

Description

The present invention relates to 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.

EP-A-0 117 355 (Hearn et al.), describes a proposed cigarette 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 8-27) 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.

Also US-A-4 340 072 describes a proposed cigarette type smoking article with a rod-like fuel element having 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 preventing a lighting flame from entering the central axial passage of the fuel element. 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.

Also EP-A-0 074 201 describes a proposed cigarette type smoking article with a combustible carbonized rod which is either a filter with a length of from 10 mm to 40 mm or the sole fuel element of a tobacco-free cigarette wherein the fuel element has a length of from 85 mm to 120 mm. If in this known smoking article the combustible carbonized rod is used as a filter the known smoking article has a tobacco column extending over about half of the overall length of the smoking article and being disposed in front of the filter. When such an embodiment of the known smoking article is smoked, purportedly the carbon filter traps TPM and then, when the burning zone reaches the carbon filter, it burns in a manner resembling the tobacco column but releases no TPM of its own and little of the trapped, condensed TPM produced by the combustion of the tobacco column.

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

Starting from a cigarette type smoking article having a mouth end and including a fuel element comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means comprising an aerosol forming material, which aerosol generating means is disposed between the lighting end of the fuel element and the mouth end, according to subject invention this object is achieved by designing such a smoking article such that a charge of tobacco is located between the rear end of the fuel element and the mouth end of the article and is physically separate from the aerosol generating means, and that said fuel element is about 20 mm or less in length prior to smoking and is structured and arranged to burn throughout smoking to generate heat to volatilize aerosol forming material during puffing throughout smoking of the article.

Starting from a cigarette type smoking article having a mouth end and including a fuel element comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means comprising an aerosol forming material and being disposed between the rear end of the fuel element and the mouth end, according to subject invention this object is achieved by providing

such a smoking article with a fibrous insulating member surrounding at least a portion of the fuel element and with a charge of tobacco located between the rear end of the fuel element and the mouth end of the article and being physically separate from the aerosol generating means.

Starting from a cigarette type smoking article having a mouth end and including a fuel element comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means comprising an aerosol forming material and being disposed between the rear end of the fuel element and the mouth end, according to subject invention this object is achieved by designing such a smoking article such that the fuel element is about 20 mm or less in length prior to smoking, and that the smoking article has a fibrous insulating member circumscribing at least a portion of the fuel element.

Starting from a cigarette type smoking article having a mouth end and including a fuel element comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means comprising an aerosol forming material and being disposed between the rear end of the fuel element and the mouth end, according to subject invention this object is achieved by a heat conducting member structured and arranged to transfer heat from the fuel element to the aerosol generating means during puffing and between puffs substantially throughout the time of the burning of the fuel element, and by a fibrous insulating member surrounding at least a portion of the fuel element.

Starting from a smoking article having a mouth end and including a fuel element comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means comprising an aerosol forming material and being disposed between the rear end of the fuel element and the mouth end, according to subject invention this object is achieved by designing such a smoking article such that the fuel element is about 20 mm or less in length prior to smoking and by providing a heat conducting member structured and arranged to transfer heat from the fuel element to the aerosol generating means during puffing and between puffs substantially throughout the time of the burning of the fuel element.

In all of the aforesaid inventive smoking articles the heat generated by the fuel element during smoking is more efficiently used for producing an aerosol resembling the smoke of a conventional cigarette type smoking article.

Further advantageous features of the inventive cigarette type smoking article are described in the enclosed claims 6 to 98.

The present invention provides for a cigarette type smoking article which 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.

Preferably, the heat exchange relationship between the fuel element and the aerosol generating means is achieved by providing a heat transferring member, preferably 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 preferably provided with a peripheral insulating member, such as a jacket of insulating fibers, the jacket being preferably 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 conven-

tional 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 conditions. (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 such.

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) (cm²)(°C/cm), of less than about 0.05, preferably less than about 0.02, most preferably less than about 0.005. See, Hack's Chemical Dictionary, 34 (4th ed., 1969) and Lance's Handbook of Chemistry, 10, 272-274 (11th ed., 1973).

Preferred embodiments of the smoking article according to the present invention are 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 through 9 are longitudinal views of various embodiments of the invention;

Figure 1A is a sectional view of the embodiment of Figure 1, taken along lines 1A-1A in Figure 1;

Figure 2A is a longitudinal view of a modified, tapered fuel element of the embodiment of Figure 2;

Figure 3A is a sectional view of the embodiment of Figure 3, taken along lines 3A-3A in Figure 3; and

Figure 10 depicts the average peak temperature profile of the smoking article of Example 5 during use.

DETAILED DESCRIPTION OF THE INVENTION

The embodiment of the invention illustrated in Figure 1, which preferably has the diameter of a conventional cigarette, includes a short, combustible carbonaceous fuel element 10, an abutting aerosol generating means 12, and a foil lined paper tube 14, which forms the mouthend piece 15 of the article. In this embodiment, fuel element 10 is a "blowpipe" charcoal, i.e. carbonized wood, which is provided with

five longitudinally extending holes 16. See Figure 1A. The fuel element 10, which is about 20 mm long, optionally may be wrapped with cigarette paper to improve lighting of the charcoal fuel. This paper may be treated with known burn additives.

Aerosol generating means 12 includes a plurality of glass beads 20 coated with an aerosol forming substance or substances, such as glycerin. The glass beads are held in place by a porous disc 22, which may be made of cellulose acetate. This disc may be provided with a series of peripheral grooves 24 which provide passages between the disc and the foil lined tube 14.

The foil lined paper tube 14, which forms the mouthend piece of the article, surrounds aerosol generating means 12 and the rear, non-lighting end of fuel element 10. The tube also forms an aerosol delivery passage 26 between the aerosol generating means 12 and mouth end 15 of the article.

The presence of foil lined tube 14, which couples the nonlighting end of fuel 10 to aerosol generator 12, also increases heat transfer to the aerosol generator. The foil also helps to extinguish the fire cone. When only a small amount of the unburned fuel remains, heat loss through the foil acts as a heat sink which helps to extinguish the fire cone.

The foil used in this article is typically an aluminum foil of 0.35 mils (0.0089 mm) in thickness, but the thickness and/or the type of metal employed may be varied to achieve any desired degree of heat transfer. Other types of heat conducting members such as Grafoil, available from Union Carbide, also may be employed.

The article illustrated in Figure 1 also includes an optional mass or plug of tobacco 28 to contribute flavor to the aerosol. This tobacco charge 28 may be placed at the mouth end of disc 22, as shown in Figure 1, or it may be placed between glass beads 20 and disc 22. It also may be placed in passage 26 at a location spaced from aerosol generator 12.

In the embodiment shown in Figure 2, the short fuel element 10 is a pressed carbon rod or plug, about 20 mm long, which is provided with an axial hole 16. Alternatively, the fuel may be formed from carbonized fibers and preferably also provided with an axial passageway corresponding to hole 16. In this embodiment, aerosol generating means 12 includes a thermally stable conductive carbonaceous substrate 30, 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 32, as is shown in Figure 2. This embodiment also includes a mass of tobacco 28 which is preferably placed at the mouth end of substrate 30. For appearance sake, this article also includes an optional high porosity cellulose acetate filter 34, which may be provided with peripheral grooves 36 to provide passages for the aerosol forming substance between filter 34 and foil tube 14. Optionally, as shown in Figure 2A, the lighting end 11 of the fuel element may be tapered to improve lightability.

The embodiment of the invention illustrated in Figure 3, includes a short combustible carbonaceous fuel element 10, connected to aerosol generating means 12 by a heat conductive rod 99 and by a foil lined paper tube 14, which also leads to the mouth end 15 of the article. In this embodiment, fuel element 10 may be blowpipe charcoal or a pressed or extruded carbon rod or plug or other carbonaceous fuel source.

Aerosol generating means 12 includes a thermally stable carbonaceous substrate 30, such as a plug of porous carbon, which is impregnated with an aerosol forming substance or substances. This embodiment includes a void space 97 between the fuel element 10 and the substrate 30. The portion of the foil lined tube 14 surrounding this void space includes a plurality of peripheral holes 100 which permit sufficient air to enter the void space to provide appropriate pressure drop.

As shown in Figures 3 and 3A, the heat conducting means includes a conductive rod 99 and the foil lined tube 14. The rod 99, preferably formed of aluminum, has at least one, preferably from 2 to 5, peripheral grooves 96 therein, to allow air passage through the substrate. The article of Figure 3 has the advantage that the air introduced into the void space 97 contains less carbon oxidation products because it is not drawn through the burning fuel.

The embodiment illustrated in Figure 4 includes a fibrous carbon fuel element 10, such as carbonized cotton or rayon. The fuel element includes a single axial hole 16. The substrate 38 of the aerosol generator is a granular, thermally stable carbon. A mass of tobacco 28 is located immediately behind the substrate. This article is provided with a cellulose acetate tube 40, in place of the foil lined tube of previous embodiments. This tube 40 includes an annular section 42 of cellulose acetate tow surrounding an optional plastic, e.g., polypropylene tube 44. At the mouth end 15 of this element there is a low efficiency cellulose acetate filter plug 45. The entire length of the article is wrapped in cigarette-type paper 46. A cork or white ink coating 48 may be used on the mouth end to simulate tipping. A foil strip 50 is located on the inside of the paper, toward the fuel end of the article. This strip preferably extends from the rear portion of the fuel element to the mouth end of the tobacco charge 28. It may be integral with the paper or it may be a separate piece applied before the paper overwrap.

The embodiment of Figure 5 is similar to that of Figure 4. In this embodiment, the aerosol generating means 12 is formed by an aluminum macrocapsule 52 which is filled with a granular substrate or, as shown in the drawing, a mixture of a granular substrate 54, and tobacco 56. The macrocapsule 52 is crimped at its ends 58, 60 to enclose the material and to inhibit migration of the aerosol former. The crimped end 58, at the fuel end, preferably abuts the rear end of the fuel element to provide for conductive heat transfer. A void space 62 formed by end 58 also helps to inhibit migration of the aerosol former to the fuel. Longitudinal passageways 59 and 61 are provided to permit the passage of air and the aerosol forming substance. Macrocapsule 52 and fuel element 10 may be united by a conventional cigarette paper 47, as illustrated in the drawing, by a perforated ceramic paper, or a foil strip. If cigarette paper is used, a strip 64 near the rear end of the fuel should be printed or treated with sodium silicate or other known materials which cause the paper to extinguish. The entire length of the article is overwrapped with conventional cigarette paper 46.

Figure 6 illustrates another embodiment having a pressed carbon fuel plug 10. In this embodiment, the fuel element has a tapered lighting end 11 for easier lighting and a tapered rear end 9 for easy fitting into a tubular foil wrapper 66. Abutting the rear end of the fuel element is an aluminum disc 68 with a center hole 70. A second, optional aluminum disc 72 with hole 74 is located at the mouth end of the aerosol generator 12. In between is a zone 76 of a particulate substrate and a zone 78 of tobacco. The foil wrapper 66 in which the fuel element is mounted extends back beyond the second aluminum disc 72. This embodiment also includes a hollow cellulose acetate rod 42 with an internal polypropylene tube 44, and a cellulose acetate filter plug 45. The entire length of the article is preferably wrapped with cigarette paper 46.

The embodiment shown in Figure 7 illustrates the use of a substrate 80 embedded within a large cavity 82 in fuel element 10. In this embodiment, the fuel element preferably is formed from an extruded carbon, and the substrate 80 usually is a relatively rigid, porous material. The entire length of the article is wrapped with conventional cigarette paper 46. This embodiment may also include a foil strip 84 to couple fuel element 10 to the cellulose acetate tube 40 and to help extinguish the fuel.

The embodiments shown in Figures 8 and 9 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 8, 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 46. The jacket 86 extends to the mouth end of substrate 30, but may replace cellulose acetate rod 42.

In the embodiment shown in Figure 9, an aluminum macrocapsule 52 of the type shown in Figure 5 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 in a manner similar to that shown in Figure 8.

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.

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 this 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 therefore 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 utilized 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/CO₂ 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 11 in Figures 1 through 5. 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. Combustion 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, silicones, boron, organic polymers, cellulose, and the like, including mixtures of these materials. Nonfibrous insulating materials, such as silica aerogel, pearlite, 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 abutts 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 foil lined tube of Figures 1 - 3 and the cellulose acetate tube employed in the embodiments of Figures 4 - 9. 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 examples which aid 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 1

A smoking article was constructed in accordance with the embodiment of Figure 1. The fuel element was a 25 mm long piece of blow pipe charcoal, with five 0.040 in. (1.02 mm) longitudinal passageways made with a number 60 drill bit. The charcoal weighed 0.375 g. The fuel element was wrapped with conventional treated cigarette paper. The substrate was 500 mg of glass beads (0.64 in. [1.63 mm] average diameter) having two drops, approximately 50 mg, of glycerol coated on their surface. When packed into the tube, this substrate was about 6.5 mm long. The foil lined tube consisted of a 0.35 mil (0.0089 mm) layer of aluminum foil inside a 4.25 mil (0.108 mm) layer of white spirally wound paper. This tube surrounded the rear 5 mm of the fuel element. A short (8 mm) piece of cellulose acetate with four grooves around the periphery was used to hold the glass beads against the fuel source. An additional grooved cellulose acetate filter piece of 8 mm length was inserted into the mouth end of the tube to give the appearance of a conventional cigarette. The overall length of the article was about 70 mm.

Models of this type delivered considerable aerosol on the lighting puff, reduced amounts of aerosol on puffs 2 and 3, and good delivery of aerosol on puffs 4 through 9. Models of this type generally yielded about 5-7 mg of wet total particulate matter (WTPM) when machine smoked under FTC smoking procedures of a 35 ml puff volume, a two second puff duration, and a 60 second puff frequency.

Example 2

A. Four smoking articles were constructed with 10 mm long pressed carbon fuel elements and glass bead substrates. The fuel elements were formed from 90% PCB-G and 10% SCMC, at about 5000 pounds (2273 kg) of applied load with the tapered lighting end illustrated in Figure 2A. A single 0.040 in (1.02 mm) hole was formed down the center of each element. Three of the four fuel sources were wrapped with 8 mm wide strips of conventional cigarette paper. The fuel elements were inserted about 2 mm into 70 mm long sections of the foil lined tube described in Example 1. Glass beads, coated with the amount of glycerol indicated in the following table, were inserted into the open end of the foil lined tube and were held against the fuel element by 5 mm long foamed polypropylene filters having a series of longitudinally extending peripheral grooves. A 5 mm long low efficiency cellulose acetate filter piece was inserted into the mouth end of each article. These articles were machine smoked under FTC smoking conditions and the wet total particulate matter (WTPM) was collected on a series of Cambridge pads. The results of these experiments are reported in Table I.

TABLE I

	Glass Beads (wt)	Aerosol Former (wt)	WTPM (mg)/Puffs				
			1-3	4-6	7-9	10-12	Total
A	400.4 mg	40.5 mg	8.1	4.5	0.9	0	13.5
B*	405.6 mg	59.4 mg	10.2	1.9	0.7	0	12.8
C	404.0 mg	60.6 mg	7.6	6.9	0.4	0	14.9
D	803.8 mg	81.0 mg	5.9	2.5	3.7	0.9	13.0

*The fuel rod in this model was not wrapped with cigarette paper.

B. Three smoking articles similar to those described in Example 2A were constructed with 20 mm long blowpipe charcoal fuel elements of the type described in Example 1. These articles were machine smoked under FTC smoking conditions, and the WTPM was collected on a series of Cambridge pads. The results of these tests are reported in Table II.

TABLE II

	Glass Beads (wt)	Aerosol Former (wt)	WTPM (mg)/Puffs				
			1-3	4-6	7-9	10-12	Total
E	402.4 mg	60.6 mg	0.1	5.4	6.2	0.6	12.3
F*	404.7 mg	63.1 mg	0.5	0.9	2.2	3.1	7.0
G	500.0 mg	50.0 mg	0.3	2.9	3.0	0	6.2

*The fuel rod in this model was not wrapped with cigarette paper.

Example 3

A. Four smoking articles were constructed as shown in Figure 2 with a 10 mm pressed carbon fuel element having the tapered lighting end illustrated in Figure 2A. The fuel element was made from 90% PCB-G carbon and 10% SCMC, at about 5000 pounds (2273 kg) of applied load. A 0.040 in. (1.02 mm) hole was drilled down the center of the element. The substrate for the aerosol former was cut and machined to shape from PC-25, a porous carbon sold by Union Carbide Corporation, Danbury, CT. The substrate in each article was about 2.5 mm long, and about 8 mm in diameter. It was loaded with an average of about 27 mg of a 1:1 propylene glycol-glycerol mixture. The foil lined tube mouthend piece, of the same type as used in Example 1, enclosed the rear 2 mm of the fuel element and the substrate. A plug of Burley tobacco, about 100 mg was placed against the mouth end of the substrate. A short, about 5-9 mm, baffled polypropylene filter piece was placed in the mouth end of the foil lined tube. A 32 mm length of a cellulose acetate filter with a hollow polypropylene tube in the core was placed between the tobacco and the filter piece. The overall length of each article was about 78 mm.

B. Six additional articles were constructed substantially as in Example 3A, but the substrate length was increased to 5 mm, and a 0.040 in. (1.02 mm) hole was drilled through the substrate. In addition, these articles did not have a cellulose acetate/polypropylene tube. About 42 mg of the propylene glycol-glycerol mixture was applied to the substrate. In addition, two plugs of Burley tobacco, about 100-150 mg each, were used. The first was placed against the mouth end of the substrate, and the second one was placed against the filter piece.

C. Four additional articles were constructed substantially as in Example 3A, except that an approximately 100 mg plug of flue-cured tobacco containing about six percent by weight of diammonium monohydrogen phosphate was used in lieu of the plug of Burley tobacco.

D. The smoking articles from Examples 3A-C were tested using the standard Ames Test. See Ames, et al., *Mut. Res.*, 31:347-364 (1975), as modified by Nagas et al., *Mut. Res.*, 42:335 (1977), and 113:173-215 (1983). The samples 3A and C were "smoked" on a conventional cigarette smoking machine using the conditions of a 35 ml puff volume, a two second puff duration, and a 30 second puff frequency, for ten puffs. The smoking articles of Example 3B were smoked in the same manner except that a 60

second puff frequency was used. Only one filter pad was used for each group of articles. This afforded the following wet total particulate matter (WTPM) for the indicated groups of articles:

	WTPM
Example 3A	63.4 mg
Example 3B	50.6 mg
Example 3C	69.2 mg

The filter pad for each of the above examples containing the collected WTPM was shaken for 30 minutes in DMSO to dissolve the WTPM. Each sample was then diluted to a concentration of 1 mg/ml and used "as is" in the Ames assay. Using the procedure of Nagas et al., Mut. Res. 42:335-342 (1977), 1 mg/ml concentrations of WTPM were admixed with the S-9 activating system, plus the standard Ames bacterial cells, and incubated at 37°C for twenty minutes. The bacterial strain used in this Ames assay was Salmonella typhimurium, TA 98. See Purchase et al., Nature, 264:624-627 (1976). Agar was then added to the mixture, and plates were prepared. The agar plates were incubated for two days at 37°C, and the resulting cultures were counted. Four plates were run for each dilution and the standard deviations of the colonies were compared against a pure DMSO control culture. As shown in Table III, there was no mutagenic activity caused by the WTPM obtained from any of the smoking articles tested. This can be ascertained by comparison of the mean number of revertants per plate with the mean number of revertants obtained from the control (0 ug WTPM/Plate). For mutagenic samples, the mean number of revertants per plate will increase with increasing doses.

TABLE III

Example 3A			
Dose (ug WTPM/Plate)		Mean Revertants/Plate	S.D.*
Control	0	49.3	3.4
	33	51.3	9.1
	66	50.5	7.0
	99	50.8	5.2
	132	51.5	5.3
	165	53.8	10.1
	198	48.3	4.6
Example 3B			
Dose (ug WTPM/Plate)		Mean Revertants/Plate	S.D.*
Control	0	56	10.5
	31.5	40	7.8
	63	48.3	6.3
	94.5	54.0	8.4
	126	39	4.7
	157.5	42.5	9.3
	189	43	9.1
Example 3C			
Dose (ug WTPM/Plate)		Mean Revertants/Plate	S.D.*
Control	0	48.3	5.7
	36	50.3	9.9
	72	49.0	3.9
	108	55.3	4.5
	144	43.0	6.4
	180	42.3	8.8
	216	44.3	7.8

*Standard Deviation

Example 4

Five smoking articles were constructed as shown in Figure 2. Each article had a 10 mm pressed carbon fuel source as described in Example 3A. This fuel element was inserted 3 mm into one end of a 70 mm long aluminum foil lined tube of the type described in Example 1. A 5 mm long carbon felt substrate, cut from rayon carbon felt sold by Fiber Materials, Inc., was butted against the fuel source. This substrate was loaded with an average of about 97 mg of a 1:1 mixture of glycerin and propylene glycol, about 3 mg of nicotine, and about 0.1 mg of a mixture of flavorants. A 5 mm long section of blended tobacco was butted against the mouth end of the substrate. A 5 mm long cellulose acetate filter piece was placed in the mouth end of the foil lined tube.

These articles were machine smoked under the FTC conditions. The aerosol from these articles was collected on a single Cambridge pad (133.3 mg WTPM), diluted in DMSO to a final concentration of 1 mg WTPM per ml and tested for Ames activity as described in Example 3D using each of the following strains: Salmonella typhimurium TA 1535, 1537, 1538, 98, and 100. As shown in Table IV there was no mutagenic activity caused by the WTPM collected from the articles tested.

TABLE IV

TA 1535			TA 1537		
Dose*		Mean Revertants	Dose*		Mean Revertants
Control	0	16	Control	0	
	25	13		25	
	50	14		50	
	75	17		75	
	100	14		100	
	125	13		125	
	150	12		150	
TA 1538			TA 98		
Dose*		Mean Revertants	Dose*		Mean Revertants
Control	0	15	Control	0	
	25	13		25	
	50	22		50	
	75	16		75	
	100	20		100	
	125	18		125	
	150	19		150	
TA 100					
Dose*		Mean Revertants			
Control	0	110			
	25	108			
	50	105			
	75	99			
	100	107			
	125	108			
	150	109			

ug WTPM/Plate

Example 5

A smoking article was built as shown in Figure 2 with a 10 mm pressed carbon fuel plug having the configuration shown in Figure 2A, but with no tobacco. The fuel element was made from a mixture of 90% PCB-G activated carbon and 10% SCMC as a binder at about 5000 pounds (2273 kg) of applied load. The fuel element was provided with a 0.040 in (1.02 mm) longitudinal passageway. The substrate was a 10 mm long porous carbon plug made from Union Carbide's PC-25. It was provided with a 0.029 in. (0.74 mm) drilled axial hole, and was loaded with 40 mg of a (1:1) mixture of propylene glycol and glycerol. The foil lined tube, as in Example 1, encircled the rear 2 mm of the fuel element and formed the mouthend piece. The article did not have a filter tip, but was overwrapped with conventional cigarette paper. The total length of the article was 80 mm.

The average peak temperatures for this article are shown for both "puff" and "smolder" in Figure 10. As shown, the temperature declines steadily between the rear end of the fuel element and mouthend. This assures the user of no unpleasant burning sensation when using a product of this invention.

Example 6

A smoking article was constructed in accordance with the embodiment of Figure 3. The fuel element was a 19 mm long piece of blowpipe charcoal, with no longitudinal passageways. Embedded 15 mm into the fuel element was a 1/8 in. (3.2 mm) diameter aluminum rod, 28 mm in length. Four 9 mm x 0.025 in. (0.64 mm) peripheral grooves, spaced 90° apart were cut into the portion of the aluminum rod which pierced the substrate. The substrate was Union Carbide PC-25 carbon 8 mm in length. The grooves in the aluminum rod extended about 0.5 mm beyond the end of the substrate toward the fuel. The substrate was loaded with 150 mg of glycerol. The foil lined tube, which was the same as in Example 1, enclosed a portion of the rear of the fuel element. A gap was left between the non-burning end of the fuel element and the substrate. A series of holes were cut through the foil lined tube in this gap region to allow for air flow. A similar smoking article was constructed with a pressed carbon fuel plug.

Example 7

A smoking article was constructed as shown in Figure 4 with a fuel source of carbonized cotton fiber. Four slivers of cotton were tightly braided together with cotton string to form a rope with a diameter of about 0.4 in. (10.2 mm). This material was placed in a nitrogen atmosphere furnace which was heated to 950°C. It took about 1 1/2 hours to reach that temperature, which was then held for 1/2 hour. A 16 mm piece was cut from this pyrolyzed material to be used as the fuel element. A 2 mm axial hole was made through the element with a probe. The fuel element was inserted 2 mm into a 20 mm long foil lined tube of the type described in Example 1. 100 mg of Union Carbide PC-25, in granular form, containing 60 mg of a 1:1 propylene glycol-glycerol mixture, was inserted into the foil lined tube. A 5 mm long plug of tobacco, about 60 mg, was located immediately behind the granular substrate in the foil lined tube. A 48 mm long annular cellulose acetate tube with an internal 4.5 mm I.D. polypropylene tube was inserted about 3 mm into the foil lined tube. A second foil lined tube, 50 mm in length, was inserted over the cellulose acetate tube, until it abutted against the 20 mm foil lined tube. A 5 mm long cellulose acetate filter plug was inserted into the end of this second foil lined tube. The overall length was 84 mm. When lit, this article produced substantial amounts of aerosol throughout the first six puffs with a tobacco flavor.

Example 8

A smoking article was constructed as shown in Figure 5 with a 15 mm long fibrous fuel element substantially as described in Example 7. The macrocapsule was formed from a 15 mm long piece of 4 mil (0.10 mm) thick aluminum foil, which was crimped to form a 12 mm long capsule. This macrocapsule was loosely filled with 100 mg of granulated PC-60, a carbon obtained from Union Carbide, and 50 mg of blended tobacco. The granular carbon was impregnated with 60 mg of a 1:1 mixture of propylene glycol and glycerol. The macrocapsule, the fuel element, and the mouthend piece were united by an 85 mm long piece of conventional cigarette paper.

Example 9

A smoking article was constructed in accordance with the embodiment of Figure 6 with a 7 mm long pressed carbon fuel element containing 90% PXC carbon and 10% SCMC. The longitudinal passageway was 0.040 in. (1.02 mm) in diameter. This fuel plug was inserted into a 17 mm long aluminum foil lined tube so that 3 mm of the fuel element was inside the tube. An 8 mm diameter disc of 3.5 mil (0.089 mm) aluminum foil, with a 0.049 in. (1.24 mm) diameter center hole, was inserted into the other end of the tube and butted against the end of the fuel source.

Union Carbide PG-60 carbon was granulated and sieved to a particle size of -6 to +10 mesh. 80 mg of this material was used as the substrate, and 80 mg of a 1:1 mixture of glycerin and propylene glycol was loaded on this substrate. The impregnated granules were inserted into the foil tube and rested against the foil disk on the end of the fuel source. 50 mg of blended tobacco was loosely placed against the substrate granules. An additional foil disk with a 0.049 in. (1.24 mm) central hole was inserted into the foil tube on the mouth end of the tobacco. A long hollow cellulose acetate rod with a hollow polypropylene tube as described in Example 7 was inserted 3 mm into the foil lined tube. A second foil lined tube was inserted over the cellulose acetate rod against the end of the 17 mm foil lined tube.

This model delivered 11.0 mg of aerosol in the first three puffs when "smoked" under FTC conditions. Total aerosol delivery for nine puffs was 24.9 mg.

Example 10

A smoking article having the fuel element and substrate configuration of Figure 7 was made using a 15 mm long annular pressed carbon fuel element with an inner diameter of about 4 mm and an outer diameter of about 8 mm. The fuel was made from 90% PCB-G activated carbon and 10% SCMC. The substrate was a 10 mm long piece formed of Union Carbide PC-25 carbon with an external diameter of about 4 mm. The substrate, loaded with 55 mg of a 1:1 glycerin/propylene glycol mixture, was inserted within the end of the fuel closer to the mouth end of the article. This fuel/substrate combination was inserted 7 mm into a 70 mm foil lined tube which had a short cellulose acetate filter at the mouthend. The length of the article was about 77 mm.

The article delivered substantial amounts of aerosol on the first three puffs, and over the useful life of the fuel element.

Example 11

A modified version of the smoking article of Figure 9 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 extruded 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 cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material, said aerosol generating means being disposed between the lighting end of the fuel element and the mouth end (15), characterized in that a charge of tobacco (28) is located between the rear end of the fuel element (10) and the mouth end (15) of the article and is physically separate from the aerosol generating means (12; 38; 80; 30; 52, 54), and that said fuel element is about 20 mm or less in length prior to smoking and is structured and arranged to burn throughout smoking to generate heat to volatilize aerosol forming material during puffing throughout smoking of the article.
2. A cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material and being disposed between the rear end of the fuel element (10) and the mouth end (15), characterized by a fibrous insulating member (86) surrounding at least a portion of the fuel element (10) and a charge of tobacco (56) located between the rear end of the fuel element (10) and the mouth end (15) of the article and being physically separate from the aerosol generating means (12; 38; 80; 30; 52, 54).
3. A cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming



Example 10

A smoking article having the fuel element and substrate configuration of Figure 7 was made using a 15 mm long annular pressed carbon fuel element with an inner diameter of about 4 mm and an outer diameter of about 8 mm. The fuel was made from 90% PCB-G activated carbon and 10% SCMC. The substrate was a 10 mm long piece formed of Union Carbide PC-25 carbon with an external diameter of about 4 mm. The substrate, loaded with 55 mg of a 1:1 glycerin/propylene glycol mixture, was inserted within the end of the fuel closer to the mouth end of the article. This fuel/substrate combination was inserted 7 mm into a 70 mm foil lined tube which had a short cellulose acetate filter at the mouthend. The length of the article was about 77 mm.

The article delivered substantial amounts of aerosol on the first three puffs, and over the useful life of the fuel element.

Example 11

A modified version of the smoking article of Figure 8 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 extruded 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 cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material, said aerosol generating means being disposed between the lighting end of the fuel element and the mouth end (15), characterized in that a charge of tobacco (28) is located between the rear end of the fuel element (10) and the mouth end (15) of the article and is physically separate from the aerosol generating means (12; 38; 80; 30; 52, 54), and that said fuel element is about 20 mm or less in length prior to smoking and is structured and arranged to burn throughout smoking to generate heat to volatilize aerosol forming material during puffing throughout smoking of the article.
2. A cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material and being disposed between the rear end of the fuel element (10) and the mouth end (15), characterized by a fibrous insulating member (86) surrounding at least a portion of the fuel element (10) and a charge of tobacco (56) located between the rear end of the fuel element (10) and the mouth end (15) of the article and being physically separate from the aerosol generating means (12; 38; 80; 30; 52, 54).
3. A cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming



material and being disposed between the rear end of the fuel element (10) and the mouth end (15), characterized in that the fuel element (10) is about 20 mm or less in length prior to smoking and by a fibrous insulating member (86) circumscribing at least a portion of the fuel element (10).

- 5 4. A cigarette type smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material and being disposed between the rear end of the fuel element (10) and the mouth end (15), characterized by a heat conducting member (14; 99; 50; 47; 52; 68, 66) structured and arranged to
10 transfer heat from the fuel element (10) to the aerosol generating means (12; 38; 80; 30; 52, 54) during puffing and between puffs substantially throughout the time of the burning of the fuel element (10), and a fibrous insulating member (86) surrounding at least a portion of the fuel element (10).
- 15 5. A smoking article having a mouth end (15) and including a fuel element (10) comprising primarily carbon as such and having a lighting end and a rear end, and a physically separate aerosol generating means (12; 38; 80; 30; 52, 54) comprising an aerosol forming material and being disposed between the rear end of the fuel element (10) and the mouth end (15), characterized in that the fuel element (10) is about 20 mm or less in length prior to smoking and by
20 a heat conducting member (14; 99; 50; 47; 52; 68, 66) structured and arranged to transfer heat from the fuel element (10) to the aerosol generating means (12; 38; 80; 30; 52, 54) during puffing and between puffs substantially throughout the time of the burning of the fuel element (10).
- 25 6. Article as claimed in claim 5, wherein the heat conducting member comprises a container (66, 68, 72) overlapping the rear portion of the fuel element (10), enclosing the aerosol generating means (76), and permitting the passage of air and the aerosol forming material, and wherein a charge of tobacco (78) is located between the rear end of the fuel element (10) and the mouth end (15) of the article.
- 30 7. Article as claimed in claim 4, wherein the heat conducting member comprises a container overlapping the rear portion of the fuel element, enclosing the aerosol generating means, and permitting the passage of air and the aerosol forming material, and wherein a charge of tobacco is located between the rear end of the fuel element and the mouth end of the
35 article.
8. Article as claimed in claim 1, wherein the aerosol generating means (54) is disposed between the rear end of the fuel element (10) and the mouth end (15) and enclosed by
40 a container (52) which permits the passage of air and of the aerosol forming material, wherein a fibrous insulating member (86) circumscribes at least a portion of the fuel element, and wherein a mouthend piece (45) is provided.
- 45 9. Article according to one of claims 1 to 8, wherein the fuel element (10) is located at the lighting end of the article.
10. Article according to one of claims 1 to 9, wherein the fuel element (10) includes at least one longitudinally extending passageway (16).
- 50 11. Article according to claim 10, wherein the fuel element (10) has a plurality of such passageways (16).
12. Article according to claim 10 or 11, wherein at least one passageway (16) is in the form of a hole.
13. Article according to claim 2 or 4, wherein the fuel element (10) is about 30 mm or less in length prior to
55 smoking.
14. Article according to claim 13, wherein the fuel element (10) is about 20 mm or less in length prior to smoking.



15. Article according to one of the preceding claims, wherein the fuel element is about 15 mm or less in length prior to smoking.
- 5 16. Article according to one of claims 2 and 4 to 15, wherein the fuel element (10) is about 5 mm to 30 mm in length prior to smoking.
17. Article according to one of the preceding claims, wherein the fuel element (10) is about 5 mm to 20 mm in length prior to smoking.
- 10 18. Article according to claim 17, wherein the fuel element (10) is from about 5 mm to 15 mm in length prior to smoking.
19. Article according to one of the preceding claims, wherein the fuel element (10) has a diameter between about 3 mm and 8 mm.
- 15 20. Article according to claim 19, wherein the fuel element (10) has a diameter between about 4 mm and 5 mm.
- 20 21. Article according to one of the preceding claims, wherein the fuel element (10) has a density of at least 0,5 g/cm³.
22. Article according to claim 21, wherein the fuel element (10) has a density range from about 0,5 g/cm³ to about 1,5 g/cm³.
- 25 23. Article according to claim 22, wherein the fuel element (10) has a density of more than about 0.7 g/cm³.
24. Article according to claim 23, wherein the fuel element (10) has a density of more than about 0.8 g/cm³.
- 30 25. Article according to one of the preceding claims, wherein the fuel element (10) comprises at least about 50 % by weight carbon as such.
26. Article according to claim 25, wherein the fuel element (10) comprises at least 60% to 80% by weight carbon as such.
- 35 27. Article according to claim 26, wherein the fuel element (10) comprises at least about 80% by weight carbon as such.
28. Article according to claim 27, wherein the fuel element (10) comprises at least about 85% by weight carbon as such.
- 40 29. Article according to one of the preceding claims, wherein the fuel element (10) has a tapered lighting end (11).
30. Article according to one of the preceding claims, wherein the fuel element (10) is a pressed or extruded mass.
- 45 31. Article according to one of the preceding claims, wherein the fuel element (10) is substantially free of volatile organic material.
- 50 32. Article according to one of the preceding claims, wherein the constituents forming the mass of the fuel element (10) are selected to avoid any substantially visible sidestream smoke during smolder.
33. Article according to one of claims 1 to 3 and 8 to 32 with a heat conducting member (14; 99; 50; 47, 52; 66, 68) structured and arranged to transfer heat from the fuel element (10) to the aerosol generating means (12; 38; 80; 30; 52, 54) during puffing and between puffs substantially throughout the time of the burning of the fuel element (10).
- 55



34. Article according to one of claims 4, 5 and 33 wherein the heat conducting member (14; 99; 50; 47, 52; 66, 68) contacts or overlaps at least a portion of the fuel element (10) and of the aerosol generating means (12; 38; 80; 30; 52, 54).
- 5 35. Article according to one of claims 4, 5, 33 and 34, wherein the heat conducting member (14; 50; 47, 52; 66, 68) encompasses at least a portion of the aerosol generating means (12; 38; 80; 30; 52; 54).
36. Article according to one of claims 4, 5 and 33 to 35, wherein the heat conducting member (99) is at least partially within the fuel element (10).
- 10 37. Article according to one of claims 4, 5 and 33 to 36, wherein the heat conducting member (14; 50; 47, 52; 66, 68) 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 (12; 38; 80; 30; 52, 54).
- 15 38. Article according to one of claims 4, 5 and 33 to 37, wherein the heat conducting member is a heat conducting container (52; 66, 68, 72) for the aerosol generating means (54; 76).
39. Article according to claim 38, wherein the fuel end of the conductive container (52; 66, 68, 72) contacts the rear portion of the fuel element (10).
- 20 40. Article according to one of claims 4, 5 and 33 to 39, wherein the heat conducting member (14; 99; 50; 47, 52; 66, 68) is spaced behind the lighting end of the fuel element (10).
- 25 41. Article according to one of claims 4, 5 and 33 to 40, wherein the heat conducting member (14; 99; 50; 47, 52; 66, 68) is a metallic member, preferably of aluminum.
42. Article according to one of claims 6, 7, 33 to 37, 40 and 41, wherein the container (52; 66, 68, 72) is a heat conductive metallic tube.
- 30 43. Article according to one of claims 38 to 42, wherein the container (50; 66) overlaps the rear portion of the fuel element (10), encloses the aerosol generating means (38; 76), and permits the passage of air and the aerosol forming material.
- 35 44. Article according to one of claims 36, 40 and 41, wherein the heat conducting member comprises a conductive rod (99) embedded within at least a portion of both the fuel element (10) and the aerosol generating means (30).
- 45 45. Article according to one of claims 1, 5 to 7 and 9 to 44, further comprising an insulating member (86) which circumscribes at least a portion of the fuel element (10).
- 40 46. Article according to one of claims 6 to 8, 38, 39, 42 and 43, further comprising an insulating member (86) which circumscribes at least a portion of the conductive container (52).
- 45 47. Article according to one of claims 2 to 4, 8, 45 and 46, wherein the insulating member (86) is non-combustible.
48. Article according to one of claims 2 to 4, 8 and 45 to 47, wherein the insulating member (86) is at least 0.5 mm thick.
- 50 49. Article according to claim 48, wherein the insulating member (86) is about 1 mm to 2 mm thick.
50. Article according to one of claims 2 to 4, 8 and 45 to 49, wherein the insulating member (86) comprises an air permeable mass of inorganic fibers.
- 55 51. Article according to one of claims 2 to 4, 8 and 45 to 50, wherein the insulating member (86) is resilient.



52. Article according to claim 51, wherein the insulating member comprises an air permeable resilient jacket (86) of fibers.
53. Article according to one of claims 2 to 4, 8 and 45 to 52, wherein the insulating member (86) has a thermal conductivity of less than about 0.005 g-cal/(sec) (cm²) (° C/cm).
54. Article according to one of claims 2 to 4, 8 and 45 to 53, wherein the insulating member (86) surrounds at least a portion of the aerosol generating means (54).
55. Article according to one of claims 2 to 4, 8 and 45 to 54, wherein said insulating member (86) comprises a material which fuses during use.
56. Article according to one of claims 2 to 4, 8 and 45 to 55, wherein said insulating member (86) comprises a low temperature grade of glass fibers.
57. Article according to claim 56, wherein said insulating member (86) comprises glass fibers having a softening point below about 650° C.
58. Article according to one of claims 3 to 5 and 9 to 57, wherein a charge of tobacco (28; 78; 56) is provided.
59. Article according to claim 58, wherein the charge of tobacco (28; 78; 56) is located between the rear end of the fuel element (10) and the mouth end (15) of the article.
60. Article according to one of the preceding claims, wherein tobacco (28; 78; 56) is placed between the aerosol generating means (20; 30; 38; 76; 54) and the mouth end (15) of the article.
61. Article according to claim 60, wherein the tobacco (28; 78; 56) is placed at the rear end of the aerosol generating means (20; 30; 38; 76; 54).
62. Article according to one of the preceding claims, comprising a charge of tobacco extract being located between the rear end of the fuel element (10) and the mouth end (15) of the article.
63. 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).
64. 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).
65. Article according to one of the preceding claims, wherein the aerosol generating means (12; 30; 28; 38; 54; 56; 76; 78) abuts the fuel element (10).
66. Article according to one of the preceding claims, wherein the fuel element (10) and the aerosol generating means (12; 30; 28; 38; 54; 56; 76; 78) are arranged in a conductive heat exchange relationship such that the aerosol generating means receives conductive heat transfer substantially throughout the time of burning of the fuel element.
67. Article according to claim 66, wherein the fuel element (10) and the aerosol generating means (12; 30; 38; 54; 76; 80) arranged in a conductive heat exchange relationship by contact between the aerosol generating means and a part of the fuel element.
68. Article according to one of the preceding claims, wherein the aerosol generating means (12; 30; 28; 54; 76) is located no more than about 30 mm from the lighting end of the fuel element (10).
69. Article according to claim 68, wherein the aerosol generating means (12; 30; 28; 54; 76) is located no more than about 15 mm from the lighting end of the fuel element (10).



70. Article according to one of the preceding claims, wherein the aerosol generating means (12; 30; 28; 54; 76) is loaded with from about 20 mg to 120 mg of aerosol forming material.
71. Article according to claim 70, wherein the aerosol generating means (12; 30; 28; 54; 76) is loaded with 35 mg to 85 mg of aerosol forming material.
72. 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 (12; 30; 28; 38; 54; 56; 76; 78) is delivered as wet total particulate matter under smoking conditions of 35 ml puffs of 2 seconds duration separated by 58 seconds of smolder.
73. Article according to one of the preceding claims, wherein the article delivers at least about 0.6 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.
74. Article according to one of the preceding claims, wherein the aerosol generating means (12; 30; 28; 38; 54; 56; 76; 78) 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.
75. Article according to one of the preceding claims, wherein the aerosol generating means (12; 30; 28; 54; 76) 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.
76. Article according to claim 75, 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.
77. Article according to one of the preceding claims, wherein the aerosol generating means (54; 56; 76; 78) is arranged in a container (52; 66; 68; 72).
78. Article according to claim 77, wherein the container (52) is crimped at its mouth end.
79. Article according to one of the preceding claims, wherein the aerosol generating means (20; 38; 54; 76) includes a tobacco extract.
80. Article according to one of the preceding claims, wherein volatile flavoring agents are placed between the aerosol generating means (30) and the mouth end (15).
81. Article according to one of the preceding claims, wherein the constituents of the article are selected and arranged such that the smoke produced by the article 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.
82. Article according to one of the preceding claims, wherein the constituents of the article are selected and arranged such that the smoke produced by the article has no mutagenic activity in the wet total particulate matter, as measured by the Ames Test.
83. Article according to one of claims 1 to 18 and 21 to 82, wherein the article has a diameter of about 8 mm or less.
84. Article according to one of the preceding claims, wherein the article has the size and shape of a cigarette.
85. Article according to one of the preceding claims, wherein the smoking article additionally includes a mouth end piece (45).



86. Article according to claim 85, wherein the smoking article includes means (44) for delivering the aerosol forming material to the user, said mouth end piece (45) and aerosol delivering means (44) extend over more than half the length of the article.
- 5 87. Article according to one of the preceding claims, wherein the constituents of the article are selected and arranged such that the article delivers a visible smoke-like aerosol.
88. Article according to one of the preceding claims, wherein the article is adapted to be used together with a separate mouthpiece.
- 10 89. 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 (54; 56; 30) and to the mouthpiece (45).
- 15 90. Article according to one of the preceding claims, wherein the aerosol generating means (12) comprises a thermally stable substance (20) bearing an aerosol forming material.
91. Article according to claim 90, wherein the thermally stable substrate (20) includes ceramics.
- 20 92. Article according to one of the preceding claims, wherein the aerosol generating means (12) comprises a particulate substrate (20).
93. Article according to one of the preceding claims, comprising in addition a filter (45).
- 25 94. 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 to the aerosol generating means to volatilize the aerosol forming material during puffing throughout smoking.
95. Article according to one of the preceding claims, wherein the fuel element (10) and the aerosol generating means (30; 54, 56) are designed and to transfer heat from the fuel element to the aerosol generating means to maintain the aerosol generating means heated between puffs.
- 30 96. Article according to one of claims 1 to 66 and 68 to 95, wherein the aerosol generating means (12; 30; 38; 54; 76; 80) is in contact with the fuel element (10) to receive heat from the fuel element substantially throughout the time of the burning of the fuel element.
- 35 97. 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).
- 40 98. Article according to one of the preceding claims, wherein the burning of the fuel element (10) produces no disposable ash during use.

Patentansprüche

- 45 1. Zigarettenartiger Rauchartikel mit einem Mundende (15), welcher umfaßt:
ein Brennstoffelement (10), das hauptsächlich Kohlenstoff als solchen aufweist und ein anzuzündendes Ende sowie ein hinteres Ende hat, und
körperlich gesonderte Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54), welche ein Aerosol-bildendes
50 Material aufweisen und zwischen dem anzuzündenden Ende des Brennstoffelements und dem Mundende (15) angeordnet sind,
dadurch gekennzeichnet, daß
eine Tabakladung (28) zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende (15) des Rauchartikels angeordnet und von den Aerosolerzeugungsmitteln (12; 38; 80; 30; 52, 54)
55 körperlich getrennt ist, und daß das Brennstoffelement vor dem Rauchen eine Länge von ungefähr 20 mm oder weniger hat und so ausgebildet und angeordnet ist, daß es während des gesamten Rauchvorgangs brennt, um Wärme zur Verflüchtigung Aerosol-bildenden Materials beim Ziehen während des gesamten Rauchvorgangs des Rauchartikels zu erzeugen.



2. Zigarettenartiger Rauchartikel mit einem Mundende (15) welcher umfaßt:
ein Brennstoffelement (10), das hauptsächlich Kohlenstoff als solchen aufweist und ein anzuzündendes
Ende sowie ein hinteres Ende hat, und
körperlich gesonderte Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54), welche ein Aerosol-bildendes
Material aufweisen und zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende
(15) angeordnet sind,
gekennzeichnet durch ein faseriges Isolierglied (86), das mindestens einen Teil des Brennstoffelements
(10) umgibt, und eine Tabakladung (56), welche zwischen dem hinteren Ende des Brennstoffelements
(10) und dem Mundende (15) des Rauchartikels liegt und von den Aerosolerzeugungsmitteln (12; 38;
80; 30; 52, 54) körperlich getrennt ist.
3. Zigarettenartiger Rauchartikel mit einem Mundende (15), welcher umfaßt:
ein Brennstoffelement (10), das hauptsächlich Kohlenstoff als solchen aufweist und ein anzuzündendes
Ende sowie ein hinteres Ende hat, und
körperlich gesonderte Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54), welche ein Aerosol-bildendes
Material aufweisen und zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende
(15) angeordnet sind,
dadurch gekennzeichnet, daß das Brennstoffelement vor dem Rauchen eine Länge von ungefähr 20
mm oder weniger hat und daß ein faseriges Isolierglied (86) mindestens einen Teil des Brennstoffele-
ments (10) umschließt.
4. Zigarettenartiger Rauchartikel mit einem Mundende (15), welcher umfaßt
ein Brennstoffelement (10), das hauptsächlich Kohlenstoff als solchen aufweist und ein anzuzündendes
Ende sowie ein hinteres Ende hat, und
körperlich gesonderte Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54), welche ein Aerosol-bildendes
Material aufweisen und zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende
(15) angeordnet sind,
gekennzeichnet durch ein wärmeleitendes Glied (14; 99; 50; 47, 52; 68, 66), welches angeordnet und
ausgebildet ist, um während des Ziehens sowie zwischen den Zügen im wesentlichen während der
ganzen Brennzeit des Brennstoffelements (10) Wärme vom Brennstoffelement (10) auf die Aerosoler-
zeugungsmittel (12; 38; 80; 30; 52, 54) zu übertragen, sowie durch ein faseriges Isolierglied (86), das
mindestens einen Teil des Brennstoffelements (10) umgibt.
5. Rauchartikel mit einem Mundende (15), welcher umfaßt
ein Brennstoffelement (10), das hauptsächlich Kohlenstoff als solchen aufweist und ein anzuzündendes
Ende sowie ein hinteres Ende hat, und
körperlich gesonderte Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54), welche ein Aerosol-bildendes
Material aufweisen und zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende
(15) angeordnet sind,
dadurch gekennzeichnet, daß das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr
20 mm oder weniger hat und daß ein wärmeleitendes Glied (14; 99; 50; 47, 52; 68, 66) vorgesehen,
angeordnet und ausgebildet ist, um während des Ziehens sowie zwischen den Zügen im wesentlichen
während der ganzen Brennzeit des Brennstoffelements (10) Wärme vom Brennstoffelement (10) auf die
Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54) zu übertragen.
6. Artikel nach Anspruch 5, bei dem das wärmeleitende Glied einen Behälter (66, 68, 72) aufweist,
welcher den hinteren Teil des Brennstoffelements (10) überlappt, die Aerosolerzeugungsmittel (76)
umgibt und den Durchgang von Luft und des Aerosol-bildenden Materials zuläßt, und bei dem eine
Tabakladung (78) zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende (15)
des Artikels angeordnet ist.
7. Artikel nach Anspruch 4, bei dem das wärmeleitende Glied einen Behälter aufweist, welcher den
hinteren Teil des Brennstoffelements überlappt, die Aerosolerzeugungsmittel umgibt und den Durch-
gang von Luft und des Aerosol-bildenden Materials zuläßt, und bei dem eine Tabakladung zwischen
dem hinteren Ende des Brennstoffelements und dem Mundende des Artikels angeordnet ist.
8. Artikel nach Anspruch 1, bei dem die Aerosolerzeugungsmittel (54) zwischen dem hinteren Ende des
Brennstoffelements (10) und dem Mundende (15) angeordnet sind sowie von einem Behälter (52)



umgeben werden, der den Durchgang von Luft und des Aerosol-bildenden Materials zuläßt, bei dem ein faseriges Isolierglied (86) mindestens einen Teil des Brennstoffelements umgibt, und bei dem ein Mundendestück (45) vorgesehen ist.

- 5 9. Artikel nach einem der Ansprüche 1 bis 8, bei dem das Brennstoffelement (10) am anzuzündenden Ende des Artikels angeordnet ist.
10. Artikel nach einem der Ansprüche 1 bis 9, bei dem das Brennstoffelement (10) wenigstens einen sich in Längsrichtung erstreckenden Durchlaß (16) aufweist.
- 10 11. Artikel nach Anspruch 10, bei dem das Brennstoffelement (10) mehrere solcher Durchlässe (16) hat.
12. Artikel nach Anspruch 10 oder 11, bei dem wenigstens ein Durchlaß (16) die Gestalt eines Loches hat.
- 15 13. Artikel nach Anspruch 2 oder 4, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 30 mm oder weniger hat.
14. Artikel nach Anspruch 13, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 20 mm oder weniger hat.
- 20 15. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement vor dem Rauchen eine Länge von ungefähr 15 mm oder weniger hat.
- 25 16. Artikel nach einem der Ansprüche 2 und 4 bis 15, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 5 mm bis 30 mm hat.
17. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 5 mm bis 20 mm hat.
- 30 18. Artikel nach Anspruch 17, bei dem das Brennstoffelement (10) vor dem Rauchen eine Länge von ungefähr 5 mm bis 15 mm hat.
19. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) einen Durchmesser zwischen ungefähr 3 mm und 8 mm hat.
- 35 20. Artikel nach Anspruch 19, bei dem das Brennstoffelement (10) einen Durchmesser zwischen ungefähr 4 mm und 5 mm hat.
21. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) eine Dichte von mindestens 0,5 g/cm³ hat.
- 40 22. Artikel nach Anspruch 21, bei dem das Brennstoffelement (10) eine Dichte im Bereich von ungefähr 0,5 g/cm³ bis ungefähr 1,5 g/cm³ hat.
- 45 23. Artikel nach Anspruch 22, bei dem das Brennstoffelement (10) eine Dichte von mehr als ungefähr 0,7 g/cm³ hat.
24. Artikel nach Anspruch 23, bei dem das Brennstoffelement (10) eine Dichte von mehr als ungefähr 0,8 g/cm³ hat.
- 50 25. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) mindestens ungefähr 50 Gew.% Kohlenstoff als solchen enthält.
- 55 26. Artikel nach Anspruch 25, dessen Brennstoffelement (10) mindestens 60 Gew.% bis 80 Gew.% Kohlenstoff als solchen enthält.
27. Artikel nach Anspruch 26, dessen Brennstoffelement (10) mindestens ungefähr 80 Gew.% Kohlenstoff als solchen enthält.



28. Artikel nach Anspruch 27, dessen Brennstoffelement (10) mindestens ungefähr 85 Gew.% Kohlenstoff als solchen enthält.
29. Artikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) ein sich verjüngendes anzuzündendes Ende (11) hat.
30. Artikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) eine gepreßte oder extrudierte Masse ist.
31. Artikel nach einem der vorhergehenden Ansprüche, dessen Brennstoffelement (10) im wesentlichen frei ist von flüchtigem organischem Material.
32. Artikel 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.
33. Artikel nach einem der Ansprüche 1 bis 3 und 8 bis 32, mit einem wärmeleitenden Glied (14; 99; 50; 47, 52; 66, 68), welches derart ausgebildet und angeordnet ist, daß es im wesentlichen während der ganzen Brennzeit des Brennstoffelements (10) sowohl während des Ziehens, als auch zwischen den Zügen Wärme vom Brennstoffelement (10) auf die Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54) überträgt.
34. Artikel nach einem der Ansprüche 4, 5 und 33, bei dem das wärmeleitende Glied (14; 99; 50; 47, 52; 66, 68) zumindest einen Teil des Brennstoffelements (10) und einen Teil der Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54) berührt oder überlappt.
35. Artikel nach einem der Ansprüche 4, 5, 33 und 34, dessen wärmeleitendes Glied (14; 50; 47, 52; 66, 68) zumindest einen Teil der Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54) umfaßt.
36. Artikel nach einem der Ansprüche 4, 5 und 33 bis 35, dessen wärmeleitendes Glied (99) mindestens zum Teil innerhalb des Brennstoffelements (10) liegt.
37. Artikel nach einem der Ansprüche 4, 5 und 33 bis 36, dessen wärmeleitendes Glied (14; 50; 47, 52; 66, 68) einen Teil der sich in Längsrichtung erstreckenden äußeren Peripherie des Brennstoffelements (10) und mindestens einen Teil der sich in Längsrichtung erstreckenden äußeren Peripherie der Aerosolerzeugungsmittel (12; 38; 80; 30; 52, 54) umschließt.
38. Artikel nach einem der Ansprüche 4, 5 und 33 bis 37, dessen wärmeleitendes Glied ein wärmeleitender Behälter (52; 66, 68, 72) für die Aerosolerzeugungsmittel (54; 76) ist.
39. Artikel nach Anspruch 38, bei dem ein dem Brennstoffelement zugewandtes Ende des wärmeleitenden Behälters (52; 66, 68, 72) einen hinteren Teil des Brennstoffelements (10) berührt.
40. Artikel nach einem der Ansprüche 4, 5 und 33 bis 39, dessen wärmeleitendes Glied (14; 99; 50; 47, 52; 66, 68) sich im Abstand hinter dem anzuzündenden Ende des Brennstoffelements (10) befindet.
41. Artikel nach einem der Ansprüche 4, 5 und 33 bis 40, dessen wärmeleitendes Glied (14; 99; 50; 47, 52; 66, 68) ein metallisches Glied ist, vorzugsweise aus Aluminium.
42. Artikel nach einem der Ansprüche 6, 7, 33 bis 37, 40 und 41, bei dem der Behälter (52; 66, 68, 72) ein wärmeleitendes metallisches Röhrchen ist.
43. Artikel nach einem der Ansprüche 38 bis 42, bei dem der Behälter (50; 66) den hinteren Teil des Brennstoffelements (10) überlappt, die Aerosolerzeugungsmittel (38; 76) umgibt und den Durchgang von Luft und des Aerosol-bildenden Materials zuläßt.
44. Artikel nach einem der Ansprüche 36, 40 und 41, bei dem das wärmeleitende Glied ein leitfähiges Stäbchen (99) umfaßt, welches zumindest in einen Teil des Brennstoffelements (10) und in einen Teil



der Aerosolerzeugungsmittel (30) eingebettet ist.

45. Artikel nach einem der Ansprüche 1, 5 bis 7 und 9 bis 44, welcher ferner ein Isolierglied (86) aufweist, das zumindest einen Teil des Brennstoffelements (10) umfaßt.
46. Artikel nach einem der Ansprüche 6 bis 8, 38, 39, 42 und 43, welcher außerdem ein Isolierglied (86) aufweist, das mindestens einen Teil des leitenden Behälters (52) umfaßt.
47. Artikel nach einem der Ansprüche 2 bis 4, 8, 45 und 46, dessen Isolierglied (86) nicht-brennbar ist.
48. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 47, bei dem das Isolierglied (86) mindestens 0,5 mm dick ist.
49. Artikel nach Anspruch 48, dessen Isolierglied (86) ungefähr 1 mm bis 2 mm dick ist.
50. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 49, bei dem das Isolierglied (86) eine luftdurchlässige Masse von anorganischen Fasern aufweist.
51. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 50, dessen Isolierglied (86) elastisch ist.
52. Artikel nach Anspruch 51, dessen Isolierglied eine luftdurchlässige, elastische Hülse (86) aus Fasern aufweist.
53. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 52, bei dem das Isolierglied (86) eine Wärmeleitfähigkeit von weniger als ungefähr 0,005 g-cal/(sec) (cm²) (°C/cm) hat.
54. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 53, bei dem das Isolierglied (86) mindestens einen Teil der Aerosolerzeugungsmittel (54) umgibt.
55. Artikel nach einem der Ansprüche 2 bis 4, 8 und 45 bis 54, bei dem das Isolierglied (86) ein Material aufweist, welches beim Gebrauch schmilzt.
56. Artikel nach einem der Ansprüche 2 bis 4, 8 und 5 bis 55, bei dem das Isolierglied (86) eine Niedertemperatursorte von Glasfasern aufweist.
57. Artikel nach Anspruch 56, bei dem das Isolierglied (86) Glasfasern aufweist, die einen Erweichungspunkt unter ca. 650 ° C haben.
58. Artikel nach einem der Ansprüche 3 bis 5 und 9 bis 57, in dem eine Tabakladung (28; 78; 56) vorgesehen ist.
59. Artikel nach Anspruch 58, bei dem die Tabakladung (28; 78; 56) zwischen dem hinteren Ende des Brennstoffelements (10) und dem Mundende (15) des Artikels angeordnet ist.
60. Artikel nach einem der vorhergehenden Ansprüche, bei dem zwischen den Aerosolerzeugungsmitteln (20; 30; 38; 76; 54) und dem Mundende (15) des Artikels Tabak (28; 78; 56) angeordnet ist.
61. Artikel nach Anspruch 60, in dem der Tabak (28; 78; 56) am rückwärtigen Ende der Aerosolerzeugungsmittel (20; 30; 38; 76; 54) angeordnet ist.
62. Artikel nach einem der vorhergehenden Ansprüche, welcher eine Tabakextraktmenge zwischen dem rückwärtigen Ende des Brennstoffelements (10) und dem Mundende (15) des Artikels aufweist.
63. Artikel nach einem der vorhergehenden Ansprüche, bei dem - in Längsrichtung des Artikels - die Aerosolerzeugungsmittel (30; 54, 56) dem Brennstoffelement (10) benachbart angeordnet sind.
64. Artikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (30; 54, 56) sehr nahe am Brennstoffelement (10) angeordnet sind.



65. Artikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (12; 30; 28; 38; 54; 56; 76, 78) an das Brennstoffelement (10) angrenzen.
66. Artikel nach einem der vorhergehenden Ansprüche, bei dem das Brennstoffelement (10) und die Aerosolerzeugungsmittel (12; 30; 28; 38; 54; 56; 76, 78) sich so in auf Wärmeleitung beruhendem Wärmeaustausch miteinander befinden, daß den Aerosolerzeugungsmitteln im wesentlichen während der ganzen Brennzeit des Brennstoffelements durch Wärmeleitung Wärme zugeführt wird.
67. Artikel nach Anspruch 66, bei dem sich das Brennstoffelement (10) und die Aerosolerzeugungsmittel (12; 30; 38; 54; 56; 80) durch Berührung zwischen den Aerosolerzeugungsmitteln und einem Teil des Brennstoffelements in auf Wärmeleitung beruhendem Wärmeaustausch miteinander befinden.
68. Artikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (12; 30; 28; 54; 76) so angeordnet sind, daß ihr Abstand vom anzuzündenden Ende des Brennstoffelements (10) nicht mehr als ungefähr 30 mm beträgt.
69. Artikel nach Anspruch 68, bei dem die Aerosolerzeugungsmittel (12; 30; 28; 54; 76) so angeordnet sind, daß ihr Abstand vom anzuzündenden Ende des Brennstoffelements (10) nicht mehr als ungefähr 15 mm beträgt.
70. Artikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (12; 30; 28; 54; 76) mit ungefähr 20 mg bis 120 mg Aerosol-bildendem Material beladen sind.
71. Artikel nach Anspruch 70, bei dem die Aerosolerzeugungsmittel (12; 30; 28; 54; 76) mit 35 mg bis 85 mg Aerosol-bildendem Material beladen sind.
72. Artikel nach einem der vorhergehenden Ansprüche, bei dem unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glosten von 58 Sekunden Dauer voneinander getrennt sind, mehr als ungefähr 15 Gewichtsprozent des von den Aerosolerzeugungsmitteln (12; 30; 28; 38; 54; 56; 76, 78) getragenen Aerosol-bildenden Materials als Gesamtmenge feuchter Teilchen abgegeben werden.
73. Artikel nach einem der vorhergehenden Ansprüche, welcher unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glosten von 58 Sekunden Dauer voneinander getrennt sind, bei den ersten drei Zügen mindestens ungefähr 0,6 mg Gesamtmenge feuchter Teilchen abgibt.
74. Artikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (12; 30; 28; 38; 54; 56; 76, 78) mit ausreichend Aerosol-bildendem Material beladen sind, um zu bewirken, daß der Artikel unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glosten mit einer Dauer von 58 Sekunden voneinander getrennt sind, während der ersten drei Züge mindestens ungefähr 1,5 mg Gesamtmenge feuchter Teilchen abgibt.
75. Artikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (12; 30; 28; 54; 76) 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 Glosten mit einer Dauer von 58 Sekunden voneinander getrennt sind, bei mindestens 6 Zügen im Durchschnitt mindestens ungefähr 0,8 mg Gesamtmenge feuchter Teilchen pro Zug abgibt.
76. Artikel nach Anspruch 75, welcher unter Rauchbedingungen mit Zügen von 35 ml und 2 Sekunden Dauer, die durch Glosten von 58 Sekunden voneinander getrennt sind, über mindestens 10 Züge im Durchschnitt pro Zug mindestens ungefähr 0,8 mg Gesamtmenge feuchter Teilchen abgibt.
77. Artikel nach einem der vorhergehenden Ansprüche, bei dem die Aerosolerzeugungsmittel (54, 56; 76, 78) in einem Behälter ((52; 66, 68, 72) angeordnet sind.
78. Artikel nach Anspruch 77, dessen Behälter (52) an seinem mundseitigen Ende umgebogen ist.



79. Artikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (20; 38; 54; 76) ein Tabakextrakt enthalten.
80. Artikel nach einem der vorhergehenden Ansprüche, bei dem flüchtige bzw. verdampfbare Geruchs- bzw. Geschmacksmittel zwischen den Aerosolerzeugungsmitteln (30) und dem Mundende (15) angeordnet sind.
81. Artikel nach einem der vorhergehenden Ansprüche, dessen Bestandteile so ausgewählt und angeordnet sind, daß der von dem Artikel erzeugte Rauch im wesentlichen aus Oxiden von Kohlenstoff, Luft, Wasser, flüchtigen, in den Aerosolerzeugungsmitteln (30; 54, 56) enthaltenen Substanzen, anderen erwünschten flüchtigen Substanzen und Spuren von anderen Materialien besteht.
82. Artikel nach einem der vorhergehenden Ansprüche, dessen Bestandteile so ausgewählt und angeordnet sind, daß der vom Artikel erzeugte Rauch, gemessen durch den Ames-Test, in der Gesamtmenge feuchter Teilchen keine mutagenen Aktivitäten zeigt.
83. Artikel nach einem der Ansprüche 1 bis 18 und 21 bis 82, welcher einen Durchmesser von ungefähr 8 mm oder weniger hat.
84. Artikel nach einem der vorhergehenden Ansprüche, welcher die Größe und die Gestalt einer Zigarette hat.
85. Artikel nach einem der vorhergehenden Ansprüche, welcher zusätzlich ein Mundende-Stück (45) hat.
86. Artikel nach Anspruch 85, welcher Mittel (44) zur Abgabe des Aerosol-bildenden Materials an den Benutzer aufweist, wobei das besagte Mundende-Stück (45) und die Aerosol-Abgabemittel (44) sich über mehr als die Hälfte der Länge des Artikels erstrecken.
87. Artikel nach einem der vorhergehenden Ansprüche, dessen Bestandteile so ausgewählt und angeordnet sind, daß er ein sichtbares, rauchähnliches Aerosol abgibt.
88. Artikel nach einem der vorhergehenden Ansprüche, welcher zur Benutzung mit einem getrennten Mundstück zurechtgemacht ist.
89. Artikel nach einem der vorhergehenden Ansprüche, welcher desweiteren Mittel (52; 44; 87, 44) zum Leiten der Gase des Brennstoffelements (10) durch die Aerosolerzeugungsmittel (54, 56; 30) und zum Mundstück (45) aufweist.
90. Artikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (12) eine das Aerosol-bildende Material tragende thermisch stabile Substanz (20) aufweisen.
91. Artikel nach Anspruch 90, dessen thermisch stabiles Substrat (20) keramisches Material enthält.
92. Artikel nach einem der vorhergehenden Ansprüche, dessen Aerosolerzeugungsmittel (12) ein teilchenförmiges Substrat (20) aufweisen.
93. Artikel nach einem der vorhergehenden Ansprüche, welcher desweiteren ein Filter (45) aufweist.
94. Artikel 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 auf die Aerosolerzeugungsmittel übertragen wird, um das Aerosol-bildende Material während des Ziehens über den ganzen Rauchvorgang zu verflüchtigen bzw. zu verdampfen.
95. Artikel 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 auf die Aerosolerzeugungsmittel übertragen wird, um letztere zwischen den Zügen erwärmt zu halten.



96. Artikel nach einem der Ansprüche 1 bis 66 und 68 bis 95, bei dem die Aerosolerzeugungsmittel (12; 30; 38; 54; 76; 80) das Brennstoffelement (10) berühren, um im wesentlichen während der ganzen Brennzeit des Brennstoffelements von diesem Wärme zu erhalten.
97. Artikel nach einem der vorhergehenden Ansprüche, welcher ferner ein Isolierglied (86) aufweist, das so gestaltet und angeordnet ist, daß es den Wärmeübergang vom Brennstoffelement (10) auf die Aerosolerzeugungsmittel (30; 54, 56) vergrößert.
98. Artikel nach einem der vorhergehenden Ansprüche, bei dem während des Gebrauchs das Brennen des Brennstoffelements (10) keine ablösbare Asche erzeugt.

Revendications

1. Article à fumer de type cigarette ayant un embout (15) et incluant un élément combustible (10) comprenant essentiellement du carbone comme tel et ayant une extrémité d'allumage et une extrémité arrière, et un dispositif générant un aérosol, physiquement séparé (12; 38; 80; 30; 52, 54) comprenant une matière formant aérosol, le dispositif générant un aérosol étant placé entre l'extrémité d'allumage de l'élément combustible et l'embout (15), caractérisé en ce qu'une charge de tabac (28) est placée entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) de l'article et est physiquement séparée du dispositif générant un aérosol (12; 38; 80; 30; 52, 54) et en ce que l'élément combustible a une longueur d'environ 20 mm ou moins avant le fumer et est structuré et arrangé pour brûler au cours du fumer pour générer de la chaleur pour volatiliser la matière formant aérosol au cours de la bouffée pendant le fumer de l'article.
2. Article à fumer de type cigarette ayant un embout (15) et incluant un élément combustible (10) comprenant essentiellement du carbone comme tel et ayant une extrémité d'allumage et une extrémité arrière, et un dispositif générant un aérosol, séparé physiquement (12; 38; 80; 30; 52, 54) comprenant une matière formant aérosol, le dispositif générant un aérosol étant placé entre l'extrémité d'allumage de l'élément combustible (10) et l'embout (15), caractérisé en ce qu'un membre isolant fibreux (86) entoure au moins une partie de l'élément combustible (10) et une charge de tabac (56) placée entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) de l'article et est physiquement séparé du dispositif générant un aérosol (12; 38; 80; 30; 52, 54).
3. Article à fumer de type cigarette ayant un embout (15) et incluant un élément combustible (10) comprenant essentiellement du carbone comme tel et ayant une extrémité d'allumage et une extrémité arrière, et un dispositif générant un aérosol, séparé physiquement (12; 38; 80; 30; 52, 54) comprenant une matière formant aérosol et étant placé entre l'extrémité arrière de l'élément combustible (10) et l'embout (15), caractérisé en ce que l'élément combustible (10) a une longueur d'environ 20 mm ou moins avant le fumer et en ce qu'un membre isolant fibreux (86) enserre au moins une partie de l'élément combustible (10).
4. Article à fumer de type cigarette ayant un embout (15) et incluant un élément combustible (10) comprenant essentiellement du carbone comme tel et ayant une extrémité d'allumage et une extrémité arrière, et un dispositif générant un aérosol, séparé physiquement (12; 38; 80; 30; 52, 54) comprenant une matière formant aérosol et étant placé entre l'extrémité arrière de l'élément combustible (10) et l'embout (15), caractérisé en ce qu'un membre de transfert de chaleur (14; 99; 50; 47, 52; 68, 66) est structuré et arrangé pour transférer de la chaleur depuis l'élément combustible (10) vers le dispositif générant un aérosol (12; 38; 80; 30; 52, 54) pendant les bouffées et entre les bouffées, sensiblement pendant la période de combustion de l'élément combustible (10) et en ce qu'un membre isolant fibreux (86) entoure au moins une partie de l'élément combustible (10).
5. Article à fumer de type cigarette ayant un embout (15) et incluant un élément combustible (10) comprenant essentiellement du carbone comme tel et ayant une extrémité d'allumage et une extrémité arrière, et un dispositif générant un aérosol, séparé physiquement (12; 38; 80; 30; 52, 54) comprenant une matière formant aérosol et étant placé entre l'extrémité arrière de l'élément combustible (10) et l'embout (15), caractérisé en ce que l'élément combustible (10) a une longueur d'environ 20 mm ou moins avant le fumer et en ce qu'un membre de transfert de chaleur (14; 99; 50; 47, 52; 68, 66) est structuré et arrangé pour transférer de la chaleur depuis l'élément combustible (10) vers le dispositif



généralant un aérosol (12; 38; 80; 30; 52, 54) pendant les bouffées et entre les bouffées, sensiblement pendant la période de consommation de l'élément combustible (10).

- 5 6. Article suivant la revendication 5, dans lequel le membre de transfert de chaleur comprend un récipient (66, 68, 72) recouvrant la partie arrière de l'élément combustible (10), renfermant le dispositif généralant un aérosol (76) et permettant le passage d'air et de la matière formant aérosol, et dans lequel une charge de tabac (78) est placée entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) de l'article.
- 10 7. Article suivant la revendication 4, dans lequel le membre de transfert de chaleur comprend un récipient recouvrant la partie arrière de l'élément combustible, renfermant le dispositif généralant un aérosol et permettant le passage d'air et de la matière formant aérosol, et dans lequel une charge de tabac est placée entre l'extrémité arrière de l'élément combustible et l'embout de l'article.
- 15 8. Article suivant la revendication 1, dans lequel le dispositif généralant un aérosol (54) est placé entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) et est entouré d'un récipient (52) qui permet le passage d'air et de la matière formant aérosol, dans lequel un membre isolant fibreux (86) enserre au moins une partie de l'élément combustible et dans lequel une pièce d'embouchure (45) est fournie.
- 20 9. Article suivant l'une quelconque des revendications 1 à 8, dans lequel l'élément combustible (10) est placé à l'extrémité d'allumage de l'article.
- 25 10. Article suivant l'une quelconque des revendications 1 à 9, dans lequel l'élément combustible (10) comprend au moins une voie de passage (16) longitudinale.
11. Article suivant la revendication 10, dans lequel l'élément combustible (10) a une pluralité de telles voies de passage (16).
- 30 12. Article suivant la revendication 10 ou 11, dans lequel la voie de passage (16), au nombre d'au moins une, a la forme d'un trou.
13. Article suivant la revendication 2 ou 4, dans lequel l'élément combustible (10) a une longueur d'environ 30 mm ou moins avant le fumer.
- 35 14. Article suivant la revendication 13, dans lequel l'élément combustible (10) a une longueur d'environ 20 mm ou moins avant le fumer.
- 40 15. Article suivant l'une quelconque des revendications, dans lequel l'élément combustible a une longueur d'environ 15 mm ou moins avant le fumer.
16. Article suivant l'une quelconque des revendications 2 et 4 à 15, dans lequel l'élément combustible (10) a une longueur d'environ 5 mm à 30 mm avant le fumer.
- 45 17. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) a une longueur d'environ 5 mm à 20 mm avant le fumer.
18. Article suivant la revendication 17, dans lequel l'élément combustible (10) a une longueur d'environ 5 mm à 15 mm avant le fumer.
- 50 19. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) a un diamètre compris entre environ 3 mm et 8 mm.
20. Article suivant la revendication 19, dans lequel l'élément combustible (10) a un diamètre compris entre environ 4 mm et 5 mm.
- 55 21. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) a une masse spécifique d'au moins 0,5 g par cm³.



22. Article suivant la revendication 21, dans lequel l'élément combustible (10) a un intervalle de masse spécifique d'environ 0,5 g par cm^3 à environ 1,5 g par cm^3 .
23. Article suivant la revendication 22, dans lequel l'élément combustible (10) a une masse spécifique supérieure à environ 0,7 g par cm^3 .
24. Article suivant la revendication 23, dans lequel l'élément combustible (10) a une masse spécifique de plus d'environ 0,8 g par cm^3 .
25. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) comprend au moins environ 50% en poids de carbone, comme tel.
26. Article suivant la revendication 25, dans lequel l'élément combustible (10) comprend au moins environ 60% à 80% en poids de carbone, comme tel.
27. Article suivant la revendication 26, dans lequel l'élément combustible (10) comprend au moins environ 80% en poids de carbone, comme tel.
28. Article suivant la revendication 27, dans lequel l'élément combustible (10) comprend au moins environ 85% en poids de carbone, comme tel.
29. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) a une extrémité d'allumage (11) conique.
30. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) est une masse pressée ou extrudée.
31. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) est sensiblement exempt de matière organique volatile.
32. Article suivant l'une quelconque des revendications précédentes, dans lequel les constituants formant la masse de l'élément combustible (10) sont choisis pour éviter toute fumée latérale sensiblement visible au cours de la consommation.
33. Article suivant l'une quelconque des revendications 1 à 3 et 8 à 32, dans lequel un membre de transfert de chaleur (14; 99; 50; 47; 52; 66; 68) est structuré et arrangé pour transférer la chaleur depuis l'élément combustible (10) vers le dispositif générant un aérosol (12; 38; 80; 30; 52, 54) pendant les bouffées et entre les bouffées, substantiellement pendant la période de combustion de l'élément combustible (10).
34. Article suivant l'une quelconque des revendications 4, 5 et 33, dans lequel le membre de transfert de chaleur (14; 99; 50; 47; 52; 66; 68) entre en contact ou recouvre au moins une partie de l'élément combustible (10) et du dispositif générant un aérosol (12; 38; 80; 30; 52, 54).
35. Article suivant l'une quelconque des revendications 4, 5, 33 et 34, dans lequel le membre de transfert de chaleur (14; 50; 47; 52; 66; 68) enveloppe au moins une partie du dispositif générant un aérosol (12; 38; 80; 30; 52, 54).
36. Article suivant l'une quelconque des revendications 4, 5 et 33 à 35, dans lequel le membre de transfert de chaleur (99) est au moins partiellement dans l'élément combustible (10).
37. Article suivant l'une quelconque des revendications 4, 5 et 33 à 36, dans lequel le membre de transfert de chaleur (14; 50; 47; 52; 66; 68) enserre une partie de la périphérie longitudinale externe de l'élément combustible (10) et au moins une partie de la périphérie longitudinale externe du dispositif générant un aérosol (12; 38; 80; 30; 52, 54).
38. Article suivant l'une quelconque des revendications 4, 5 et 33 à 37, dans lequel le membre de transfert de chaleur est un récipient conduisant la chaleur (52; 66; 68, 72) pour le dispositif générant un aérosol



(54, 76).

39. Article suivant la revendication 38, dans lequel l'extrémité combustible du récipient conducteur (52; 66, 68, 72) entre en contact avec la partie arrière de l'élément combustible (10).
- 5 40. Article suivant l'une quelconque des revendications 4, 5 et 33 à 39, dans lequel le membre de transfert de chaleur (14; 99; 50; 47, 52; 66, 68) est placé derrière l'extrémité d'allumage de l'élément combustible (10).
- 10 41. Article suivant l'une quelconque des revendications 4, 5 et 33 à 40, dans lequel le membre de transfert de chaleur (14; 99; 50; 47, 52; 66, 68) est un membre métallique, de préférence en aluminium.
42. Article suivant l'une quelconque des revendications 6, 7, 33 à 37, 40 et 41, dans lequel le récipient (52; 66, 68, 72) est un tube métallique conducteur de la chaleur.
- 15 43. Article suivant l'une quelconque des revendications 38 à 42, dans lequel le récipient (50; 66) recouvre la partie arrière de l'élément combustible (10), renferme le dispositif générant un aérosol (38; 76) et permet le passage d'air et de la matière formant aérosol.
- 20 44. Article suivant l'une quelconque des revendications 36, 40 et 41, dans lequel le membre de transfert de chaleur comprend un bâtonnet conducteur (99) encastré dans au moins une partie de l'élément combustible (10) et du dispositif générant un aérosol (30).
45. Article suivant l'une quelconque des revendications 1, 5 à 7 et 9 à 44, comprenant, de plus, un
- 25 membre isolant (86) qui enserre au moins une partie de l'élément combustible (10).
46. Article suivant l'une quelconque des revendications 6 à 8, 38, 39, 42 et 43, comprenant, de plus, un membre isolant (86) qui enserre au moins une partie du récipient conducteur (52).
- 30 47. Article suivant l'une quelconque des revendications 2 à 4, 8, 45 et 46, dans lequel le membre isolant (86) est non combustible.
48. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 47, dans lequel le membre isolant (86) a une épaisseur d'au moins 0,5 mm.
- 35 49. Article suivant la revendication 48, dans lequel le membre isolant (86) a une épaisseur d'environ 1 mm à 2 mm.
50. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 49, dans lequel le membre isolant
- 40 (86) comprend une masse perméable à l'air de fibres inorganiques.
51. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 50, dans lequel le membre isolant (86) est élastique.
- 45 52. Article suivant la revendication 51, dans lequel le membre isolant comprend un manteau élastique de fibres, perméable à l'air (86).
53. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 52, dans lequel le membre isolant (86) a une conductibilité thermique inférieure à environ 0,005 g-cal/(sec) (cm²) (°C/cm).
- 50 54. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 53, dans lequel le membre isolant (86) entoure au moins une partie du dispositif générant un aérosol (54).
- 55 55. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 54, dans lequel le membre isolant (86) comprend une matière qui fond au cours de l'utilisation.
56. Article suivant l'une quelconque des revendications 2 à 4, 8 et 45 à 55, dans lequel le membre isolant (86) comprend des fibres de verre basse température.



57. Article suivant la revendication 56, dans lequel le membre isolant (86) comprend des fibres de verre ayant un point de ramollissement inférieur à environ 350 °C.
58. Article suivant l'une quelconque des revendications 3 à 5 et 9 à 57, dans lequel une charge de tabac (28; 78; 56) est placée.
59. Article suivant la revendication 58, dans lequel la charge de tabac (28; 78; 56) est placée entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) de l'article.
60. Article suivant l'une quelconque des revendications précédentes, dans lequel du tabac (28; 78; 56) est placé entre le dispositif générant un aérosol (20; 30; 38; 76; 54) et l'embout (15) de l'article.
61. Article suivant la revendication 60, dans lequel le tabac (28; 78; 56) est placé à l'extrémité arrière du dispositif générant un aérosol (20; 30; 38; 76; 54).
62. Article suivant l'une quelconque des revendications précédentes, comprenant une charge d'extrait de tabac placée entre l'extrémité arrière de l'élément combustible (10) et l'embout (15) de l'article.
63. Article suivant l'une quelconque des revendications précédentes, dans lequel, dans la direction longitudinale de l'article, le dispositif générant un aérosol (30; 54; 56) est placé de manière adjacente à l'élément combustible (10).
64. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (30; 54; 56) est à proximité de l'élément combustible (10).
65. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12; 30; 28; 38; 54; 56; 76; 78) s'appuie sur l'élément combustible (10).
66. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) et le dispositif générant un aérosol (12; 30; 28; 38; 54; 56; 76; 78) sont placés en une relation d'échange de chaleur par conduction, de sorte que le dispositif générant un aérosol reçoive un transfert de chaleur par conduction, sensiblement tout au cours de la combustion de l'élément combustible.
67. Article suivant la revendication 66, dans lequel l'élément combustible (10) et le dispositif générant un aérosol (12; 30; 38; 54; 76; 80) sont placés en une relation d'échange de chaleur par conduction, par contact entre le dispositif générant un aérosol et une partie de l'élément combustible.
68. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12; 30; 28; 54; 76) est placé à pas plus d'environ 30 mm de l'extrémité d'allumage de l'élément combustible (10).
69. Article suivant la revendication 68, dans lequel le dispositif générant un aérosol (12; 30; 28; 54; 76) est placé à pas plus d'environ 15 mm de l'extrémité d'allumage de l'élément combustible (10).
70. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12; 30; 28; 54; 76) est chargé par environ 20 mg à 120 mg d'une matière formant aérosol.
71. Article suivant la revendication 70, dans lequel le dispositif générant un aérosol (12; 30; 28; 54; 76) est chargé par environ 35 mg à 85 mg d'une matière formant aérosol.
72. Article suivant l'une quelconque des revendications précédentes, dans lequel plus d'environ 15% en poids d'une matière formant aérosol supportée par le dispositif générant un aérosol (12; 30; 28; 38; 54; 56; 76; 78) est délivrée sous forme d'une matière particulaire humide totale dans des conditions de fumer de bouffées de 35 ml d'une durée de 2 secondes, séparées par 58 secondes de consommation.
73. Article suivant l'une quelconque des revendications précédentes, dans lequel l'article délivre au moins environ 0,6 mg de matière particulaire totale humide dans les trois premières bouffées dans des conditions de fumer de bouffées de 35 ml d'une durée de 2 secondes, séparées par 58 secondes de



consumation.

- 5 74. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12; 30; 28, 38; 54, 56; 76; 78) est chargé de suffisamment de substance formant aérosol, de sorte que l'article délivre au moins environ 1,5 mg de matière particulaire totale humide dans les trois premières bouffées dans des conditions de fumer de bouffées de 35 ml d'une durée de 2 secondes, séparées par 58 secondes de consommation.
- 10 75. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12; 30; 28; 54; 76) est chargé avec suffisamment de substance formant aérosol, de sorte que l'article délivre une moyenne d'au moins environ 0,8 mg par bouffée de matière particulaire totale humide dans des conditions de fumer de bouffées de 35 ml d'une durée de 2 secondes, séparées par 58 secondes de consommation, pendant au moins 6 bouffées.
- 15 76. Article suivant la revendication 75, dans lequel l'article délivre une moyenne d'au moins environ 0,8 mg par bouffée de matière particulaire totale humide dans des conditions de fumer de bouffées de 35 ml d'une durée de 2 secondes, séparées par 58 secondes de consommation, pendant au moins 10 bouffées.
- 20 77. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (54, 56; 76, 78) est placé dans un récipient (52; 66, 68, 72).
78. Article suivant la revendication 77, dans lequel le récipient (52) est ondulé à son embout.
- 25 79. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (20; 38; 54; 76) comprend un extrait de tabac.
80. Article suivant l'une quelconque des revendications précédentes, dans lequel des agents aromatisants volatils sont placés entre le dispositif générant un aérosol (30) et l'embout (15).
- 30 81. Article suivant l'une quelconque des revendications précédentes, dans lequel les constituants de l'article sont choisis et placés, de sorte que la fumée produite par l'article consiste essentiellement en des oxydes de carbone, de l'air, de l'eau, les substances volatiles comprises dans le dispositif générant un aérosol (30; 54, 56), d'autres produits volatils souhaités et des quantités très faibles d'autres matières.
- 35 82. Article suivant l'une quelconque des revendications précédentes, dans lequel les constituants de l'article sont choisis et placés, de sorte que la fumée produite par l'article ne présente pas d'activité mutagène dans la matière particulaire totale humide, mesurée par le test Ames.
- 40 83. Article suivant l'une quelconque des revendications 1 à 18 et 21 à 82, dans lequel l'article a un diamètre d'environ 8 mm ou moins.
84. Article suivant l'une quelconque des revendications précédentes, dans lequel l'article a la taille et la
- 45 forme d'une cigarette.
85. Article suivant l'une quelconque des revendications précédentes, dans lequel l'article à fumer comprend, de plus, une pièce d'embout (45).
- 50 86. Article suivant la revendication 85, dans lequel l'article à fumer comprend un dispositif (44) pour délivrer la matière formant aérosol à l'utilisateur, la pièce d'embout (45) et le dispositif délivrant l'aérosol (44) s'étendant sur plus de la moitié de la longueur de l'article.
87. Article suivant l'une quelconque des revendications précédentes, dans lequel les constituants de
- 55 l'article sont choisis et placés, de sorte que l'article délivre un aérosol visible, de type fumée.
88. Article suivant l'une quelconque des revendications précédentes, dans lequel l'article est adapté pour être utilisé avec une embouchure séparée.



89. Article suivant l'une quelconque des revendications précédentes, dans lequel l'article à fumer comprend, de plus, un dispositif (52, 44; 87, 44) pour diriger les gaz depuis l'élément combustible (10) au travers du dispositif générant un aérosol (54, 56; 30) et vers l'embouchure (45).
- 5 90. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12) comprend une substance thermiquement stable (20) portant une matière formant aérosol.
91. Article suivant la revendication 90, dans lequel le substrat thermiquement stable (20) comprend des céramiques.
- 10 92. Article suivant l'une quelconque des revendications précédentes, dans lequel le dispositif générant un aérosol (12) comprend un substrat particulière (20).
93. Article suivant l'une quelconque des revendications précédentes, comprenant, de plus, un filtre (45).
- 15 94. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) et le dispositif générant un aérosol (30; 54, 56) sont formés et arrangés pour transférer de la chaleur depuis l'élément combustible vers le dispositif générant un aérosol, pour volatiliser la matière formant aérosol au cours de la bouffée pendant le fumer.
- 20 95. Article suivant l'une quelconque des revendications précédentes, dans lequel l'élément combustible (10) et le dispositif générant un aérosol (30; 54, 56) sont formés et arrangés pour transférer de la chaleur depuis l'élément combustible vers le dispositif générant un aérosol, pour maintenir chaud le dispositif générant un aérosol, entre les bouffées.
- 25 96. Article suivant l'une quelconque des revendications 1 à 66 et 68 à 95, dans lequel le dispositif générant un aérosol (12; 30; 38; 54, 76; 80) est en contact avec l'élément combustible (10) pour recevoir de la chaleur depuis l'élément combustible, sensiblement pendant le temps de combustion de l'élément combustible.
- 30 97. Article suivant l'une quelconque des revendications précédentes, comprenant de plus un membre isolant (86), qui est formé et arrangé pour augmenter le transfert de chaleur depuis l'élément combustible (10) vers le dispositif générant un aérosol (30; 54, 56).
- 35 98. Article suivant l'une quelconque des revendications précédentes, dans lequel la combustion de l'élément combustible (10) ne produit pas de cendre jetable en cours d'utilisation.