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(54) **HYDRATED LIME TOBACCO SMOKE
FILTER**

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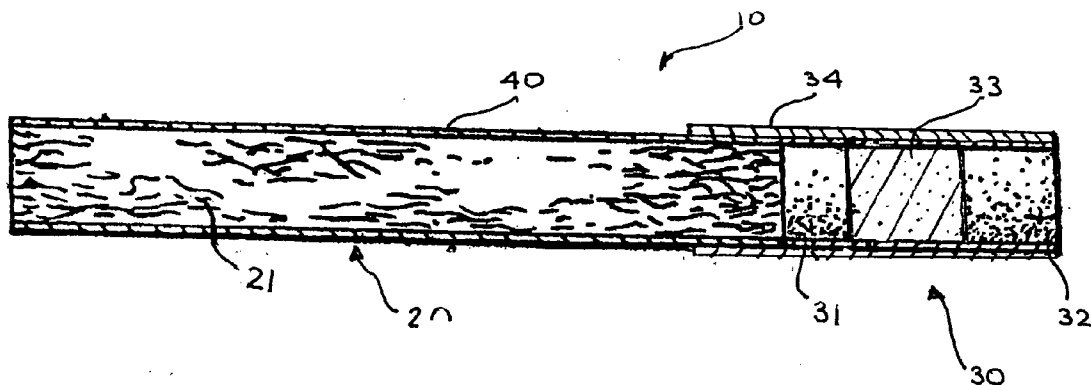
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(57) **ABSTRACT**

A multi-sectioned filter section for reducing the content of toxic constituents contained in a stream of tobacco smoke. The multi-sectioned filter section is composed of at least one non-fibrous section and at least one fibrous plug section. The multi-sectioned filter section is adaptable for use in tobacco products such as cigarettes, cigars, cigarillos and smoking articles such as tobacco pipes and cigarette and cigar holders.

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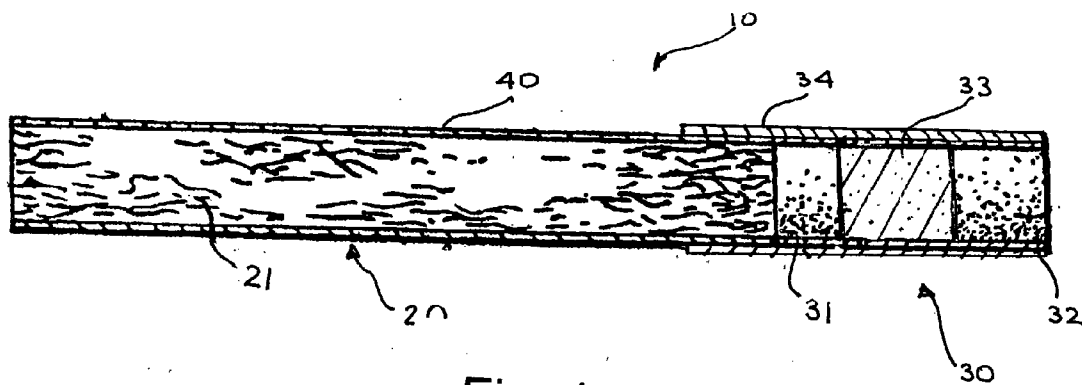


Fig. 1

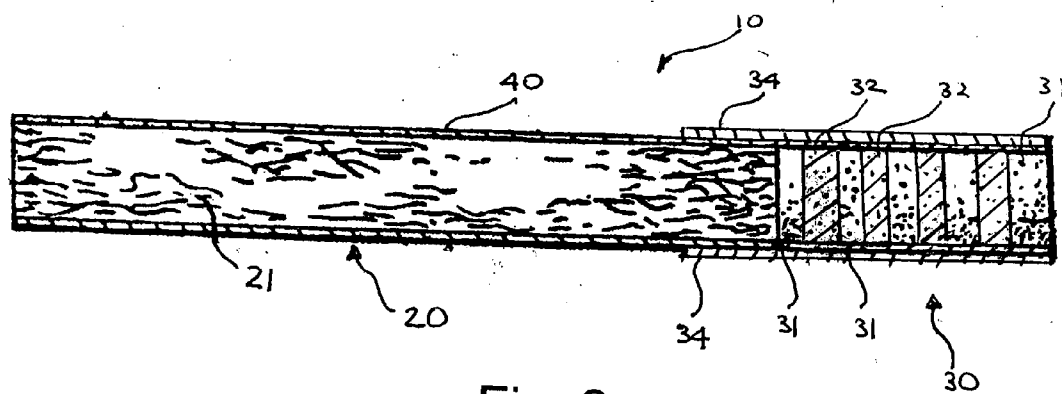


Fig. 2

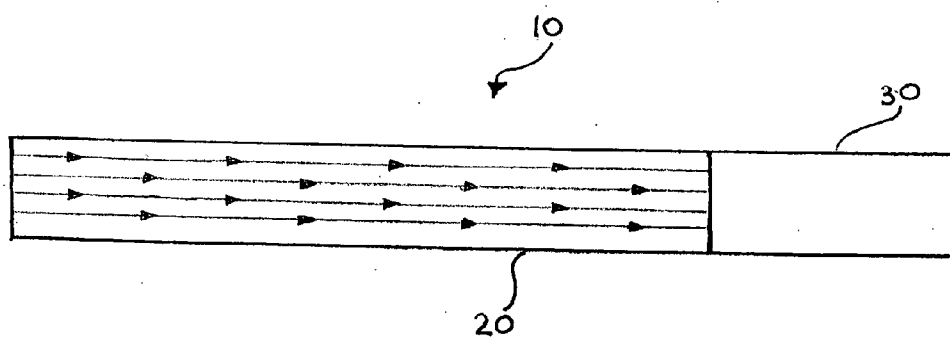


Fig. 3

HYDRATED LIME TOBACCO SMOKE FILTER

FIELD OF THE INVENTION

[0001] The invention relates generally to a multi-sectioned filter for reducing the level of toxic constituents such as tar, nicotine, carbon monoxide, nitrous oxides and the like that are drawn into the filter during the smoking of a tobacco product or tobacco article.

DESCRIPTION OF THE RELATED ART

[0002] Tobacco smoke is produced during the burning of a tobacco product such as cigarettes, cigars and cigarillos, and a tobacco article such as cigarette and cigar holders, and tobacco pipes. The long-term harmful effects of tobacco smoke are well known. For instance, cigarette smoking is a leading cause of lung cancer, and the leading cause of cancer death in both men and women in the United States. Worldwide, lung cancer kills over one million people each year. Tobacco smoke contains over 60 carcinogens. These chemicals represent approximately 7 chemical classes (polycyclic aromatic hydrocarbons, arenes, N-nitrosamines, aromatic and heterocyclic aromatic amines, aldehydes, organic compounds, and inorganic compounds).

[0003] Tobacco-specific nitrosamines (TSNAs) are a class of known carcinogens that are formed during the curing, processing, fermentation, and combustion of tobacco. TSNAs have been identified in cigarette tobacco, tobacco smoke, environmental tobacco smoke, smokeless tobacco and other tobacco products such as cigars and bidi cigarettes. The TSNAs show the highest concentration of any group of strong carcinogens in mainstream cigarette smoke. NNN is measured at 0.3 to 89 $\mu\text{g/g}$ (microgram per gram) in processed tobacco, at 0.12 to 3.7 μg per cigarette in mainstream smoke and at 0.15 to 1.7 μg per cigarette in sidestream smoke. NNK is measured at 0.2 to 7 $\mu\text{g/g}$ in processed tobacco, at 0.08 to 0.77 μg per cigarette in mainstream smoke and at 0.2 to 1.4 μg per cigarette in sidestream smoke. Information on levels of TSNAs in cigarette tobacco filler is relevant to levels of TSNAs in tobacco smoke. An average of 9% (6.9 to 11%) of NNK transfers from tobacco to smoke when the tobacco is burned and this represents, on average, 32% (26 to 37%) of the NNK in smoke. Exposure to TSNAs from tobacco products is confirmed by their detection in a variety of biological samples. An extensive body of scientific evidence spanning about three decades provides clear evidence that TSNAs are an important group of potent carcinogens in tobacco and tobacco smoke. People are exposed to TSNAs by using tobacco (smoking or oral) and by exposure to second hand or environmental tobacco smoke. Evidence is sufficient that the lung is a target of TSNA-induced cancer and that NNK is one carcinogen likely to play a role in human tobacco-induced lung cancer. NNN occurs in greater concentrations in cigarette smoke than any other esophageal carcinogen. Smoking is also a cause of esophageal cancer and is responsible for 70-80% of esophageal cancer deaths in the United States.

[0004] Conventional cigarettes are generally composed of two sections—a tobacco-containing portion generally referred to as the tobacco or cigarette rod, and a filter portion which is typically referred to as the filter tipping. The filter portion for tobacco smoking products such as cigarettes, cigars and cigarillos, as well as smoking articles such as

cigarette and cigar holders and tobacco pipes have been developed for reducing the content of toxic constituents in a stream of tobacco smoke, with mouthpieces containing filter materials for removing part of the nicotine and tar substances without substantially filtering out the aroma substances.

[0005] A wide variety of materials have been proposed as suitable filters for tobacco smoke in order to reduce exposure to toxic tobacco smoke constituents. Such filter materials are typically composed of cellulose, cellulose acetates, polyethylene, crepe, paper, or active carbon.

[0006] U.S. Pat. No. 6,591,839 to Meyer et al. discloses a filter material composed of ground expanded clay and zeolite for reducing harmful substances in tobacco smoke. The expanded clay is synthetically produced using natural raw or crude clay that is shaped into small, round pieces and subsequently burned in a furnace. The small round pieces are first caused to expand in the course of the burning process under heat, and the surfaces of the small spheres of clay are then slightly sintered (melted). The interior of the small spheres has a porous structure with numerous air inclusions. The expanded clay is thereafter ground.

[0007] Heretofore, none of the aforementioned prior art systems provide a filter for a tobacco smoking product or tobacco smoking article that effectively reduces the level of toxic constituents in the tobacco smoke stream prior to delivery to the smoker. The prior art also lacks such a filter that incorporates a non-toxic, non-combustible and inorganic material such as calcium hydroxide, or such a filter whose physical characteristics optimizes its filtration action.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the invention to provide a multi-sectioned filter for reducing the level of toxic constituents such as tar, nicotine, carbon monoxide, nitrous oxides and the like that are drawn into the filter during the smoking of a tobacco product.

[0009] It is another object of the invention to provide such a filter that incorporates a non-toxic, non-combustible and inorganic material that makes the production of such filters more economically and environmentally attractive.

[0010] It is an additional object of the invention to provide such a filter having physical characteristics that are porous and non-fibrous to thereby optimize filtration of the tobacco smoke before delivery to the smoker.

[0011] It is yet another object of the invention to provide such a filter which includes at least one section of calcium hydroxide, i.e., hydrated lime, for the efficient and effective absorption of toxic constituents from the stream of tobacco smoke prior to delivery to the smoker.

[0012] In accordance with these objects and the principles of the invention, provided herein is a multi-sectioned filter for a tobacco product or article that incorporates at least substrate of hydrated lime filter section for effectuating the removal of toxic constituents such as tar, nicotine, carbon monoxide, nitrous oxides and the like from a stream of tobacco smoke that are drawn into the filter section.

[0013] Hydrated lime, chemically known as calcium hydroxide, calcium hydrate or caustic lime, is produced when quicklime (calcium or magnesium oxide) is reacted

with water in an atmospheric hydrator. Hydrated lime is suitable for a wide range of applications including: the treatment of potable water, waste water and municipal sludge, as a chemical process additive; the stabilization of toxic waste for site remediation and various construction uses including soil stabilization and anti-stripping in asphalt mixes. Both relative activity of the quicklime and the temperature of the hydrating water will determine the surface area of the resulting hydrated lime. The chemical activity of hydrated lime is dependent upon particle size, and the smaller the crystal size the greater the surface area of the hydrated lime.

[0014] Provided in an embodiment of the invention is a multi-sectioned filter for removing toxic constituents from a stream of tobacco smoke produced by tobacco products, the filter including first and second filter sections composed of a filter plug material, and a third filter section composed of a non-fibrous, inorganic material. In such an embodiment, the non-fibrous, inorganic material comprises hydrated lime. The hydrated lime preferably has a surface area of about 10-85 m²/g, a mean particle diameter of about 1.7-10 micrometers and a pore volume of about 0.1-0.25 cc/g. The hydrated lime may also be produced in the form of a paste, powder or granule.

[0015] Also provided in another embodiment of the invention is a multi-sectioned filter which includes first and second filter sections composed of a fibrous plug material; and a third filter section positioned between the first and second filter sections, the third filter section being composed of a hydrated lime material capable of absorbing toxic constituents contained in a stream of tobacco smoke produced as a result of the tobacco smoke being drawn through the multi-sectioned filter. In accordance with this embodiment, the first, second and third filter sections are positioned in tandem and circumscribed by a plug wrap.

[0016] In yet another embodiment of the invention, a multi-sectioned cigarette filter is provided including a plurality of fibrous filter plug filter sections and a plurality of calcium hydroxide filter sections capable of absorbing toxic constituents contained in a stream of tobacco smoke.

[0017] These and other objects, features and advantages of the invention will become more apparent from the following description when taken in conjunction with the detailed drawings that show, for purposes of illustration only, the preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The advantages of the invention will become more apparent to those skilled in the art in conjunction with the detailed description of the preferred embodiments of the invention, in which:

[0019] FIGS. 1 and 2 show longitudinal sectional views of a cigarette having a filter in accordance with the invention; and

[0020] FIG. 3 shows a diagrammatic view of a cigarette made in accordance with the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0021] Referring now to drawing FIGS. 1 and 2, which show in a preferred embodiment of the invention a cigarette

10 including a tobacco section 20 and a filter section 30. The tobacco section 20 is typically filled with a smokable material such as tobacco 21. Tipping paper 40 is wrapped around the periphery of the filter section 30 and a portion of the tobacco section 20 to complete the cigarette construction. The tipping paper 40 may be provided with a plurality of holes (not shown) for introducing air into the tobacco smoke stream as the smoke is drawn through the filter section 30. The tobacco section 20 preferably has a length ranging from about 35 mm to about 85 mm, and a circumference of about 17 mm to about 27 mm. Tobacco sections 20 having short lengths (i.e., in a range of about 35 mm to about 50 mm), however, may be employed in accordance with the invention. The filter section 30 preferably has a length ranging from about 15 mm to about 40 mm, and a circumference of about 17 mm to about 27 mm.

[0022] As indicated in the representation shown in FIG. 1 of the drawing figures, the filter section 30 is of a multi-sectioned type that includes a first filter plug 31 positioned at a first end of the filter section 30 which abuts the tobacco section 20, a second filter plug 32 positioned at the "mouth-end" of the filter section 30, a third section 33 composed of a porous substrate of a non-fibrous, inorganic material that is positioned between the first and second filter plugs 31, 32, and a plug wrap 34 circumscribed about the filter section 30 for maintaining the structural integrity of the filter section 30. In accordance with the invention, it is preferred to situate the first and second filter plugs 31, 32 at the inner most (i.e., adjacent to the tobacco section 20) and outermost (i.e., at the "mouth-end") sections of the filter section 30.

[0023] As shown in drawing FIG. 2, the multi-sectioned filter section 30 may also include a plurality of fibrous filter plug sections 31 and a plurality of non-fibrous filter sections 32. In accordance with this aspect of the invention, it is also preferable to situate the fibrous filter plugs 31 at the inner most (i.e., adjacent to the tobacco section 20) and outermost (i.e., at the "mouth-end") sections of the filter section 30. Moreover, in an effort to enhance the filtering action of the multi-sectioned filter 30, it is preferred that non-fibrous filter sections account for at least 50% of the entire filter section 30.

[0024] The filter plugs 31, 32 are preferably composed of a filamentary or fibrous material. More preferably, each filter plug 31, 32 may be made, as is known in the art, from a variety of materials, such materials commonly being cellulose, cellulose acetate tow, paper, cotton, polypropylene web, polypropylene tow, polyester tow or combinations thereof. Moreover, at least one of the filter plugs may contain additive materials and/or flavoring agents.

[0025] The non-toxic filter material of the third filter section 33 is preferably a commercial grade of calcium hydroxide (Ca(OH)₂), i.e., hydrated lime, that may also be of food grade quality in accordance with any standards established by the U.S. Food & Drug Administration (FDA). The hydrated lime may preferably take the form of any one of pastes, granules, beads and/or powders for incorporation into the filter section 33. While it is preferred that the filter material 31 lacks additive materials, additives and flavoring agents may be incorporated therein to provide a more consumer-acceptable filter section 33. Accordingly, the non-fibrous material, i.e., calcium hydroxide, contained in the non-fibrous filter section serve to absorb toxic constituents

contained in the tobacco smoke stream and thereby significantly reduce the level of toxic constituents prior to delivery to the smoker.

[0026] In another effort to optimize the overall filtration action of the third filter section **33**, hydrated lime having favorable physical properties such as high surface area, high porosity, and small particle size may be used in accordance with the invention. More preferably, such hydrates may be characterized by having surface areas in the range of about 10-85 m²/g, mean particle diameters of about 1.7-10 micrometers, pore volumes in the range of about 0.1-0.25 cc/g, and crystallite sizes of greater than about 200 Angstroms. Moreover, ventilating the filter portion **30** in accordance with conventional methods known in the art may also optimize the desired filtering action. The hydrated lime in accordance with the invention is commercially available at a number of sources, such as Mississippi Lime of Alton, Ill.

[0027] The cigarette **10** is used by lighting one end of the tobacco section **20**, which produces tobacco smoke as a result of the combustion of the tobacco-filled tobacco section. Upon lighting the cigarette **10**, the smoker inhales to combine with the heat from combustion toxic constituents such as tar, nicotine, carbon monoxide and nitrous oxides that are drawn longitudinally from the tobacco section **20** to the filter section **31** as indicated by the arrows shown in FIG. **3**. As these toxic constituents come into contact with the non-fibrous filter section, the hydrated lime contained therein absorbs at least the tar and nicotine from the tobacco smoke stream before passing to the fibrous filter section **32**. Such a configuration is aesthetically pleasing insofar as the filter section(s) composed of hydrated lime is not exposed to the smoker.

[0028] Accordingly, when the cigarette **10** is smoked, a significant portion of the smoke stream from the cigarette **10** is filtered first through the inner fibrous filter section(s) and then the hydrated lime filter section(s) prior to its passing through the outer fibrous filter section(s) **32** and subsequent delivery to the smoker. Such a design facilitates the reduction of toxic constituents before the outermost fibrous filter section is exposed to the smoke stream, and thus, gives the smoker a significantly filtered smoke stream. This is advantageous in producing a tobacco smoke stream that is predominately free of toxic constituents, thereby reducing the risk of exposure of the smoker to illnesses derived from the combustion of tobacco. Incorporating hydrated lime as one of the filtering materials is also advantageous since it is a non-toxic, non-combustible and inorganic material that makes the production of such filters more economically and environmentally attractive. An even more advantageous feature of the invention is the physical characteristics of hydrated lime, particularly its porosity and non-fibrous quality, help facilitate the optimization of a filtration action, thereby the efficient and effective absorption of toxic constituents.

[0029] It is apparent that innumerable variations of the preferred embodiments described hereinbefore may be utilized. For instance, the filter plug sections and the non-fibrous filter section may each vary in length and diameter, relative to any dimensions specified herein and relative to each other. Moreover, the various filter section dimensions may be optimized for a particular tobacco blend or for particular tobacco rod dimensions. However, these as well as other variations are believed to fall within the spirit and scope of the invention as covered by the claims attached herein.

What is claimed is:

1. A filter for removing toxic constituents from a stream of tobacco smoke produced by tobacco smoking products and tobacco smoking articles, said filter comprising at least one substrate of an inorganic material.

2. The filter of claim 1, wherein said inorganic material is non-fibrous.

3. The filter of claim 2, wherein said non-fibrous, inorganic material comprises hydrated lime.

4. The filter of claim 3, wherein said hydrated lime has a surface area of about 10-85 m²/g.

5. The filter of claim 4, wherein said hydrated lime has a mean particle diameter of about 1.7-10 micrometers.

6. The filter of claim 5, wherein said hydrated lime has a pore volume of about 0.1-0.25 cc/g.

7. The filter of claim 3, wherein said hydrated lime is in a form selected from the group consisting of granules, beads, paste and powder.

8. A multi-sectioned cigarette filter comprising:

first and second filter sections comprising a fibrous plug material; and

a third filter section positioned between said first and second filter sections, said third filter section comprising a hydrated lime material capable of absorbing toxic constituents contained in a stream of tobacco smoke produced as a result of the tobacco smoke being drawn through said multi-sectioned filter,

wherein said first, second and third filter sections are positioned in tandem and circumscribed by a plug wrap.

9. The filter of claim 8, wherein said fibrous plug material is any one selected from the group consisting of cellulose, cellulose acetate tow, paper, cotton, polypropylene web, polypropylene tow, polyester tow and combinations thereof.

10. The filter of claim 8, wherein said first, second and third filter sections are circumscribed by a single plug wrap material.

11. A multi-sectioned cigarette filter comprising a plurality of fibrous filter plug filter sections and a plurality of calcium hydroxide filter sections capable of absorbing toxic constituents contained in a stream of tobacco smoke.

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