

## Description

The present invention relates to a smoking article having a front end and a rear end and comprising a fuel element having a lighting end, and a physically separate aerosol generating means comprising at least one aerosol forming material and being disposed between the lighting end of the fuel element and said rear end. More particularly, the present invention relates to such a smoking article which produces an aerosol that resembles tobacco smoke, and which contains no more than a minimal amount of incomplete combustion or pyrolysis products.

Many smoking articles have been proposed through the years, especially over the last 20 to 30 years, but none of these products has ever realized any commercial success.

US-A-4 340 072 describes a proposed cigarette type smoking article with a rod-like fuel element having a cigarette paper overwrap and a central axial passage, an aerosol generating means defined by a chamber and a short filter tip all of which are arranged one behind another. The overall length of the smoking article is 70 mm, and its diameter is 7 mm. The fuel element is a moulding or extrusion of reconstituted tobacco and/or tobacco substitute, e. g. of a mixture of carbon and a binder (SCMC), and the front end of its axial passage may be closed by a plug made from the same material and serving the purpose of closing the central axial passage of the fuel element and thereby assisting even lighting of the article. The chamber of the aerosol generating means contains inhalant material which, when contacted by hot gases produced by the burning fuel element and sucked through its axial passage and through the chamber of the aerosol generating means, purportedly forms an aerosol for inhalation by the smoker. According to the drawings of US-A-4 340 072 the length of the rod-like fuel element is about 73 % of the overall length of the cigarette type smoking article and therefore about 51 mm.

EP-A-0 117 355 describes a proposed cigarette type smoking article having a carbon heat source with an axial passageway and a separate flavor generator. The heat source (page 2, line 23 to page 7, line 14) is formed by pyrolyzing a preformed, tube-shaped ligno-cellulosic material of e. g. 90 mm or 65 mm length (see Comparative Example 1 and Example 4, respectively) under specified conditions, followed by at least one additional specified process step. The purported flavor generator (page 8, lines 8 to 27) comprises a substrate material, which may be tobacco, alumina, etc., adjacent the mouth end, which is impregnated with or inherently contains at least one thermally releasable flavorant. The flavor generator also may comprise a flavored,

foamed core inside the heat source. A conventional filter may be placed after the flavor generator. The purported formation of an aerosol during use is described from page 8, line 28 to page 9, line 8. During pyrolysis the tube-shaped ligno-cellulosic material experiences a maximum dimensional shrinkage of 37,5 % (see page 12, lines 3 and 4) so that from a tube-shaped ligno-cellulosic material with a length of 65 mm a carbon heat source with a length of more than 40 mm is obtained.

Despite decades of interest and effort, there is still no smoking article on the market which provides the benefits and advantages associated with conventional cigarette smoking, without delivering considerable quantities of incomplete combustion and pyrolysis products.

It is the object of the present invention to provide a smoking article of the type having a fuel element and a separate aerosol generator which is more efficient during smoking.

According to subject invention this object is achieved by providing a smoking article as defined at the beginning with a resilient insulating member, surrounding at least a portion of the fuel element and comprising inorganic fibers and being at least 0,5 mm thick, and with an overwrap for the insulating member.

In such a smoking article the heat generated by the fuel element during smoking is more efficiently used for producing an aerosol resembling the smoke of a conventional smoking article.

The inventive smoking article is capable of producing substantial quantities of aerosol, both initially and over the useful life of the product, without significant thermal degradation of the aerosol former and without the presence of substantial pyrolysis or incomplete combustion products, and preferably without substantial quantities of sidestream smoke. Smoking articles in accordance with the present invention are capable of providing the user with the sensations and benefits of cigarette smoking, without burning tobacco.

Preferably, the fuel element is less than about 30 mm in length, more preferably less than 15 mm in length, has a density of at least 0.5 g/cc, and is provided with one or more longitudinal passages. Advantageously, the aerosol generating means includes a heat stable substrate including one or more aerosol forming substances. Preferably, the heat exchange relationship between the fuel and the aerosol generator is achieved by providing a heat conducting member, such as a metal foil, which efficiently conducts or transfers heat from the burning fuel element to the aerosol generating means. This heat conducting member preferably contacts the fuel element and the aerosol generating means around at least a portion of their peripheral surfaces. In addition, at least a part of the fuel

element is provided with a peripheral insulating member, such as a jacket of insulating fibers, the jacket being resilient and at least 0.5 mm thick, which reduces radial heat loss and assists in retaining and directing heat from the fuel element toward the aerosol generating means. The insulating member preferably overwraps at least part of the fuel element, and advantageously at least part of the aerosol generating means.

Because the preferred fuel element is relatively short, the hot, burning fire cone is always close to the aerosol generating means, which maximizes heat transfer thereto and maximizes the resultant production of aerosol, especially in embodiments which are provided with a heat conducting member. The preferred use of a relatively short, low mass substrate or carrier as the aerosol generating means, in close proximity to the short fuel element, also increases aerosol production by minimizing the heat sink effect of the substrate. Because the aerosol forming substance is physically separate from the fuel element, it is exposed to substantially lower temperatures than are present in the burning fire cone, thereby minimizing the possibility of thermal degradation of the aerosol former. Moreover, the especially preferred use of a carbonaceous fuel element which is substantially free of volatile organic material eliminates the presence of substantial pyrolysis or incomplete combustion products and eliminates the generation of substantial sidestream smoke.

The smoking article of the present invention normally is provided with a mouthend piece including means, such as a longitudinal passage, for delivering the volatile material produced by the aerosol generating means to the user. Advantageously, the article has the same overall dimensions as a conventional cigarette, and as a result, the mouthend piece and the aerosol delivery means usually extend over more than half the length of the article. Alternatively, the fuel element and the aerosol generating means may be produced without a built-in mouthend piece or aerosol delivery means, for use with a separate, disposable or reusable mouthend piece.

The smoking article of the present invention also may include a charge or plug of tobacco which may be used to add a tobacco flavor to the aerosol. Preferably, the tobacco is placed at the mouth end of the aerosol generating means, or it may be mixed with the carrier for the aerosol forming substance. Flavoring agents also may be incorporated into the article to flavor the aerosol delivered to the user.

Preferred embodiments of the invention are capable of delivering at least 0.6 mg of aerosol, measured as wet total particulate matter, in the first 3 puffs, when smoked under FTC smoking con-

ditions. (FTC smoking conditions consist of two seconds of puffing (35 ml total volume) separated by 58 seconds of smolder). More preferred embodiments of the invention are capable of delivering 1.5 mg or more of aerosol in the first 3 puffs. Most preferably, embodiments of the invention are capable of delivering 3 mg or more of aerosol in the first 3 puffs when smoked under FTC smoking conditions. Moreover, preferred embodiments of the invention deliver an average of at least about 0.8 mg of wet total particulate matter per puff for at least about 6 puffs, preferably at least about 10 puffs, under FTC smoking conditions.

The smoking article of the present invention also is capable of providing an aerosol which is chemically simple, consisting essentially of oxides of carbon, air, water, and the aerosol which carries any desired flavorants or other desired volatile materials, and trace amounts of other materials. The aerosol preferably has no significant mutagenic activity according to the Ames test discussed hereinafter. In addition, the article may be made virtually ashless so that the user does not have to remove any ash during use.

As used herein, and only for the purposes of this application, "aerosol" is defined to include vapors, gases, particles, and the like, both visible and invisible, and especially those components perceived by the user to be "smoke-like," generated by action of the heat from the burning fuel element upon substances contained within the aerosol generating means, or elsewhere in the article. As so defined, the term "aerosol" also includes volatile flavoring agents and/or pharmacologically or physiologically active agents, irrespective of whether they produce a visible aerosol.

As used herein, the phrase "conductive heat exchange relationship" is defined as a physical arrangement of the aerosol generating means and the fuel element whereby heat is transferred by conduction from the burning fuel element to the aerosol generating means substantially throughout the burning period of the fuel element. Conductive heat exchange relationships can be achieved by locating the aerosol generating means in contact with the fuel element and in close proximity to the burning portion of the fuel element, and/or by utilizing a conductive member to carry heat from the burning fuel to the aerosol generating means. Preferably both methods of providing conductive heat transfer are used.

As used herein, the term "carbonaceous" means primarily comprising carbon.

As used herein, the term "insulating means" applies to all materials which act primarily as insulators. Preferably, these materials do not burn during use, but they may include slow burning carbons and like materials, as well as materials

which fuse during use, such as low temperature grades of glass fibers. The insulators have a thermal conductivity in g-cal/(sec) (cm<sup>2</sup>)(°C/cm) , of less than about 0.05, preferably less than about 0.02, most preferably less than about 0.005. See, Hackh's Chemical Dictionary, 34 (4th ed., 1969) and Lange's Handbook of Chemistry, 10, 272-274 (11th ed., 1973).

It is suggested to use a fuel element which has a plurality of longitudinally extending passages therethrough.

A preferred embodiment of the inventive article comprises a heat conducting member which contacts both the fuel element and the aerosol generator means. Preferably, the heat conducting member is metallic. It is then proposed to use as said metallic member a metallic foil which encompasses at least a portion of both the fuel element and the aerosol generator means. For such an article it is proposed to use a metallic member which encloses a substrate bearing the aerosol forming material. In an alternative embodiment the metallic member is a metallic rod embedded within at least a portion of both the fuel element and the aerosol generator means.

It may be advantageous to have the aerosol generating means at least partially contained within a cavity in the fuel element.

Preferably, the aerosol generating means comprises a porous, nonparticulate substrate, having a longitudinal passageway at least partially therethrough.

In a preferred embodiment the aerosol generating means contains a substrate loaded with from about 35 mg to 85 mg of aerosol former. Preferably, at least about 15 weight percent of the aerosol former is delivered as wet total particulate matter under FTC smoking conditions.

A preferred embodiment of the inventive article comprises a charge of tobacco located between the mouth end of the fuel element and the mouth end of the article.

Preferred embodiments of the inventive article are designed such that the fuel element produces substantially no visible sidestream smoke during smolder.

A preferred embodiment of an elongate inventive smoking article comprises a fuel element less than 30 mm in length, a physically separate aerosol generating means including a carrier bearing an aerosol forming material, means for conducting heat from the fuel element to the aerosol generating means, and an insulating member which surrounds at least a portion of the fuel element. Preferably, the heat conducting means comprises a heat conducting member which contacts both the fuel element and the aerosol generating means, and more advantageously the heat conducting

member encloses the carrier for the aerosol forming material.

Further advantageous features are subject of enclosed claims 2 to 89.

The smoking article of the present invention is described in greater detail in the accompanying drawings and in the detailed description of the invention which follow.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1 and 2 are longitudinal views of two embodiments of the invention.

The embodiment of the invention illustrated in Fig. 1, which preferably has the diameter of a conventional cigarette, includes a short, combustible carbonaceous fuel element 10, and an abutting aerosol generating means 30. The fuel element 10 may be an element of "blowpipe" charcoal, i. e. carbonized wood, a pressed or extruded carbon rod or plug, or an other carbonaceous fuel element, and it is provided with one or several longitudinally extending holes 16.

In this embodiment, the aerosol generating means 30 has a thermally stable conductive carbonaceous substrate, such as a plug of porous carbon, which is impregnated with an aerosol forming substance or substances. This substrate may be provided with an optional axial passageway.

The lighting end 11 of the fuel element 10 may be tapered to improve lightability.

The embodiments shown in Figures 1 and 2 include a nonburning insulating jacket 86 around fuel element 10 to insulate and concentrate the heat in the fuel element. These embodiments also help to reduce any fire causing potential of the burning fire cone.

In the embodiment shown in Figure 1, both fuel element 10 and substrate 30 are located within an annular jacket or tube 86 of insulating fibers, such as ceramic (e.g., glass) fibers. Nonburning carbon or graphite fibers may be used in place of ceramic fibers. Fuel element 10 is preferably an extruded carbon plug having a hole 16. In the illustrated embodiment, the lighting end 11 extends slightly beyond the edge of jacket 86 for ease of lighting. Substrate 30 is a solid porous carbon material, although other types of substrates may be used. The substrate and the rear portion of the fuel element are surrounded by a piece of aluminum foil 87. As illustrated, this jacketed fuel/substrate unit is coupled to a mouthend piece, such as the elongated cellulose acetate tube 40 shown in the drawing, with an overwrap of conventional cigarette paper 48. The jacket 86 extends to the mouth end of substrate 30.

The tube 40 also forms an aerosol delivery passage 26 between the aerosol generating means

30 and the mouth end 15 of the article.

The article may include an optional mass or plug of tobacco to contribute flavor to the aerosol. This tobacco charge may be placed at the mouth end of the aerosol generating means 30, or it may be placed in passage 26 at a location spaced from the aerosol generating means 30.

The tube 40 includes an annular section 42 of cellulose acetate tow surrounding an optional plastic, e. g. polypropylene tube 44. As shown in Fig. 1, the jacket 86 extends to the mouth end of substrate 30 but may replace the cellulose acetate rod 42. At the mouth end 15 of tube 44 there is a low efficiency cellulose acetate filter plug 45.

In the embodiment shown in Figure 2, an aluminum macrocapsule 52 is used to enclose a granular substrate 54 and tobacco 56. This macrocapsule is preferably positioned entirely within the insulator jacket 86. In addition, the lighting end 11 of fuel element 10 does not protrude beyond the forward end of jacket 86. Preferably, the macrocapsule and the rear portion of the fuel element are surrounded by a piece of aluminum foil.

Alternatively, the aluminum foil 52 which surrounds the substrate is only crimped at the mouth end. In such an embodiment, the rear end of the fuel element may be inserted into one end of the foil and a polypropylene tube may be fitted over or placed in abutment with the mouth end of the foil. The entire assembly is overwrapped with fiberglass to a diameter of a conventional cigarette.

The granular substrate 54 may be a granular, thermally stable carbon. The capsule 52 is crimped at its ends to enclose the material 54, 56 and to inhibit migration of the aerosol former. The crimped end at the fuel end preferably abuts the rear end of the fuel element to provide for conductive heat transfer. A void spaced formed by the front end of the capsule also helps to inhibit migration of the aerosol former to the fuel. Longitudinal passageways are provided in the crimped ends to permit the passage of air and the aerosol forming substance. Capsule 52 and fuel element 10 may be united by a conventional cigarette paper, a perforated ceramic paper, or a foil strip. If cigarette paper is used, a strip near the rear end of the fuel element should be printed or treated with sodium silicate or other known materials which cause the paper to extinguish.

Upon lighting any of the aforesaid embodiments, the fuel element burns, generating the heat used to volatilize the aerosol forming substance or substances present in the aerosol generating means. These volatile materials are then drawn toward the mouthend, especially during puffing, and into the user's mouth, akin to the smoke of a conventional cigarette.

Because the fuel element preferably is relatively short, the hot, burning fire cone is always close to the aerosol generating body, which maximizes heat transfer to the aerosol generating means, and resultant production of aerosol, especially when the preferred heat conducting member is used. In addition, the preferred insulating member tends to confine, direct, and concentrate the heat toward the central core of the article, thereby increasing the heat transferred to the aerosol forming substance.

Because the aerosol forming substance is physically separate from the fuel element, it is exposed to substantially lower temperatures than are present in the burning fire cone. This minimizes the possibility of thermal degradation of the aerosol former. This also results in aerosol production during puffing, but little or no aerosol production during smolder. In addition, the use of the preferred carbonaceous fuel elements and a physically separate aerosol generating means eliminates the presence of substantial pyrolysis or incomplete combustion products and avoids the production of substantial sidestream smoke.

Because of the small size and burning characteristics of the preferred carbonaceous fuel element employed in the present invention, the fuel element usually begins burning over substantially all of its exposed length within a few puffs. Thus, the portion of the fuel element adjacent to the aerosol generating means becomes hot quickly, which significantly increases heat transfer to the aerosol generating means, especially during the early and middle puffs. Because the preferred fuel element is short, there is never a long section of nonburning fuel to act as a heat sink, as was common in previous thermal aerosol articles. Heat transfer, and therefor aerosol delivery, also is enhanced by the use of holes through the fuel, which draw hot air to the aerosol generator, especially during puffing.

In the preferred embodiments of the invention, the short carbonaceous fuel element, heat conducting member, insulating means, and passages in the fuel cooperate with the aerosol generator to provide a system which is capable of producing substantial quantities of aerosol, on virtually every puff. The close proximity of the fire cone to the aerosol generator after a few puffs, together with the insulating means, results in high heat delivery both during puffing and during the relatively long period of smolder between puffs.

While not wishing to be bound by theory, it is believed that the aerosol generating means is maintained at a relatively high temperature between puffs, and that the additional heat delivered during puffs, which is significantly increased by the hole or holes in the fuel element, is primarily uti-

lized to vaporize the aerosol forming substance. This increased heat transfer makes more efficient use of the available fuel energy, reduces the amount of fuel needed, and helps deliver early aerosol. Further, the conductive heat transfer utilized in the present invention is believed to reduce the carbon fuel combustion temperature which, it is further believed, reduces the CO/CO<sub>2</sub> ratio in the combustion products produced by the fuel. See, e.g., G. Hagg, General Inorganic Chemistry, at p. 592 (John Wiley & Sons, 1969).

Furthermore, by the appropriate selection of the fuel element, the insulating jacket, the paper overwrap, and the heat conducting means, it is possible to control the burn properties of the fuel source. This provides opportunities for control of heat transfer to the aerosol generator, which in turn, alters the number of puffs and/or the amount of aerosol delivered to the user.

In general, the combustible fuel elements which may be employed in practicing the invention are less than about 30 mm long. Advantageously the fuel element is about 20 mm or less, preferably about 15 mm or less in length. Advantageously, the diameter of the fuel element is between about 3 and 8 mm, preferably about 4 to 5 mm. The density of the fuel elements employed herein has ranged from about 0.5 g/cc to about 1.5 g/cc. Preferably, the density is greater than 0.7 g/cc., more preferably greater than 0.8 g/cc. Preferably, the fuel is provided with one or more longitudinally extending holes, such as holes 16 in Figures 1 and 2. These holes provide porosity and increase early heat transfer to the substrate by increasing the amount of hot gases which reach the substrate.

The preferred fuel elements employed herein are primarily formed of a carbonaceous material. Carbonaceous fuel elements are preferably from about 5 to 15 mm, more preferably, from about 8 to 12 mm in length. Carbonaceous fuel elements having these characteristics are sufficient to provide fuel for at least about 7 to 10 puffs, the normal number of puffs generally obtained by smoking a conventional cigarette under FTC conditions.

Preferably, the carbon content of such a fuel element is at least 60 - 70%, most preferably at least about 80% or more by weight. Excellent results have been achieved with fuel elements having a carbon content of above about 85% by weight. High carbon content fuels are preferred because they produce minimal pyrolysis and incomplete combustion products, little or no visible sidestream smoke, and minimal ash and have high heat capacity. However, lower carbon content fuel elements, e.g., about 50 - 65 weight percent, are within the scope of this invention, especially where a nonburning inert filler is used.

Also, while not preferred, other fuel materials may be employed, such as tobacco, tobacco substitutes and the like, provided that they generate and conduct sufficient heat to the aerosol generating means to produce the desired level of aerosol from the aerosol forming material, as discussed above. The density of the fuel used should be above about 0.5g/cc., preferably above about 0.7 g/cc., which is higher than the densities normally used in conventional smoking articles. Where such other materials are used, it is much preferred to include carbon in the fuel, preferably in amounts of at least about 20 - 40% by weight, more preferably at least about 50% by weight, and most preferably at least about 65 - 70% by weight, the balance being the other fuel components, including any binder, burn modifiers, moisture, etc.

The carbonaceous materials used in or as the preferred fuel may be derived from virtually any of the numerous carbon sources known to those skilled in the art. Preferably, the carbonaceous material is obtained by the pyrolysis or carbonization of cellulosic materials, such as wood, cotton, rayon, tobacco, coconut, paper, and the like, although carbonaceous materials from other sources may be used.

In most instances, the carbonaceous fuel element should be capable of being ignited by a conventional cigarette lighter without the use of an oxidizing agent. Burning characteristics of this type may generally be obtained from a cellulosic material which has been pyrolyzed at temperatures between about 400 °C to about 1000 °C, preferably between about 500 °C to about 950 °C, in an inert atmosphere or under a vacuum. The pyrolysis time is not believed to be critical, as long as the temperature at the center of the pyrolyzed mass has reached the aforesaid temperature range for at least a few minutes. However, a slow pyrolysis, employing gradually increasing temperatures over several hours is believed to produce a more uniform material with a higher carbon yield.

While undesirable in most cases, carbonaceous fuel elements which require the addition of an oxidizing agent to render them ignitable by a cigarette lighter are within the scope of this invention, as are carbonaceous materials which require the use of a glow retardant or other type of combustion modifying agent. Such combustion modifying agents are disclosed in many patents and publications and are known to those of ordinary skill in the art.

The most preferred carbonaceous fuel elements used in practicing the invention are substantially free of volatile organic material. By that, it is meant that the fuel element is not purposely impregnated or mixed with substantial amounts of volatile organic materials, such as volatile aerosol

forming or flavoring agents, which could degrade in the burning fuel. However, small amounts of water, which are naturally adsorbed by the fuel, may be present therein. Similarly, small amounts of aerosol forming substances may migrate from the aerosol generating means and thus may also be present in the fuel element.

A preferred carbonaceous fuel element is a pressed or extruded carbon mass prepared from carbon and a binder, by conventional pressure forming or extrusion techniques. A preferred activated carbon for such a fuel element is PCB-G, and a preferred non-activated carbon is PXC, both available from Calgon Carbon Corporation, Pittsburgh, PA. Other preferred carbons for pressure forming and/or extrusion are prepared from pyrolyzed cotton or pyrolyzed papers.

The binders which may be used in preparing such a fuel element are well known in the art. A preferred binder is sodium carboxymethylcellulose (SCMC), which may be used alone, which is preferred, or in conjunction with materials such as sodium chloride, vermiculite, bentonite, calcium carbonate, and the like. Other useful binders include gums, such as guar gum, and other cellulose derivatives, such as methylcellulose and carboxymethylcellulose (CMC).

A wide range of binder concentrations can be utilized. Preferably, the amount of binder is limited to minimize contribution of the binder to undesirable combustion products. On the other hand, sufficient binder must be included to hold the fuel element together during manufacture and use. The amount used will thus depend on the cohesiveness of the carbon in the fuel element.

If desired, the aforesaid fuel elements may be pyrolyzed after formation, for example, to about 650°C for two hours, to convert the binder to carbon thereby forming a virtually 100% carbon fuel element.

The fuel elements employed in the present invention also may contain one or more additives to improve burning, such as up to about 5 weight percent sodium chloride to improve smoldering characteristics and as a glow retardant. Also, up to about 5, preferably 1 to 2, weight percent of potassium carbonate may be included to improve lightability. Additives to improve physical characteristics, such as clays like kaolins, serpentines, attapulgites, and the like also may be used.

Another carbonaceous fuel element is a carbon fiber fuel, which may be prepared by carbonizing a fibrous precursor, such as cotton, rayon, paper, polyacrylonitrile, and the like. Generally, pyrolysis at from about 650°C to 1000°, preferably at about 950°, for about 30 minutes, in an inert atmosphere or vacuum, is sufficient to produce a suitable carbon fiber with good burning characteristics. Com-

bustion modifying additives also may be added to these fibrous fuels.

The aerosol generating means used in practicing the invention is physically separate from the fuel element. By physically separate it is meant that the substrate, container or chamber which contains the aerosol forming materials is not mixed with, or a part of, the burning fuel element. As noted previously, this arrangement helps reduce or eliminate thermal degradation of the aerosol forming substance and the presence of sidestream smoke. While not a part of the fuel, the aerosol generating means is in a conductive heat exchange relationship with the fuel element, and preferably abuts or is adjacent to the fuel element.

Preferably, the aerosol generating means includes one or more thermally stable materials which carry one or more aerosol forming substances. As used herein, a thermally stable material is one capable of withstanding the high temperatures, e.g., 400°C - 600°C, which exist near the fuel without decomposition or burning. The use of such material is believed to help maintain the simple "smoke" chemistry of the aerosol, as evidenced by the lack of Ames activity in the preferred embodiments. While not preferred, other aerosol generating means, such as heat rupturable microcapsules, or solid aerosol forming substances, are within the scope of the invention, provided they are capable of releasing sufficient aerosol forming vapors to satisfactorily resemble tobacco smoke.

Thermally stable materials which may be used as a substrate or carrier for the aerosol forming substance are well known to those skilled in the art. Useful substrates should be porous and must be capable of retaining an aerosol forming compound when not in use and capable of releasing a potential aerosol forming vapor upon heating by the fuel element.

Useful thermally stable materials include thermally stable adsorbent carbons, such as porous grade carbons, graphite, activated, or nonactivated carbons, and the like. Other suitable materials include inorganic solids such as ceramics, glass, alumina, vermiculite, clays such as bentonite, and the like. The currently preferred substrate materials are carbon felts, fibers, and mats, activated carbons, and porous carbons such as PC-25 and PG-60 available from Union Carbide, as well as SGL carbon available from Calgon.

Depending upon the particular aerosol generating means employed herein, the composition and configuration thereof may generally be selected from particulate, fibrous, porous blocks, solid blocks with one or more axially extending passageways therethrough, and the like. Substrates, especially particulates, may be placed within a container, preferably formed from a metallic foil.

The aerosol generating means used in the invention is usually located no more than about 60 mm, preferably no more than 30 mm, most preferably no more than 15 mm from the lighting end of the fuel element. The aerosol generator may vary in length from about 2 mm to about 60 mm, preferably from about 5 mm to 40 mm, and most preferably from about 20 mm to 35 mm. If a non-particulate substrate is used, it may be provided with one or more holes, to increase the surface area of the substrate, and to increase air flow and heat transfer.

The aerosol forming substance or substances used in the invention must be capable of forming an aerosol at the temperatures present in the aerosol generating means when heated by the burning fuel element. Such substances preferably will be composed of carbon, hydrogen and oxygen, but they may include other materials. The aerosol forming substances can be in solid, semisolid, or liquid form. The boiling point of the substance and/or the mixture of substances can range up to about 500 °C. Substances having these characteristics include polyhydric alcohols, such as glycerin and propylene glycol, as well as aliphatic esters of mono-, di-, or poly-carboxylic acids, such as methyl stearate, dodecandioate, dimethyl tetradodecandioate, and others.

Preferably, the aerosol forming substances will include a mixture of a high boiling, low vapor pressure substance and a low boiling, high vapor pressure substance. Thus, on early puffs, the low boiling substance will provide most of the initial aerosol, while, when the temperature in the aerosol generator increases, the high boiling substance will provide most of the aerosol.

The preferred aerosol forming substances are polyhydric alcohols, or mixtures of polyhydric alcohols. Especially preferred aerosol formers are selected from glycerin, propylene glycol, triethylene glycol, or mixtures thereof.

The aerosol forming substance may be dispersed on or within the aerosol generating means in a concentration sufficient to permeate or coat the substrate, carrier, or container. For example, the aerosol forming substance may be applied full strength or in a dilute solution by dipping, spraying, vapor deposition, or similar techniques. Solid aerosol forming components may be admixed with the substrate and distributed evenly throughout prior to formation.

While the loading of the aerosol forming substance will vary from carrier to carrier and from aerosol forming substance to aerosol forming substance, the amount of liquid aerosol forming substances may generally vary from about 20 mg to about 120 mg, preferably from about 35 mg to about 85 mg, and most preferably from about 45

mg to about 65 mg. As much as possible of the aerosol former carried on the aerosol generating means should be delivered to the user as WTPM. Preferably, above about 2 weight percent, more preferably above about 15 weight percent, and most preferably above about 20 weight percent of the aerosol former carried on the aerosol generating means is delivered to the user as WTPM.

The aerosol generating means also may include one or more volatile flavoring agents, such as menthol, vanillin, artificial coffee, tobacco extracts, nicotine, caffeine, liquors, and other agents which impart flavor to the aerosol. It also may include any other desirable volatile solid or liquid materials.

As previously pointed out, the smoking article of the present invention also may include a charge or plug of tobacco which may be used to add a tobacco flavor to the aerosol. Preferably, the tobacco is placed at the mouth end of the aerosol generating means, or it may be mixed with the carrier for the aerosol forming substance. Flavoring agents also may be incorporated into the article to flavor the aerosol delivered to the user.

If a charge of tobacco is employed, hot vapors are swept through the bed of tobacco to extract and vaporize the volatile components in the tobacco, without the need for tobacco combustion. Thus the user of this smoking article receives an aerosol which contains the qualities and flavors of natural tobacco without the combustion products produced by a conventional cigarette.

Alternatively, these optional agents may be placed between the aerosol generating means and the mouthend, such as in a separate substrate or chamber in the passage which leads from the aerosol generating means to the mouthend, or in the optional tobacco charge. If desired, these volatile agents may be used in lieu of part, or all, of the aerosol forming substance, so that the article delivers a nonaerosol flavor or other material to the user.

Articles of the type disclosed herein may be used or may be modified for use as drug delivery articles, for delivery of volatile pharmacologically or physiologically active materials such as ephedrine, metaproterenol, terbutaline or the like.

The heat conducting member preferably employed in practicing this invention is typically a metallic foil, such as aluminum foil, varying in thickness from less than about 0.01 mm to about 0.1 mm, or more. The thickness and/or the type of conducting material may be varied to achieve virtually any desired degree of heat transfer. As shown in the illustrated embodiments, the heat conducting member preferably contacts or overlaps a portion of the fuel element and the aerosol generating means, and may form the container which encloses the aerosol forming substance.

Insulating members which may be used in accordance with the present invention generally comprise inorganic or organic fibers such as those made out of glass, alumina, silica, vitreous materials, mineral wool, carbons, silicon, boron, organic polymers, cellulose, and the like, including mixtures of these materials. Nonfibrous insulating materials, such as silica aerogel, perlite, glass, and the like, formed in mats, strips or other shapes, may also be used. Preferred insulating members are resilient, to help simulate the feel of a conventional cigarette. These materials act primarily as an insulating jacket, retaining and directing a significant portion of the heat formed by the burning fuel element to the aerosol generating means. Because the insulating jacket becomes hot adjacent to the burning fuel element, to a limited extent, it also may conduct heat toward the aerosol generating means.

Currently preferred insulating materials include ceramic fibers, such as glass fibers. Two especially preferred glass fibers are available from the Manning Paper Company of Troy, New York, under the designations, Manniglas 1000 and Manniglas 1200. Generally the insulating fiber is wrapped over at least a portion of the fuel element and any other desired portion of the article, to a final diameter of from about 7 to 8 mm. Thus, the preferred thickness of the insulating layer is from about 0.5 mm to 2.5 mm, preferably, from about 1 mm to 2 mm. When possible, glass fiber materials having a low softening point, e.g., below about 650 °C, are preferred.

When the insulating means is fibrous, there is preferably employed a barrier means at the mouth end of the article. One such barrier means comprises an annular member of high density cellulose acetate tow which abuts the fibrous insulating means and which is sealed, preferably at the mouth end, with, for example, glue, to block air flow through the tow.

In most embodiments of the invention, the fuel/aerosol generating means combination will be attached to a mouthend piece, such as a foil lined paper or cellulose acetate/plastic tubes illustrated in the figures, although a mouthend piece may be provided separately, e.g., in the form of a cigarette holder. This element of the article provides the passageway which channels the vaporized aerosol forming substance into the mouth of the user. Due to its length, preferably about 50 to 60 mm or more, it also keeps the hot fire cone away from the mouth and fingers of the user.

Suitable mouthend pieces should be inert with respect to the aerosol forming substances, should have a water or liquid proof inner layer, should offer minimum aerosol loss by condensation or filtration, and should be capable of withstanding the

temperature at the interface with the other elements of the article. Preferred mouthend pieces include the cellulose-acetate tube employed in the embodiments of Figures 1 and 2. Other suitable mouthend pieces will be apparent to those of ordinary skill in the art.

The mouthend pieces of the invention may include an optional "filter" tip, which is used to give the article the appearance of the conventional filtered cigarette. Such filters include low density cellulose acetate filters and hollow or baffled plastic filters, such as those made of polypropylene. In addition, the entire length of article or any portion thereof may be overwrapped with cigarette paper.

The aerosol produced by the preferred articles of the present invention is chemically simple, consisting essentially of air, oxides of carbon, the aerosol which carries any desired flavorants or other desired volatile materials, water, and trace amounts of other materials. The wet total particulate matter (WTPM) produced by the preferred articles of this invention has no mutagenic activity as measured by the Ames test, i.e., there is no significant dose response relationship between the WTPM of the present invention and the number of revertants occurring in standard test microorganisms exposed to such products. According to the proponents of the Ames test, a significant dose dependent response indicates the presence of mutagenic materials in the products tested. See Ames *et al.*, *Mut. Res.*, 31:347-364 (1975); Nagas *et al.*, *Mut. Res.*, 42:335 (1977).

A further benefit from the preferred embodiments of the present invention is the relative lack of ash produced during use in comparison to ash from a conventional cigarette. As the preferred carbon fuel source is burned, it is essentially converted to oxides of carbon, with relatively little ash generation, and thus there is no need to dispose of ashes while using the article.

The smoking article of the present invention will be further illustrated with reference to the following example which aids in the understanding of the present invention, but which are not to be construed as limitations thereof. All percentages reported herein, unless otherwise specified, are percent by weight. All temperatures are expressed in degrees Celsius and are uncorrected. In all instances, the smoking articles have a diameter of about 7 to 8 mm, the diameter of a conventional cigarette.

#### Example

A modified version of the smoking article of Figure 2 was made as follows: A 9.5 mm long carbon fuel source with a 4.5 mm diameter and a 1 mm diameter longitudinal passageway was extrud-



ed from a mixture of 10% SCMC, 5% potassium carbonate, and 85% carbonized paper mixed with 10% water. The mixture had a dough-like consistency and was fed into an extruder. The extruded material was cut to length after drying at 80°C overnight. The macrocapsule was made from a 22 mm long piece of 0.0089 mm thick aluminum formed into a cylinder of 4.5 mm I.D. The macrocapsule was filled with (a) 70 mg of vermiculite containing 50 mg of a 1:1 mixture of propylene glycol and glycerin, and (b) 30 mg of burley tobacco to which 6% glycerin and 6% propylene glycol had been added. The fuel source and macrocapsule were joined by inserting the fuel source about 2 mm into the end of the macrocapsule. A 35 mm long polypropylene tube of 4.5 mm I.D. was inserted in the other end of the macrocapsule. The fuel source, macrocapsule and polypropylene tube were thus joined to form a 65 mm long, 4.5 mm diameter segment. This segment was wrapped with several layers of Manniglas 1000 from Manning paper Company until a circumference of 24.7 mm was reached. The unit was then combined with a 5 mm long cellulose acetate filter and wrapped with cigarette paper. When smoked under FTC conditions, the article delivered 8 mg of WTPM over the initial three puffs; 7 mg WTPM over puffs 4-6; and 5 mg WTPM over puffs 7-9. Total aerosol delivery over the 9 puffs was 20 mg. When placed horizontally on a piece of tissue paper, the article did not ignite or even scorch the tissue paper.

### Claims

1. A smoking article having a front end and a rear end and comprising:
  - (a) a fuel element (10) having a lighting end (11);
  - (b) a physically separate aerosol generating means (30; 54, 56) comprising at least one aerosol forming material and being disposed between the lighting end (11) of the fuel element (10) and said rear end; characterized by:
    - (c) a resilient insulating member (86), surrounding at least a portion of the fuel element (10) and comprising inorganic fibers and being at least 0.5 mm thick; and
    - (d) an overwrap (46) for the insulating member (86).
2. Article as claimed in claim 1, said smoking article being designed as a cigarette type article wherein the fuel element (10), the aerosol generating means (30; 54, 56) and the insulating member (86) are structured and arranged to transfer heat from the fuel element (10) to

said aerosol forming material both during puffing and during smolder.

3. Article according to claim 1 or 2, wherein the fuel element (10) is located at the lighting end (11) of the article.
4. Article according to one of the preceding claims, wherein the fuel element (10) includes at least one longitudinally extending passageway (16).
5. Article according to claim 4, wherein the fuel element (10) has a plurality of such passageways (16).
6. Article according to claim 4 or 5, wherein at least one passageway (16) is in the form of a hole.
7. Article according to one of the preceding claims, wherein the fuel element (10) is about 30 mm or less in length prior to smoking.
8. Article according to claim 7, wherein the fuel element (10) is about 20 mm or less in length prior to smoking.
9. Article according to claim 8, wherein the fuel element (10) is about 15 mm or less in length before smoking.
10. Article according to one of claims 7 to 9, wherein the fuel element (10) has a length of at least about 5 mm prior to smoking.
11. Article according to one of the preceding claims, wherein the fuel element (10) has a diameter between about 3 mm and 8 mm.
12. Article according claim 11, wherein the fuel element (10) has a diameter of from about 4 mm to about 5 mm.
13. Article according to one of the preceding claims, wherein the fuel element (10) has a density of at least 0.5 g/cm<sup>3</sup>.
14. Article according to claim 13, wherein the fuel element (10) has a density range from about 0.5 g/cm<sup>3</sup> to about 1.5 g/cm<sup>3</sup>.
15. Article according to claim 13 or 14, wherein the fuel element (10) has a density of more than about 0.7 g/cm<sup>3</sup>.
16. Article according to one of claims 13 to 15, wherein the fuel element has a density of at



least about 0.8 g/cm<sup>3</sup>.

17. Article according to one of the preceding claims, wherein the fuel element (10) is carbonaceous.

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18. Article according to claim 17, wherein the fuel element (10) comprises at least about 50 % by weight carbon as such.

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19. Article according to claim 18, wherein the fuel element (10) comprises at least 60 % to 80 % by weight carbon.

20. Article according to claim 19, wherein the fuel element (10) comprises at least about 80 % by weight carbon.

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21. Article according to claim 20, wherein the fuel element (10) comprises at least about 85 % by weight carbon.

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22. Article according to one of the preceding claims, wherein the fuel element (10) has a tapered lighting end.

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23. Article according to one of the preceding claims, wherein the fuel element (10) is a pressed or extruded carbonaceous mass.

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24. Article according to one of the preceding claims, wherein the fuel element (10) is substantially free of volatile organic material.

25. Article according to one of the preceding claims, wherein the constituents of the mass forming the fuel element (10) are selected to avoid any substantial visible sidestream smoke during smolder.

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26. Article according to one of the preceding claims, further comprising an insulating member (86) which is designed and arranged to increase heat transfer from the fuel element (10) to the aerosol generating means (30;54,56).

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27. Article according to one of the preceding claims, wherein the insulating member (86) surrounds at least a portion of the aerosol generating means (30;54,56)

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28. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is arranged in a container (87;52).

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29. Article according to one of the preceding claims, wherein a heat transferring member

(87;52) is provided for transferring heat generated by the fuel element (10) to the aerosol generating means (30;54,56) substantially throughout the time of burning of the fuel element.

30. Article according to one of the preceding claims, wherein a heat transfer member (87;52) is provided which contacts or overlaps at least a portion of the fuel element (10) and of the aerosol generating means (30;54,56).

31. Article according to claim 29 or 30, wherein the heat transferring member (87;52) encompasses at least a portion of the aerosol generating means (30;54,56).

32. Article according to one of claims 29 to 31, wherein the heat transferring member is at least partially within the fuel element.

33. Article according to one of claims 29 to 32, wherein the heat transferring member (87;52) circumscribes a portion of the external longitudinal periphery of the fuel element (10) and at least a portion of the external longitudinal periphery of the aerosol generating means (30;54,56).

34. Article according to one of claims 29 to 33, wherein the heat transferring member is a heat conducting container (52) for the aerosol generating means (54,56).

35. Article according to claim 34, wherein the fuel end of the conductive container (52) contacts the rear portion of the fuel element (10).

36. Article according to one of the claims 29 to 35, wherein the heat transferring member (87;52) is spaced behind the lighting end (11) of the fuel element (10).

37. Article according to one of the claims 29 to 36, wherein the heat transferring member (87;52) is a metallic member, preferably of aluminum.

38. Article according to one of claims 28 to 37, wherein the container (87;52) is a heat conductive metallic tube.

39. Article according to one of the claims 28 to 38, wherein the container (87) overlaps the rear portion of the fuel element (10), encloses the aerosol generating means (30), and permits the passage of air and the aerosol forming material.



40. Article according to one of claims 29 to 39, wherein the heat transferring member comprises a conductive rod embedded within at least a portion of both the fuel element and the aerosol generating means.
41. Article according to one of claims 34 to 40, comprising an insulating member (86) which circumscribes at least a portion of the conductive container (87;52).
42. Article according to one of the preceding claims, wherein the insulating member (86) is non-combustible.
43. Article according to one of the preceding claims, wherein the insulating member (86) is about 1 mm to 2.5 mm thick.
44. Article according to claim 43, wherein the insulating member (86) is about 1 mm to 2 mm thick.
45. Article according to one of the preceding claims, wherein the insulating member (86) comprises an air permeable mass of inorganic fibers.
46. Article according to one of the preceding claims, wherein the insulating member (86) comprises an air permeable resilient jacket of fibers.
47. Article according to one of the preceding claims, wherein the insulating member (86) has a thermal conductivity of less than about 0.005 g-cal/(sec) (cm<sup>2</sup>) (°C/cm).
48. Article according to one of the preceding claims, wherein said insulating member (86) comprises a material which fuses during use.
49. Article according to claim 48, wherein the insulating member (86) comprises inorganic fibers which fuse during use.
50. Article according to one of the preceding claims, wherein said insulating member (86) comprises a low temperature grade of glass fibers.
51. Article according to claim 50, wherein said insulating member (86) comprises glass fibers having a softening point below about 650° C.
52. Article according to one of the preceding claims, wherein a charge of tobacco (56) is provided.
53. Article according to claim 52, wherein the charge of tobacco (56) is located between the rear end of the fuel element (10) and the mouth end (15) of the article.
54. Article according to one of the preceding claims, wherein tobacco is placed between the aerosol generating means and the mouth end of the article.
55. Article according to claim 54, wherein the tobacco is placed at the rear end of the aerosol generating means.
56. Article according to one of the preceding claims, comprising a charge of tobacco extract being located between the rear end of the fuel element and the mouth end of the article.
57. Article according to one of the preceding claims, wherein in the longitudinal direction of the article the aerosol generating means (30;54,56) is disposed adjacent to the fuel element (10).
58. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is in close proximity to the fuel element (10).
59. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) abuts the fuel element (10).
60. Article according to one of the preceding claims, wherein the fuel element (10) and aerosol generating means (30;54,56) are arranged in a conductive heat exchange relationship such that the aerosol generating means (30;54,56) receives conductive heat transfer substantially throughout the time of burning of the fuel element (10).
61. Article according to claim 60, wherein the fuel element (10) and the aerosol generating means (30;54,56) are arranged in a conductive heat exchange relationship by contact between the aerosol generating means and a part of the fuel element.
62. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is located no more than about 30 mm from the lighting end (11) of the fuel element (10).
63. Article according claim 62, wherein the aerosol generating means (30;54,56) is located no



more than about 15 mm from the lighting end (11) of the fuel element (10).

64. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is loaded with from about 20 mg to 120 mg of aerosol forming material.
65. Article according to claim 64, wherein the aerosol generating means (30;54,56) is loaded with 35 mg to 85 mg of aerosol forming material.
66. Article according to one of the preceding claims, wherein above about 15 weight percent of an aerosol forming material carried by the aerosol generating means (30;54,56) is delivered as wet total particulate matter under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder.
67. Article according to one of the preceding claims, wherein the article delivers at least about 0.8 mg of wet total particulate matter in the first 3 puffs under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder.
68. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is loaded with sufficient aerosol forming substance such that the article delivers at least about 1.5 mg of wet total particulate matter in the first 3 puffs under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder.
69. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) is loaded with sufficient aerosol forming substance such that the article delivers an average of at least about 0.8 mg per puff of wet total particulate matter under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder for at least 6 puffs.
70. Article according to claim 69, wherein the article delivers an average of at least about 0.8 mg per puff of wet total particulate matter under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder for at least 10 puffs.
71. Article according to one of claims 28 to 70, wherein the container (52) is crimped at its mouth end.

72. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) includes a tobacco extract.

- 5 73. Article according to one of the preceding claims, wherein volatile flavoring agents are placed between the aerosol generating means (30;54,56) and the mouth end (15).
- 10 74. Article according to one of the preceding claims, wherein the smoke produced consists essentially of the oxides of carbon, air, water, volatile substance comprised in the aerosol generating means (30;54,56), other desired volatiles and trace amounts of other materials.
- 15 75. Article according to one of claims 17 to 74, wherein the article has no mutagenic activity in the wet total particulate matter, as measured by the Ames Test.
- 20 76. Article according to one of the preceding claims, wherein the article has a diameter of about 8 mm or less.
- 25 77. Article according to one of the preceding claims, wherein the article has the size and shape of a cigarette.
- 30 78. Article according to one of the preceding claims, wherein the smoking article additionally includes a mouthend piece (40).
- 35 79. Article according to claim 78, wherein the smoking article includes means (44) for delivering the aerosol forming material to the user, said mouthend piece (40) and aerosol delivering means (44) extend over more than half the length of the article.
- 40 80. Article according to one of the preceding claims, wherein the article delivers a visible smoke-like aerosol.
- 45 81. Article according to one of the preceding claims, wherein the article is adapted to be used together with a separate mouthpiece.
- 50 82. Article according to one of the preceding claims, wherein the smoking article additionally comprises means (52,44;87,44) for directing gases of the fuel element (10) through the aerosol generating means (30;54,56) and to the mouthpiece (45).
- 55 83. Article according to one of the preceding claims, wherein the aerosol generating means (30;54,56) comprises a thermally stable sub-



strate (30;54) bearing an aerosol forming material.

84. Article according to claim 83, wherein the thermally stable substrate (54) includes ceramics.

85. Article according to one of the preceding claims, wherein the aerosol generating means (54,56) comprises a particulate substrate (54).

86. Article according to one of the preceding claims, comprising in addition a filter (45).

87. Article according to one of the preceding claims, wherein the fuel element (10) and the aerosol generating means (30;54,56) are designed and arranged to transfer heat from the fuel element (10) to the aerosol generating means (30;54,56) to volatilize the aerosol forming material during puffing throughout smoking.

88. Article according to one of claims 1 to 60 and 62 to 87, wherein the aerosol generating means (30) is in contact with the fuel element (10) to receive heat from the fuel element substantially throughout the burning period of the fuel element.

89. Article according to one of the preceding claims, wherein the burning of the fuel element (10) produces no disposable ash during use.

#### Patentansprüche

1. Rauchartikel mit einem vorderen und einem hinteren Ende, welcher umfaßt:

- (a) ein Brennstoffelement (10), das ein anzuzündendes Ende (11) hat;
- (b) körperlich gesonderte Aerosolerzeugungsmittel (30; 54, 56), die wenigstens ein Aerosol-bildendes Material aufweisen und zwischen dem anzuzündenden Ende (11) des Brennstoffelements (10) und dem genannten hinteren Ende angeordnet sind;

gekennzeichnet durch:

- (c) ein elastisches Isolierglied (86), welches mindestens einen Teil des Brennstoffelements (10) umschließt, anorganische Fasern aufweist und mindestens 0,5 mm dick ist; und
- (d) eine Umhüllung (46) für das Isolierglied (86).

2. Rauchartikel nach Anspruch 1, welcher als zigarettenartiger Artikel gestaltet ist, wobei das Brennstoffelement (10), die Aerosolerzeugungsmittel (30; 54, 56) und das Isolierglied

(86) für einen Wärmeübergang vom Brennstoffelement (10) auf das Aerosol-bildende Material sowohl während des Ziehens, als auch während des Glöstens ausgebildet und angeordnet sind.

3. Rauchartikel nach Anspruch 1 oder 2, bei dem das Brennstoffelement (10) am vorderen Ende (11) des Artikels angeordnet ist.

4. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) wenigstens einen sich in Längsrichtung erstreckenden Durchlaß (16) aufweist.

5. Rauchartikel nach Anspruch 4, bei dem das Brennstoffelement (10) mehrere solcher Durchlässe (16) hat.

6. Rauchartikel nach Anspruch 4 oder 5, bei dem wenigstens ein Durchlaß (16) die Gestalt eines Loches hat.

7. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 30 mm oder weniger hat.

8. Rauchartikel nach Anspruch 7, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 20 mm oder weniger hat.

9. Rauchartikel nach Anspruch 8, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 15 mm oder weniger hat.

10. Rauchartikel nach einem der Ansprüche 7 bis 9, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von mindestens ungefähr 5 mm hat.

11. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) einen Durchmesser zwischen ungefähr 3 mm und 8 mm hat.

12. Rauchartikel nach Anspruch 11, bei dem das Brennstoffelement (10) einen Durchmesser von ungefähr 4 mm bis ungefähr 5 mm hat.

13. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) eine Dichte von mindestens 0,5 g/cm<sup>3</sup> hat.

14. Rauchartikel nach Anspruch 13, dessen Brennstoffelement (10) eine Dichte im Bereich von ungefähr 0,5 g/cm<sup>3</sup> bis ungefähr 1,5 g/cm<sup>3</sup> hat.



15. Rauchartikel nach Anspruch 13 oder 14, dessen Brennstoffelement (10) eine Dichte von mehr als ungefähr 0,7 g/cm<sup>3</sup> hat.
16. Rauchartikel nach einem der Ansprüche 13 bis 15, dessen Brennstoffelement eine Dichte von mindestens ungefähr 0,8 g/cm<sup>3</sup> hat. 5
17. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) ein Kohlenstoff-Brennstoffelement ist. 10
18. Rauchartikel nach Anspruch 17, dessen Brennstoffelement (10) mindestens ungefähr 50 Gew.% Kohlenstoff als solchen enthält. 15
19. Rauchartikel nach Anspruch 18, dessen Brennstoffelement (10) mindestens 60 Gew.% bis 80 Gew.% Kohlenstoff enthält. 20
20. Rauchartikel nach Anspruch 19, dessen Brennstoffelement (10) mindestens ungefähr 80 Gew.% Kohlenstoff enthält.
21. Rauchartikel nach Anspruch 20, dessen Brennstoffelement (10) mindestens ungefähr 85 Gew.% Kohlenstoff enthält. 25
22. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) ein sich verjüngendes anzuzündendes Ende hat. 30
23. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) eine gepreßte oder extrudierte Kohlenstoff-Masse ist. 35
24. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) im wesentlichen frei ist von flüchtigem organischem Material. 40
25. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Bestandteile der das Brennstoffelement (10) bildenden Masse so ausgewählt sind, daß während des Glühens kein wesentlicher sichtbarer Nebenstromrauch entsteht. 45
26. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher ferner ein Isolierglied (86) aufweist, das so gestaltet und angeordnet ist, daß es den Wärmeübergang vom Brennstoffelement (10) zu den Aerosolerzeugungsmitteln (30; 54, 56) vergrößert. 50  
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27. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) mindestens einen Teil der Aerosolerzeugungsmittel (30; 54, 56) umschließt.
28. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) in einem Behälter (87; 52) angeordnet sind.
29. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem ein Wärmeübertragungsglied (87; 52) vorgesehen ist, um durch das Brennstoffelement (10) erzeugte Wärme im wesentlichen während der ganzen Brennzeit des Brennstoffelements auf die Aerosolerzeugungsmittel (30; 54, 56) zu übertragen.
30. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem ein Wärmeübertragungsglied (87; 52) vorgesehen ist, das mindestens einen Teil des Brennstoffelements (10) und der Aerosolerzeugungsmittel (30; 54, 56) kontaktiert oder überlappt.
31. Rauchartikel nach Anspruch 29 oder 30, bei dem das Wärmeübertragungsglied (87; 52) mindestens einen Teil der Aerosolerzeugungsmittel (30; 54, 56) umfaßt.
32. Rauchartikel nach einem der Ansprüche 29 bis 31, bei dem das Wärmeübertragungsglied mindestens zum Teil innerhalb des Brennstoffelements liegt.
33. Rauchartikel nach einem der Ansprüche 29 bis 32, bei dem das Wärmeübertragungsglied (87; 52) einen Teil der sich in Längsrichtung erstreckenden äußeren Peripherie des Brennstoffelements (10) und der Aerosolerzeugungsmittel (30; 54, 56) umschließt.
34. Rauchartikel nach einem der Ansprüche 29 bis 33, bei dem das Wärmeübertragungsglied ein wärmeleitender Behälter (52) für die Aerosolerzeugungsmittel (54, 56) ist.
35. Rauchartikel nach Anspruch 34, bei dem ein dem Brennstoffelement zugewandtes Ende des wärmeleitenden Behälters (52) einen hinteren Teil des Brennstoffelements (10) berührt.
36. Rauchartikel nach einem der Ansprüche 29 bis 35, bei dem das Wärmeübertragungsglied (87; 52) sich im Abstand hinter dem anzuzündenden Ende (11) des Brennstoffelements (10) befindet.
37. Rauchartikel nach einem der Ansprüche 29 bis 36, bei dem das Wärmeübertragungsglied (87;



- 52) ein metallisches Glied ist, vorzugsweise aus Aluminium.
38. Rauchartikel nach einem der Ansprüche 28 bis 37, bei dem der Behälter (87; 52) ein wärmeleitendes metallisches Röhrchen ist. 5
39. Rauchartikel nach einem der Ansprüche 28 bis 38, bei dem der Behälter (87) den hinteren Teil des Brennstoffelements (10) überlappt, die Aerosolerzeugungsmittel (30) umgibt und den Durchgang von Luft und des Aerosol-bildenden Materials zuläßt. 10
40. Rauchartikel nach einem der Ansprüche 29 bis 39, bei dem das Wärmeübertragungsglied ein leitfähiges Stäbchen umfaßt, das zumindest in einen Teil des Brennstoffelements und in einen Teil der Aerosolerzeugungsmittel eingebettet ist. 15
41. Rauchartikel nach einem der Ansprüche 34 bis 40, welcher ein Isolierglied (86) aufweist, das mindestens einen Teil des leitenden Behälters (87; 52) umfaßt. 20
42. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) nicht-brennbar ist. 25
43. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) ungefähr 1 mm bis 2,5 mm dick ist. 30
44. Rauchartikel nach Anspruch 43, bei dem das Isolierglied (86) ungefähr 1 mm bis 2 mm dick ist. 35
45. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) eine luftdurchlässige Masse von anorganischen Fasern aufweist. 40
46. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) eine luftdurchlässige, elastische Hülse aus Fasern ist. 45
47. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) eine Wärmeleitfähigkeit von weniger als ungefähr 0,005 g-cal/(sec) (cm<sup>2</sup>) (°C/cm) hat. 50
48. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) ein Material enthält, welches beim Gebrauch schmilzt. 55
49. Rauchartikel nach Anspruch 48, bei dem das Isolierglied (86) anorganische Fasern aufweist, die beim Gebrauch schmelzen.
50. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Isolierglied (86) eine Niedertemperatursorte von Glasfasern aufweist.
51. Rauchartikel nach Anspruch 50, bei dem das Isolierglied (86) Glasfasern aufweist, die einen Erweichungspunkt unter ungefähr 650 °C haben.
52. Rauchartikel nach einem der vorhergehenden Ansprüche, in dem eine Tabakladung (56) vorgesehen ist.
53. Rauchartikel nach Anspruch 52, bei dem die Tabakladung (56) zwischen dem hinteren Ende des Brennstoffelements (10) und dem mundseitigen Ende (15) des Rauchartikels angeordnet ist.
54. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem zwischen den Aerosolerzeugungsmitteln und dem mundseitigen Ende des Rauchartikels Tabak angeordnet ist.
55. Rauchartikel nach Anspruch 54, bei dem der Tabak am rückwärtigen Ende der Aerosolerzeugungsmittel angeordnet ist.
56. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher eine Tabakextraktmenge zwischen dem rückwärtigen Ende des Brennstoffelements und dem mundseitigen Ende des Rauchartikels aufweist.
57. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem - in Längsrichtung des Rauchartikels - die Aerosolerzeugungsmittel (30; 54, 56) dem Brennstoffelement (10) benachbart angeordnet sind.
58. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) sehr nahe am Brennstoffelement (10) angeordnet sind.
59. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) an das Brennstoffelement (10) angrenzen.
60. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) und die Aerosolerzeugungsmittel (30; 54, 56) sich so in auf Wärmeleitung beruhendem

Wärmeaustausch miteinander befinden, daß den Aerosolerzeugungsmitteln (30; 54, 56) im wesentlichen während der ganzen Brennzeit des Brennstoffelements (10) durch Wärmeleitung Wärme zugeführt wird.

61. Rauchartikel nach Anspruch 60, bei dem sich das Brennstoffelement (10) und die Aerosolerzeugungsmittel (30; 54, 56) durch Berührung zwischen den Aerosolerzeugungsmitteln und einem Teil des Brennstoffelements in auf Wärmeleitung beruhendem Wärmeaustausch miteinander befinden.
62. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) so angeordnet sind, daß ihr Abstand vom anzuzündenden Ende (11) des Brennstoffelements (10) nicht mehr als ungefähr 30 mm beträgt.
63. Rauchartikel nach Anspruch 62, bei dem die Aerosolerzeugungsmittel (30; 54, 56) so angeordnet sind, daß ihr Abstand vom anzuzündenden Ende (11) des Brennstoffelements (10) nicht mehr als ungefähr 15 mm beträgt.
64. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) mit ungefähr 20 mg bis 120 mg Aerosol-bildendem Material beladen sind.
65. Rauchartikel nach Anspruch 64, bei dem die Aerosolerzeugungsmittel (30; 54, 56) mit 35 mg bis 85 mg Aerosolbildendem Material beladen sind.
66. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glasten von 58 Sekunden Dauer voneinander getrennt sind, mehr als ungefähr 15 Gew.% des von den Aerosolerzeugungsmitteln (30; 54, 56) getragenen Aerosol-bildenden Materials als Gesamtmenge feuchter Teilchen abgegeben werden.
67. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glasten von 58 Sekunden Dauer voneinander getrennt sind, bei den ersten drei Zügen mindestens ungefähr 0,6 mg Gesamtmenge feuchter Teilchen abgibt.
68. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (30; 54, 56) mit ausreichend Aerosol-bilden-

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dem Material beladen sind, um zu bewirken, daß der Rauchartikel unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glasten mit einer Dauer von 58 Sekunden voneinander getrennt sind, während der ersten drei Züge mindestens ungefähr 1,5 mg Gesamtmenge feuchter Teilchen abgibt.

69. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (30; 54, 56) mit ausreichend Aerosol-bildendem Material beladen sind, um zu bewirken, daß der Rauchartikel unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glasten von 58 Sekunden voneinander getrennt sind, bei mindestens sechs Zügen im Durchschnitt mindestens ungefähr 0,8 mg Gesamtmenge feuchter Teilchen pro Zug abgibt.
70. Rauchartikel nach Anspruch 69, welcher unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glasten von 58 Sekunden voneinander getrennt sind, über mindestens zehn Züge im Durchschnitt pro Zug mindestens 0,8 mg Gesamtmenge feuchter Teilchen abgibt.
71. Rauchartikel nach einem der Ansprüche 28 bis 70, bei dem der Behälter (52) an seinem mundseitigen Ende umgebogen ist.
72. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (30; 54, 56) ein Tabakextrakt enthalten.
73. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem flüchtige bzw. verdampfbare Geruchs- bzw. Geschmacksmittel zwischen den Aerosolerzeugungsmitteln (30; 54, 56) und dem mundseitigen Ende (15) angeordnet sind.
74. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem der erzeugte Rauch im wesentlichen aus Oxyden von Kohlenstoff, Luft, Wasser, flüchtigen, in den Aerosolerzeugungsmitteln (30; 54, 56) enthaltenen Substanzen, anderen erwünschten flüchtigen Substanzen und Spuren von anderen Materialien besteht.
75. Rauchartikel nach einem der Ansprüche 17 bis 74, welcher, gemessen durch den Ames-Test, in der Gesamtmenge feuchter Teilchen keine mutagenen Aktivitäten zeigt.
76. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher einen Durchmesser von



ungefähr 8 mm oder weniger hat.

77. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher die Größe und die Gestalt einer Zigarette hat.

78. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher zusätzlich ein Mundende-Stück (40) aufweist.

79. Rauchartikel nach Anspruch 78, welcher Mittel (44) zur Abgabe des Aerosol-bildenden Materials an den Benutzer aufweist, wobei das besagte Mundende-Stück (40) und die Aerosol-Abgabemittel (44) sich über mehr als die Hälfte der Länge des Rauchartikels erstrecken.

80. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher ein sichtbares, rauchähnliches Aerosol abgibt.

81. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher zur Benutzung mit einem getrennten Mundstück zurechtgemacht ist.

82. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher des weiteren Mittel (52, 44; 87, 44) zum Leiten der Gase des Brennstoffelements (10) durch die Aerosolerzeugungsmittel (30; 54, 56) und zum Mundstück (45) aufweist.

83. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (30; 54, 56) ein thermisch stabiles Substrat (30; 54) aufweisen, welches das Aerosol-bildende Material trägt.

84. Rauchartikel nach Anspruch 83, dessen thermisch stabiles Substrat (54) keramisches Material enthält.

85. Rauchartikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (54, 56) ein teilchenförmiges Substrat (54) aufweisen.

86. Rauchartikel nach einem der vorhergehenden Ansprüche, welcher des weiteren ein Filter (45) aufweist.

87. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) und die Aerosolerzeugungsmittel (30; 54, 56) so gestaltet und angeordnet sind, daß Wärme vom Brennstoffelement (10) auf die Aerosolerzeugungsmittel (30; 54, 56) übertragen wird, um das Aerosol-bildende Material wäh-

rend des Ziehens über den ganzen Rauchvorgang zu verflüchtigen bzw. zu verdampfen.

88. Rauchartikel nach einem der Ansprüche 1 bis 60 und 62 bis 87, bei dem die Aerosolerzeugungsmittel (30) das Brennstoffelement (10) berühren, um im wesentlichen während der ganzen Brennzeit des Brennstoffelements von diesem Wärme zu erhalten.

89. Rauchartikel nach einem der vorhergehenden Ansprüche, bei dem während des Gebrauchs das Brennen des Brennstoffelements (10) keine ablösbare Asche erzeugt.

## Revendications

1. Article à fumer ayant une extrémité antérieure et une extrémité arrière et comprenant :

(a) un élément combustible (10) ayant une extrémité d'allumage (11) ;

(b) un moyen physiquement séparé (30 ; 54, 56) générateur d'aérosol, comprenant au moins une matière formant un aérosol et disposé entre l'extrémité d'allumage (11) de l'élément combustible (10) et ladite extrémité arrière ;

caractérisé par :

(c) un élément isolant élastique (86) entourant au moins une partie de l'élément combustible (10), constitué de fibres minérales et ayant au moins 0,5 mm d'épaisseur ; et  
(d) une enveloppe (46) de l'élément isolant (86).

2. Article selon la revendication 1, ledit article à fumer étant conçu sous forme d'un article du type d'une cigarette dans lequel l'élément combustible (10), le moyen générateur d'aérosol (30 ; 54, 56) et l'élément isolant (86) sont structurés et disposés de manière à transmettre de la chaleur de l'élément combustible (10) à ladite matière formant un aérosol aussi bien pendant qu'une bouffée est tirée que pendant les intervalles entre bouffées.

3. Article selon la revendication 1 ou 2, dans lequel l'élément combustible (10) est placé à l'extrémité d'allumage (11) de l'article.

4. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) comprend au moins un passage (16) s'étendant longitudinalement.

5. Article selon la revendication 4, dans lequel l'élément combustible (10) comprend plusieurs de ces passages (16).



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| <p>6. Article selon la revendication 4 ou 5, dans lequel au moins un passage (16) est en forme de trou.</p> <p>7. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) a une longueur d'environ 30 mm ou moins avant que l'article soit fumé.</p> <p>8. Article selon la revendication 7, dans lequel l'élément combustible (10) a environ 20 mm ou moins de longueur avant que l'article soit fumé.</p> <p>9. Article selon la revendication 8, dans lequel l'élément combustible (10) a une longueur d'environ 15 mm ou moins avant que l'article soit fumé.</p> <p>10. Article selon l'une des revendications 7 à 9, dans lequel l'élément combustible (10) a une longueur d'au moins environ 5 mm avant que l'article soit fumé.</p> <p>11. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) a un diamètre compris entre environ 3 mm et 8 mm.</p> <p>12. Article selon la revendication 11, dans lequel l'élément combustible (10) a un diamètre d'environ 4 mm à environ 5 mm.</p> <p>13. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) a une densité d'au moins 0,5 g/cm<sup>3</sup>.</p> <p>14. Article selon la revendication 13, dans lequel l'élément combustible (10) a une plage de densité d'environ 0,5 g/cm<sup>3</sup> à environ 1,5 g/cm<sup>3</sup>.</p> <p>15. Article selon la revendication 13 ou 14, dans lequel l'élément combustible (10) a une densité supérieure à environ 0,7 g/cm<sup>3</sup>.</p> <p>16. Article selon l'une des revendications 13 à 15, dans lequel l'élément combustible (10) a une densité d'au moins environ 0,8 g/cm<sup>3</sup>.</p> <p>17. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) est carboné.</p> <p>18. Article selon la revendication 17, dans lequel l'élément combustible (10) contient au moins environ 50% en poids de carbone en tant que tel.</p> | <p>5</p> <p>10</p> <p>15</p> <p>20</p> <p>25</p> <p>30</p> <p>35</p> <p>40</p> <p>45</p> <p>50</p> <p>55</p> | <p>19. Article selon la revendication 18, dans lequel l'élément combustible (10) contient au moins 60% à 80% en poids de carbone.</p> <p>20. Article selon la revendication 19, dans lequel l'élément combustible (10) contient au moins environ 80% en poids de carbone.</p> <p>21. Article selon la revendication 20, dans lequel l'élément combustible (10) contient au moins environ 85% en poids de carbone.</p> <p>22. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) a une extrémité d'allumage conique.</p> <p>23. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) est une masse carbonée comprimée ou extrudée.</p> <p>24. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) est sensiblement exempt de matière organique volatile.</p> <p>25. Article selon l'une des revendications précédentes, dans lequel les constituants de la masse formant l'élément combustible (10) sont choisis de manière à éviter tout filet visible notable de fumée pendant les intervalles entre bouffées.</p> <p>26. Article selon l'une des revendications précédentes, comprenant par ailleurs un élément isolant (86) qui est conçu et disposé pour accroître le transfert de chaleur de l'élément combustible (10) au moyen générateur d'aérosol (30 ; 54, 56).</p> <p>27. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) entoure au moins une partie du moyen générateur d'aérosol (30 ; 54, 56).</p> <p>28. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est placé dans un réservoir (87 ; 52).</p> <p>29. Article selon l'une des revendications précédentes, dans lequel un élément de transfert de chaleur (87 ; 52) est réalisé pour transférer la chaleur dégagée par l'élément combustible (10) au moyen générateur d'aérosol (30 ; 54, 56) sensiblement pendant la totalité du temps pendant lequel l'élément combustible brûle.</p> |
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30. Article selon l'une des revendications précédentes, dans lequel un élément de transfert de chaleur (87 ; 52) qui est prévu est en contact avec ou chevauche au moins une partie de l'élément combustible (10) et du moyen générateur d'aérosol (30 ; 54, 56) 5
31. Article selon la revendication 29 ou 30, dans lequel l'élément de transfert de chaleur (87 ; 52) entoure au moins une partie du moyen générateur d'aérosol (30 ; 54, 56). 10
32. Article selon l'une des revendications 29 à 31, dans lequel l'élément de transfert de chaleur se trouve au moins partiellement à l'intérieur de l'élément combustible. 15
33. Article selon l'une des revendications 29 à 32, dans lequel l'élément de transfert de chaleur (87 ; 52) enveloppe une partie de la périphérie longitudinale extérieure de l'élément combustible (10) et au moins une partie de la périphérie longitudinale extérieure du moyen générateur d'aérosol (30 ; 54, 56). 20
34. Article selon l'une des revendications 29 à 33, dans lequel l'élément de transfert de chaleur est un réservoir (52) du moyen générateur d'aérosol (54, 56) qui conduit la chaleur. 25
35. Article selon la revendication 34, dans lequel l'extrémité côté combustible du réservoir conducteur (52) est en contact avec la partie arrière de l'élément combustible (10). 30
36. Article selon l'une des revendications 29 à 35, dans lequel l'élément de transfert de chaleur (87 ; 52) est placé à distance derrière l'extrémité d'allumage (11) de l'élément combustible (10). 35
37. Article selon l'une des revendications 29 à 36, dans lequel l'élément de transfert de chaleur (87 ; 52) est un élément métallique, de préférence en aluminium. 40
38. Article selon l'une des revendications 28 à 37, dans lequel le réservoir (87 ; 52) est un tube métallique conducteur de la chaleur. 45
39. Article selon l'une des revendication 28 à 38, dans lequel le réservoir (87) chevauche la partie arrière de l'élément combustible (10), entoure le moyen générateur d'aérosol (30) et permet le passage de l'air et de la matière formant l'aérosol. 50
40. Article selon l'une des revendications 29 à 39, dans lequel l'élément de transfert de chaleur consiste en une tige conductrice noyée dans au moins une partie aussi bien de l'élément combustible que du moyen générateur d'aérosol. 55
41. Article selon l'une des revendications 34 à 40, comprenant un élément isolant (86) qui entoure au moins une partie du réservoir conducteur (87 ; 52).
42. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) est non combustible.
43. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) a une épaisseur d'environ 1 mm à 2,5 mm.
44. Article selon la revendication 43, dans lequel l'élément isolant (86) a une épaisseur d'environ 1 mm à 2 mm.
45. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) consiste en une masse de fibres minérales perméable à l'air.
46. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) consiste en une chemise élastique de fibres perméable à l'air.
47. Article selon l'une des revendications précédentes, dans lequel l'élément isolant (86) a une conductibilité thermique inférieure à environ 0,005 g-cal/(sec)(cm<sup>2</sup>) (°C/cm).
48. Article selon l'une des revendications précédentes, dans lequel ledit élément isolant (86) consiste en une matière qui fond pendant l'utilisation.
49. Article selon la revendication 48, dans lequel l'élément isolant (86) consiste en fibres minérales qui fondent pendant l'utilisation.
50. Article selon l'une des revendications précédentes, dans lequel ledit élément isolant (86) consiste en une qualité de fibres de verre à basse température.
51. Article selon la revendication 50, dans lequel ledit élément isolant (86) consiste en fibres de verre ayant un point de ramollissement inférieur à environ 650 °C.



52. Article selon l'une des revendications précédentes, dans lequel une charge de tabac (56) est placée.
53. Article selon la revendication 52, dans lequel la charge de tabac (56) est placée entre l'extrémité arrière de l'élément combustible (10) et l'extrémité (15) côté bouche de l'article. 5
54. Article selon l'une des revendications précédentes, dans lequel le tabac est placé entre le moyen générateur d'aérosol et l'extrémité côté bouche de l'article. 10
55. Article selon la revendication 54, dans lequel le tabac est placé à l'extrémité arrière du moyen générateur d'aérosol. 15
56. Article selon l'une des revendications précédentes, comprenant une charge d'extrait de tabac qui est placée entre l'extrémité arrière de l'élément combustible et l'extrémité côté bouche de l'article. 20
57. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est placé adjacent à l'élément combustible (40) dans la direction longitudinale de l'article. 25
58. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est à proximité immédiate de l'élément combustible (10). 30
59. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est en butée contre l'élément combustible (10). 35
60. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) et le moyen générateur d'aérosol (30 ; 54, 56) sont placés en relation conductrice d'échange de chaleur de façon que le moyen générateur d'aérosol (30 ; 54, 56) reçoive par conductibilité le transfert de chaleur sensiblement pendant la totalité du temps pendant lequel l'élément combustible (10) brûle. 40
61. Article selon la revendication 60, dans lequel l'élément combustible (10) et le moyen générateur d'aérosol (30 ; 54, 56) sont placés en relation conductrice d'échange de chaleur par contact entre le moyen générateur d'aérosol et une partie de l'élément combustible. 45
62. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) n'est pas placé à plus d'environ 30 mm de l'extrémité (11) d'allumage de l'élément combustible (10). 50
63. Article selon la revendication 62, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) n'est pas placé à plus d'environ 15 mm de l'extrémité (11) d'allumage de l'élément combustible (10).
64. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est chargé d'environ 20 mg à 120 mg de matière formant un aérosol.
65. Article selon la revendication 64, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est chargé de 35 mg à 85 mg de matière formant un aérosol.
66. Article selon l'une des revendications précédentes, dans lequel plus d'environ 15 pour cent en poids de la matière formant l'aérosol portée par le moyen générateur d'aérosol (30 ; 54, 56) sont délivrés sous forme de substance humide totalement particulaire dans des conditions de fumée de 35 ml de bouffées d'une durée de 2 secondes séparées par 58 secondes d'intervalles entre bouffées.
67. Article selon l'une des revendications précédentes, dans lequel l'article délivre au moins environ 0,6 mg de substance humide totalement particulaire pendant les trois premières bouffées dans des conditions de fumée de 35 ml de bouffées d'une durée de 2 secondes séparées par 58 secondes d'intervalles entre bouffées.
68. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est chargé de suffisamment de substance formant l'aérosol pour que l'article délivre au moins environ 1,5 mg de substance humide totalement particulaire pendant les trois premières bouffées dans des conditions de fumée de 35 ml de bouffées d'une durée de 2 secondes séparées par 58 secondes d'intervalles entre bouffées.
69. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) est chargé de suffisamment de substance formant l'aérosol pour que l'article délivre une moyenne d'au moins environ 0,8 mg par bouffée de substance humide tota-



lement particulaire, dans des conditions de fumée de 35 ml de bouffées d'une durée de 2 secondes séparées par 58 secondes d'intervalles entre bouffées, pour au moins 6 bouffées.

70. Article selon la revendication 69, dans lequel l'article délivre une moyenne d'au moins environ 0,8 mg par bouffée de substance humide totalement particulaire, dans des conditions de fumée de 35 ml de bouffées d'une durée de 2 secondes séparées par 58 secondes d'intervalles entre bouffées, pour au moins 10 bouffées.

71. Article selon l'une des revendications 28 à 70, dans lequel le réservoir (52) a un bord rabattu à l'extrémité côté bouche.

72. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) contient un extrait de tabac.

73. Article selon l'une des revendications précédentes, dans lequel des agents volatiles de saveur sont placés entre le moyen générateur d'aérosol (30 ; 54, 56) et l'extrémité côté bouche (15).

74. Article selon l'une des revendications précédentes, dans lequel la fumée produite consiste essentiellement en oxydes de carbone, air, eau, substance volatile que contient le moyen générateur d'aérosol (30 ; 54, 56), d'autres substances volatiles souhaitées et des quantités en traces d'autres matières.

75. Article selon l'une des revendications 17 à 74, dans lequel l'article n'a aucune activité mutagène dans la substance humide totalement particulaire, telle que mesurée par le test Ames.

76. Article selon l'une des revendications précédentes, dans lequel l'article a un diamètre d'environ 8 mm ou moins.

77. Article selon l'une des revendications précédentes, dans lequel l'article a la dimension et la forme d'une cigarette.

78. Article selon l'une des revendications précédentes, dans lequel l'article à fumer comprend de plus une pièce d'embout buccal (40).

79. Article selon la revendication 78, dans lequel l'article à fumer comprend un moyen (44) pour délivrer la matière formant l'aérosol à l'utilisateur, ladite pièce d'embout buccal (40) et le moyen délivrant l'aérosol (44) se prolongeant

sur plus de la moitié de la longueur de l'article.

80. Article selon l'une des revendications précédentes, dans lequel l'article délivre un aérosol visible analogue à une fumée.

81. Article selon l'une des revendications précédentes, dans lequel l'article est adapté pour être utilisé avec une embouchure séparée.

82. Article selon l'une des revendications précédentes, dans lequel l'article à fumer comprend de plus un moyen (52, 44 ; 87, 44) pour diriger les gaz de l'élément combustible (10) à travers le moyen générateur d'aérosol (30 ; 54, 56) et vers l'embouchure (45).

83. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (30 ; 54, 56) comprend un substrat thermiquement stable (30 ; 54) portant la matière formant l'aérosol.

84. Article selon la revendication 83, dans lequel le substrat thermiquement stable (54) contient une matière céramique.

85. Article selon l'une des revendications précédentes, dans lequel le moyen générateur d'aérosol (54, 56) comprend un substrat particulier (54).

86. Article selon l'une des revendications précédentes, comprenant de plus un filtre (45).

87. Article selon l'une des revendications précédentes, dans lequel l'élément combustible (10) et le moyen générateur d'aérosol (30 ; 54, 56) sont conçus et disposés pour transférer de la chaleur de l'élément combustible (10) au moyen générateur d'aérosol (30 ; 54, 56) afin de volatiliser la matière formant l'aérosol pendant les bouffées pendant toute la durée de fumée.

88. Article selon l'une des revendications 1 à 60 et 62 à 87, dans lequel le moyen générateur d'aérosol (30) est en contact avec l'élément combustible (10) de manière à recevoir de la chaleur de l'élément combustible pendant sensiblement la totalité de la période pendant laquelle l'élément combustible brûle.

89. Article selon l'une des revendications précédentes, dans lequel le brûlage de l'élément combustible (10) ne produit aucune cendre à jeter pendant l'utilisation.