. and 8,678,013 Crooks, et al.; and U.S. Pat. App. Pub. Nos. 2005/0066986 to Nestor et al.; US 2012/0067360 to Conner et al.; and 2015/0157052 to Ademe et al. Additionally, substrate materials can have the types of forms or configurations set forth in U.S. Pat. No. 8,839,799 to Conner et al.; as a gathered web or sheet, using the types of techniques generally set forth in U.S. Pat. No. 4,807,809 to Pryor et al., or in the form of a web or sheet that is shredded into a plurality of longitudinally extending strands, using the types of techniques generally set forth in U.S. Pat. No. 5,025,814 to Raker.

[0054] The manner by which the aerosol-forming material is contacted with the substrate material (e.g., the tobacco material) can vary. The aerosol-forming material can be applied to a formed tobacco material, or can be incorporated into processed tobacco materials during manufacture of those materials. The aerosol forming material can be dissolved or dispersed in an aqueous liquid, or other suitable solvent or liquid carrier, and sprayed onto that substrate material. See, for example, U.S. Patent Application Pub. No. 2005/0066986 to Nestor et al. The amount of aerosol-forming material employed relative to the dry weight of substrate material can vary. Materials including exceedingly high levels of aerosol-forming material can be difficult to process into cigarette rods using conventional types of automated cigarette manufacturing equipment.

[0055] Cast sheet types of materials may incorporate relatively high levels of aerosol-forming material. Reconstituted tobaccos manufactured using paper-making types of processes may incorporate moderate levels of aerosol-forming material. Tobacco strip and cut filler tobacco can incorporate lower amounts of aerosol-forming material. Various paper and non-paper substrates including gathered, laminated, laminated metal/metallic, strips,

beads such as alumina beads, open cell foam, foamed monolith, air permeable matrices, and other materials can be used within the scope of the disclosure. See, for example, U.S. Pat. Nos. 5,183,062; 5,203,355; and 5,588,446; each to Clearman.

[0056] The laminated paper or other wrapping material may be constructed in accordance with the disclosure of U.S. Pat. No. 6,849,085 to Marton, or in accordance with other appropriate methods and/or materials.

[0057] In some preferred smoking articles, both ends of the aerosol-generating segment 61 are open to expose the substrate element 85 thereof. Together, the heat generating segment 35 and the aerosol-generating segment 61 form an aerosol generation system 99. The aerosol-generating segment is positioned adjacent to the downstream end of the heat generation segment such that those segments are axially aligned in an end-to-end relationship. Those segments can abut one another, or be positioned in a slightly spaced apart relationship, which may include an optional buffer region 110 (which may, in some instances, include a heat conductive and air-porous spacer element). The outer cross-sectional shapes and dimensions of those segments, when viewed transversely to the longitudinal axis of the smoking article 10, can be essentially identical to one another. The physical arrangement of those components preferably is such that heat is transferred (e.g., by mechanisms that includes conductive and convective heat transfer) from the heat source 40 to the adjacent substrate element 85, throughout the time that the heat source is actuated (e.g., burned) during use of the smoking article 10.

[0058] A buffer region 110 may reduce potential scorching or other thermal degradation of portions of the aerosol-generating segment 61. The buffer region may mainly include empty air space, or it may be partially or substantially completely filled with a non-combustible material such as, for example, metal, organic, inorganic, ceramic, or polymeric materials, or any combination thereof. The buffer regions may be from about 1 mm to about 10 mm or more in thickness (length), but often will be about 2 mm to about 5 mm in thickness (length). If desired, the buffer region or spacer segment 110 can incorporate catalytic materials, such as materials incorporating cerium or copper ions or oxides and/or salts of cerium and copper ions. See, for example, U.S. Patent No. 8,469,035 to Banerjee et al. and 8,617,263 to Banerjee et al.; and U. S. Pat. Appl. Pub. Nos. 2007/0215168 to Banerjee et al.

[0059] The components of the aerosol generation system 99 preferably are attached to one another, and secured in place using an overwrap material 118. For example, the overwrap material can include a paper wrapping material or a laminated paper-type material that circumscribes a downstream portion of the heat generation segment 35, and at least a portion of outer longitudinally extending surface of the aerosol-generating segment 61. The inner surface of the overwrap material 118 may be secured to the outer surfaces of the components it circumscribes by a suitable adhesive. One skilled in the art will appreciate that the aspects disclosed herein directed to the reduction, minimization, or elimination of scorching or charring of the outer wrapping material 75 or wrapping paper 90 may thus also be applicable to the overwrap material 118, to the extent that the overwrap material 118 overlaps the outer wrapping material 75 or extends over the interface between the heat generation segment 35 and the aerosol-generating segment 61.

[0060] The smoking article 10 preferably includes a suitable mouthpiece such as, for example, a filter element 135, positioned at the mouth end 18 thereof. The filter element 135 preferably is positioned at one end of the aerosol generation system 99, such that the filter element 135 and the aerosol-generating segment 99 are axially aligned in an end-to-end relationship, abutting one another and without any barrier therebetween. Preferably, the general cross-sectional shapes and dimensions of those segments 99,135 are essentially identical to one another when viewed transversely to the longitudinal axis of the smoking article. The filter element 135 can include filter material 140 that is overwrapped along the longitudinally extending surface thereof with circumscribing plug wrap material 142. In one example, the filter material 140 includes plasticized cellulose acetate tow, or other suitable cigarette-type filter material. Both ends of the filter element 135 preferably are open to permit the passage of aerosol therethrough. In some instances, the filter element 135 may be configured to include any combination of paper plug, void, and conventional cigarette filter material (i.e., cellulose acetate tow), as necessary or desired.

[0061] The filter element may also include a crushable flavor capsule of the type described in U.S. Pat. No. 7,479,098 to Thomas et al. and U.S. Pat. No. 7,793,665 to Dube et al.; and U.S. Pat. No. 8,186,359 to Ademe et al.

[0062] The aerosol-generating system 99 preferably is attached to the filter element 135 using tipping material 150. Examples of tipping materials are described, for example, in U.S. Pat. Nos. 7,789,089 to Dube et al., and in U.S. Pat. App. Publ. Nos. 2007/0215167 to Crooks et al., 2010/0108081 to Joyce et al., 2010/0108084 to Norman et al., and 2013/0167849 to Ademe et al.; and PCT Pat. App. Pub. No. 2013/160671 to Dittrich et al.

[0063] The smoking article 10 may include an air dilution provision, such as a series of perforations 160, each of which may extend through the filter element tipping material 150 and plug wrap material 142. Alternatively, the various perforations can extend around the smoking article as a ring in a region upstream from that shown.

[0064] A representative smoking article 10 has a length of between about 80 mm and about 100 mm. For example, for a smoking article 10 having a length of about 85 mm, a representative heat generation segment 35 can have a length of between about 10 mm and about 15 mm, a representative aerosol-generating segment 61 can have a length of between about 40 mm and about 55 mm, and a representative filter element 135 can have

a length of between about 20 mm and about 30 mm.

[0065] Cigarettes described with reference to FIG. 1 may be used in much the same manner as those cigarettes that have been commercially marketed under the trade names "Premier" and "Eclipse" by R. J. Reynolds Tobacco Company, and "Steam Hot One" by Japan Tobacco Inc. That is, the fuel element or heat source is lit using a match or cigarette lighter. The burning fuel element / heat source resulting from such ignition produces heat which is transferred to the substrate element within the aerosol-generating region of the cigarette. The substrate element(s), including the aerosol forming materials, and tobacco flavors and components, are heated and volatilize, and form aerosol. That aerosol is entrained in drawn air, and drawn through the filter element into the mouth of the smoker.

[0066] FIG. 2 illustrates another representative smoking article 10 in the form of a cigarette, according to another aspect of the present disclosure. Preferably, the smoking article 10 has the overall size, shape and general appearance, and incorporates those types of components, of that smoking article described previously with reference to FIG. 1. However, as compared to the embodiment of FIG. 1, the length of the filter segment 135 is extended, and the length of aerosol-generating segment 61 is decreased. For example, for the embodiment shown, the filter element 135 is a two piece segment; possessing an extreme mouth end segment 182, and a tubular segment 184 positioned between the aerosol-generating segment and the extreme mouth end segment. As such, the representative smoking article of FIG. 2 is a four-segment smoking article, while the representative smoking article of FIG. 1 is a three-segment smoking article.

[0067] Typically, the tubular segment 184 is comprised of a steam bonded and plasticized cellulose acetate tube that provides resilience, structure, and length to the smoking article while allowing for passage of drawn air therethrough. Alternatively, the tubular segment is comprised of a heat resistant plastic material (e.g., a tube comprised of polycarbonate) or a ceramic material.

[0068] A representative smoking article 10 of the type shown in FIG. 2 has a length of between about 80 mm and about 100 mm. For example, for a smoking article 10 having a length of about 85 mm, a representative heat generation segment 35 can have a length of between about 10 mm and about 15 mm, a representative aerosol-generating segment 61 can have a length of between about 10 mm and about 25 mm, a representative tubular segment 184 can have a length of between about 30 mm and about 50 mm, and a representative filter element 135 can have a length of between about 20 mm and about 30 mm.

[0069] FIG. 3 illustrates another representative smoking article 10 in the form of a cigarette. Preferably, the smoking article 10 has the overall size, shape and general appearance, and incorporates those types of components, of that smoking article described previously with reference to FIG. 2. However, a tobacco segment 198 of cut filler tobacco 200 wrapped in a paper wrapper 205 is positioned between the aerosol generation system 99 and the filter element 135. As compared to the embodiment of FIG. 2, the overall length of the two piece filter segment is decreased to accommodate the segment comprised of cut filler tobacco. As such, the representative smoking article of FIG. 3 is a five-segment smoking article, while the representative smoking article of FIG. 2 is a four-segment smoking article.

[0070] The upstream segment of the two piece filter segment 135 can be comprised of a hardened tube comprised of cellulose acetate tow, a segment of cellulose acetate tow having discrete particles of activated carbon particles dispersed throughout, a segment of cellulose acetate having a breakable flavor-containing capsule positioned therein, or the like. Typically, the downstream segment of the two piece filter segment 135 is a segment comprised of plasticized cellulose acetate tow or gathered polypropylene web. If desired, the two piece filter segment can be replaced with a single segment filter element or a three piece cavity filter.

[0071] A representative smoking article 10 of the type shown in FIG. 3 has a length of between about 80 mm and about 100 mm. For example, for a smoking article 10 having a length of about 85 mm, a representative heat generation segment 35 can have a length of between about 10 mm and about 15 mm, a representative aerosol-generating segment 61 can have a length of between about 10 mm and about 25 mm, a representative tobacco filler segment 198 can have a length of between about 30 mm and about 50 mm, and a representative filter element 135 can have an overall length of between about 20 mm and about 30 mm. For a representative filter element for the embodiment shown, the upstream filter element segment 220 can have a length of between about 5 mm and about 20 mm and the downstream filter element segment 225 can have a length of between about 5 mm and about 20 mm. For example, a representative smoking article having an overall length of about 83 mm can have a heat generation segment 35 having a length of about 12 mm, an aerosol-generating segment 61 having a length of about 13 mm, a tobacco filler segment 198 having a length of about 37 mm, a cellulose acetate tube filter segment 220 having a length of about 7 mm and a low efficiency plasticized cellulose acetate tow segment 225 having a length of about 14 mm.

[0072] Typical smoking articles also incorporate various components associated with their construction. For example, those types of components include wrapping materials, heat conductive materials, metallic foils and foil laminates, mouth-end pieces, filter elements, plug wraps, tipping materials and adhesives. Additionally, typical smoking articles can incorporate any of a wide variety of tobacco types, forms of tobacco, and blends thereof. See, for example, those representative types of components that are set forth and referenced in U.S. Pat. Nos. 5,724,997 to Fagg, et al.; 8,678,013 Crooks, et al. and

U.S. Pat. App. Pub. No. 2015/0157052 to Ademe et al.

[0073] Various combinations and varieties of flavoring agents (including various materials that alter the sensory and/or organoleptic character or nature of mainstream aerosol of a smoking article) can be incorporated within suitable smoking articles. The substrate material and various tobacco components of the smoking article can be treated with tobacco additives of the type that are traditionally used for the manufacture of cigarettes, such as casing and/or top dressing components. See, for example, the types of components set forth in U.S. Pat. No. 8,678,013 Crooks, et al.

[0074] Manners and methods for assembling representative types of smoking articles are set forth in U.S. Pat. Nos. 5,469,871 to Barnes et al. and 8,678,013 Crooks, et al.; and U.S. Pat. App. Pub. Nos. 2012/0042885 to Stone et al.; 2012/0067360 to Conner et al.; 2014/0261470 to Amiss et al.; and 2015/0157052 to Ademe et al.

[0075] In light of possible interrelationships between aspects of the present disclosure in providing the noted benefits and advantages associated therewith, the present disclosure thus particularly and expressly includes, without limitation, embodiments representing various combinations of the disclosed aspects. Thus, the present disclosure includes any combination of two, three, four, or more features or elements set forth in this disclosure, regardless of whether such features or elements are expressly combined or otherwise recited in the description of a specific embodiment herein. This disclosure is intended to be read holistically such that any separable features or elements of the disclosure, in any of its aspects and embodiments, should be viewed as intended, namely to be combinable, unless the context of the disclosure clearly dictates otherwise.

[0076] Aerosols that are produced by cigarettes of the present disclosure are those that comprise air-containing components such as vapors, gases, suspended particulates, and the like. Aerosol components can be generated from burning tobacco of some form (and optionally other components that are burned to generate heat); by thermally decomposing tobacco caused by heating tobacco and charring tobacco (or otherwise causing tobacco to undergo some form of smolder); and by vaporizing an aerosol-forming agent. As such, the aerosol can contain volatilized components, combustion products (e.g., carbon dioxide and water), incomplete combustion products, products of pyrolysis, and aerosols otherwise described as smoke.

[0077] Aerosol components also may be generated by the action of heat from burning tobacco of some form (and optionally other components that are burned to generate heat), upon substances that are located in a heat exchange relationship with tobacco material that is burned and other components that are burned. Aerosol components may also be generated by the aerosol generation system as a result of the action of the heat generation segment upon an aerosol-generating segment. In some embodiments, components of the aerosol-generating segment have an overall composition, and are positioned within the smoking article, such that those components will have a tendency not to undergo a significant degree of thermal decomposition (e.g., as a result of combustion, smoldering or pyrolysis) during conditions of normal use.

[0078] Many modifications and other aspects of the disclosures set forth herein will come to mind to one skilled in the art to which these disclosures pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. For example, those of skill in the art will appreciate that embodiments not expressly illustrated herein may be practiced within the scope of the present disclosure, including that features described herein for different embodiments may be combined with each other and/or with currently-known or future-developed technologies while remaining within the scope of the claims presented here. In some such aspects, for instance, alternate provisions for reducing, minimizing or eliminating scorching, charring, or discoloration of the outer wrapping material may be implemented, such as using an embossed overwrap material (i.e., comprised of paper) as a further layer over the outer wrapping material (i.e., cigarette paper). In such instances, the increased surface area provided by the embossing and/or the embossed overwrap material being at least partially spaced apart from the outer wrapping material may cause the overwrap material to act as an external air-cooled device (i.e., cooling fins). In still other instances, various measures could be implemented to provide visual cues of overheating or over-temperature. For example, the embossed overwrap material and/or the outer wrapping material may be printed with a thermochromic ink that visually appears or changes appearance over a temperature threshold or within a specific temperature range, and/or disappears under a temperature threshold or within a specific temperature range. In this manner, for instance, the user may be directed to refrain from using the smoking article in an over-temperature condition until the indicia provide by the thermochromic ink changes in appearance to indicate a suitable temperature of the smoking article, wherein such a measure may prevent over-temperature usage which may lead to the scorching or charring of the outer wrapping material or any other component experiencing the heat generated by the heat generation segment. In still other instances, the outer wrapping material 75 or wrapping paper / material 90 can comprise or have associated therewith a non-woven graphite or graphene sheet as a heat conductive element or otherwise to direct excess heat away from the outer wrapping paper 75. That is, the non-woven graphite or graphene sheet may be wrapped about a portion of the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extend toward the mouth end portion.

[0079] Therefore, it is to be understood that the disclosures are not to be limited to the specific aspects dis-

closed and that equivalents, modifications, and other aspects are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation. Aspects of the present disclosure are more fully illustrated by the examples herein, which are set forth to illustrate certain aspects of the present disclosure and are not to be construed as limiting the scope thereof. Unless otherwise noted, all parts and percentages are by weight.

LIST OF CLAUSES

[0080] The following numbered clauses, which are not claims, provide additional disclosure relevant to the concepts described herein:

CLAUSE 1. An elongate smoking article having a lighting end and an opposed mouth end, said smoking article comprising:

a mouth end portion disposed at the mouth end;
a heat generation portion disposed about the lighting end;
an outer wrapping material wrapped at least about the heat generation portion and extending toward the mouth end portion, so as to define a cylindrical rod; and
an aerosol-generating portion disposed within the outer wrapping material and between the heat generation portion and the mouth end portion, the aerosol-generating portion being configured to generate an aerosol in response to heat received from the heat generation portion, the aerosol-generating portion and the heat generation portion being further configured to cooperate to distribute heat received by the aerosol-generating portion from the heat generation portion, so as to prevent scorching of the outer wrapping material.

CLAUSE 2. The article of Clause 1, wherein the aerosol-generating portion comprises a rod member having a length and a maximum diameter, and wherein the rod member has a surface area greater than a surface area of a right cylinder having a length and a maximum diameter equal to the length and the maximum diameter, respectively, of the rod member.

CLAUSE 3. The article of Clause 1, wherein the aerosol-generating portion comprises a fluted rod member.

CLAUSE 4. The article of Clause 3, wherein the fluted rod member defines a channel extending longitudinally therethrough.

CLAUSE 5. The article of Clause 3, wherein the fluted rod member is extruded from a mixture including milled tobacco, calcium carbonate, binder, glycerin, water, and flavoring.

CLAUSE 6. The article of Clause 1, wherein the aerosol-generating portion comprises an aerosol-generating element wrapped by a wrapping material disposed between the aerosol-generating element and the outer wrapping material.

CLAUSE 7. The article of Clause 6, wherein the wrapping material is elected from the group consisting of a paper-foil sheet laminate, a paper-foil-paper sheet laminate, a paper-foil-tobacco sheet laminate, a non-woven graphite sheet, a graphene sheet, a graphene-foil sheet laminate, a graphene-foil-paper sheet laminate, a paper-graphene sheet laminate, a graphene ink imprinted on a paper sheet, a graphene ink imprinted on a foil sheet, carbon nanotubes engaged with a paper sheet or a foil sheet, fullerenes engaged with a paper sheet or a foil sheet, and graphene engaged with a paper sheet or a foil sheet.

CLAUSE 8. The article of Clause 7, wherein the graphene ink is imprinted according to a continuous pattern or a discontinuous pattern on the paper sheet or the foil sheet.

CLAUSE 9. The article of Clause 7, wherein the paper sheet comprises a tobacco wrapping paper sheet, and wherein the tobacco sheet comprises an extruded tobacco sheet, a cast tobacco sheet, or a reconstituted tobacco sheet.

CLAUSE 10. The article of Clause 7, wherein the foil sheet comprises a continuous foil sheet or discrete foil strips.

CLAUSE 11. The article of Clause 1, further comprising a tobacco portion disposed within the outer wrapping material, and between the heat generation portion and the aerosol-generating portion.

CLAUSE 12. The article of Clause 1, further comprising a tobacco portion disposed within the outer wrapping material, and between the aerosol-generating portion and the mouth end portion

CLAUSE 13. The article of Clause 1, further comprising a non-woven graphite sheet or a non-woven composite sheet of graphite and graphene wrapped about a portion of the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

CLAUSE 14. The article of Clause 13, wherein the

non-woven graphite sheet is laminated with the outer wrapping material.

CLAUSE 15. The article of Clause 1, further comprising a metallic foil sheet laminated with the outer wrapping material via an adhesive material therebetween, the adhesive material including therein a portion of aluminum hydroxide, and the metallic foil sheet being wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

CLAUSE 16. The article of Clause 1, wherein the outer wrapping material includes therein a portion of aluminum hydroxide, a portion of magnesium hydroxide, or a portion of calcium carbonate.

CLAUSE 17. The article of Clause 1, further comprising a glass fiber sheet wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion.

CLAUSE 18. The article of Clause 1, further comprising a heat conductive material engaged with the outer wrapping material, the heat conductive material being disposed within the outer wrapping material and extending to wrap radially at least partially about the heat generation portion and longitudinally from the heat generation portion to the aerosol-generating portion.

CLAUSE 19. The article of Clause 18, wherein the heat conductive material comprises a conductive ink imprinted on the outer wrapping material, a metallic layer deposited on a selected portion of the outer wrapping material, graphene engaged with the outer wrapping material, or a carbon material engaged with a selected portion of the outer wrapping material.

CLAUSE 20. The article of Clause 1, wherein the aerosol-generating portion is comprised of a material selected from the group consisting of a cast sheet of a tobacco material in cut filler form, a sheet of a reconstituted tobacco material in cut filler form, cut filler tobacco material treated with glycerin, aerosol-forming beads, a ceramic material including glycerin, a cast sheet of a non-tobacco material in cut filler form, a glass fiber mat including a tobacco-derived nicotine substance, a foil sheet having an aerosol forming material applied thereto, gathered paper including a tobacco-derived nicotine substance, a non-tobacco material including a tobacco-derived nicotine substance, and combinations thereof.

CLAUSE 21. The article of Clause 20, wherein the cut filler tobacco material treated with glycerin includes between about 5% and about 25% glycerin.

CLAUSE 22. The article of Clause 20, wherein the aerosol-generating portion includes a first portion and a second portion, the first portion and the second portion serially disposed between the heat generation portion and the mouth end portion.

CLAUSE 23. The article of Clause 20, wherein the aerosol-generating portion includes a first portion and a second portion, the first portion of the aerosol-generating portion being comprised of a different material than the second portion of the aerosol-generating portion.

CLAUSE 24. The article of Clause 20, wherein the aerosol-generating portion includes a first portion and a second portion, the first and second portions being mixed together to form a single aerosol-generating element.

CLAUSE 25. The article of Clause 1, wherein the aerosol-generating portion comprises a porous ceramic rod member defining at least one conduit extending longitudinally therethrough.

CLAUSE 26. The article of Clause 25, wherein the porous ceramic rod member includes an aerosol former, flavoring, or tobacco extract engaged therewith.

CLAUSE 27. The article of Clause 26, wherein the aerosol former comprises glycerin and the tobacco extract comprises tobacco derived nicotine.

CLAUSE 28. The article of Clause 25, wherein the porous ceramic rod member defines a plurality of longitudinally-extending open channels angularly spaced apart about an outer surface thereof.

CLAUSE 29. The article of Clause 1, wherein the aerosol-generating portion is comprised of aerosol-forming beads serially disposed in relation to the heat generation portion, and includes a non-tobacco plug member disposed between the beads and the mouth end portion.

CLAUSE 30. The article of Clause 1, wherein the aerosol-generating portion comprises a plurality of rod members extending in parallel with each other, the rod members being comprised of a tobacco material, a non-tobacco material, or a ceramic material..

CLAUSE 31. The article of Clause 1, wherein the heat generation portion includes a heating element comprised of a carbonized material or a pyrolyzed material, including an ignitability-enhancing material

selected from the group consisting of carbon, cotton linters, glass microspheres, a catalyst, and combinations thereof.

CLAUSE 32. The article of Clause 1, further comprising an overwrap material wrapped at least about the outer wrapping material wrapped at least about the heat generation portion, the overwrap material being embossed so as to be at least partially spaced apart from the outer wrapping material.

CLAUSE 33. The article of Clause 1, further comprising a thermochromic ink material interacted with the outer wrapping material, the thermochromic ink being configured to provide a visual indicium is response to the outer wrapping material exceeding a temperature threshold.

Claims

1. An elongate smoking article, comprising:

a mouth end portion;
a heat generation portion;
an outer wrapping material wrapped at least about the heat generation portion and extending toward the mouth end portion, so as to define a rod; and
an aerosol-generating portion disposed within the outer wrapping material and adjacent to the heat generation portion, the aerosol-generating portion comprising an aerosol-generating element wrapped by a wrapping material disposed between the aerosol-generating element and the outer wrapping material and extending from the heat generation portion to the aerosol-generating portion, the wrapping material being a laminate including a heat or thermally conductive material, the aerosol-generating portion being configured to generate an aerosol in response to heat received from the heat generation portion, and the wrapping material, the aerosol-generating portion, and the heat generation portion being further configured to cooperate to distribute heat received by the aerosol-generating portion from the heat generation portion, so as to prevent scorching of the outer wrapping material.

2. The article of Claim 1:

wherein the heat or thermally conductive material comprises a metallic foil, a conductive carbon material, or combinations thereof, deposited on or attached to a layer of the laminate; or
wherein the heat or thermally conductive material is an initial layer of the laminate closest to the aerosol-generating element.

3. The article of Claim 1 or 2:

wherein the wrapping material is selected from the group consisting of a paper-foil sheet laminate, a paper-foil-paper sheet laminate, a paper-foil-tobacco sheet laminate, a laminate including a non-woven graphite and graphene composite sheet, a laminate including a graphene sheet, a graphene-foil sheet laminate, a graphene-foil-paper sheet laminate, a paper-graphene sheet laminate, a laminate including a graphene ink imprinted on a paper sheet or a foil sheet, a laminate including carbon nanotubes engaged with a paper sheet or a foil sheet, a laminate including fullerenes engaged with a paper sheet or a foil sheet, a laminate including graphene engaged with a paper sheet or a foil sheet;
optionally wherein, when the wrapping material includes the graphene ink, the graphene ink is imprinted according to a continuous pattern or a discontinuous pattern on the paper sheet or the foil sheet;
optionally wherein, when the wrapping material includes the paper sheet, the paper sheet comprises a tobacco wrapping paper sheet that is an extruded tobacco sheet, a cast tobacco sheet, or a reconstituted tobacco sheet; or
optionally wherein, when the wrapping material includes the foil sheet, the foil sheet comprises a continuous foil sheet or discrete foil strips.

4. The article of any one of Claims 1 to 3, further comprising:

a non-woven graphite sheet or a non-woven composite sheet of graphite and graphene wrapped about a portion of the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion; optionally wherein the non-woven graphite sheet or the non-woven composite sheet of graphite and graphene is laminated with the outer wrapping material;
a metallic foil sheet laminated with the outer wrapping material via an adhesive material therebetween, the adhesive material including therein a portion of aluminum hydroxide, and the metallic foil sheet being wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping material, and extending toward the mouth end portion;
a glass fiber sheet wrapped about the heat generation portion and about a portion of the aerosol-generating portion, within the outer wrapping

material, and extending toward the mouth end portion;

a heat conductive material engaged with the outer wrapping material, the heat conductive material being disposed within the outer wrapping material and extending to wrap radially at least partially about the heat generation portion and longitudinally from the heat generation portion to the aerosol-generating portion; optionally wherein the heat conductive material comprises a conductive ink imprinted on the outer wrapping material, a metallic layer deposited on a selected portion of the outer wrapping material, graphene engaged with the outer wrapping material, or a carbon material engaged with a selected portion of the outer wrapping material;

an overwrap material wrapped at least about the outer wrapping material wrapped at least about the heat generation portion, the overwrap material being embossed so as to be at least partially spaced apart from the outer wrapping material; or

a thermochromic ink material interacted with the outer wrapping material, the thermochromic ink being configured to provide a visual indicium is response to the outer wrapping material exceeding a temperature threshold.

5. The article of any one of Claims 1 to 4, wherein the aerosol-generating portion is comprised of a material selected from the group consisting of a cast sheet of a tobacco material in cut filler form, a sheet of a reconstituted tobacco material in cut filler form, cut filler tobacco material treated with glycerin, aerosol-forming beads, a ceramic material including glycerin, a cast sheet of a non-tobacco material in cut filler form, a glass fiber mat including a tobacco-derived nicotine substance, a foil sheet having an aerosol forming material applied thereto, gathered paper including a tobacco-derived nicotine substance, a non-tobacco material including a tobacco-derived nicotine substance, and combinations thereof;

optionally wherein the cut filler tobacco material treated with glycerin includes between about 5% and about 25% glycerin;

optionally wherein the aerosol-generating portion includes a first portion and a second portion, the first portion and the second portion serially disposed between the heat generation portion and the mouth end portion;

optionally wherein the aerosol-generating portion includes a first portion and a second portion, the first portion of the aerosol-generating portion being comprised of a different material than the second portion of the aerosol-generating portion; or

optionally the aerosol-generating portion includes a first portion and a second portion, the first and second portions being mixed together to form a single aerosol-generating element.

6. The article of any one of Claims 1 to 4, wherein the aerosol-generating portion comprises a porous ceramic rod member defining at least one conduit extending longitudinally therethrough;

optionally wherein the porous ceramic rod member includes an aerosol former, flavoring, or tobacco extract engaged therewith; optionally wherein, when the porous ceramic rod member includes the aerosol former, the aerosol former comprises glycerin and the tobacco extract comprises tobacco derived nicotine; or

optionally wherein the porous ceramic rod member defines a plurality of longitudinally-extending open channels angularly spaced apart about an outer surface thereof.

7. The article of any one of Claims 1 to 4:

wherein the aerosol-generating portion is comprised of aerosol-forming beads serially disposed in relation to the heat generation portion, and includes a non-tobacco plug member disposed between the beads and the mouth end portion;

wherein the aerosol-generating portion comprises a plurality of rod members extending in parallel with each other, the rod members being comprised of a tobacco material, a non-tobacco material, or a ceramic material; or

wherein the heat generation portion includes a heating element comprised of a carbonized material or a pyrolyzed material, including an ignitability-enhancing material selected from the group consisting of carbon, cotton linters, glass microspheres, a catalyst, and combinations thereof.

8. The article of any one of Claims 1 to 7, wherein the outer wrapping material includes therein a portion of aluminum hydroxide, a portion of magnesium hydroxide, or a portion of calcium carbonate.

9. The article of any one of Claims 1 to 8, further comprising a buffer region between the heat generation portion and the aerosol-generating portion.

10. The article of Claim 9:

wherein the buffer region includes a heat conductive and air-porous spacer element, or defines an empty air space; or

wherein the buffer region is at least partially filled with a non-combustible material or a catalytic

material.

11. The article of Claim 10, wherein, when the buffer region is at least partially filled with the non-combustible material, the non-combustible material includes a metal material, an organic material, an inorganic material, a ceramic material, a polymeric material, or any combination thereof.

12. The article of Claim 10, wherein, when the buffer region is at least partially filled with the catalytic material, the catalytic material includes cerium or copper ions or oxides, or salts of cerium and copper ions.

13. The article of any one of Claims 1 to 12:

wherein the aerosol-generating portion comprises a rod member having a length and a maximum diameter, and wherein the rod member has a surface area greater than a surface area of a right cylinder having a length and a maximum diameter equal to the length and the maximum diameter, respectively, of the rod member; or

wherein the aerosol-generating portion comprises a fluted rod member; optionally wherein the fluted rod member defines a channel extending longitudinally therethrough; or optionally wherein the fluted rod member is extruded from a mixture including milled tobacco, calcium carbonate, binder, glycerin, water, and flavoring.

14. The article of any one of Claim 1 to 13, further comprising:

a tobacco portion disposed within the outer wrapping material, and between the heat generation portion and the aerosol-generating portion; or

a tobacco portion disposed within the outer wrapping material, and between the aerosol-generating portion and the mouth end portion.

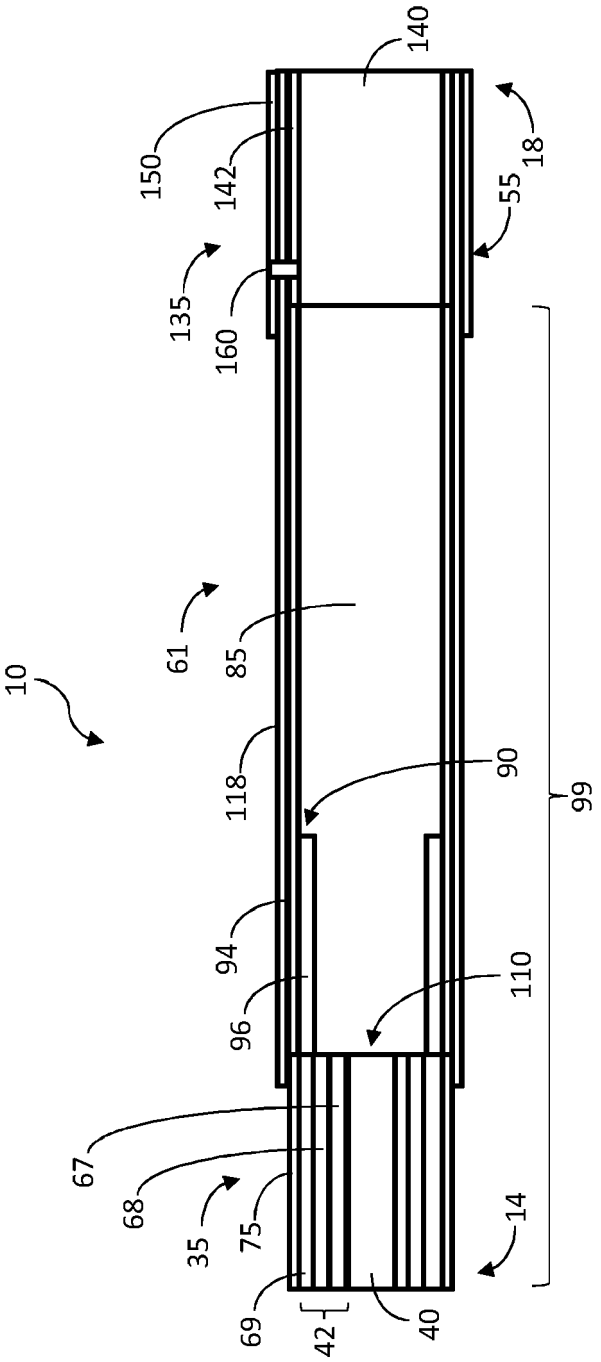
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FIG. 1

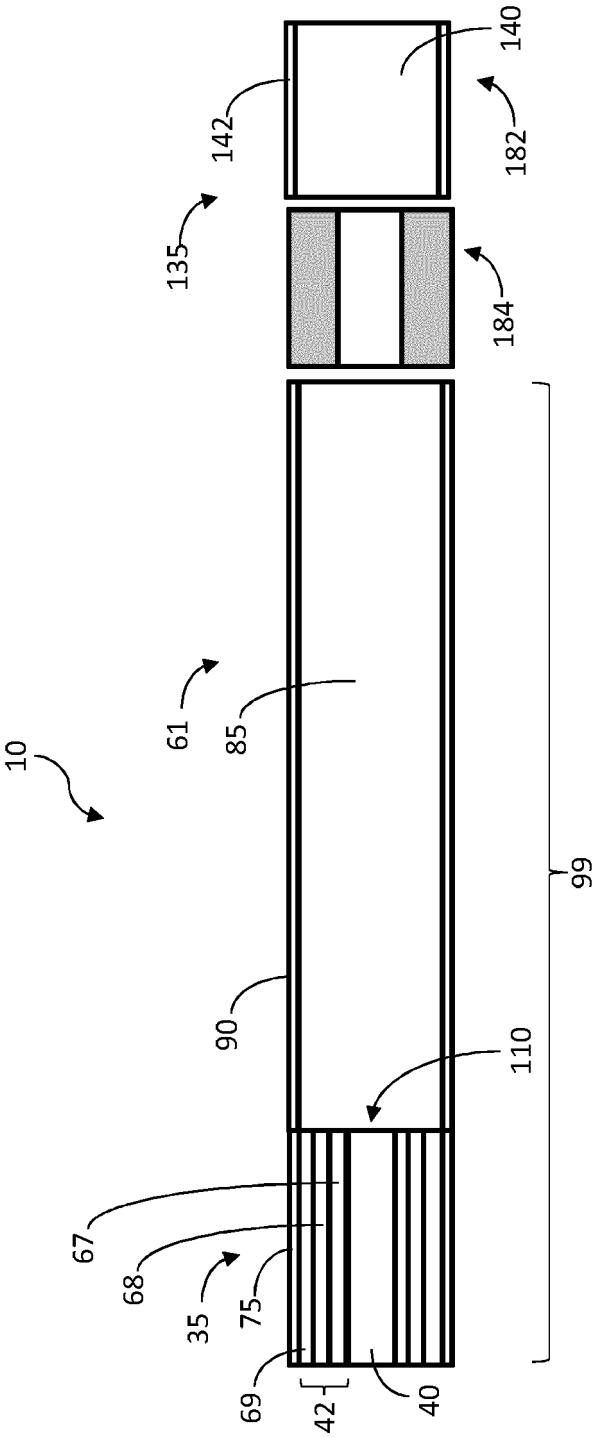

FIG. 2

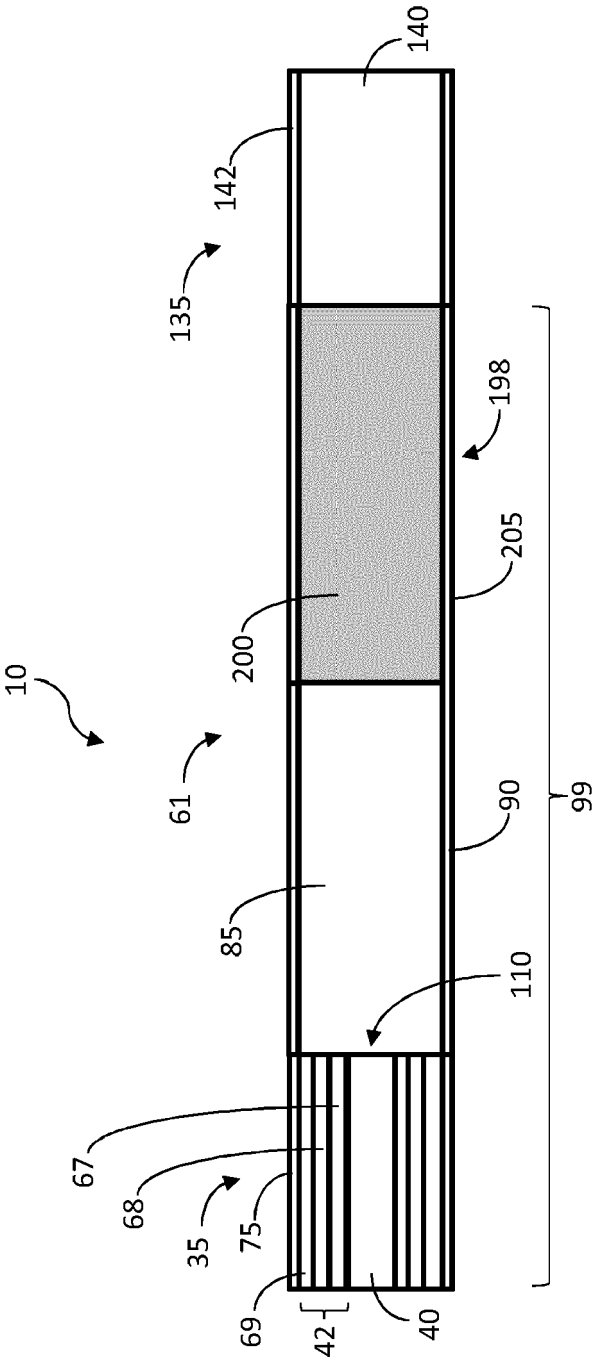

FIG. 3

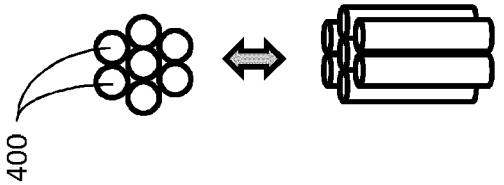

FIG. 5

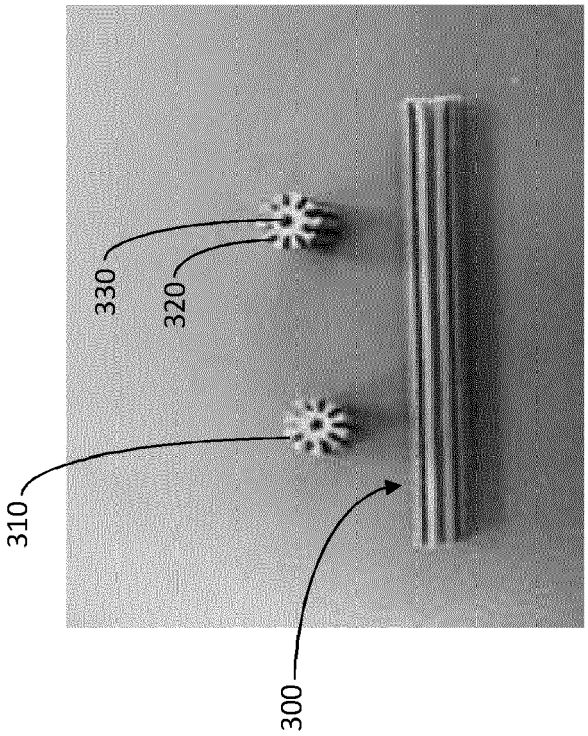

FIG. 4

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