(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 229 827 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:
22.09.2010 Bulletin 2010/38

(21) Application number: **08861079.5**

(22) Date of filing: **04.12.2008**

(51) Int Cl.:
A24D 1/02 *(2006.01)* ***A24D 3/02*** *(2006.01)*
A24D 3/16 *(2006.01)* ***D21H 27/00*** *(2006.01)*

(86) International application number:
PCT/JP2008/072074

(87) International publication number:
WO 2009/078287 (25.06.2009 Gazette 2009/26)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(30) Priority: **14.12.2007 JP 2007323802**

(71) Applicant: **Japan Tobacco Inc.**
Tokyo 105-8422 (JP)

(72) Inventors:
- **TARORA, Masafumi**
  Tokyo 130-8603 (JP)
- **TORII, Atsusi**
  Tokyo 130-8603 (JP)
- **TSUJIMOTO, Toru**
  Tokyo 130-8603 (JP)

(74) Representative: **Peckmann, Ralf**
Reinhard, Skuhra, Weise & Partner GbR
Patent- und Rechtsanwälte
Friedrichstrasse 31
80801 München (DE)

(54) CIGARETTE FILTER, AND FILTER CIGARETTE

(57) A single-segment filter having a filter plug uses a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater as a filter plug wrapper wrapping a filter material, and a multisegment filter having a plurality of filter plugs uses the high-rigidity and high-permeability paper as a filter plug wrapper wrapping a filter material and/or a shaping paper joining plurality of filter plugs. A cigarette comprises the particular filter.

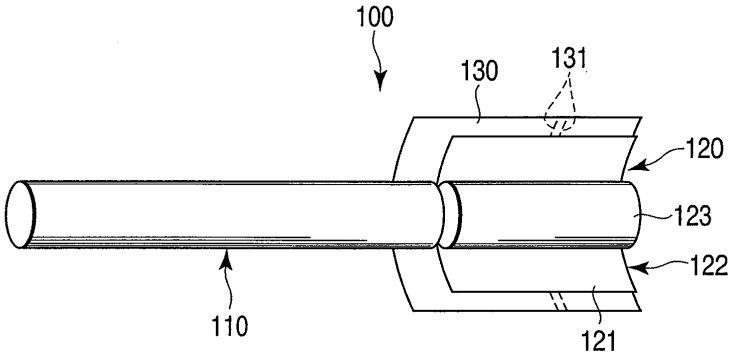

FIG. 1

EP 2 229 827 A1

Description

Technical Field

[0001] The present invention relates to a cigarette filter and a filter-tipped cigarette.

Background Art

[0002] Filter-tipped cigarettes are developed and marketed to, for example, milden the smoking taste. The filter-tipped cigarette comprise a cigarette main body formed of a tobacco filler rod, such as one comprising cut tobacco having the circumference thereof wrapped with a cigarette paper, and a filter fitted to one end of the cigarette main body. The filter has at least one filter plug. In the filter plug, a filter material is disposed in a cylindrical body formed of a wrapper (filter plug wrapper) shaped into a cylindrical configuration (generally the configuration of a circular cylinder). The filter is fitted to one end of the cigarette main body by means of a tipping paper.

[0003] The filter hardness of the filter-tipped cigarette is a parameter for the choice of cigarette by smokers. Most of now commercially available filter-tipped cigarettes use a cellulose acetate fiber bundle (tow) as a filter material (hereinafter also referred to as cellulose acetate filter). As satisfactory filter hardness cannot be obtained by the cellulose acetate fiber alone, a plasticizer (for example, triacetin) is mixed therein so as to impart hardness to the filter. It is known that the amount of triacetin added to the cellulose acetate filter of now commercially available filter-tipped cigarettes is in the range of 5 to 10% by weight based on the amount of cellulose acetate.

[0004] Some smokers are satisfied with the current filter hardness imparted by the addition of the above amount of triacetin, but some smokers like harder filters.

[0005] It is known that with respect to the cellulose acetate filter, the hardness thereof can be increased by increasing the amount of plasticizer added.

[0006] However, when the amount of triacetin added is increased to a certain extent or over, the triacetin is hydrolyzed to thereby generate acetic acid. Thus, there would occur the problem that the interior of the cigarette package is filled with the odor of acetic acid. Further, when a charcoal filter is employed, there would occur the problem that triacetin is adsorbed on the charcoal with the result that the function of the charcoal (adsorption of smoke components) cannot be fully exerted.

[0007] With respect to the filter-tipped cigarettes, it is desired for the ventilation ratio thereof to be high in order to permit the inflow of ambient air for higher dilution of mainstream smoke.

[0008] A cigarette filter of high ventilation ratio, known as a recessed cigarette filter, is disclosed in the pamphlet of International Publication WO 00/00047. This cigarette filter comprises, for example, two filter plugs both wrapped with a porous or nonporous filter plug wrapper, the two filter plugs joined to each other by means of a nonporous shaping paper. This filter is fitted to a tobacco rod by means of a tipping paper. In order to achieve a high ventilation ratio, the filter plug wrapper and the shaping paper are provided with mechanically perforated relatively large ventilation holes, and the tipping paper is provided with a relatively small ventilation hole perforated by laser. The ventilation holes would cause such problems that the cigarette manufacturing cost is increased, the versatility to a variety of cigarette products, including a low-tar cigarette or the like, is lowered, and the stability of product quality is poor. These problems are also pointed out for Jpn. PCT National Publication No. 2004-516814 disclosing a similar recessed filter.

[0009] In the pamphlet of International Publication WO 00/00047 and Jpn. PCT National Publication No. 2004-516814, there is no direct mention of the filter hardness.

Disclosure of Invention

[0010] It is an object of the present invention to provide a cigarette filter that can achieve satisfactory hardness and ventilation ratio even when the filter plug wrapper and shaping paper are not furnished with any ventilation hole and even when any hardness increasing agent is not used therein, and to provide a cigarette comprising such a cigarette filter.

[0011] According to a first aspect of the present invention, there is provided a cigarette filter comprising: a filter plug comprising a cylindrical body of a filter plug wrapper which is cylindrically shaped and a filter material disposed in the cylindrical body, **characterized in that** the filter plug wrapper is formed of a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

[0012] According to a second aspect of the present invention, there is provided a cigarette filter comprising: a plurality of filter plugs comprising a most upstream filter plug and a most downstream filter plug, each comprising a cylindrical body of a filter plug wrapper which is cylindrically shaped and a filter material disposed in the cylindrical body, and a shaping paper configured to wrap the circumference of the plurality of filter plugs and join the plurality of filter plugs to each other, **characterized in that** the filter plug wrapper of at least one of the plurality of filter plugs is formed of a high-

rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

[0013] According to a third aspect of the present invention, there is provided a cigarette filter comprising a plurality of filter plugs comprising a most upstream filter plug and a most downstream filter plug, each comprising a cylindrical body of filter plug wrapper which is cylindrically shaped, a filter material disposed in the cylindrical body, and a shaping paper configured to wrap the circumference of the plurality of filter plugs and join the plurality of filter plugs to each other, **characterized in that** the shaping paper is formed of a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

[0014] Further, according to a fourth aspect of the present invention, there is provided a filter-tipped cigarette comprising a cigarette main body comprising a tobacco rod wrapped with a cigarette paper and a cigarette filter fitted to one end of the cigarette main body, **characterized in that** the cigarette filter is formed of the cigarette filter of the present invention.

Brief Description of Drawings

[0015]

FIG. 1 is a partially developed schematic perspective view of a filter-tipped cigarette provided with a single-segment filter according to an embodiment of the present invention.

FIG. 2 is a partially developed schematic perspective view of a filter-tipped cigarette provided with a multisegment filter according to an embodiment of the present invention.

FIG. 3 is a partially developed schematic perspective view of a filter-tipped cigarette provided with a recessed single-segment filter according to an embodiment of the present invention.

FIG. 4 is a graph showing the hardness of each of cellulose acetate filter plugs according to embodiments of the present invention together with that of the conventional cellulose acetate filter plug.

FIG. 5 is a graph showing changes of the hardness of a cellulose acetate filter plug according to an embodiment of the present invention together with that of the conventional cellulose acetate filter plug brought about by changing the amount of triacetin added.

FIG. 6 is a graph showing the hardness of each of paper filter plugs according to embodiments of the present invention together with that of the conventional paper filter plug.

FIG. 7 is a graph showing changes with time of the menthol existence ratios in the cut tobacco and filter material with respect to a cellulose acetate filter.

FIG. 8 is a graph showing changes with time of the menthol existence ratios in the cut tobacco and filter material with respect to a paper filter.

FIG. 9 is a graph showing changes with time of menthol delivery into cigarette mainstream smoke with respect to each of a cigarette with a cellulose acetate filter and a cigarette with a paper filter.

Best Mode for Carrying Out the Invention

[0016] The cigarette filter of the present invention encompasses a so-called single-segment filter formed of a single filter plug and a so-called multisegment filter comprising a plurality of filter plugs including a most upstream filter plug and a most downstream filter plug. In either case, each of the filter plugs includes a cylindrical body, generally in the form of a circular cylinder, of filter plug wrapper which is cylindrically shaped and a filter material disposed in the cylindrical body. Illustratively, the filter plug includes a filter material rolled up (wrapped) with a filter plug wrapper. In the multisegment filter, the plurality of filter plugs are wrapped with a shaping paper so as to be joined to each other. In the present invention, the expressions "upstream" and "downstream" are based on the direction of flow of tobacco mainstream smoke passing through the interior of a cigarette.

[0017] In the present invention, the filter plug wrapper of the single-segment filter is formed of a specified high-rigidity and high-permeability paper. Also, in the multisegment filter of the present invention, the filter plug wrapper of at least one filter plug and/or the shaping paper is formed of a specified high-rigidity and high-permeability paper.

[0018] The high-rigidity and high-permeability paper for use in the present invention has a longitudinal rigidity (stiffness in the longitudinal direction) of paper of 30 or higher as measured in accordance with JIS P8143 (method of testing the stiffness of paper by self-weight bending) and an air permeability of 1000 CORESTA units or greater. Preferably, the high-rigidity and high-permeability paper has a longitudinal rigidity of 30 to 400 and an air permeability of 1000 to 30,000 CORESTA units.

[0019] Examples of high-rigidity and high-permeability papers for use in the present invention (represented by symbols S1 to S4) are given in Table 1. Table 1 also includes a now generally employed porous filter plug wrapper of high air permeability (conventional filter plug wrapper, represented by symbol P).

Table 1

Type of paper	Conventional filter plug wrapper	High-rigidity and high-permeability paper			
Paper symbol	P	S1	S2	S3	S4
Longitudinal rigidity (L^3/100)	12.6 - 14.4	350	108	64	60
Air permeability (CORESTA unit)	10000	2140	4080	7040	12670
Basis wt. (g/m^2)	26.5	116	68	51	48
Thickness (μm)	65	222	140	115	113

[0020] The case where cellulose acetate fiber tow is used as a filter material will be described. As aforementioned, it is of common practice to add a plasticizer, such as triacetin, to a filter in an amount corresponding to 5 to 10% by weight based on the weight of cellulose acetate fiber in order to impart a given hardness to the filter. However, when the high-rigidity and high-permeability paper according to the present invention is employed, the same filter hardness as heretofore can be achieved even by the addition of plasticizer in an amount corresponding to less than 5% (including 0%) based on the weight of cellulose acetate fiber. Needless to state, when the plasticizer is added to the cellulose acetate fiber in the same amount corresponding to 5 to 10% based on the weight thereof as heretofore, the hardness over the conventional filter can be achieved.

[0021] From the finding to now, it is understood that the addition of triacetin in an amount of over 12% by weight will dissolve the cellulose acetate fiber and will invite the problem of the occurrence of acetic acid odor attributed to the decomposition of triacetin. Accordingly, the upper-limit value of the conventional filter hardness achieved without the occurrence of these problems is the hardness corresponding to the addition of 12% by weight triacetin. However, when the high-rigidity and high-permeability paper according to the present invention is employed, the addition of 12% by weight triacetin can achieve hardness over the conventional upper-limit value. That is, the present invention can be applied to the cellulose acetate filter having triacetin added in an amount of over 10% by weight but not exceeding 12% by weight.

[0022] The filter material of the cigarette filter of the present invention is not limited to a cellulose acetate fiber. For example, it is known in the art to use a filter obtained by shaping a nonwoven fabric and a filter (paper filter) obtained by shaping a paper (having undergone creping treatment) which are free of hardness increasing agents (agents leading to an increase of filter hardness), for example, a hardener inclusive of a plasticizer, such as triacetin, and binders added to bind the filter material together (for example, polyvinyl alcohol, polyvinyl acetate, polyethylene glycol, dimethyl phthalate, diethyl phthalate and the like). These filter materials can also be used in the present invention.

[0023] It has been difficult for the filter material free of any hardness increasing agent to achieve the filter hardness equivalent to that of the cellulose acetate filter having triacetin mixed therein. However, the filter hardness equivalent to or higher than that of the cellulose acetate filter having triacetin mixed therein can be achieved by the employment of the high-rigidity and high-permeability paper according to the present invention.

[0024] The filter including the filter material free of any hardness increasing agent exerts an additional advantage when it is used in a filter-tipped cigarette having any of flavors (for example, menthol, limonene, peppermint oil or spearmint oil; an ester such as ethyl acetate, ethyl butyrate or ethyl benzoate; an alcohol such as linalool, nerol or geraniol; a phenol such as anethole; an aldehydes such as cinnamaldehyde or vanillin; a lactone and a pyrazine), together with triacetin, sorbed in the cellulose acetate fiber.

[0025] For example, in the current menthol cigarette, menthol is mixed in cut tobacco, and a cellulose acetate filter containing triacetin is fitted thereto. However, in the current cellulose acetate filter, the menthol contained in the cigarette together with triacetin is sorbed in the cellulose acetate fiber with time. The menthol sorbed in the cellulose acetate fiber does not migrate into the mainstream smoke during smoking. Accordingly, it is known that even when menthol is present in the cigarette, the menthol delivery into the mainstream smoke is decreased with time in accordance with the sorption of menthol in the filter. In contrast, in the filter material, such as a paper filter, free of any plasticizer, hardener or binder, the sorption of menthol in the filter with time does not occur as different from the cellulose acetate filter containing a plasticizer, and menthol remains in the cut tobacco. Therefore, even when the amount of menthol in the cigarette is the same, the amount of menthol delivered from the cut tobacco during smoking is greater to thereby ensure a menthol delivery higher than in the use of the cellulose acetate filter containing triacetin. In addition, as the sorption of menthol in the filter is avoided, the menthol delivery into the mainstream smoke during smoking is stable with time. Similar effects can be exerted when a flavor, such as menthol, is added to the filter per se, or when it is added to an aluminum-laminated paper within a cigarette package. Moreover, these effects can be exerted when even in the use of a cellulose acetate fiber, the addition amount of triacetin causing the sorption is decreased, or when a substance less likely to invite the

sorption than triacetin (for example, polyvinyl alcohol, polyvinyl acetate, polyethylene glycol, an epoxy resin or the like) is used as the hardness increasing agent.

[0026] Needless to state, in the multisegment filter, a filter plug formed of a filter material not containing any hardness increasing agent can be combined with a filter plug formed of a cellulose acetate fiber.

[0027] Further, the filter of the present invention can include a filter plug having activated charcoal particles (charcoal) added thereto. In the single-segment filter, activated charcoal particles can be mixed in a single filter plug. In the multisegment filter, generally, activated charcoal particles are added to a filter plug upstream of the most downstream filter plug.

[0028] Still further, the filter of the present invention can have the structure of a recessed filter as described in the pamphlet of International Publication WO 00/00047 and Jpn. PCT National Publication No. 2004-516814. Illustratively, in that case, when use is formed of a single-segment filter, the cylindrical body of the single filter plug is extended out of the downstream end face of the filter material so as to provide a recess portion. When use is formed of a multisegment filter, the shaping paper is extended out of the downstream end face of the most downstream filter plug so as to provide a recess portion.

[0029] The present invention will be described below with reference to the drawings. Like elements are identified by like reference numerals through all the drawings.

[0030] FIG. 1 is a partially developed schematic perspective view of a filter-tipped cigarette 100 provided with a single-segment filter.

[0031] The filter-tipped cigarette 100 includes a cigarette main body 110 and a filter plug 120 provided at one end of the cigarette main body 110. The cigarette main body 110 is identical to conventional cigarettes and includes a tobacco rod and a cigarette paper with which the circumference of the tobacco rod is wrapped, both not shown. The tobacco rod is formed of a tobacco filler, such as cut tobacco. The filter plug 120 includes a cylindrical body 122 of filter plug wrapper which is cylindrically shaped 121 and a filter material 123 disposed in the cylindrical body 122. The cigarette main body 110 and the filter plug 120 are joined to each other by means of a tipping paper 130 so that the end faces thereof unite with each other in the same fashion as in conventional filter-tipped cigarettes. The tipping paper 130 can be provided with ventilation holes 131.

[0032] In the filter-tipped cigarette shown in FIG. 1, the high-rigidity and high-permeability paper according to the present invention is used as the filter plug wrapper 121.

[0033] FIG. 2 is a partially developed schematic perspective view of a filter-tipped cigarette 200 provided with a two-segment filter as an example of the multisegment filter.

[0034] In the filter-tipped cigarette 200, a two-segment filter 210 is fitted to one end of a cigarette main body 110. The two-segment filter 210 includes two filter plugs 220 and 230. The upstream filter plug 220 includes a cylindrical body 222 of filter plug wrapper which is cylindrically shaped 221 and a filter material 223 disposed in the cylindrical body 222. Likewise, the downstream filter plug 230 includes a cylindrical body 232 of filter plug wrapper which is cylindrically shaped 231 and a filter material 233 disposed in the cylindrical body 232. The two filter plugs 220 and 230 are joined to each other by means of a shaping paper 240 so that the end faces thereof unite with each other. The cigarette main body 110 and the two-segment filter 210 are joined to each other by means of a tipping paper 130 so that the end faces thereof unite with each other in the same fashion as in conventional filter-tipped cigarettes.

[0035] In the filter-tipped cigarette shown in FIG. 2, either or both of the filter plug wrappers 221 and 231 can be formed of the high-rigidity and high-permeability paper according to the present invention.

[0036] As most smokers generally put the downstream filter plug 230 in the mouth, the filter hardness is often felt by the lips. Therefore, when the filter plug wrapper 231 of the downstream filter plug 230 is formed of the high-rigidity and high-permeability paper according to the present invention, even if the filter plug wrappers of other filter plugs are not formed of the high-rigidity and high-permeability paper, the smokers can feel the retention or increase of the filter hardness. Further, the smokers hold the cigarette with their fingers during smoking, so that the filter hardness may be felt by the fingers. In that case, it is desirable to use the high-rigidity and high-permeability paper according to the present invention in the filter plug wrapper 221 of the upstream filter plug 220 near the cut tobacco. Needless to state, when the high-rigidity and high-permeability paper according to the present invention is used in both the filter plug wrappers 221 and 231, the filter hardness can be simultaneously felt by the lips and fingers. Moreover, when it is intended to retain or increase the hardness of the whole of the filter with respect to the cigarette provided with the multisegment filter, the intention can be achieved by using the high-rigidity and high-permeability paper according to the present invention in the filter shaping paper 240 of the multisegment filter. In that case, both the filter plug wrappers 221 and 231 may be formed of any of conventional filter plug wrappers (rigidity (stiffness): 10 to 15, air permeability: 70 to 30,000 CORESTA units, thickness: 30 to 80 μm, and basis weight: 15 to 27 g/m^2). When it is intended to further increase the filter hardness, the intention can be achieved by not only using the high-rigidity and high-permeability paper in the filter plug wrapper 221 and/or 231 but also using the high-rigidity and high-permeability paper according to the present invention in the shaping paper 240 as well, namely, implementing the double application of the high-rigidity and high-permeability paper.

[0037] FIG. 3 is a partially developed schematic perspective view of a filter-tipped cigarette 300 provided with a recessed single-segment filter.

[0038] The cigarette 300 provided with a recessed filter includes a cigarette main body 110 and a filter plug 320 provided at one end of the cigarette main body 110. The filter plug 320 includes a cylindrical body 322 of filter plug wrapper which is cylindrically shaped 321 and a filter material 323 disposed in the cylindrical body 322. The cylindrical body 122 is extended out of the downstream end face of the filter material 323 so as to provide a recess portion 324. The cigarette main body 110 and the filter plug 320 are joined to each other by means of a tipping paper 130 so that the end faces thereof unite with each other in the same fashion as in conventional filter-tipped cigarettes. The tipping paper 130 can be provided with ventilation holes 131.

[0039] In the filter-tipped cigarette shown in FIG. 3, the high-rigidity and high-permeability paper according to the present invention is used as the filter plug wrapper 321.

EXAMPLE

[0040] The present invention will be described below with reference to the following Examples.

Example 1

[0041] Filter plugs were produced in accordance with the routine procedure using the papers indicated in Table 1 above as filter plug wrappers. The employed filter material consisted of a conventional cellulose acetate fiber tow having triacetin added thereto in an amount corresponding to 6% by weight based on the weight of the cellulose acetate fiber tow. Each of the filter plugs had a circumference of 24.5 mm and a length of 25 mm. Each of the filter plug wrappers covered the circumference of the filter material in just proportion. The hardness of each of the obtained filters was measured.

[0042] In nature, the hardness of each of the filters should be measured in the condition of the filter fitted to the cigarette. However, due to problems relating to measuring instruments, it is difficult to measure the hardness of each of the filters in the condition of the filter fitted to the cigarette. Therefore, the hardness of each of the filters was measured in the form of a filter plug before being fitted to the cigarette (hereinafter, the filter hardness was measured by the same measuring method).

[0043] The filter hardness was measured using NFQA (filter quality measuring instrument) manufactured by JT TOSHI. The results are shown in FIG. 4. The filter hardness was calculated from a strain occurring on the filter upon the application of a given load. Accordingly, the less the strain, the greater the filter hardness is. Thus, in FIG. 4, the less the value of filter hardness, the harder the filter is.

[0044] It is apparent from FIG. 4 that the filter hardness of each of the filter plugs provided with the high-rigidity and high-permeability papers S1 to S4 according to the present invention is increased over that of the filter plug provided with the now usually employed filter plug wrapper P. All the filter plugs provided with the high-rigidity and high-permeability papers S1 to S4 according to the present invention exhibited an air permeability of 1000 CORESTA units or higher. Further, the high-rigidity paper S4 exhibiting an air permeability equivalent to that of the now usually employed filter plug wrapper P could be available.

[0045] Therefore, using the high-rigidity and high-permeability paper according to the present invention makes it feasible to not only achieve the retention or increase of the filter hardness but also avoid the problems of the prior art of making ventilation holes, namely, an increase of cigarette manufacturing cost, a low versatility to a variety of cigarette products including a low-tar cigarette or the like and a poor stability of product quality.

Example 2

[0046] Filter plugs with the same size as in Example 1 were produced using the conventional filter plug wrapper P and high-rigidity and high-permeability paper S4 indicated in Table 1. The filter material was the same conventional cellulose acetate fiber tow as in Example 1, but the amount of triacetin added to the tow was changed (amounts equivalent to 0 to 12% by weight based on the weight of cellulose acetate fiber). The hardness of each of the obtained filter plugs was measured in the same manner as in Example 1. The results are shown in FIG. 5. In FIG. 5, the line a indicates the results of the use of the filter plug wrapper P, and the line b indicates the results of the use of the high-rigidity and high-permeability paper S4.

[0047] It is apparent from FIG. 5 that when the high-rigidity and high-permeability paper S4 is used, regardless of the amount of triacetin added, the filter hardness is increased over that of the filter plug using the conventional filter plug wrapper P.

[0048] As aforementioned, in the current cigarettes, triacetin is added to the filter in an amount of 5 to 10% by weight based on the weight of the filter material. However, it is seen that when the high-rigidity and high-permeability paper S4 is used, the filter hardness can be increased without the need to increase the amount of triacetin.

[0049] In the instances where the amount of triacetin is less, it is found that the filter hardness exhibited when the

conventional filter plug wrapper P is used and the amount of triacetin is about 6% by weight can be achieved by the use of triacetin in an amount of about 3% by weight when the high-rigidity and high-permeability paper S4 is used. Therefore, even when the amount of triacetin is less, the hardness equivalent to that of the current filter can be achieved by the use of the high-rigidity and high-permeability paper S4.

Example 3

[0050] So-called paper filter plugs were produced using the papers indicated in Table 1. The filter material used was a creped pulp paper. The configuration of each of the obtained filter plugs was the same as in Example 1. All the filter plugs exhibited an air-flow resistance of 350 mmH_2O/120mm. The hardness of each of the obtained filter plugs was measured in the same manner as in Example 1. The results are shown in FIG. 6.

[0051] It is apparent from FIG. 6 that the paper filter plugs wrapped with the high-rigidity and high-permeability papers according to the present invention exhibit the same satisfactorily increased hardness values as those of the cellulose acetate filter plugs of Example 1 wrapped with the high-rigidity and high-permeability papers according to the present invention. Further, an increase of filter hardness up to the level equivalent to the filter hardness exhibited by the cellulose acetate filter having triacetin added in an amount of 6% by weight can be achieved by the application of the present invention.

Example 4

[0052] Filter-tipped cigarettes were produced by fitting each of the cellulose acetate filter plug produced using the conventional filter plug wrapper P in Example 1 and the paper filter plug produced using the high-rigidity and high-permeability paper S4 in Example 3 to a cigarette main body by means of a tipping paper. Menthol was added in an amount of 3.0 mg per cigarette to the cut tobacco of the cigarette main body. The obtained filter-tipped cigarettes were stored in an atmosphere conditioned at 22°C and a relative humidity of 60% from immediately after the completion of the production up to 12 weeks. The existence ratio of menthol in the cut tobacco and filter material during the storage period was measured by the method to be described below. The results are shown in FIG. 7 and FIG. 8. FIG. 7 shows the results with respect to the cellulose acetate filter plug. FIG. 8 shows the results with respect to the paper filter plug. In

[0053] FIG. 7 and FIG. 8, each of the shaded portions indicates the ratio of menthol in the filter material, and each of the blank portions indicates the ratio of menthol in the cut tobacco.

[0054] With respect to both the filter-tipped cigarettes during the above storage period, the menthol delivery into mainstream smoke (menthol/tar ratio (M/T ratio)) was measured by the method to be described below. The results are shown in FIG. 9. In FIG. 9, the line a indicates the results with respect to the cigarette with paper filter, and the line b indicates the results with respect to the cigarette with cellulose acetate filter.

<Method of measuring the amount of menthol in cut tobacco and filter material>

[0055] Each of the cigarettes was divided into a cut tobacco portion (including the cigarette paper) and a filter portion.

[0056] Thereafter, the cut tobacco portion was put in methanol, shaken at room temperature for 40 minutes and allowed to stand still for 24 hours. The mixture was shaken once more for 40 minutes, and the supernatant was separated as a menthol extract.

[0057] On the other hand, the filter portion was put in methanol, shaken at room temperature for 40 minutes and allowed to stand still for 24 hours. The supernatant was separated as a menthol extract.

[0058] The thus obtained menthol extracts were analyzed by a gas chromatograph equipped with a hydrogen flame ionization detector (FID) as a detector. The quantity of menthol was determined by an internal standard method. As the internal standard, 1,3-butanediol was used.

<Method of measuring menthol/tar ratio>

[0059] The tar contained in tobacco mainstream smoke was measured in accordance with ISO 3308 and 4387.

[0060] With respect to the menthol contained in tobacco mainstream smoke, in accordance with ISO 4387, the mainstream smoke was trapped in a Cambridge filter, and the Cambridge filter was put in methanol and shaken at room temperature for 40 minutes. The supernatant was separated as a menthol extract. The thus obtained menthol extract was analyzed by a gas chromatograph equipped with FID as a detector. The quantity of menthol was determined by an internal standard method. As the internal standard, 1,3-butanediol was used.

[0061] The menthol/tar ratio (M/T ratio) was calculated from the values of the amounts of tar and menthol in mainstream smoke determined by the above methods.

[0062] The obtained results attest to the migration of menthol from the cut tobacco portion to the filter portion when

the cellulose acetate filter is used. Consequently, it is apparent that the menthol delivery is lowered with time. In contrast, when the paper filter is used, menthol does not migrate into the filter and remains in the cut tobacco. As a result, as compared with the use of the cellulose acetate filter, not only is the menthol delivery stabilized with time but also a high menthol delivery can be achieved.

[0063] As apparent from the above, the application of the present invention makes it feasible to achieve a menthol cigarette that while retaining its filter hardness, exhibits a high M/T ratio, namely, a high menthol delivery even when a paper containing no hardness increasing agent is used as the filter material.

Claims

1. A cigarette filter comprising: a filter plug comprising a cylindrical body of a filter plug wrapper which is cylindrically shaped and a filter material disposed in the cylindrical body, **characterized in that** the filter plug wrapper is formed of a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

2. The cigarette filter according to claim 1, **characterized in that** the filter plug contains activated charcoal particles.

3. A cigarette filter comprising: a plurality of filter plugs comprising a most upstream filter plug and a most downstream filter plug, each comprising a cylindrical body of a filter plug wrapper which is cylindrically shaped and a filter material disposed in the cylindrical body, and a shaping paper configured to wrap the circumference of the plurality of filter plugs and join the plurality of filter plugs to each other, **characterized in that** the filter plug wrapper of at least one of the plurality of filter plugs is formed of a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

4. The cigarette filter according to claim 3, **characterized in that** the shaping paper is formed of the high-rigidity and high-permeability paper.

5. A cigarette filter comprising a plurality of filter plugs comprising a most upstream filter plug and a most downstream filter plug, each comprising a cylindrical body of filter plug wrapper which is cylindrically shaped, and a filter material disposed in the cylindrical body, and a shaping paper configured to wrap the circumference of the plurality of filter plugs and join the plurality of filter plugs to each other, **characterized in that** the shaping paper is formed of a high-rigidity and high-permeability paper longitudinal rigidity of which is 30 or higher as measured in accordance with JIS P8143 and air permeability of which is 1000 CORESTA units or greater.

6. The cigarette filter according to claim 3, **characterized in that** a filter plug disposed upstream of the most downstream filter plug contains activated charcoal particles.

7. The cigarette filter according to claim 1, **characterized in that** the longitudinal rigidity of the high-rigidity and high-permeability paper is in the range of 30 to 400 and the air permeability of the paper is in the range of 1000 to 30,000 CORESTA units.

8. The cigarette filter according to claim 1,
wherein the filter material of the filter plug having the high-rigidity and high-permeability paper is formed of cellulose acetate fiber tow in which a plasticizer is mixed in a ratio of 0% to less than 5% based on the weight of the fiber tow.

9. The cigarette filter according to claim 1, wherein the filter material of the filter plug having the high-rigidity and high-permeability paper is formed of cellulose acetate fiber tow in which a plasticizer is mixed in a ratio of 5 to 10% based on the weight of the fiber tow.

10. The cigarette filter according to claim 1, wherein the filter material of the filter plug having the high-rigidity and high-permeability paper is formed of cellulose acetate fiber tow in which a plasticizer is mixed in a ratio of more than 10% but 12% or less based on the weight of the fiber tow.

11. The cigarette filter according to claim 1, wherein the filter material does not contain any hardness increasing agent.

12. The cigarette filter according to claim 11, **characterized in that** the filter material contains a paper.

13. The cigarette filter according to claim 1, **characterized by** further comprising a flavor.

14. The cigarette filter according to claim 13, wherein the flavor contains menthol.

15. The cigarette filter according to claim 1, **characterized in that** the cylindrical body is extended out of the downstream end face of the filter material so as to provide a recess portion.

16. The cigarette filter according to claim 3, **characterized in that** the shaping paper is extended out of the downstream end face of the most downstream filter plug so as to provide a recess portion.

17. A filter-tipped cigarette comprising a cigarette main body comprising a tobacco rod wrapped with a cigarette paper and a cigarette filter fitted to one end of the cigarette main body, **characterized in that** the cigarette filter is formed of the cigarette filter of claim 1.

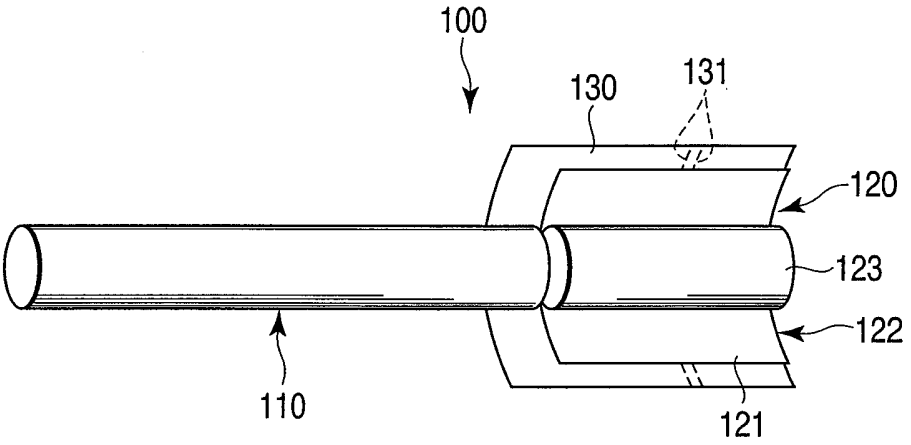
100
130
131
120
123
122
110
121

FIG. 1

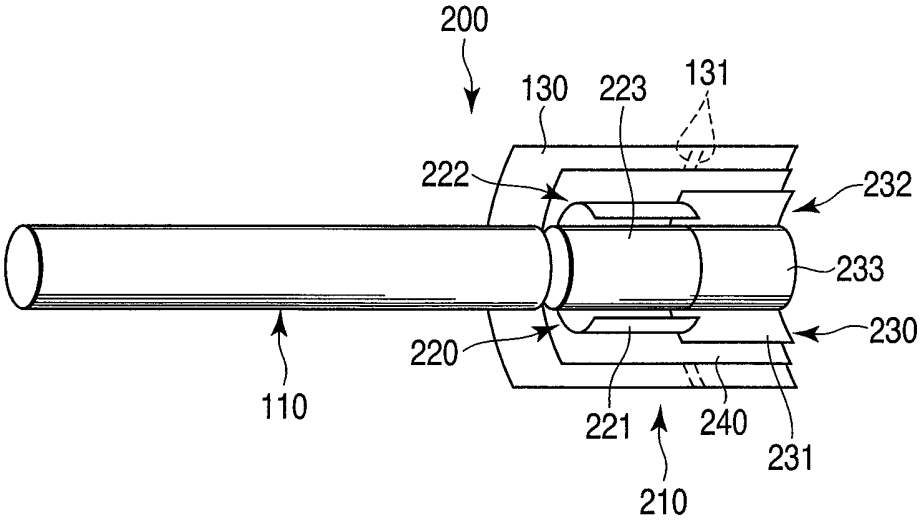
200
130
223
131
222
232
233
230
220
110
221
240
231
210

FIG. 2

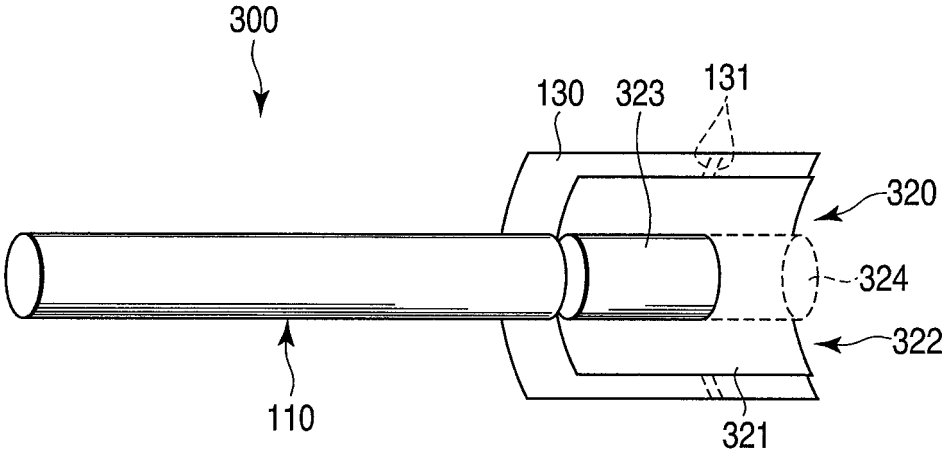

FIG. 3

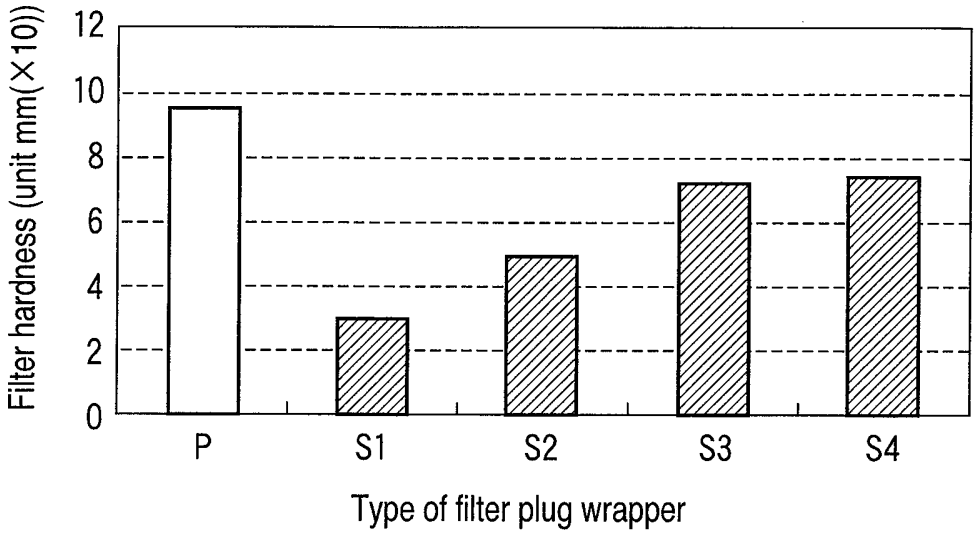
Filter hardness (unit mm(×10))
12
10
8
6
4
2
0
P
S1
S2
S3
S4
Type of filter plug wrapper

FIG. 4

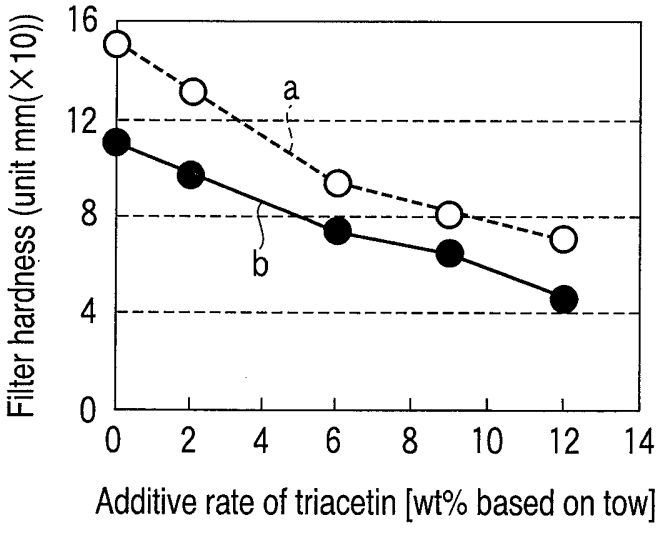
Filter hardness (unit mm(×10))
16
12
8
4
0
a
b
0
2
4
6
8
10
12
14
Additive rate of triacetin [wt% based on tow]

FIG. 5

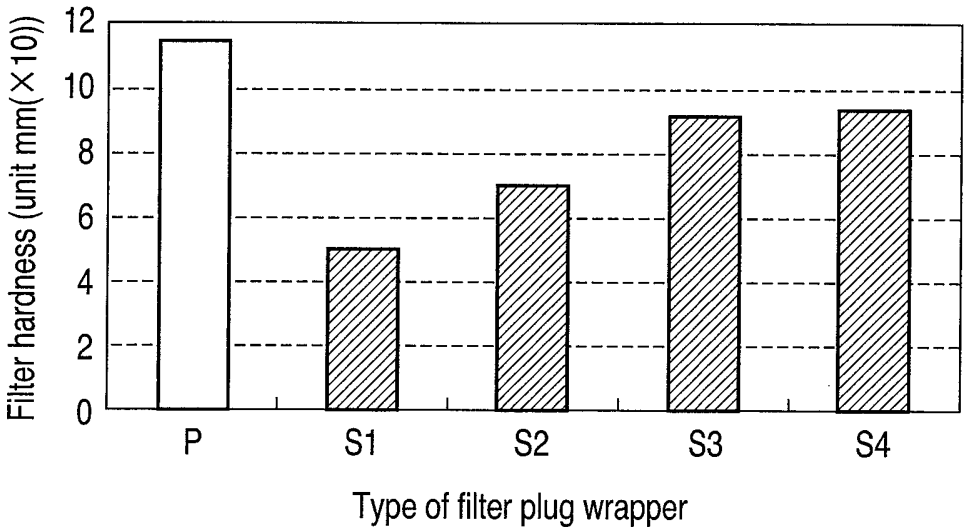
Filter hardness (unit mm(×10))
12
10
8
6
4
2
0
P
S1
S2
S3
S4
Type of filter plug wrapper

FIG. 6

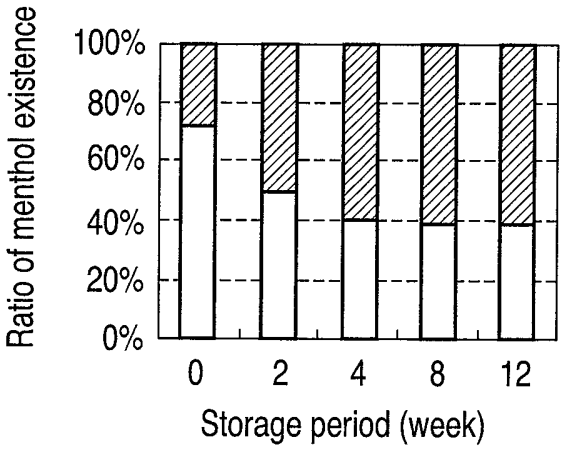
Ratio of menthol existence
100%
80%
60%
40%
20%
0%
0
2
4
8
12
Storage period (week)

FIG. 7

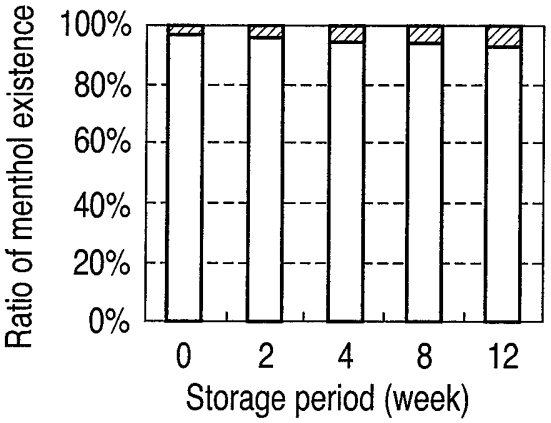
Ratio of menthol existence
100%
80%
60%
40%
20%
0%
0
2
4
8
12
Storage period (week)

FIG. 8

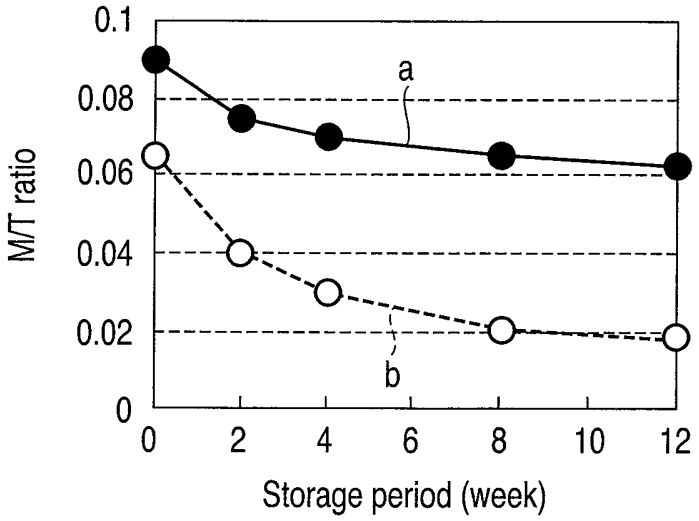
M/T ratio
0.1
0.08
0.06
0.04
0.02
0
a
b
0
2
4
6
8
10
12
Storage period (week)

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/072074

A. CLASSIFICATION OF SUBJECT MATTER
A24D1/02(2006.01)i, *A24D3/02*(2006.01)i, *A24D3/16*(2006.01)i, *D21H27/00*(2006.01)i

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)
A24D1/02, A24D3/02, A24D3/16, D21H27/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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.
A	WO 92/15209 A1 (Japan Tobacco Inc.), 17 September, 1992 (17.09.92), Claim 2 & JP 6-510679 A & US 5394895 A & EP 536407 A1 & DE 69217438 C & DE 69217438 T & CA 2082512 A & CA 2082512 A1 & JP 3194580 B2	1-17

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 March, 2009 (04.03.09)	17 March, 2009 (17.03.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/072074

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 2006-509508 A (British American Tobacco (Investments) Ltd.), 23 March, 2006 (23.03.06), Claims 4 to 6 & US 2007/0051383 A1 & GB 228819 D & EP 1569529 A & WO 2004/052128 A2 & DE 60304737 D & DE 60304737 T & CA 2508710 A & BR 317130 A & AT 323433 T & DK 1569529 T & ES 2257700 T & HK 1076230 A & PT 1569529 T & KR 10-2005-0085465 A & CN 1747663 A	1-17
A	WO 2004/091325 A1 (Japan Tobacco Inc.), 28 October, 2004 (28.10.04), Full text; all drawings & US 2006/0027243 A1 & EP 1623636 A1 & CA 2522289 A & TW 243652 B & KR 10-2005-0121717 A & CN 1774184 A & RU 2304913 C	1-17
A	WO 00/00047 A1 (PHILIP MORRIS PRODUCTS, INC.), 06 January, 2000 (06.01.00), Full text; all drawings & AU 4847399 A	1-17
A	JP 2004-516814 A (Phillip Morris Products S.A.), 10 June, 2004 (10.06.04), Full text; all drawings & EP 1299012 A & WO 2002/003819 A1 & AU 5984500 A & CA 2416144 A & HK 1058886 A & CN 1454062 A	1-17
A	JP 2005-24955 A (Daio Paper Corp.), 27 January, 2005 (27.01.05), Claim 6; Par. Nos. [0019] to [0021] (Family: none)	1

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 0000047 A **[0008] [0009] [0028]**
- JP 2004516814 PCT **[0008] [0009] [0028]**