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(54) CIGARETTE AND CIGARETTE FILTER

(57) A basic amino acid or a basic amino acid salt is added to a cigarette or a cigarette filter. It is desirable for the basic amino acid or the basic amino acid salt to be added in an amount of at least 1 mg/cigarette. It is also desirable for the basic amino acid or the basic amino acid salt to be added to the cigarette or the cigarette filter in the form of an aqueous solution. Also, it is possible to add a surfactant to the cigarette or the cigarette filter together with the basic amino acid or the basic amino acid salt.

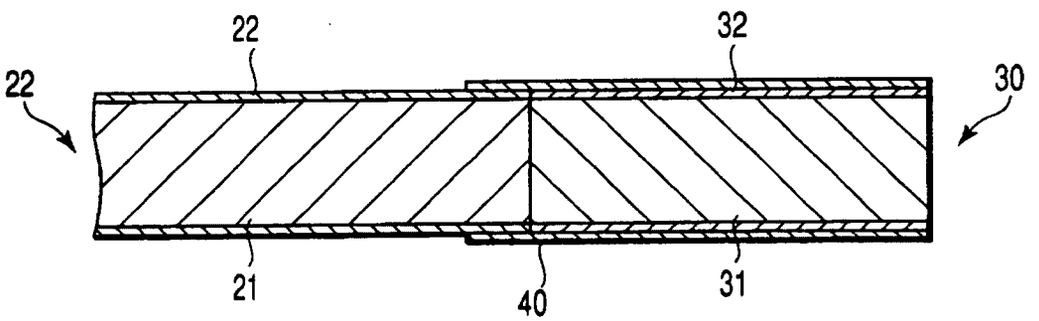

FIG. 2

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Description

Technical Field

[0001] The present invention relates to a cigarette low in the amounts of aldehydes contained in the mainstream smoke and to a cigarette filter that permits lowering the amounts of aldehydes contained in the mainstream smoke of a cigarette.

Background Art

[0002] Various chemical components are contained in the mainstream smoke inhaled by the smoker in smoking a cigarette. Among these chemical components, it was difficult to remove by adsorption the aldehydes represented by formaldehyde by the ordinary cigarette filter. Therefore, it is desirable to remove the aldehydes from the mainstream smoke of the cigarette.

[0003] It was attempted in the past to use various additives in the cigarette filter in order to remove by adsorption the aldehydes contained in the mainstream smoke of the cigarette. However, the use of the additives available in the past gives rise to problems. For example, the taste of the cigarette is impaired.

[0004] An object of the present invention is to provide a cigarette and a cigarette filter, which permit effectively lowering the aldehyde content in the mainstream smoke of a cigarette and which also permit suppressing the detrimental effects such as degradation of the cigarette taste.

Disclosure of Invention

[0005] According to a first aspect of the present invention, there is provided a cigarette containing a basic amino acid or a basic amino acid salt.

[0006] According to a second aspect of the present invention, there is provided a cigarette filter containing a basic amino acid or a basic amino acid salt.

[0007] In the present invention, it is desirable for a basic amino acid or a basic amino acid salt to be contained in an amount of at least 1 mg/cigarette. In the present invention, it is desirable for the basic amino acid or the basic amino acid salt to be contained in the cigarette or the cigarette filter in the form of an aqueous solution. It is also desirable for the cigarette or the cigarette filter of the present invention to further contain a surfactant.

Brief Description of Drawings

[0008]

FIG. 1 schematically shows the construction of an apparatus for measuring formaldehyde contained in the mainstream smoke of a cigarette, which was used in the Examples of the present invention;
FIG. 2 is a cross-sectional view showing the construction of a cigarette used in the Examples of the present invention; and
FIG. 3 is a cross-sectional view showing the construction of a cigarette filter used in another Example of the present invention.

Best Mode for Carrying Out the Invention

[0009] As a result of extensive research conducted from various viewpoints in an attempt to lower the aldehyde content in the mainstream smoke of a cigarette, the present inventors have found that a basic amino acid or a basic amino acid salt is effective in lowering the aldehyde content in the mainstream smoke of the cigarette. The basic amino acid or the basic amino acid salt includes, for example, arginine, arginine salt, lysine, lysine salt, histidine, histidine salt, ornithine, ornithine salt, citrulline, citrulline salt, hydroxyzine and hydroxyzine salt. Particularly, arginine and a salt thereof are admitted as food additives.

[0010] In the present invention, that portion of the cigarette to which the basic amino acid or the basic amino acid salt is added is not particularly limited. For example, the basic amino acid or the basic amino acid salt can be added to any of the cut tobacco, the cigarette wrapper and the filter.

[0011] It is possible for the cigarette filter of the present invention to be a filter attached to the inhaling side of the tobacco portion of the cigarette or to be a filter in the form of a cigarette holder.

[0012] In the cigarette or the cigarette filter of the present invention, the basic amino acid or the basic amino acid salt is contained in an amount of at least 1 mg/cigarette. If the amount of the basic amino acid or the basic amino acid

salt is smaller than the amount noted above, it is difficult to obtain a sufficient effect of lowering the aldehyde content in the mainstream smoke of the cigarette.

[0013] If the basic amino acid or the basic amino acid salt is used in the presence of water, the effect of lowering the aldehyde content in the mainstream smoke of the cigarette can be increased in the present invention.

[0014] The effect of lowering the aldehyde content in the mainstream smoke of the cigarette can also be increased in the case where the basic amino acid or the basic amino acid salt is used together with a surfactant. It is considered reasonable to understand that an aqueous solution containing a surfactant and a basic amino acid or a basic amino acid salt exhibits an improved wettability so as to permit the basic amino acid or the basic amino acid salt to be dispersed sufficiently, with the result that the aldehyde content in the mainstream smoke of the cigarette is lowered. The surfactant used in the present invention includes ionic surfactants such as potassium sorbate, sodium oleate and sodium laurate, and nonionic surfactants such as sucrose laurate, sucrose myristate, sucrose palmitate, and sucrose stearate, though the surfactant used in the present invention is not limited to those exemplified above.

(Examples)

[0015] In the method of measuring the aldehydes contained in the mainstream smoke of a cigarette, which was used in the following Examples, the derivative of 2,4-dinitrophenyl hydrazine (DNPH), a trapping substance, was measured by high-speed liquid chromatography (HPLC). The substances that can be measured simultaneously by this method are eight components including formaldehyde, acetaldehyde, acetone, acrolein, propionaldehyde, crotonaldehyde, methyl ethyl ketone and n-butylaldehyde. In the following Examples, the description is directed to formaldehyde among the aldehydes (carbonyl compounds) that were to be measured.

[0016] In the first step, a trapping solution was prepared by dissolving 9.51 g of 2,4-dinitrophenyl hydrazine (DNPH) in 1L of acetonitrile, followed by adding 5.6 mL of 60% perchloric acid and subsequently diluting the resultant solution with ultra pure water to 2L.

[0017] The construction of the measuring apparatus will now be described with reference to FIG. 1. As shown in FIG. 1, a DNPH trapping solution 12 is put in a Drechsel type trap 11. The Drechsel type trap 11 had an inner volume of 250 mL, the amount of the DNPH trapping solution was 100 mL, and the dead volume was 150 mL. The Drechsel type trap 11 was put in an ice water bath 13 so as to cool the trap 11. The lower end of a glass pipe 14 having a cigarette 1 mounted in the tip is dipped in the trapping solution 12 housed in the Drechsel type trap 11. Further, a glass pipe 15 having a Cambridge pad 16 mounted thereto is mounted to communicate with the dead volume of the Drechsel type trap 11, and a smoking machine 17 was connected to the Cambridge pad 16.

[0018] The cigarette 1 was attached to the glass pipe 14 so as to permit the cigarette 1 to be automatically smoked under the standard smoking conditions specified in ISO standards. To be more specific, the operation of sucking 35 mL of the smoke in a single puff for two seconds for a single cigarette was repeated at an interval of 58 seconds. While the mainstream smoke was being bubbled, formaldehyde was converted into a derivative of DNPH. Two cigarettes were used for the measurement.

[0019] The formaldehyde derivative thus formed was measured by HPLC. In the first step, the trapping solution was filtered, followed by diluting the filtered trapping solution with a Trizma Base solution (4 mL of trapping solution : 6 mL of Trizma Base solution). Then, the diluted solution was measured by HPLC. The measuring conditions of the HPLC were as follows:

Column: HP LiChrospher 100RP-18(5μ)250 × 4 mm
Guard column: HP LiChrospher 100RP-18(5μ)4 × 4 mm
Column temperature: 30°C
Detection wavelength: DAD 356 nm
Injection amount: 20 μL
Mobile phase: Gradients by three phases (solution A: ultra pure aqueous solution containing 30% of acetonitrile, 10% of tetrahydrofuran and 1% of IPA; solution B: ultra pure aqueous solution containing 65% of acetonitrile, 1% of tetrahydrofuran and 1% of IPA; solution C: 100% of acetonitrile).

[0020] The construction of the cigarette used as a sample will now be described with reference to the cross-sectional view shown in FIG. 2. As shown in FIG. 2, the cigarette having comprised a cigarette section 20 in which cut tobacco 21 was wrapped with a cigarette wrapper 22, and a filter section 30 in which a filter 31 was wrapped with a forming paper 32. The filter section 30 was mounted on the cigarette section 20 by using a tipping paper 40. It is possible to use, for example, cellulose acetate tow as the material of the filter.

[0021] Incidentally, it is possible to use a plurality of divided plugs of the filter. In this case, the individual filter plugs are wrapped with an individual plug wrap paper, followed by wrapping integrally the filter plugs with a forming paper so as to obtain the filter section 30.

[0022] In testing a cigarette prepared by using a filter for the testing having a basic amino acid or a basic amino acid salt added thereto, a tobacco section was taken out by cutting the acetate filter from a cigarette available on the market, which contained 6 mg of tar, and a sample was prepared by connecting the tobacco section to the filter for the testing. An atomizer was used for adding a basic amino acid or a basic amino acid salt to the filter for the testing. Also, where a basic amino acid or a basic amino acid salt was added to the cut tobacco, the cut tobacco was once taken out of a cigarette available on the market. Then, a basic amino acid or a basic amino acid salt was added to the cut tobacco by using a sprayer, followed by wrapping again the cut tobacco with a cigarette wrapper so as to obtain a tobacco section sample.

[0023] Incidentally, in respect of a tobacco section prepared by cutting away the filter section of a cigarette available on the market, which contained 6 mg of tar, the formaldehyde content in the mainstream smoke of the cigarette was measured by the measuring method described above with the number of puffs set at 7. The formaldehyde content was found to be 110 μg.

Example 1:

[0024] An acetate filter without a plasticizer was prepared as base filter A. Also, a filter for the testing was prepared by adding 35 mg of an aqueous solution containing 10% by weight of arginine to base filter A by using an atomizer, followed by drying the base filter A for 48 hours, the prepared filter containing 3.5 mg of arginine. Likewise, another filter for the testing was prepared by adding 35 mg of an aqueous solution containing 10% by weight of arginine glutamate to base filter A by using an atomizer, followed by drying base filter A for 48 hours, the prepared filter containing 3.5 mg of arginine glutamate.

[0025] Each of the filters thus prepared was connected to the tobacco section noted above, and the formaldehyde content (FA) in the mainstream smoke of the cigarette was measured by the measuring method described above. Table 1 shows the results. As apparent from Table 1, the cigarette using the filter prepared by adding arginine or arginine glutamate to base filter A exhibits a sufficient effect of lowering the formaldehyde content in the mainstream smoke of the cigarette, compared with the cigarette using base filter A.

Table 1

	FA [μg]	filtering rate [%]
base filter A	36.5	66.8
addition of 3.5 mg of arginine	21.9	80.3
addition of 3.5 mg of arginine glutamate	28.3	74.3

Example 2:

[0026] Base filter B was prepared by adding 6% by weight of triacetin as a plasticizer to base filter A. Base filter B is equal to the filter used in the cigarette product. Also, a filter for the testing was prepared by adding 35 mg of an aqueous solution containing 10% by weight of arginine to base filter B, followed by drying base filter B for 48 hours, the prepared filter containing 3.5 mg of arginine. Likewise, another filter for the testing was prepared by adding 35 mg of an aqueous solution containing 10% by weight of arginine glutamate to base filter B, followed by drying base filter B for 48 hours, the prepared filter containing 3.5 mg of arginine glutamate.

[0027] Each of the filters thus prepared was connected to the tobacco section noted above, and the formaldehyde content (FA) in the mainstream smoke of the cigarette was measured by the measuring method described above. Table 2 shows the results. As apparent from Table 2, the cigarette using the filter prepared by adding arginine or arginine glutamate to base filter B having a plasticizer added thereto also exhibits a sufficient effect of lowering the formaldehyde content in the mainstream smoke of the cigarette.

Table 2

	FA [μg]	filtering rate [%]
base filter B	44.0	60.0
addition of 3.5 mg of arginine	21.1	80.8
addition of 3.5 mg of arginine glutamate	34.1	69.0

Example 3:

[0028] Three kinds of filter containing 3.5 mg of arginine, 7.0 mg of arginine and 10.5 mg of arginine, respectively, were prepared by adding 35 mg of an aqueous solution containing 10% by weight of arginine, 35 mg of an aqueous solution containing 20% by weight of arginine, and 35 mg of an aqueous solution containing 30% by weight of arginine, respectively, to base filters B, followed by drying base filters B for 48 hours.

[0029] Each of the filters thus prepared was connected to the tobacco section noted above, and the formaldehyde content (FA) in the mainstream smoke of the cigarette was measured by the measuring method described above. Table 3 shows the results. As apparent from Table 3, the effect of lowering the formaldehyde content in the mainstream smoke of the cigarette is improved with increase in the amount of arginine added to the base filter B, though a sufficient effect can be obtained if 3.5 mg of arginine is added to base filter B.

Table 3

	FA [μg]	filtering rate [%]
base filter B	44.0	60.0
addition of 3.5 mg of arginine	21.1	80.8
addition of 7.0 mg of arginine	25.0	77.3
addition of 10.5 mg of arginine	20.2	81.6

Example 4:

[0030] The following measurement was performed in order to evaluate the effect of lowering the formaldehyde content in the mainstream smoke of the cigarette that is produced by arginine or arginine glutamate in the presence of water.

[0031] Specifically, 35 mg of an aqueous solution containing 10% by weight of arginine or 35 mg of an aqueous solution containing 10% by weight of arginine glutamate was added to base filter A or base filter B as in Example 1 or Example 2, followed by measuring the formaldehyde content (FA) in the mainstream smoke of the cigarette immediately after the addition of the aqueous solution as in Example 1 or Example 2. In each case, the addition amount of arginine or arginine glutamate was 3.5 mg. Table 4 shows the result. As apparent from comparison between Table 4 and Table 1 or Table 2, the effect of lowering the formaldehyde content in the mainstream smoke of the cigarette is increased in the case where arginine or arginine glutamate is present together with water.

Table 4

	FA [μg]	filtering rate [%]
base filter A	36.5	66.8
addition of 35 mg of arginine aqueous solution	14.3	87.0
addition of 35 mg of arginine glutamate aqueous solution	14.9	86.5
base filter B	44.0	60.0
addition of 35 mg of arginine aqueous solution	11.6	89.5
addition of 35 mg of arginine glutamate aqueous solution	17.8	83.8

Example 5:

[0032] An aqueous solution containing 20% by weight of arginine was added in an amount of 20% by weight by spraying to cut tobacco put in a mixing drum by using a hand sprayer, followed by drying the cut tobacco at 80°C for 5 minutes in a dryer. Then, the cut tobacco was conditioned for 48 hours so as to prepare a tobacco section consisting of 690 mg of the cut tobacco and having a length of 59 mm. Cigarette wrapper 4P35 manufactured by Mishima Seishi K.K. was used as the cigarette wrapper. The arginine addition amount was 4% by weight (27.6 mg) based on the amount of cut tobacco. Under this condition, the amount of formaldehyde contained in the mainstream smoke of the cigarette was measured at the outlet of the tobacco section as above without attaching a filter to the tobacco section. On the other hand, the base cut tobacco used for comparison was prepared by adding 20% by weight of water alone

to the cut tobacco by spraying. The amount of formaldehyde contained in the mainstream smoke of the cigarette was also measured as above at the outlet of the tobacco section using the base cut tobacco noted above. Table 5 shows the result. As apparent from Table 5, the formaldehyde content in the mainstream smoke of the cigarette can also be lowered markedly by adding arginine to the cut tobacco.

Table 5

	FA at outlet of tobacco section [μg]	reduction rate [%]
base cut tobacco	121.3	-10.3
addition of 27.6 mg of arginine	23.9	78.3

Example 6:

[0033] A measurement similar to that for Example 4 was performed in order to evaluate the effect of lowering the formaldehyde content produced by various basic amino acids or basic amino acid salts in the presence of water.

[0034] Specifically, a prescribed amount of an aqueous solution containing each of the various basic amino acids or various basic amino acid salts shown in Table 6 was added to base filter B, followed by measuring, as above, the formaldehyde content (FA) in the mainstream smoke of the cigarette immediately after addition of the aqueous solution. In each of these cases, the addition amount of the basic amino acid or the basic amino acid salt was 3.5 mg. Table 6 shows the result. As apparent from Table 6, the basic amino acid or the basic amino acid salt other than arginine also produces the effect of lowering the formaldehyde content in the mainstream smoke of the cigarette.

Table 6

	FA [μg]	filtering rate [%]
base filter B	44.0	60.0
addition of 35 mg of aqueous solution containing 10 wt% of arginine	11.6	89.5
addition of 35 mg of aqueous solution containing 10 wt% of lysine	13.1	88.1
addition of 35 mg of aqueous solution containing 10 wt% of lysine hydrochloride	18.1	83.6
addition of 70 mg of aqueous solution containing 5 wt% of histidine	12.7	88.5
addition of 35 mg of aqueous solution containing 10 wt% of citrulline	17.7	83.9
addition of 35 mg of aqueous solution containing 10 wt% of ornithine	15.7	85.7

Example 7:

[0035] A measurement similar to that for Example 2 was performed in order to evaluate the effect of lowering the formaldehyde content produced by various basic amino acids or basic amino acid salts in the presence of a surfactant.

[0036] Specifically, a prescribed amount of an aqueous solution containing arginine alone or an aqueous solution containing both arginine and each of various surfactants was added to base filter B, as shown in Table 7, followed by conditioning for 48 hours and subsequently measuring the formaldehyde content (FA) in the mainstream smoke and the increase in water content (ΔW). The surfactants used included ionic surfactants of potassium sorbate, sodium oleate and sodium laurate and nonionic surfactants of sucrose laurate, sucrose myristate, sucrose palmitate, and sucrose stearate. Table 7 shows the result. As apparent from Table 7, the effect of lowering the formaldehyde content in the mainstream smoke of the cigarette can be obtained in the case of using a basic amino acid or a basic amino acid salt together with a surfactant even if water is not present together with the basic amino acid or the basic amino acid salt. It is considered reasonable to understand that, in the case of using an aqueous solution containing both arginine and a surfactant, the wettability of the aqueous solution with the filter is improved so as to improve the dispersion capability of arginine.

Table 7

	FA [μg]	filtering rate [%]	ΔW [mg]
base filter B	44.0	60.0	0

Table 7 (continued)

	FA [μg]	filtering rate [%]	ΔW [mg]
addition of 35 mg of aqueous solution containing 10 wt% of arginine	23.2	78.9	2.06
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 20 wt% of potassium sorbate	17.9	83.7	3.35
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 2 wt% of sodium oleate	18.9	82.9	1.49
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 2 wt% of sodium laurate	18.0	83.6	1.71
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 1 wt% of sucrose laurate	20.3	81.6	-
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 1 wt% of sucrose myristate	20.9	81.0	-
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 0.5 wt% of sucrose palmitate	21.4	80.6	-
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 0.5 wt% of sucrose stearate	22.5	79.6	-
addition of 35 mg of aqueous solution containing 10 wt% of arginine and 1 wt% of glycerin fatty acid ester	20.9	81.0	-

Sucrose laurate: available from Mitsubishi-Kagaku Foods Corporation under the trade name of L-1695; Sucrose myristate: available from Mitsubishi-Kagaku Foods Corporation under the trade name of M-1695; Sucrose palmitate: available from Mitsubishi-Kagaku Foods Corporation under the trade name of P-1670; Sucrose stearate: available from Mitsubishi-Kagaku Foods Corporation under the trade name of S-1670; Glycerin fatty acid ester (decaglycerin monolaurate): available from Riken Vitamin under the trade name of Poem J-0021.

[0037] The cigarette filter of the present invention can also be used in the form of a cigarette holder constructed as shown in FIG. 3. As shown in the drawing, the cigarette filter comprises a cylindrical cigarette holder body 41 and a filter 31 arranged within the cigarette holder body 41. A basic amino acid or a basic amino acid salt is contained in the filter 31. The cigarette holder body 41 is formed integral with a mouthpiece section 42. The aldehyde content in the mainstream smoke of the cigarette can also be lowered in the case of using the cigarette filter of the particular construction.

[0038] As described above in detail, using the cigarette and the cigarette filter of the present invention can effectively lower the content of aldehydes in the mainstream smoke of a cigarette.

Claims

1. A cigarette containing a basic amino acid or a basic amino acid salt.

2. A cigarette according to claim 1, **characterized in that** the basic amino acid or the basic amino acid salt is contained in an amount of at least 1 mg/cigarette.

3. A cigarette according to claim 1, **characterized in that** the basic amino acid or the basic amino acid salt is added in the form of an aqueous solution.

4. A cigarette according to claim 1, **characterized in that** the basic amino acid or the basic amino acid salt is selected from the group consisting of arginine, arginine salt, lysine, lysine salt, histidine, histidine salt, ornithine, ornithine salt, citrulline, citrulline salt, hydroxyzine and hydroxyzine salt.

5. A cigarette according to any one of claims 1 to 4, further containing a surfactant.

6. A cigarette filter containing a basic amino acid or a basic amino acid salt.

7. A cigarette filter according to claim 6, **characterized in that** the basic amino acid or the basic amino acid salt is contained in an amount of at least 1 mg/cigarette.

8. A cigarette filter according to claim 6, **characterized in that** the basic amino acid or the basic amino acid salt is added in the form of an aqueous solution.

9. A cigarette filter according to claim 6, **characterized in that** the basic amino acid or the basic amino acid salt is selected from the group consisting of arginine, arginine salt, lysine, lysine salt, histidine, histidine salt, ornithine, ornithine salt, citrulline, citrulline salt, hydroxyzine and hydroxyzine salt.

10. A cigarette filter according to any one of claims 6 to 9, further containing a surfactant.

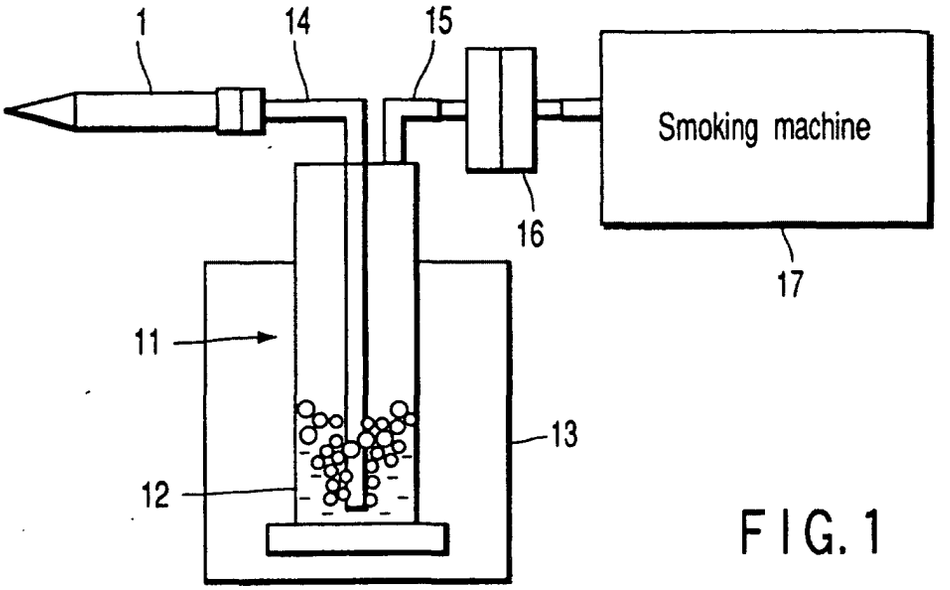

FIG. 1

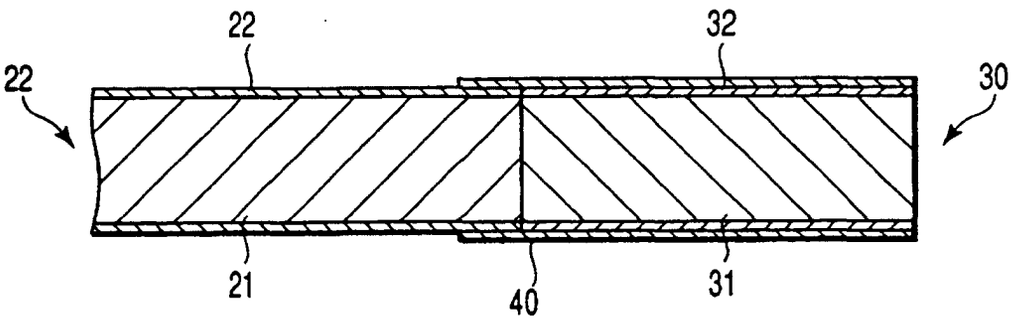

FIG. 2

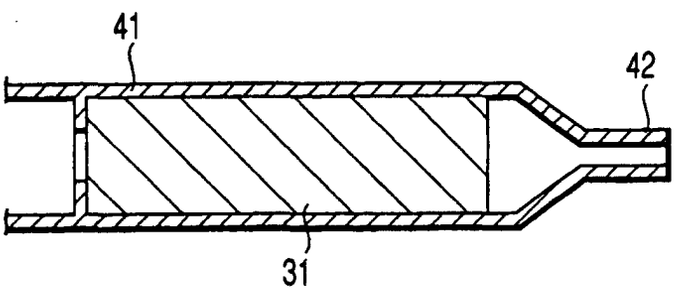

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/00040

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] A24B15/32, A24D3/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] A24B3/12, 15/00, A24D3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 62-232371 A (Mitsui Toatsu Chemicals, Inc.), 12 October, 1987 (12.10.87), Page 2, upper right column; page 3, upper right column (Family: none)	6-9 1-5,10
Y	JP 2001-516771 A (Thione International, Inc.), 02 October, 2001 (02.10.01), Par. Nos. [0001], [0037] & US 5829449 A & WO 99/15035 A	1-5,10
A	JP 3-4766 A (T. Hasegawa Co., Ltd.), 10 January, 1991 (10.01.91), Page 2, lower left column (Family: none)	1,3-4

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
30 January, 2003 (30.01.03)	12 February, 2003 (12.02.03)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/00040

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-514888 A (Lesser, Graig), 21 December, 1999 (21.12.99), Page 18 & US 5501238 A & WO 98/15197 A	10
A	JP 62-14774 A (Mitsuo NAKAJIMA), 23 January, 1987 (23.01.87), Page 2, upper left column (Family: none)	5,10

Form PCT/ISA/210 (continuation of second sheet) (July 1998)