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(71) Applicant *(for all designated States except US)*: **PHILIP MORRIS PRODUCTS S.A.** [CH/CH]; Quai Jeanrenaud 3, CH-2000 Neuchatel (CH).

(72) Inventor: **CLARK, David**; 2910 Newquay Lane, Richmond, VA 23236-1358 (US).

(74) Agent: **MARLOW, Nicholas, Simon**; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).

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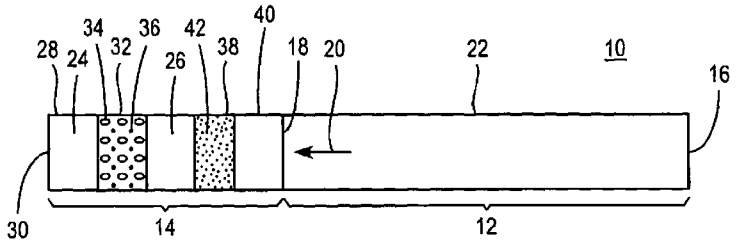

FIG. 1

(57) Abstract: A multicomponent smoking article filter (14) adapted to be disposed at the non-burning end of a rod (12) of smokable material, comprising a first plug (24), a second plug (26), a first cavity (32) disposed between the first plug and the second plug, wherein the first cavity comprises a plurality of cellulosic granules (34) containing a flavorant, and either a plurality of cellulosic granules (36) containing a humectant, or containing water, or a combination thereof, and a second cavity (38) comprising a sorbent (42) disposed upstream from the first cavity relative to the direction (20) of mainstream smoke drawn through the filter. Also disclosed is a smoking article (10) including such a filter. Also disclosed is a method of improving the quality of mainstream smoke in a smoking article comprising providing such a smoking article filter, introducing into the first cavity a plurality of cellulosic granules containing a flavorant, and either a plurality of cellulosic granules containing a humectant, or containing water, or a combination thereof, or introducing into the plug a plurality of cellulosic granules containing a flavorant, and either a plurality of cellulosic granules containing a humectant, or containing water, or a combination thereof.

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METHODS FOR IMPROVING QUALITY OF MAINSTREAM SMOKE AND MULTICOMPONENT FILTERS AND SMOKING ARTICLES THEREFOR

SUMMARY

Disclosed herein are methods for improving the quality of mainstream smoke in a smoking article, where the smoking article contains a rod of smokable material; and a multicomponent filter disposed at the non-burning end of the rod of smokable material. More particularly, disclosed herein are methods for making mainstream smoke in a smoking article more organoleptically pleasing.

According to a first aspect of the invention there is provided a multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising a first segment comprising at least one of a plurality of cellulosic granules containing a humectant, a plurality of cellulosic granules containing water and a plurality of cellulosic granules containing a flavorant, and a second segment comprising sorbent, the second segment located upstream from the first segment relative to the direction of mainstream smoke drawn through the filter comprising a sorbent.

In some preferred embodiments, ventilation, such as ventilation hole, is provided proximate to the first segment, the second segment or both segments.

In one preferred aspect of the invention there is provided a multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising:

a first plug;

a second plug;

a first cavity disposed between the first plug and the second plug, wherein the first cavity comprises at least one of:

a plurality of cellulosic granules containing a flavorant;

a plurality of cellulosic granules containing a humectant; and

a plurality of cellulosic granules containing water, and

a second cavity comprising a sorbent disposed upstream from the first cavity relative to the direction of mainstream smoke drawn through the filter. If the plurality of cellulosic granules contains a humectant it is preferred that they also contain water.

In some preferred embodiments, ventilation, such as ventilation holes, is provided proximate to the first cavity, the second cavity or the second plug.

In another preferred aspect of the invention there is provided multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising:

a plug comprising at least one of:

a plurality of cellulosic granules containing a flavorant;

a plurality of cellulosic granules containing a humectant, and

a plurality of cellulosic granules containing water; and

a second cavity comprising a sorbent disposed upstream from the cavity relative to the direction of mainstream smoke drawn through the filter. If the plurality of cellulosic granules contains a humectant it is preferred that they also contain water.

In some preferred embodiments the cellulosic granules comprise microcrystalline cellulose (MCC).

The invention also provides a smoking article comprising a multicomponent smoking article filter according to the first aspect of the invention having a buccal end and a tipping end, and a rod of smokable material disposed adjacent to the tipping end of the multicomponent. smoking article filter. In some preferred embodiments the smokable material comprises tobacco. Some preferred embodiments further comprise tipping paper disposed to attach the multicomponent smoking article filter to the rod of smokable material. In some preferred embodiments the smoking article is a cigarette. In some of these embodiments, the cigarette is an electrically heated cigarette.

According to a second aspect of the invention, there is provided a method of improving the quality of mainstream smoke in a smoking article comprising a rod of smokable material and a multicomponent filter disposed at a non-burning end of the rod of smokable material, the multicomponent filter comprising a first segment and a second segment upstream from the first segment relative to the direction of mainstream smoke drawn through the filter, the second segment comprising a sorbent, the method comprising introducing into the first segment at least one of a plurality of cellulosic granules containing a humectant, a plurality of cellulosic granules containing water; and a plurality of cellulosic granules containing a flavorant.

Some preferred methods further comprise adding or removing a sufficient number of particles of a filler material, which filter material is inactive toward constituents of mainstream smoke resulting from smoking the smokable material, to said first cavity to maintain the first cavity in an essentially fully filled condition.

In some preferred methods, the improving of the quality of the mainstream smoke comprises reducing or removing an organoleptic dry note or organoleptic earthy note or both in said mainstream smoke.

In some preferred methods, the first cavity comprises (1) a plurality of cellulosic granules containing a flavorant, and (2) a plurality of cellulosic granules containing a humectant. Preferred cellulosic granule comprise microcrystalline cellulose (MCC).

In some preferred methods the humectant comprises glycerin.

In some preferred methods the first cavity comprises a plurality of cellulosic granules, wherein at least one cellulosic granule contains both a humectant and water.

In some preferred methods the first cavity comprises a plurality of cellulosic granules containing a humectant and a plurality of granules containing water.

In some embodiments, the multicomponent filter contains a first plug, a second plug, a first cavity disposed between the first plug and the second plug, and a second cavity comprising a sorbent disposed upstream from the first cavity relative to the direction of mainstream smoke drawn through the filter. The method comprises introducing into the first cavity (1) a plurality of cellulosic granules containing a flavorant, and (2) either a plurality of cellulosic granules containing a humectant, or containing water, or a combination thereof.

In another aspect, the present invention provides a multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising a first cavity comprising (1) a plurality of cellulosic granules containing a flavorant and (2) either a plurality of cellulosic granules containing a humectant, or containing water, or a combination thereof, and a second cavity comprising a sorbent disposed upstream from the plug relative to the direction of mainstream smoke drawn through the filter.

Preferably, the filter comprises a first plug and a second plug, the first cavity being disposed between the first plug and the second plug.

The second cavity may contain, in certain embodiments, cellulosic granules that contain a humectant, and/or cellulosic granules that contain water, and/or cellulosic granules that contain both humectant and water. A particularly suitable humectant is glycerin. Particularly suitable cellulosic granules are those containing of microcrystalline cellulose (MCC).

In an embodiment is provided a multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising: a plug, comprising: (1) a plurality of cellulosic granules containing a flavorant, and (2) either a plurality of cellulosic granules containing a humectant, or containing water, or a combination thereof; and a second cavity comprising a sorbent disposed upstream from the plug relative to the direction of mainstream smoke drawn through the filter.

In some embodiments, the dual cavity arrangement of the multicomponent smoking article, having a sorbent disclosed upstream (relative to the direction of travel of the mainstream smoke) and having a downstream cavity containing celluosic granules with a flavorant, and cellulosic granules that contain either a humectant, or water, or both, provides subjectively pleasing flavor and other sensory characteristics to the mainstream smoke. More particularly, embodiments of the method and smoking article filters disclosed herein provide desired flavor to the mainstream smoke, while minimizing or avoiding dryness or organoleptic dry flavor notes or organoleptic earthy notes in the smoke, which can sometimes occur when a sorbent, such as activated carbon or the like, is used to filter the smoke.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a schematic diagram showing a sectional view of an embodiment of a smoking article containing a multicomponent smoking article filter described herein.

Figure 2 is a schematic diagram of a particular embodiment of a smoking article disclosed herein having vents and the multicomponent smoking article filter described herein, in partial cutaway view.

Figure 3 is a schematic diagram showing a sectional view of an embodiment of a smoking article containing another embodiment of a multicomponent smoking article filter described herein.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Smoking articles, particularly cigarettes, generally comprise a tobacco rod of shredded tobacco (usually, in cut filler form) surrounded by a paper wrapper, and a cylindrical filter aligned in an end-to-end relationship with the tobacco rod. Typically, the filter includes a plug of cellulose acetate tow attached to the tobacco rod by tipping paper. Ventilation of mainstream smoke can be achieved with a row or rows of perforations about a location along the filter. Such ventilation provides dilution of drawn mainstream smoke with ambient air to reduce the delivery of tar.

Upon lighting a cigarette, a smoker draws mainstream smoke from the coal at the lit end of the cigarette. The drawn cigarette smoke first enters the upstream end portion of the filter and then passes through the downstream portion adjacent the buccal (mouth) end of the cigarette. In addition to a plug of cellulose acetate or other fibrous material, some filters can contain a cavity, *e.g.* formed by a plurality of plugs, and having an activated carbon sorbent disposed therein. Such arrangements are sometimes known as plug-space-plug arrangements.

Mainstream smoke from smoking articles containing such activated carbon-containing filters (sometimes known as "charcoal" or "charcoal-filtered" cigarettes) tend to have a flavor note that is contrary to consumer preferences. This can limit their widespread employment in commercially offered cigarettes For example, while not wishing to be bound by any theory, it is believed that the sorbent removes at least some flavor components that consumers find desirable, and/or decreases the perceived moisture content of the mainstream smoke. As a result, it is believed that consumers perceive the smoke to be drier or to contain a dry flavor note that would not be experienced without the sorbent.

It would be desirable to provide a smoking article having a filter incorporating a sorbent such as activated carbon and/or other materials capable of absorbing and/or adsorbing gas phase constituents present in mainstream smoke, while providing favorable absorption/adsorption, dilution (*e.g.*, via vents to admit air into the filter) and drawing characteristics, adding flavor to the filtered smoke, and avoiding the perception of dryness or dry flavor notes in the smoke, so as to enhance consumer acceptability.

Furthermore, it would be desirable to provide such a filter with desirable residence time in the adsorbent/absorbent-containing region while simultaneously achieving a pressure drop downstream of the dilution region and the adsorbent/absorbent so as to provide acceptable drawing characteristics of puffs of smoke having reduced gas phase constituents but with acceptable taste and resistance-to-draw.

As used herein, the terms "a" or "an" are intended to include one or more of the feature or element described thereby. Herein, the "upstream" and "downstream" relative positions between filter segments and other features are described in relation to the direction of mainstream smoke as it is drawn from the rod of smoking material and through the multicomponent filter. Herein, the term "sorbent" is intended to include absorbent and adsorbent materials. As used herein, the term "about" in conjunction with a numeral value includes slightly more or slightly less then the numerical value, to a deviation of ± 10%.

In accordance with one embodiment, a smoking article, such as a cigarette, comprises a tobacco rod and a multi-component filter comprising a sorbent disposed in a second, upstream cavity, and a segment containing cellulosic granules that contain a flavorant, and cellulosic granules containing a humectant or water, or a combination thereof, located in a first cavity downstream of the second cavity.

Figure 1 is a schematic diagram of a nonlimiting, exemplary embodiment of a smoking article 10 described herein. The smoking article 10 contains a rod of smokable material 12 and a multicomponent filter 14. The rod of smokable material has a burning end 16, which will be lit during smoking thereof, and a non-burning end 18. Multicomponent filter 14 is disposed adjacent to non-burning end 18, *i.e.*, is disposed downstream of the rod of smokable material 12 relative to the direction of mainstream smoke, indicated by arrow 20. The rod of smokable material is desirably contained within a wrapper 22, generally made of paper. It should be noted that the relative lengths of multicomponent filter 14 and rod of smoking material 12 are not necessarily to scale, in order to more clearly illustrate the features of the smoking article, and in particular, the features of multicomponent filter 14.

In this embodiment, multicomponent filter 14 comprises a first plug 24 and a second plug 26, each disposed within a plug wrap 28, generally made of paper. First plug 24 is disposed at the buccal end 30 of the multicomponent filter 14, and second plug 26 is disposed upstream of first plug 24 relative to direction of mainstream smoke 20. Between them, first plug 24 and second plug 26 define a first cavity 32. Disposed within this first cavity are cellulosic granules (*e.g.*, granules of MCC) containing a flavorant 34 and cellulosic granules (*e.g.*, granules of MCC) containing a humectant, or containing water, or a combination thereof 36. In a particular embodiment, space remaining in first cavity 32 after the introduction of granules 34 can be filled with granules 36, so as to reduce the likelihood that the first cavity

32 will be crushed, and to allow for variation in the lengths of the first and second cavities so as to better utilize the properties of the flavorant and sorbent.

First plug 24 and second plug 26 are preferably each in the form of a cellulose acetate plug or other suitable fibrous or webbed material of moderate to low particulate efficiency. Preferably, the particulate efficiency is low, with the denier and grand total denier being selected such that the desired total RTD (resistance to draw) of the multi-component filter 14 is achieved.

In this embodiment, multicomponent filter 14 also comprises a second cavity 38, which is disposed upstream from first cavity 32 relative to the direction of mainstream smoke 20. In the embodiment illustrated, second cavity 38 is defined by second plug 26 and a third plug 40, but other arrangements are also possible, *e.g.*, where a third and fourth plug define the second cavity, or where the non-burning end 18 of rod of smokable material 12 defines one end of second cavity 30. Second cavity 38 contains particles or granules of sorbent 42. If a third plug 40 is used, in a particular embodiment, it may be a plug of cellulose acetate tow of low resistance to draw, and is preferably made as short as possible within the limits of high-speed machineability and preferably has the lowest particulate RTD amongst the filter components comprising the multicomponent filter 14.

In the alternative, some or all of the third plug 40 may comprise a carbon-filled material, such as particles or granules of carbon-such as activated carbon, on tow, such as cellulose acetate tow, or such as carbon-filled paper. Such embodiments can beneficially increase gas-phase constituent removal or decrease the requirements for sorbent in second cavity 38.

In a particular embodiments, the sorbent desirably comprises high surface area, activated carbon. Desirably, this carbon is in the form of granules and the like. Preferably, the carbon is a coconut shell-based carbon of typical ASTM mesh size used in the cigarette industry, or finer mesh size. Preferably, the high surface area carbon has a specific surface area (square meters per gram) of approximately 1000 m^2/g (square meters per gram) or greater.

The bed of activated carbon is adapted to adsorb constituents of mainstream smoke, particularly those of the gas phase including aldehydes, ketones and other volatile organic compounds, and in particular 1, 3-butadiene, acrolein, isoprene, propionaldehyde, acrylonitrile, benzene, toluene, styrene, acetaldehyde and hydrogen cyanide. With respect to the sorbent particles 42, it is preferred that they have a mesh size of from 10 to 70, and more preferably a mesh size of 20 to 50. Sorbent materials other than carbon may be used as explained below and fall within the definition of sorbent materials as used herein.

Preferably, the sorbent particles 42 in second cavity 38 form a carbon bed of at least 70 mg to 120 mg, more particularly 90 mg to 120 mg or greater of carbon in a fully filled condition or 160 mg to 180 mg or greater of carbon in a 85% filled condition or better, which in combination with other features provides a flavorful cigarette that achieves significant reductions

in gas phase constituents of the mainstream smoke, *e.g.*, reductions of 90% or greater in one or more of 1, 3 butadiene, acrolein, isoprene, propionaldehyde, acrylonitrile, benzene, toluene, styrene, and reductions of 80% or greater in one or more of acetaldehyde and hydrogen cyanide.

In certain embodiments, it is preferable to load approximately 180 mg of carbon plus or minus approximately 10 mg of carbon to achieve a average 85% fill in a 12 mm cavity using the more traditional cigarette circumferences (approximately 22 mm to 26 mm). This level of fill, together with the indicated amount of carbon will generally be sufficient to achieve 90% tar weighted reduction of acrolein and/or 1,3 butadiene relative to an industry standard, machine made cigarette (known as a 1R4F cigarette). Lower carbon loadings can be utilized to equal effect as one approaches a fully filled condition of 95% or greater. With carbon loadings in the range of 70 mg to 120 mg, and more particularly in the range of 90 mg to 120 mg, compacted, fully filled plug-space-plug filters provide 90% or greater reduction in acrolein and/or 1,3 butadiene in relation to levels of such in 1R4F cigarettes. Such arrangement provides significant savings in amounts of carbon that may be desirable to remove these smoke constituents, and offers substantial savings in costs of manufacture. The compressed and/or fully filled plug-space-plug filter configuration also provides a more consistent performance in gas phase treatment from cigarette to cigarette.

In certain embodiments at least some, if not all, of the sorbent particles 42 are flavor-bearing or otherwise impregnated with a flavor so that the sorbent bed of the upstream second cavity 38 is adapted not only to remove one or more gas phase smoke constituents from mainstream smoke, but also to release flavor into the mainstream smoke stream. In these embodiments, preferably flavor is added to the sorbent, such as carbon particles, by spraying flavorant upon a batch of activated carbon in a mixing (tumbling) drum or alternatively in a fluidized bed with nitrogen as the fluidizing agent, wherein flavorant may then be sprayed onto the sorbent particles in the bed.

In embodiments wherein the sorbent can also be flavor-bearing, as mainstream smoke is drawn through the upstream portion of the multicomponent filter 14, gas phase smoke constituents are removed and flavor is released from the sorbent.

In these embodiments, both the downstream flavor releasing segment and the flavor-bearing carbon bed contribute a flavor note throughout all puffs during smoking, but the flavor contribution of the downstream segment is greater during the initial puffs than during later puffs. Conversely, the flavor contribution of the carbon bed is greater during the later puffs. Flavor delivery is therefore balanced and consistent throughout the entire smoking process. Additional flavor delivery can be obtained by using plug wraps, tipping paper, or cellulose acetate plugs that have flavorant deposited thereon, or flavorant bearing yarns incorporated therein.

Whether flavorant-containing sorbents are used or not, flavor is released into the mainstream smoke as it passes through the first cavity, located downstream of the sorbent.

In a particular embodiment, ventilation can be provided to limit the amount of tobacco being combusted during each puff and is arranged at a location spaced downstream from the sorbent to lower mainstream smoke velocity through the sorbent. Referring to Figure 2, preferably one or more circumferential rows of perforations 44 are formed through the tipping paper 46 at a location downstream of the second cavity 38, preferably in the region of second plug 26. The preferred placement maximizes distance between the buccal end 30 of the multicomponent filter 14 and the perforations 44, which preferably is at least 12 mm (millimeters) or more so that a smoker's lips do not occlude the perforations 44. Furthermore, the introduction of diluting air flows at an upstream end portion of the second plug 26 lowers the particulate efficiency of the downstream portions of the second plug 26. As a result, the upstream location of the ventilation along the second plug 26 facilitates its ability to provide a more elevated (yet moderate) RTD without a significant elevation of particulate efficiency, so as to help maintain a desired low particulate efficiency in the second plug 26. Preferably, the level of ventilation is preferably in the range of 40 to 60% and more preferably approximately 45% to 55% in a 6 mg FTC tar delivery cigarette.

Without wishing to be bound by any theory, it is believed that ventilation not only provides dilution of the mainstream smoke but also effects a reduction of the amount of tobacco combusted during each puff when coupled with a low particulate efficiency filter 14. Ventilation reduces drawing action on the coal at the lit end of the smoking article, and thereby reduces the amount of tobacco that is combusted during a puff. As a result, absolute quantities of smoke constituents are reduced. Preferably, the various components of the multicomponent filter 14 provide low particulate efficiencies, and the amount of ventilation is selected such that differences between the desired FTC tar delivery of the cigarette and the output of the rod of smoking material 12 are minimized. This arrangement improves the ratio of carbon monoxide content of the delivered smoke to its FTC tar level (CO to Tar ratio). In contrast, prior practices tended to first establish an output level of the rod of smokable material 12 and utilized particulate filtration to drive FTC tar delivery down to a desired level. These prior practices tended to combust an excess of tobacco, and accordingly, exhibit higher CO to Tar ratios than typically achieved with preferred cigarette embodiments disclosed herein.

In addition, advantageously, this embodiment of the filter addresses the desirability of achieving optimum residence times for the smoke in the regions of the filter bearing the sorbent material while also achieving favorable dilution of the smoke with ambient air and inducing an acceptable resistance to draw as is expected by most smokers.

Advantageously, the perforations 44 are located downstream from the second cavity 38, so that mainstream smoke velocity through the second cavity 38 is reduced and dwell time of

the main stream smoke amongst the sorbent particles 42 in second cavity 38 is increased. The extra dwell time, in turn, increases the effectiveness of the sorbent in reducing targeted mainstream smoke constituents. The smoke is diluted by ambient air passing through perforations 44 and mixing with the mainstream smoke to achieve air dilution in the approximate range of 45% to 65%. For example, with 50% air dilution, the flow through the cigarette upstream of the dilution perforations is reduced 50% thereby reducing the smoke velocity by 50%.

The location of ventilation holes 44 shown in Figure 2 achieves the aforementioned effects of increasing dwell time (and effectiveness of removing constituents), and/or promoting release of flavorants. The same or similar effects are achieved when ventilation holes 44 are located either at or proximate to a downstream end portion of sorbent bed 42 or at or proximate to an upstream end portion of flavor bed 36 or both. By adjusting the location of ventilation holes 44 with respect to the bed of sorbent particles 42 and the bed of granules 36, flavor delivery over initial and later puffs can be adjusted and an overall consistent sensorial experience achieved.

The length of the four filter components of cigarette 10 in the preferred embodiment is as follows: the length of third plug 40 is preferably 2 mm to 6 mm; the second cavity 38 is preferably 10 mm to 12 mm for carbon loading of 180 mg; the length of second plug 26 is preferably 2 mm to 8 mm; the length of first cavity 32 is preferably 10 mm to 12 mm; and the length of first plug 24 is preferably 2 mm to 8 mm. Overall the level of "tar" (FTC) is preferably in the range of 6 mg with a puff count of 7 or greater. Each of the components of multicomponent filter 14 are desirably of low particulate efficiency, and preferably, amongst all the plugs, the third plug 40 is of the lowest RTD and particulate efficiency because it is upstream of the ventilation and therefore has greater effect upon the mainstream smoke. Unlike the other plugs, the third plug 40 receives the mainstream smoke in the absence of a diluting air stream.

Figure 3 is a schematic diagram, shown in sectional view, of an embodiment of a smoking article wherein a mixture of (1) cellulosic granules containing flavorant and (2) either cellulosic granules containing a humectant, or containing water, or a combination thereof, are disposed on a fibrous plug in the multicomponent filter of the smoking article. As compared to the embodiment of a smoking article shown in Figure 1, the embodiment of a smoking article of Figure 3 replaces first cavity 32 and second plug 26 with plug 48, containing cellulosic granules containing flavorant 34 and cellulosic granules containing humectant, or water, or a combination thereof 36 disposed on a fibrous tow 50, such as cellulose acetate tow.

While not wishing to be bound by any theory, it is believed that different absorption and desorption events occur when mainstream tobacco smoke interacts with a bed of flavor granules as compared to those that occur when mainstream tobacco smoke interacts with a bed comprising a mixture of cellulosic flavor granules and either or both of cellulosic granules

containing humectant and cellulosic granules containing water. The inclusion of varying amounts of either or both of cellulosic granules containing humectant and cellulosic granules containing water allows for the adjustment of the length of the first cavity, and consequently, the length of the second cavity, within the constraints of an overall length for the multicomponent filter, while maintaining the essentially fully filled condition of the first cavity. As a result, this allows for adjustments in the lengths of the first cavity and/or the second cavity, so that these lengths promotes desired sensorial attributes, or enhances other desired attributes, such as dwell-time of mainstream smoke passing through the cavities. For example, the inclusion of varying amounts of either or both of cellulosic granules containing humectant and cellulosic granules containing water in the first cavity allows the accommodation of flavor release agents or sorbents (such as activated carbon) that function more effectively when dispersed along a longer cavity than they do in shorter cavities, or conversely.

With respect to the smoking articles described herein, the filters can be used in traditional or non-traditional cigarettes, such as cigarettes smoked in electrically heated cigarette smoking systems. For the example of a traditional cigarette, the length of the rod of smoking material 12 is preferably around 49 mm, and the length of the multi-component filter 14 is preferably 26 mm to 36 mm, more particularly around 34 mm.

With respect to conventional cigarettes, tobacco rod 12 may be wrapped with a conventional cigarette wrapper, or banded paper may be used for this purpose. Banded cigarette paper has spaced apart integrated cellulose bands that encircle the finished tobacco rod of cigarette 10 to modify the mass burn rate of the cigarette so as to reduce risk of igniting a substrate if the cigarette 10 is left thereon smoldering. US 5 263 999 and US 5 997 691 describe banded cigarette paper, which patents are incorporated herein in their entirety.

With respect to the cellulosic granules containing flavorant, the granules are preformed before adding to the multi-component filter. Flavorants can be included during the process of making the granules or can be later added to the granules. Alternatively or in addition, flavorants can be added to a coating on the granules, said coating having optionally the additional function of providing a controlled release of the flavor components in the granules. Volatile flavorants can be added during the process of preparing the granules or to the preformed granules, depending on the process used for preparing the granules. Depending on the method of preparing the granules, it may be more desirable to add volatile flavorants to the preformed granules than to add these flavorants during the process of preparing the granules. Liquid compounds can be added to the granules by, for example, impregnating the granules with liquid formulations containing, for example, volatile flavors, diluents, and the like. Alternatively, compounds and compositions can be added to the granules by mixing the granules or by fluidized bed spraying of the granules, or by other suitable methods. In general, the cellulosic flavor granules can contain from 1% to 99% by weight of flavorant, more

particularly from 10% to 90% by weight of flavorant, and from 99 to 1% by weight of cellulosic binder, more particularly from 90% to 10% by weight of cellulosic binder, based on the dried granules.

The functionality of the cellulosic granules (whether cellulosic flavor granules or cellulosic granules containing humectant and/or water) can be tailored to have a more controlled-delivery release of flavorant, humectant, and/or water. For example, diffusion of the flavors from the granules can be adjusted by controlling granule porosity and density as well as by any controlled-release coating added to the granules. For instance, the granules can be overcoated with polymeric coatings of different functionalities and or compositions (*e.g.*, single or multiple overcoats depending on the application) to control the delivery and release of the active compounds. For example, in embodiments wherein tobacco particles are included in the cellulosic flavor granules, it should be noted that the weight percent of cellulosic binder and weight percent of tobacco particles appear to have conflicting effects: an increase in tobacco content increases the flavorant impact on the taste of the smoke but can decrease the mechanical properties (*i.e.*, hardness, attrition resistance) of the cellulosic flavor granules. On the other hand, an increase in the cellulosic binder (*e.g.*, MCC) appears to decrease the impact on the taste but increases the mechanical strength. The mechanical strength and uniformity in size distribution are also affected by the liquid content in the wet mass, size of the opening on the extrusion die, and processing parameters such as extrusion speed, rotation speed, and duration of spheronization. For a given blend of tobacco particles, the optimal formulation and processing conditions are empirically determined.

In another aspect, the cellulosic granules can act as a delivery system for delivering flavors naturally occurring in the components of the granule formulation. Alternatively, the cellulosic granules can act as a medium for creating and/or enhancing naturally occurring flavors through Maillard, enzymatic, or other types of reactions. It is further contemplated that the granules can be altered or enhanced by thermal treatment of the granules after formation. The thermal treatment can further enhance reactions such as Maillard reactions and enzymatic reactions and thereby flavors of the smoking article containing said granules. For example, the granules can be treated by heating at a temperature from about 40 °C to about 300 °C for a period of about 5 minutes to several hours.

The cellulosic flavor granules can be prepared using known extrusion and spheronization processes or high shear granulation for producing pharmaceutical pellets and flavored beads.

In a particular embodiment, the cellulosic flavor granules can be formed using the methods described in US 2007/0000505, which is incorporated herein by reference, for forming tobacco beads having binders. However, the granules need not contain tobacco particles, and may contain other flavorants instead of, or in addition to, tobacco flavor.

More particularly, one example of a suitable cellulosic flavor granule can be prepared by (1) mixing solid flavorant particles, such as tobacco particles, with water, optional additional flavorants, and a dry or liquid cellulosic binder, to form a uniform wet mass; (2) forcing the uniform wet mass through a restricted area via extrusion to form strands of extrudate; (3) breaking the extrudate strands into short lengths and rounding the broken extrudate pieces by placing them on a rotating plate within a cylinder to form wet spheres (*i.e.*, spheronizing); and (4) drying the wet spheres to remove a portion of the liquid. Additionally, flavorants and/or coatings can be added after drying and/or the cellulosic granules can further undergo a thermal treatment as discussed above.

The wet mass can be prepared in a mixer such as a planetary mixer, wherein mixing occurs. The extrusion can be carried out using extruders such as the screw, sieve and basket, roll and ram type extruders. Spheronization can be carried out using a spinning friction plate that effects rounding of extrudate particles. Water is preferably used to provide the wet mass with desired rheological characteristics. For example, the water content can be adjusted to achieve the desired plasticity, for example, the water content may range from 20% to 150% (preferably 40 to 60%) by weight or at least about in a proportion of one-to-four to four-to-one of liquid to dry material. With the use of liquid flavorants, the liquid content of the wet mass is preferably adjusted to account for the effect of the liquid flavorant on the rheological characteristics of the wet mass. Details of extrusion and spheronization techniques can be found in "Extrusion-Spheronisation--A Literature Review" by Chris Vervaet *et al*, 1995 International Journal of Pharmaceutics 116:131-146, and also in US 5 725 886, the entire contents of each of which are incorporated herein by reference. The flavoring agents can vary, and include menthol, vanillin, citric acid, malic acid, cocoa, licorice, and the like, as well as combinations thereof. See, Leffingwell *et al*, TOBACCO FLAVORING FOR SMOKING PRODUCTS (1972).

In a particular embodiment, the tobacco particles can be mixed with a suitable dry binder, such as those disclosed herein or for example an extrusion and spheronization aiding composition and reagents, a water swellable polymer, polymer binders or mixtures of these reagents. The admixed binder-tobacco particles composition can then be further admixed with a liquid binder to form a uniform wet mass. Alternatively, the admixed binder-tobacco particles comprising composition can be further admixed with flavorants and/or flavor precursors, or any combination of liquid and dry binders, flavorants, flavor precursors, and fillers.

Cellulosic binders are particularly desirable because they also function as extrusion and spheronization aiding reagents, and are capable of holding liquid rather like a sponge. These binders also further restrict the separation of the liquid from the solid that can occur during extrusion and spheronization processes. These include, but are not limited to, microcrystalline cellulose (MCC), hydroxypropyl methylcellulose (HPMC), low substituted hydroxypropyl

cellulose (L-HPC), cellulose ethers, hydroxypropyl cellulose (HPC), carboxymethyl cellulose (CMC), more amorphous forms of cellulose (*e.g.*, powdered cellulose), combinations of crystalline and modified cellulose (*e.g.*, hydroxypropyl cellulose and hydroxypropyl methylcellulose), and amorphous cellulose. Other natural polysaccharides and their derivatives are also contemplated for use in the cellulosic flavor granules. Other binders and extrusion and spheronization aiding reagents may also optionally be included, such as pectinic acid, lactose, glyceryl monostearate, polyvinyl pyrolidone (PVP), EUDRAGIT®, and combinations thereof.

Microcrystalline cellulose (MCC) is the preferred cellulosic material for use in the cellulosic flavor granules. Whereas various flavor carriers may need heat or water to release volatile flavor compounds into mainstream smoke, cellulosic flavor granules can release such flavor constituents under ambient conditions. While any conventional cigarette flavor additives, such as tobacco extracts and menthol can be optionally incorporated in the cellulosic flavor granules, it is preferred that the cellulosic flavor granules incorporate flavor additives that compensate for loss of desired taste due to filtration by the upstream sorbent material. In the case of an upstream activated carbon sorbent, the cellulosic flavor granules preferably add to the filtered mainstream smoke flavor constituents, which meet the smoker's expectations for the type of cigarette being smoked, *e.g.*, full flavor, mild flavor, or the like.

The cellulosic flavor granules may also optionally contain an aerosol forming agent, such as glycerin, propylene glycol, triacetin, propylene carbonate, and combinations thereof.

In embodiments where tobacco particles form part or all of the flavorant, the tobacco particles can be formed by taking parts of the tobacco plant (leaf, stem, and the like) and grinding the dried portions into a fine powder or dust. The ground tobacco particles preferably have an average particle diameter suitable for forming a wet tobacco mixture which can be formed into tobacco beads. More particularly, the ground tobacco is preferably sieved with mesh size 35 to provide tobacco particles with a maximum particle size of about 0.5 mm.

The tobacco parts used to make the tobacco particles can be from any different type of tobacco used to prepare smoking articles such as but not limited to Burley, Bright, Oriental, or blends thereof, as well as genetically altered, chemically altered, or mechanically altered tobacco plants and blends thereof. More particularly, the blend of ground tobacco particles is preferably obtained from the lamina of tobacco plants. Cellulosic flavor granules which contain only tobacco lamina of Burley, Bright and/or Oriental and other tobacco varieties can provide delivery of enhanced flavor to mainstream smoke passing through the filter of a smoking article containing the cellulosic flavor granules. However, other tobacco plant parts such as ground stems and tobacco dust can be included in the ground tobacco particles. The type of tobacco is preferably selected from the group consisting of Burley, Bright, and Oriental. The blend of ground tobacco particles can include up to 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, or 100% by weight of Burley; up to

5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, or 100% by weight of Bright; and/or up to 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%, 85%, 90%, 95%, or 100% by weight of Oriental.

The blend of the tobacco particles used, the composition of the cellulosic binder and other binder components, the concentration of liquid in the cellulosic flavor granules, and the size of the cellulosic flavor granules are all elements which can be altered alone or in combination with each other to achieve a desired taste for the mainstream smoke, as well as to achieve the desired mechanical strength and roundness of the resulting cellulosic flavor granules. The strength and roundness of the cellulosic flavor granules depends in part on the starting materials.

The cellulosic flavor granules formed using the methods discussed provide multiparticulates in a generally spherical shape. For example, the cellulosic flavor granules are preferably in the form of spheroids, wherein the spheroids are substantially round or substantially oval in shape. The wet mass is extruded through suitably sized pierced screens and spheronized using a rotating disk having a grooved surface. The spheres are then dried in a fluidized bed or conventional convection oven or vacuum oven to a moisture level of about 0.5% to about 25%. Further, each spheroid of the tobacco beads can have a diameter of about 0.1 mm to about 2.5 mm, preferably about 0.2 mm to about 1.2 mm, and more preferably about 0.3 mm to about 0.7 mm. The resulting cellulosic flavor granules possess good flow properties in filter rod making machines, low friability, and uniform packing characteristics. As a flavor carrier, these cellulosic flavor granules provide additional tobacco related aroma to the smoke of the smoking article, as compared to the flavor carriers made from non-tobacco materials.

The cellulosic flavor granules can be formed from the extrudate by using an LCI QJ-230T Marumerizer at a suitable rotation speed (*e.g.*, 1200 rpm) for a suitable time (*e.g.*, 10 minutes). The cellulosic flavor granules can comprise a number of flavorants in addition to, or in place of, the tobacco flavor provided by the presence of tobacco particles. These flavorants includes flavor materials that are practically unlimited, although water-soluble, alcohol-soluble and oil-soluble flavors are preferable. The flavor additives for the cellulosic flavor granules can be incorporated for example using a solvent mixture. A preferred solvent mixture does not impart undesired aftertastes to the mainstream smoke passing through the filter. Using a solvent mixture, it is possible to incorporate the optional flavor constituents into the cellulosic flavor granules in minute amounts, on the order of parts per million.

Tobacco products generally contain one or more flavors as additives for enhancement of the smoking flavor. Flavors which are added to tobacco products are normally categorized into two groups; a primary flavor group for casing sources, and a secondary flavor group for top flavors. These flavors are often added to shredded tobacco by means of a direct spraying

technique, which takes place during the process of manufacturing cigars or cigarettes. In accordance with one embodiment, a traditional cigarette, such as a lit-end cigarette, or non-traditional cigarette, such as a cigarette used in an electrical smoking system (see US 6 026 820, incorporated herein by reference in its entirety) can include a standard or common tobacco mixture in the tobacco rod and appropriately flavored cellulosic flavor granules in a filter of the cigarette can be used to achieve desired taste attributes of the cigarette. In another embodiment, the cellulosic flavor granules are incorporated in a filter of a smoking article which uses heat from a combustible fuel element to volatilize tobacco (see, for example, US 4 966 171, incorporated herein by reference in its entirety).

One advantage of the cellulosic flavor granules when used in a filter downstream of a sorbent is that addition of special flavoring additives to the tobacco rod can be omitted. Instead, the desired flavoring can be provided in the cellulosic flavor granules. While the cellulosic flavor granules are effective in modifying the taste of mainstream smoke passing through cigarette filters having upstream sorbents such as activated carbon, the cellulosic flavor granules are also used to flavor mainstream smoke in cigarettes which do not include sorbent material in the filter. This allows a standard tobacco mixture to be used in the tobacco rod of a standard lit-end cigarette and the desired taste attributes of different cigarette products (*e.g.*, regular, mild, full flavor, *etc*) to be provided by the cellulosic flavor granules, which contain flavorant effective to achieve the desired taste of the mainstream smoke. Similarly, the cellulosic flavor granules can be used in filters of non-traditional cigarettes, such as those used with electrically heated cigarette smoking systems, wherein the cigarettes include standard tobacco plug and/or tobacco mat constructions and desired flavor attributes can be achieved by loading the cigarette filter with the cellulosic flavor granules that contribute the desired taste in the mainstream smoke.

Again, not wishing to be bound by theory, to the extent that mainstream smoke passing through the sorbent may produce heat (perhaps a heat from adsorption), the cellulosic flavor granules can be located adjacent the sorbent such that heat produced at the sorbent location may be used to supplement (promote) flavor release from the cellulosic flavor granules. Additionally, it is envisioned that a catalyst or other agent may be added to the cigarette filter at an upstream location (with or without the sorbent) so as to create an exothermic event as the mainstream smoke passes through the upstream location, whereby flavor release from the cellulosic flavor granules is enhanced.

Typical flavorants used in the cellulosic flavor granules include includes at least one or more ingredients, preferably in liquid form, such as saturated, unsaturated, fatty and amino acids; alcohols, including primary and secondary alcohols; esters; activated carbonyl compounds, including ketones and aldehydes; lactones; cyclic organic materials including benzene derivatives, alicyclics, hetero-cyclics such as furans, thiazoles, thiazolidines, pyridines,

pyrazines and the like; sulfur-containing materials including thiols, sulfides, disulfides and the like; proteins; lipids; carbohydrates; so-called flavor potentiators; natural flavoring materials such as cocoa, vanilla, and caramel; essential oils and extracts, such as menthol, carvone and the like; artificial flavoring materials such as vanillin; Burley, Oriental and Virginia tobacco-like taste nuances and the like; and aromatic materials such as fragrant alcohols, fragrant aldehydes, ketones, nitriles, ethers, lactones, hydrocarbons, synthetic essential oils, and natural essential oils including Burley, Oriental and Virginia tobacco-like aroma nuances and the like. The quantity of flavorant contained in the cellulosic flavor granules can be chosen to provide a desired rate of delivery of volatile flavor compounds to mainstream smoke passing through the filter during smoking of the entire cigarette. The flavorant is preferably released into the mainstream smoke without heating of the cellulosic flavor granules, *i.e.*, the flavorant is released into the smoke at or about room temperature.

More particularly, typical flavors include lavender, cinnamon, cardamom, apium graveolens, fenugreek, cascarilla, sandalwood, bergamot, geranium, honey essence, rose oil, vanilla, lemon oil, orange oil, mint oils, cassia, caraway, cognac, jasmine, chamomile, menthol, cassia, ylang-ylang, sage, spearmint, ginger, coriander, and coffee. Each of the flavors can be used singly or mixed with others. If desired, diluent agents can be added to the cellulosic flavor granules. Diluent agents which can be used for this purpose include powdered starch, such as but not limited to corn starch and potato starch, rice powder, calcium carbonate, diatomaceous earth, talc, acetate powder, and pulp flock. The flavorant can also be in the form of a solid matrix (liquid flavorants spray dried with a starch). The flavorant can also be in the form of solids, liquids or gels. The flavorant can be present in the cellulosic flavor granules in an amount of up to 50% by weight (*e.g.*, 0.1% to 5%, 5% to 10%, 10% to 15%, 15% to 20%, 20% to 25%, 25% to 30%, 30% to 35%, 35% to 40%, 40% to 45% or 45% to 50%).

The drying of the cellulosic flavor granules can be carried out under vacuum to the second moisture content of about 8% to about 25% of a total weight of the cellulosic flavor granules . Preferably, the second moisture content is about 10% to 20%, and most preferably about 12% to about 18% of a total weight of the cellulosic flavor granules. As an alternative, the drying of the cellulosic flavor granules can be carried out in other drying equipment such as a conventional fluidized bed dryer or in a conventional oven dryer. However, vacuum drying of the cellulosic flavor granules is preferred because the taste resulting from the cellulosic flavor granules in a smoking article is enhanced when vacuum drying is used. Not wishing to be bound by theory, it is believed that vacuum drying minimizes loss of organic compounds providing desired organoleptic properties and promotes migration of flavor compounds to the surface of the cellulosic flavor granules. Accordingly, a preferred cellulosic flavor granules comprises a granule that has been vacuum dried to a predetermined moisture content of about 8% to 25% by weight.

With respect to the cellulosic granules containing humectant, and cellulosic granules containing water, similar considerations are applicable. For example, the cellulosic granules containing humectant can be prepared by involving a humectant, such as a glycerin, propylene glycol, triacetin, propylene carbonate, and the like, onto the granules using techniques similar to those described above for flavorants. For cellulosic granules containing water, the granules can be formed and dried until the desired moisture content is reached, or the dried granules can be sprayed or undried or otherwise combined with the desired quantity of water. The humectant or water can be present in the cellulosic granules in an amount of up to 50% by weight (*e.g.*, 0.1% to 5%, 5% to 10%, 10% to 15%, 15% to 20%, 20% to 25%, 25% to 30%, 30% to 35%, 35% to 40%, 40% to 45% or 45% to 50%).

The smoking cigarettes comprising a multicomponent filter containing an upstream bed of unflavored activated carbon and a downstream bed of cellulosic granules containing flavorant, and cellulosic granules containing humectant, such as glycerin, and/or cellulosic granules containing water resulted in the presence of a flavorful tobacco note during the first several puffs and the presence of a balanced, moist, flavorful note in later puffs. By contrast, cigarettes comprising a flavored carbon bed but cellulosic granules containing flavorant and humectant and/or water downstream of the flavored carbon bed provided mainstream smoke wherein the first several puffs had the less desirable flavor notes typical of more traditional "charcoal" cigarettes.

The cellulosic flavor granules, cellulosic granules containing humectant, and/or cellulosic granules containing water can be added to the multicomponent filter in amounts necessary or desirable to achieve the desired effect. For example, cellulosic flavor granules can be added in amounts ranging from about 20 mg to about 160 mg per multicomponent filter. Cellulosic granules containing humectant can be added in amounts ranging from about 20 mg to about 160 mg per multicomponent filter, more particularly from about 30 mg to about 140 mg per multicomponent filter.

The specific embodiments disclosed herein are merely illustrative and should not be considered restrictive in any way. The scope of the invention is given by the appended claims, rather than the preceding description, and all variations and equivalents which fall within the range of the claims are intended to be embraced therein. For example, sorbents other than activated carbon might be employed, such as mesoporous molecular sieves, silica gel, or other material. Moreover, the present invention may be practiced with cigarettes of various circumferences, narrow cigarettes as well as wide. Also, while the present invention is preferably practiced with unflavored tobacco rods, flavored tobacco filler is also contemplated. Furthermore, in all embodiments the sorbent itself may be either flavor-bearing or without flavor; and the sorbent may be granular, beaded, flaked, fibrous and/or other suitable forms. Furthermore, the ventilation holes of the preferred embodiments are preferably at a location

downstream of the sorbent bearing filter segment, but other locations are workable, even at a location along the sorbent segment. It is also contemplated that the sorbent and the cellulosic flavor granules be mixed together.

CLAIMS

1. A multicomponent smoking article filter adapted to be disposed at the non-burning end of the rod of smokable material, comprising:

a first segment comprising at least one of:

a plurality of cellulosic granules containing a humectant;

a plurality of cellulosic granules containing water; and

a plurality of cellulosic granules containing a flavorant; and

a second segment comprising sorbent, the second segment located upstream from the first segment relative to the direction of mainstream smoke drawn through the filter comprising a sorbent.

2. The multicomponent smoking article filter according to claim 1 wherein the sorbent comprises activated carbon.

3. The multicomponent smoking article filter according to claim 1 wherein the humectant comprises glycerin.

4. The multicomponent smoking article filter according to claim 1 wherein the cellulosic granules comprise microcrystalline cellulose (MCC).

5. The multicomponent smoking article filter according to claim 1 wherein the first segment further comprises one or more particles of a filler that is inactive toward constituents of mainstream smoke resulting from smoking the smokable material.

6. The multicomponent smoking article filter according to claim 1 wherein the first segment comprises a plurality of cellulosic granules, wherein at least one cellulosic granule contains both a humectant and water or wherein the first segment comprises a plurality of cellulosic granules containing a humectant and a plurality of cellulosic granules containing water.

7. The multicomponent smoking article filter according to claim 1 wherein the first segment comprises a first cavity between a first plug and a second plug.

8. The multicomponent smoking article filter according to claim 7 wherein said second segment is disposed downstream of a third plug.

9. The multicomponent smoking article filter according to claim 7 wherein the third plug comprises cellulose acetate tow.

10. The multicomponent smoking article filter according to claim 7 wherein the third plug comprises carbon particles or granules on tow.

11. The multicomponent smoking article filter according to claim 7 wherein the third plug comprises carbon-filled paper.

12. The multicomponent smoking article filter according to claim 1 wherein the first segment comprises a plug.

13. The multicomponent smoking article filter according to claim 1 wherein the second segment comprises a cavity.

14. The multicomponent smoking article filter according to claim 7 or claim 13 further comprising ventilation holes proximate at least one of the first plug, the first cavity, the second cavity and the second plug.

15. A smoking article comprising a multicomponent smoking article filter according to claim 1 having a buccal end and a tipping end, and a rod of smokable material disposed adjacent to the tipping end of the multicomponent smoking article filter.

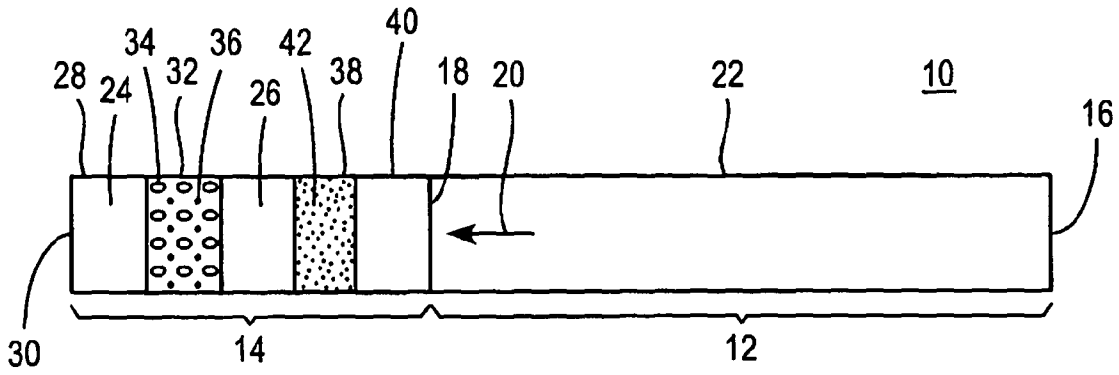

FIG. 1

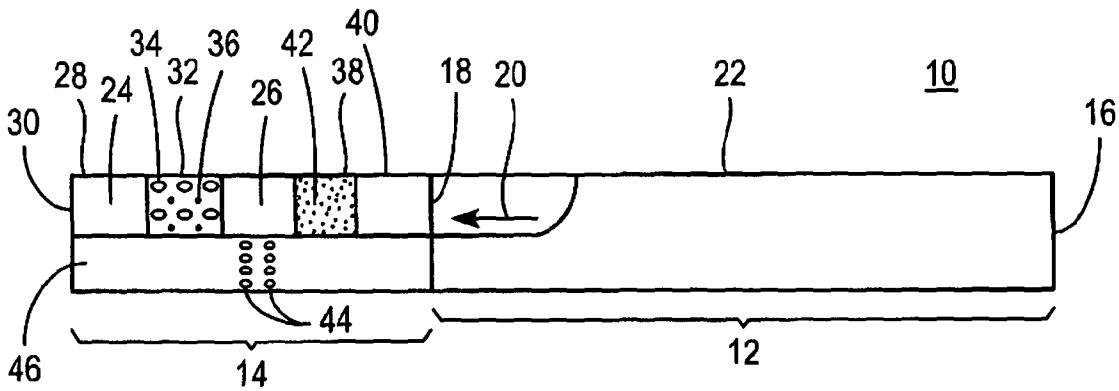

FIG. 2

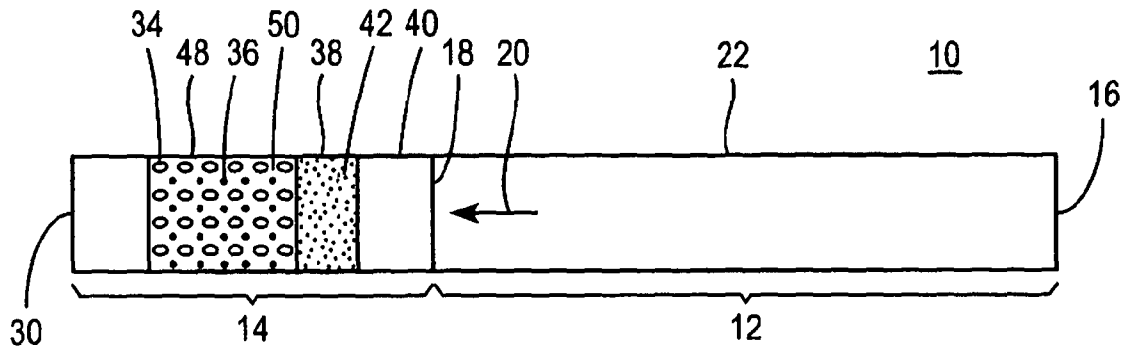

FIG. 3