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

(11) **EP 2 636 791 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.09.2013 Bulletin 2013/37

(21) Application number: **12762832.9**

(22) Date of filing: **30.03.2012**

(51) Int Cl.:
D21H 27/00 *(2006.01)* ***A24D 1/02*** *(2006.01)*
D21H 17/67 *(2006.01)*

(86) International application number:
PCT/JP2012/058622

(87) International publication number:
WO 2012/133797 (04.10.2012 Gazette 2012/40)

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

(30) Priority: **31.03.2011 JP 2011077902**

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

(72) Inventors:
- **ISHIKAWA, Nobuyuki**
  Tokyo 130-8603 (JP)
- **YOSHIMURA, Tetsuya**
  Tokyo 130-8603 (JP)
- **SASAKAWA, Kiyohiro**
  Tokyo 130-8603 (JP)

(74) Representative: **Isarpatent**
Patent- und Rechtsanwälte
Friedrichstrasse 31
80801 München (DE)

(54) CIGARRETE PAPER EFFECTIVE IN REDUCING AMOUNT OF VISIBLE SIDESTREAM SMOKE AND CONTENT OF CARBON MONOXIDE IN MAINSTREAM SMOKE, AND CIGARRETE

(57) This invention is intended to provide a cigarette paper capable of reducing both a visible sidestream smoke amount and a carbon monoxide amount in a mainstream smoke. The invention provides a cigarette paper having a grammage of 40 to 55 g/m^2 and containing calcium carbonate in an amount of 18 g/m^2 or more. Where the primary particles of calcium carbonate having a columnar shape or a needle shape are used, the carbon monoxide amount in the mainstream smoke decreases significantly, as compared with the case where the primary particles of calcium carbonate having another shape are used.

EP 2 636 791 A1

Description

Technical Field

[0001] This invention relates to a cigarette paper and a cigarette, and more specifically relates to a cigarette paper and a cigarette reducing a visible sidestream smoke amount and a carbon monoxide amount in mainstream smoke.

Background Art

[0002] Recently, a cigarette (low sidestream smoke cigarette) having a small amount of sidestream smoke to be generated has been developed. Whether such a cigarette actually has a small amount of sidestream smoke to be generated is usually determined by a so- called fishtail method (described in Health Canada Test Method T- 212) . In this fishtail method, the amount of total particulate matter in sidestream smoke is measured, and the amount of the total particulate matter is considered as a sidestream smoke amount.

[0003] In order to provide a cigarette having a small amount of sidestream smoke to be generated, a filler which is a compound exhibiting combustion inhibiting effect is added to a cigarette paper. For example, Patent Document 1 discloses that magnesium hydroxide gel is added, and Patent Document 2 discloses that a filler having a high-specific surface area formed of calcium carbonate and so on is added.

[0004] Meanwhile, Patent Document 3 discloses a cigarette paper which can reduce the sidestream smoke amount according to visual observation (also referred to as the visible sidestream smoke amount in this specification) rather than the sidestream smoke amount according to the fishtail method. This cigarette paper contains calcium carbonate in an amount of 30 g/m^2 or more and a combustion regulating agent such as potassium citrate in an amount of 3% by weight or more.

Citation List

[0005] Patent Literature

Patent Literature 1: Jpn. Pat. Appln. KOKOKU Publication No. 63-37621
Patent Literature 2: Japanese Patent No. 2730894
Patent Literature 3: Japanese Patent No. 3897700

Summary of Invention

Technical Problem

[0006] Although the low sidestream smoke cigarette according to the prior art significantly reduces the sidestream smoke amount, there is a tendency to increase the carbon monoxide amount in the mainstream smoke.

[0007] Accordingly, an object of the invention is to provide a cigarette paper which can reduce a visible sidestream smoke amount and at the same time can reduce a carbon monoxide amount in a mainstream smoke.

Solution to Problem

[0008] In order to solve the above problem, this invention provides a cigarette paper having a grammage of 40 to 55 g/m^2 and containing calcium carbonate in an amount of 18 g/m^2 or more.

[0009] This invention further provides a cigarette including a cigarette rod including tobacco shreds wrapped into a rod shape with the cigarette paper, and a filter coaxially connected to an end of the cigarette rod by a tipping paper.

Advantageous Effects of Invention

[0010] A cigarette paper and a cigarette according to this invention reduce the amount of sidestream smoke generated and the amount of carbon monoxide in main stream smoke.

Brief Description of Drawings

[0011]

FIG. 1 is a view schematically showing a typical shape of primary particles of calcium carbonate.

FIG. 2 is a view schematically showing an example of secondary particles having a bur shape.
FIG. 3 is a schematic perspective view showing an apparatus which measures the amount of visible sidestream smoke of a smoking article according to the present invention.
FIG. 4 is a block diagram schematically showing a constitution of the apparatus which measures the amount of visible sidestream smoke of the smoking article according to the present invention.
FIG. 5 is a schematic diagram showing a visible sidestream smoke amount evaluation apparatus which can be used in sensory evaluation.

Description of Embodiments

[0012] Hereinafter, the present invention will be explained in detail.

[0013] The cigarette paper according to this invention has a grammage of 40 to 55 g/m^2 and contains calcium carbonate in an amount of 18 g/m^2 or more.

[0014] Pulp fiber used in the cigarette paper according to this invention can be constituted of flax pulp fiber used in a typical cigarette paper, wood pulp fiber (hardwood pulp, softwood pulp), and so on.

[0015] The cigarette paper according to this invention is prepared by mixing 18 g/m^2 or more of calcium carbonate with the pulp fiber. Calcium carbonate is contained in the form of particles, and although the particle diameter can be suitably selected in terms of cost and ease of papermaking, the particle diameter is preferably 0.02 to 10 μm. The content of calcium carbonate is preferably 29 g/m^2 or less. The content of calcium carbonate is more preferably 20 to 25 g/m^2. In this specification, the content of calcium carbonate means the amount of calcium carbonate contained in a cigarette paper after manufacture. The amount of calcium carbonate in the cigarette paper can be obtained by extracting and then quantifying calcium ions as described in an example to be described later.

[0016] Calcium carbonate used in this invention is a synthetic calcium carbonate synthesized by chemical reaction, and primary particles of the synthetic calcium carbonate are all in substantially the same shape and size and are homogeneous. In this specification, the term "primary particles" refers to fundamental particles constituting a power immediately after synthesis by chemical reaction, and the term "secondary particles" refers to an aggregate formed by agglomeration of a large number of primary particles.

[0017] The shape of the primary particles of calcium carbonate to be used is not particularly limited, and the primary particles having any shape of a spindle shape, a cubic shape, a columnar shape, and a needle shape can be used. However, when calcium carbonate in which the primary particles have a columnar shape or a needle shape is used, the amount of carbon monoxide in mainstream smoke is significantly reduced in comparison with the case of using calcium carbonate having another shape.

[0018] FIG. 1 shows a typical shape of a primary particle of calcium carbonate. The primary particle shown in FIG. 1 have a shape extending in one direction. The direction of extension of the particle is the longitudinal direction, and the maximum value in the longitudinal direction is referred to as the length (L). The direction perpendicular to the longitudinal direction is the lateral direction, and the maximum value in the lateral direction is referred to as the width (W). The ratio of length (L) to width (W) of the primary particle is referred to as an aspect ratio. The ratio (aspect ratio) of the length (L) to the width (W) of the columnar or needle-shaped primary particle is preferably not less than 4 and less than 10. Both the columnar particle and the needle-shaped particle refer to particles having an aspect ratio of not less than 4 (FIG. 1). The columnar shape and the needle shape can be distinguished by whether or not the primary particle observed with an electron microscope has a pointed shape. Namely, the columnar shape does not have a pointed shape (FIGS. 1(d) and (f)), and the needle shape has a pointed shape (FIGS. 1(a) and (c)). The needle shape may have a pointed shape at the both ends in the extending direction of the particle or may have the pointed shape at one end. The columnar shape includes not only a circular cylindrical shape but also a truncated conical shape.

[0019] The width (W) and the length (L) of the primary particle can be measured using a scanning electron microscope, for example.

[0020] In a preferred aspect, in the calcium carbonate used in this invention, it is preferable that the primary particle has a columnar shape or a needle shape, and, at the same time, the shape of the secondary particle formed by agglomeration in a process of typical papermaking has a bur shape. The bur shape represents an agglomeration shape in which tens to thousands of primary particles having a columnar or needle shape are three-dimensionally entangled. As a specific example of the bur shape, there are aspects shown in Jpn. Pat. Appln. KOKAI Publication Nos. 55-40849 and 59-94700. FIG. 2 schematically shows an example of the bur shape. The bur shape has a central core body at its center, a large number of primary particles may protrude from the central core body, and the bur shape may not have the central core body at its center. Calcium carbonate in which the secondary particles have a bur shape is commercially available as Cal-light-SA (Shiraishi Kogyo Kaisha, Ltd.) and bur-shaped calcium carbonate (Newlime Co., Ltd.), for example.

[0021] When calcium carbonate in which the secondary particles are in the form of a bur shape is used, calcium carbonate in the form of the primary particle (having a columnar or needle shape) may be contained in pulp fiber, calcium carbonate in the form of the secondary particle (having a bur shape) may be contained in the pulp fiber, or calcium

carbonate as a mixture having the forms of the primary particle and the secondary particle may be contained in the pulp fiber. In each case, calcium carbonate has a bur shape in the cigarette paper.

[0022] In this invention, preferably, the primary particles of calcium carbonate have a columnar or needle shape. More preferably, an average aspect ratio of the primary particles falls within the range of not less than 4 and less than 10, and an average length (L) of the primary particles is 0.1 to 1.5 μm. It is still more preferable that the density of the obtained cigarette paper is 0.4 to 1.0 g/m^3.

[0023] To obtain the average aspect ratio, representative plural (at least 50, and for example, 50 to 200) particles are selected, the aspect ratio is obtained by measuring the width (W) and the length (L) of the primary particles for each particle, and an average value of the aspect ratio is obtained, whereby the average aspect ratio can be obtained. To obtain the average length (L), representative plural (at least 50, and for example, 50 to 200) particles are selected, the length (L) of each particle is measured, and an average value of the length (L) is obtained, whereby the average length (L) can be obtained.

[0024] The cigarette paper according to this invention has a grammage of 40 to 55 g/m^2. It is more preferable that the grammage of the cigarette paper is 42 to 50 g/m^2.

[0025] The cigarette paper according to this invention may contain a combustion regulating agent. As the combustion regulating agent, an alkali metal citrate is preferably used, and particularly preferred are potassium citrate and sodium citrate, and these combustion regulating agents may be used alone or may be used in combination. The cigarette paper preferably contains the combustion regulating agent in an amount of 1.0 to 5.0% by weight, and more preferably 1.5 to 4.0% by weight.

[0026] The cigarette paper according to this invention reduces the amount of visible sidestream smoke of a cigarette and, at the same time, can reduce the amount of carbon monoxide in mainstream smoke in comparison with a conventional cigarette paper.

[0027] The cigarette paper according to this invention can be used as a cigarette paper of a cigarette with a filter. Namely, according to one aspect of this invention, there is provided a cigarette which includes a cigarette rod including tobacco shreds wrapped into a rod shape with the cigarette paper of the invention and a filter coaxially connected to an end of the cigarette rod by a tipping paper.

[0028] The amount of carbon monoxide in mainstream smoke can be measured as the carbon monoxide amount per smoke draft obtained by dividing the total amount per cigarette in specified cigarette smoking conditions (Health Canada Test Method: 55 ml/2 s) by the total number of smoke drafts.

[0029] Although the amount of visible sidestream smoke can be measured by sensory evaluation, the amount of visible sidestream smoke can be simply measured using a visible sidestream smoke amount measuring apparatus disclosed in Japanese Patent No. 3683792 (or Patent Literature 3). The visible sidestream smoke amount measuring apparatus will be hereinafter described using FIGS. 3 and 4 (reproductions of FIGS. 1 and 2 of the Japanese Patent No. 3683792) for confirmation.

[0030] FIG. 3 is a schematic perspective view showing the visible sidestream smoke amount measuring apparatus disclosed in the Japanese Patent No. 3683792. FIG. 4 is a block diagram schematically showing a configuration of the visible sidestream smoke amount measuring apparatus.

[0031] As shown in FIGS. 3 and 4, a visible sidestream smoke amount measuring apparatus 10 is provided with a spontaneous combustion chamber 11 for a smoking article, a visible light emitting unit 12 used for applying a predetermined visible light beam to sidestream smoke, generated by spontaneous combustion of the smoking article and naturally rising (moving up) in the spontaneous combustion chamber 1, in a direction substantially perpendicular to a direction of a flow of the sidestream smoke, and a scattered light intensity detection unit 14 used for detecting, as an index of the amount of visible sidestream smoke, the intensity of scattered light scattered by sidestream smoke in a direction substantially perpendicular to the direction of the visible light beam.

[0032] The spontaneous combustion chamber 11 is formed of a light-shielding material and constituted of a rectangular parallelepiped tubular body elongated in a longitudinal direction prescribed by four sidewalls 11a to 11d, for example. Sidewall 11a has in its lower portion a smoking article insertion opening 111 through which a smoking article SA such as a lit cigarette is fitted in the spontaneous combustion chamber 11. The four sidewalls 11a to 11d prescribing the spontaneous combustion chamber 11 respectively have ventilation windows 112 to 115 such as mesh windows at their lowermost end portions so that air required for spontaneous combustion of the smoking article SA can be supplied in the spontaneous combustion chamber 11. It is preferable that the position of the insertion opening 111 for a smoking article is set to a position where sidestream smoke SSS from the smoking article SA fitted in the spontaneous combustion chamber 11 through the insertion opening 111 passes through the ventilation windows 112 to 115 is not affected by disturbance of outside air entering inside the spontaneous combustion chamber 11, and a distance from the smoking article SA to the upper end of the spontaneous combustion chamber 11 is sufficient such that the sidestream smoke SSS is not substantially swayed.

[0033] Glass beads (not shown) are filled in a bottom space of the spontaneous combustion chamber 11 surrounded by the ventilation windows 112 to 115 so that the flow of the sidestream smoke SSS rising in the spontaneous combustion

chamber 11 due to spontaneous combustion of the smoking article is not disturbed, whereby an air flow rectifying layer can be formed. The upper end of the spontaneous combustion chamber 11 is opened. An exhaust hood 15 can be installed at the open end for the purpose of exhausting in the spontaneous combustion chamber 11. The spontaneous combustion chamber 11 is required to be exhausted so as to avoid substantial influence on the spontaneous combustion of the smoking article SA. In the event of exhaust, in order to prevent the disturbance of the flow of the sidestream smoke SSS naturally rising in the spontaneous combustion chamber 11 due to the spontaneous combustion of the smoking article, it is preferable that a rectification filter 16 is attached across an upper open end of the spontaneous combustion chamber 11.

[0034] The exhaust hood 15 has an exhaust duct 151 on its top, and the exhaust duct 151 is connected to an exhaust system (not shown).

[0035] The visible light emitting unit 12 is provided outside the spontaneous combustion chamber 11. In an example shown in FIG. 3, the visible light emitting unit 12 is provided outside sidewall 11b facing sidewall 11a of the spontaneous combustion chamber 11 in which the smoking article SA is inserted. A visible light transmission window 116 is provided at a portion of sidewall 11b facing the visible light emitting unit 12. The visible light emitting unit 12 has a visible light source (not shown) and applies a visible light beam VLB to the sidestream smoke SSS, generated by the spontaneous combustion of the smoking article SA and naturally rising in the spontaneous combustion chamber 11, in the direction substantially perpendicular to the direction of the flow of the sidestream smoke SSS. A visible light source is not limited especially as long as the visible light is emitted, and although a visible light laser, a visible light-emitting diode, a halogen lamp, and so on can be used, for example, an A light source specified by international commission on illumination is representatively used.

[0036] The visible light beam (visible light flux) VLB emitted from the visible light emitting unit 12 has a substantial cross-sectional surface in which the visible light can be applied to the sidestream smoke SSS naturally rising in the spontaneous combustion chamber 11 while, even if the sidestream smoke SSS is somewhat swayed, the sway is sufficiently covered. For example, the visible light beam VLB has a width w (FIG. 4) in the direction perpendicular to the irradiation direction and, at the same time, has a rectangular cross section having a height in a direction substantially perpendicular to the irradiation direction of the visible light beam VLB so as to correspond to a visual field in the sensory evaluation in consideration of a human visual field. It is preferable that the width w is at least equal to a sway width of the sidestream smoke SSS in the direction perpendicular to the irradiation direction of the visible light beam. The cross-sectional surface of the visible light beam is not limited to a rectangular shape and may be an elliptical shape, a circular shape, and so on. In such shaping of the visible light beam, a mask having an opening corresponding to the cross-sectional surface of the visible light beam may be used, or a lens system constituted of a combination of a convex lens and a concave lens may be used, for example, and the shaping itself can be performed by a well-known method.

[0037] It is preferable that a light absorption unit 13 used for absorbing/removing all light emitted from the visible light emitting unit 12 and transmitted through the sidestream smoke SSS so that measurement is not affected is provided outside the spontaneous combustion chamber 11 facing the visible light emitting unit 12 and, in the example shown in FIG. 3, provided outside sidewall 11a. A visible light transmission window 117 is provided at a portion of sidewall 11a facing the light absorption unit 13.

[0038] A scattered light intensity detection unit 14 is provided outside the spontaneous combustion chamber 11 in the direction perpendicular to the direction of the light beam emitted from the light intensity detection unit 12, and in an example shown in FIG. 3, the scattered light intensity detection unit 14 is provided outside sidewall 11d. A visible light transmission window 118 is provided at a portion of sidewall 11d facing the scattered light intensity detection unit 14. As described above, the scattered light intensity detection unit 14 detects the intensity of scattered light (hereinafter referred to as 90 degree scattered light) SVL scattered in the direction substantially perpendicular to the irradiation direction of the visible light beam VLB among the light applied to the sidestream smoke SSS and scattered by the sidestream smoke SSS. The scattered light intensity detection unit 14 is provided in itself with a well-known optical system (not shown) used for collecting the 90 degree scattered light SVL and has a photoelectric converter (not shown) which converts the collected 90 degree scattered light SVL into an electrical signal and outputs the electrical signal. As the photoelectric converter, a photomultiplier which converts light into a voltage signal can be preferably used. The converted voltage signal is subjected to analog-to-digital conversion, for example, and then can be subjected to data sampling with a personal computer. Data acquisition interval and acquisition time can be arbitrarily set, and typically measurement at 300 points can be performed at an interval of 0.2 seconds for 1 minute.

[0039] The detected intensity of the 90 degree scattered light SVL correlates very well with the amount of visible sidestream smoke, and as the detected intensity of the 90 degree scattered light is large, it can be determined that the amount of visible sidestream smoke is relatively large. It was shown that the intensity of the 90 degree scattered light does not correlate with the total amount of particulate matter in the sidestream smoke.

[0040] It is preferable to install external stray light shielding boxes 17 to 19 between the visible light emitting unit 12 and the visible light transmission window 116, between the light absorbing unit 13 and the visible light transmission window 117, and between the scattered light intensity detection unit 14 and the visible light transmission window 118

in order to prevent external stray light from entering through each visible light transmission window.

[0041] When a representative example of the entire size of an apparatus 10 and so on are shown, the spontaneous combustion chamber 11 has a rectangular solid shape of 11 cm × 11 cm having a height of 80 cm, and the smoking article insertion opening 111 is provided at a position of 50 cm from the lower end of the spontaneous combustion chamber 11, a distance from the smoking article SA to the center of visible light beam is 10 cm, and the visible light beam emitted from the visible light emitting unit has a cross section with a size of 5 cm × 5 cm.

[0042] As shown in FIG. 4, the visible sidestream smoke amount measuring apparatus preferably has conversion table means 20 that converts the 90 degree scattered light intensity detected by the scattered light intensity detection unit 14 into the amount of visible sidestream smoke and outputs the amount of visible sidestream smoke based on a correlative relationship between the 90 degree scattered light intensity and the amount of visible sidestream smoke. In the conversion table means, the correlative relationship between the 90 degree scattered light intensity obtained in advance and the amount of visible sidestream smoke is input as a conversion equation, a calibration curve, and so on, a 90 degree scattered light intensity signal output from the scattered light intensity detection unit 14 is converted into the amount of visible sidestream smoke, and the amount of visible sidestream smoke is output. In order to obtain the correlative relationship between the 90 degree scattered light intensity and the amount of visible sidestream smoke, the amount of visible sidestream smoke of the smoking articles such as a large number of cigarettes is first evaluated by sensory evaluation according to a two-point comparison method, and the amount of visible sidestream smoke is converted into a number. The 90 degree scattered light intensity of the same smoking article detected by this apparatus is measured. For example, when the vertical axis represents the amount of visible sidestream smoke and the horizontal axis represents the 90 degree scattered light intensity, the calibration curve can be obtained by plotting obtained measured values. The conversion equation from the 90 degree scattered light intensity to the amount of visible sidestream smoke can be obtained based on the calibration curve.

[0043] The sensory evaluation according to the two-point comparison method can be performed using a visible sidestream smoke amount evaluation apparatus shown in FIG. 5, for example. Namely, a standard cigarette CIG1 and a target cigarette CIG2 are spontaneously combusted in two bilaterally symmetric spontaneous combustion chambers 31 and 32, and there is employed such a questionnaire that with respect to the standard cigarette CIG1 having 5 points, how much the amount of sidestream smoke of the target cigarette CIG2 is observed within a range of 0 to 10 points. The chambers 31 and 32 are provided respectively with observation windows 311 and 321 having a fixed longitudinal width, and visible light sources 33 and 34 are provided in the upper portions of the respective chambers. Preferably, each longitudinal width of the observation windows 311 and 321 corresponds to the height of the visible light beam emitted from the visible light emitting unit 12 of the visible sidestream smoke amount measuring apparatus, and the distance from the cigarettes CIG1 and CIG2 to the lower ends of the observation windows 311 and 321 corresponds to a distance from the smoking article SA at the lower end of the visible light beam emitted from the visible light emitting unit 12 of the visible sidestream smoke amount measuring apparatus. The visible light from the visible light sources 33 and 34 is applied from above to the sidestream smokes SS1 and SS2, and the sidestream smokes SS1 and SS2 are observed only from the observation windows 311 and 321.

[0044] The 90 degree scattered light intensity obtained by the visible sidestream smoke amount measuring apparatus correlates very well with amount of the visible sidestream smoke in the sensory evaluation, and this fact is demonstrated in Japanese Patent No. 3897700. In this invention, when the sensory evaluation according to the two-point comparison method is performed using the visible sidestream smoke amount evaluating apparatus shown in FIG. 5, it is confirmed that when a value of visible sidestream smoke amount/SBR (hereinafter referred to as the amount of visible sidestream smoke) shown as an index in this example is not more than 5.0×10^{-2} (min/mm), it can be determined that the amount of visible sidestream smoke according to the sensory evaluation is sufficiently reduced with respect to a standard typical cigarette.

Examples

[0045] Hereinafter, the invention will be described with reference to examples. In the following examples, calcium carbonate PCX- 850 and Cal- light- SA were purchased from Shiraishi Kogyo Kaisha, Ltd., and needle- shaped calcium carbonate and bur- shaped calcium carbonate were purchased from Newlime Co., Ltd.

[0046] The primary particle of PCX-850 has a spindle shape, and although the primary particles form the secondary particle, a bur shape is not formed. The primary particle of Cal-light-SA has a columnar shape, and the primary particles are agglomerated to form a bur-shaped secondary particles. The primary particle of the needle-shaped calcium carbonate has a needle shape, and the primary particles does not form the secondary particle. The primary particle of bur-shaped calcium carbonate has a needle shape, and the primary particles are agglomerated to form the bur-shaped secondary particle.

Comparative examples 1 to 3, examples 1 to 4, and reference examples

[0047] A pulp mixture in which the weight ratio of bleached broad leaf tree kraft pulp (LBKP) to bleached coniferous tree kraft pulp (NBKP) is 8:2 is beaten so that a freeness is about 100 mL in Canadian Standard Freeness, and calcium carbonate shown in Table 1 as a filler is added to the beaten pulp mixture in a content shown in Table 1. With the use of an obtained paper stock, a cigarette paper (the grammage is shown in Table 1) is subjected to papermaking by a TAPPI standard sheet machine. Potassium citrate aqueous solution as a combustion regulating agent is coated onto a surface of the obtained cigarette paper so that potassium citrate in an amount of 3 to 4 wt% on the dry base is contained in the cigarette paper. This cigarette paper is matched for two or more days under conditions of a temperature of 22°C and a relative humidity of 60% and cut into a predetermined length. In the amount of calcium carbonate in the cigarette paper, ultrasonic extraction is performed for 30 minutes in 0.3 N aqueous hydrochloric acid, and calcium carbonate is quantified as calcium ions by a capillary electrophoresis system (7100) manufactured by Agilent Technologies, and calcium ions are converted into calcium carbonate, whereby the amount of calcium carbonate in the cigarette paper is obtained.

[0048] With the use of the obtained cigarette paper and tobacco shreds (American blend), a cigarette is produced by a tobacco roller (Rizla). As the size of the cigarette, the circumference is 22.6 mm, and the length is 67 mm. A normal filter (having a length of 31 mm) is provided to be mounted on one end of the cigarette with the use of a tipping paper. The filling amount of the tobacco shreds is 0.515 g per cigarette.

[0049] The amount of visible sidestream smoke of the obtained cigarette is measured using an apparatus shown in FIGS. 3 and 4, the amount of carbon monoxide in mainstream smoke is measured using a Micro-GC (3000A) manufactured by Agilent Technologies, and the amount of carbon monoxide per smoke (puff) is calculated.

[0050] In the measurement of the amount of visible sidestream smoke, in order to correct the difference between days in sensitivity of a visible laser, for each measurement, the amount of visible sidestream smoke of each cigarette is standardized with a visible sidestream smoke amount measured value in a standard cigarette (reference cigarette 3R4F) (accordingly, the unit is nondimensional). In order to eliminate influence of the grammage of the cigarette paper and the kind and content of calcium carbonate, the standardized amount of visible sidestream smoke is divided by the spontaneous combustion rate (SBR) (unit: mm/min) of a cigarette. SBR is measured at an atmosphere linear velocity of 200 mm/s. The results are indicated in Table 1.

[0051] The reference example is an example of using calcium carbonate (Unibur- 70) (although it is not available now, it is stored by the present applicant) described in Jpn. Pat. Appln. KOKAI Publication No. 59- 94700.

Table 1

Examples	Cigarette paper			Cigarette	
	Calcium carbonate		Cigarette paper grammage (g/m^2)	Visible sidestream smoke amount/SBR (min/mm)	CO amount in mainstream smoke (mg/puff)
	Kind	Content (g/m^2)			
Comparative Example 1	PCX-850	11.0	43.6	7.3×10^{-2}	4.6
Comparative Example 2		15.0	45.0	6.8×10^{-2}	4.5
Example 1		18.8	47.0	4.7×10^{-2}	4.3
Example 2		23.5	47.1	4.4×10^{-2}	3.4
Example 3		28.0	47.2	4.8×10^{-2}	3.9
Example 4		25.0	53.0	4.8×10^{-2}	4.1
Comparative Example 3		30.0	63.0	3.3×10^{-2}	5.0
Reference Example	Unibur-70	10.5	27.5	7.8×10^{-2}	3.3

[0052] As can be seen in the result shown in Table 1, it is confirmed that if the content of calcium carbonate is not less than 18 g/m^2, the value of the visible sidestream smoke amount per spontaneous combustion rate (SBR) is less than 5.0×10^{-2}. This fact shows that the visible sidestream smoke is sufficiently reduced (examples 1 to 4). Meanwhile,

It will be shown that when the amount of calcium carbonate is less than 18 g/m^2, including the reference example, the amount of visible sidestream smoke is large (comparative examples 1 and 2).

[0053] Although the yield of calcium carbonate with respect to the amount of pulp in the cigarette paper depends on the amount of pulp, it is considered that the maximum value is 40 to 60%, and when the yield is 40 to 50%, the grammage of the cigarette paper required for maintaining not less than 18 g/m^2 of calcium carbonate is assumed to be not less than 40 g/m^2. When the content of calcium carbonate is further increased, the grammage is required to be increased, and accompanying this, the amount of carbon monoxide in the sidestream smoke is increased. Specifically, it can be confirmed from the comparative example 3, that when the grammage is more than 55 g/m^2, although there is a tendency to reduce the amount of visible sidestream smoke, the amount of carbon monoxide in the mainstream smoke is increased.

[0054] According to above, when the cigarette paper has a grammage of 40 to 55 g/m^2 and contains calcium carbonate in an amount of not less than 18 g/m^2, the amount of sidestream smoke generated and the amount of carbon monoxide in the mainstream smoke can be reduced. As shown in the comparative example 2, when the cigarette paper has a grammage of 42 to 50 g/m^2 and contains calcium carbonate in an amount of 20 to 25 g/m^2, it is possible to expect greater effects.

Examples 5 and 6

[0055] In the examples 5 and 6, in calcium carbonate in which the primary particles have comparable length (L) and the shapes of the primary particles are different, the influence of the shape of the primary particles on the amount of visible sidestream smoke and the mainstream smoke is examined. As calcium carbonate in which the primary particles have different shapes, PCX-850 and Cal-light-SA are used. The contents of PCX-850 and Cal-light-SA are 22.5 and 23.0 g/m^2, respectively.

[0056] A cigarette paper is manufactured as in the above examples to produce a cigarette except that the grammage of the cigarette paper and the kind of calcium carbonate are changed as shown in the following Table 2. The amount of visible sidestream smoke and the amount of carbon monoxide in the main stream smoke of the obtained cigarette are measured. Further, with regard to the obtained cigarette paper, in order to examine a mechanism in which the amount of carbon monoxide in the main stream smoke is reduced, the density of the cigarette paper is measured. The results are shown in Table 2.

[0057] The length (L) of the primary particle described in Table 2 is an average of the length (L) of 100 primary particles measured by means of Winroof image analysis software (Mitani Corporation) using an SEM image captured with a JSM-5310 scanning electron microscope manufactured by JEOL. Although the aspect ratio of calcium carbonate used in this example is indicated in Table 2, the width (W) of the primary particle is measured in a similar manner to the length (L) of the primary particle, and the ratio (L/W) of the length (L) of the primary particle to the width (W) is calculated.

Table 2

Examples	Cigarette paper						Cigarette	
	Calcium carbonate				Cigarette paper grammage (g/m^2)	Cigarette paper density (g/cm^3)	CO amount in mainstream smoke (mg/puff)	Visible sidestream smoke amount/SBR (min/mm)
	Kind	Shape of primary particle	Primary particle average length (L) (μm)	Average aspect ratio				
Example 5	PCX-850	Spindle	1.00*	3.5	46.4	0.65	3.5	4.4×10^{-2}
Example 6	Cal-light-SA	Columnar	1.21	9.5	45.1	0.52	3.0	4.8×10^{-2}
* Shiraishi Kogyo Kaisha, Ltd. Nominal value (long diameter) is described								

[0058] As can be seen in the result shown in Table 2, when the calcium carbonate in which the primary particles have a columnar shape and the calcium carbonate in which the primary particles have a spindle shape are compared with each other, the amount of carbon monoxide in the main stream smoke of the cigarette paper using the columnar calcium carbonate is lower, and therefore, it is confirmed that the shape of the primary particle is important. With regard to the density of the cigarette paper, in comparison with the cigarette paper using the calcium carbonate in which the primary

particles have a spindle shape, when the calcium carbonate in which the primary particles have a columnar shape is used, the reduction of the cigarette paper density can be confirmed. When the calcium carbonate (Cal- light- SA) in which the primary particles have a columnar shape is used, it is assumed that the density of the cigarette paper is reduced, so that the amount of carbon monoxide in the mainstream smoke is reduced. When a limitation in manufacturing at present is considered, a suitable aspect ratio (L/W) of the columnar or needle- shaped calcium carbonate is preferably not less than 4 and less than 10. When Cal- light- SA is used, the visible sidestream smoke falls within a range of not more than 5.0×10^{-2} (min/mm) , and therefore, it can be said that the amount of visible sidestream smoke can be sufficiently reduced.

Examples 7 and 8

[0059] Next, in calcium carbonate in which the secondary particles similarly have a bur shape, the influence of the length (L) of the primary particle on the amount of visible sidestream smoke and the amount of carbon monoxide in the mainstream smoke is examined. As calcium carbonate having columnar or needle- shaped primary particles having different length (L) , bur- shaped calcium carbonate and Cal- light- SA are used.

[0060] A cigarette paper is manufactured as in the above examples to produce a cigarette except that the grammage of the cigarette paper and the kind of calcium carbonate are changed as shown in the following Table 3. The amount of visible sidestream smoke and the amount of carbon monoxide in the main stream smoke of the obtained cigarette are measured. The results are indicated in Table 3. The length (L) of the primary particle described in Table 3 is an average of the length (L) of 100 primary particles measured according to the above method. The primary particles of bur-shaped calcium carbonate have an average aspect ratio of 6.7, and the primary particles of Cal-light-SA have an average aspect ratio of 9.5.

Table 3

Examples	Cigarette paper					Cigarette	
	Calcium carbonate				Cigarette paper grammage (g/m^2)	CO amount in mainstream smoke (mg/puff)	Visible sidestream smoke amount/SBR (min/mm)
	Trade name	Shape of primary particle	Primary particle average length (L) (μm)	Content (g/m^2)			
Example 7	Bur-shaped calcium carbonate	Needle-shaped	3.30	23.4	49.2	4.1	3.2×10^{-2}
Example 8	Cal-light-SA	Columnar	1.21	23.6	48.1	3.2	3.0×10^{-2}

[0061] As can be seen in the result shown in Table 3, in the cigarette paper using two kinds of calcium carbonate in which the secondary particles similarly have a bur shape, it is confirmed that the amount of carbon monoxide in the main stream smoke in the cigarette paper using Cal-light-SA in which the length (L) of the primary particles is small is further reduced. Thus, it can be shown that the smaller the size of the primary particle, the larger the effect of reducing the amount of carbon monoxide in the mainstream smoke, and considering variation of the length (L) of the primary particles, it is assumed that the average length (L) of the primary particles is preferably not more than 1.5 μm.

Examples 9 and 10

[0062] The influence of whether or not the secondary particles of calcium carbonate are in the form of a bur shape on the amount of visible sidestream smoke and the amount of carbon monoxide in the mainstream smoke is examined.

[0063] A cigarette paper is manufactured as in the above examples to produce a cigarette except that the grammage of the cigarette paper and the kind of calcium carbonate are changed as shown in the following Table 4. The amount of visible sidestream smoke and the amount of carbon monoxide in the mainstream smoke of the obtained cigarette are measured. The results are indicated in Table 4. In the bur-shaped calcium carbonate used here, the primary particles have a needle shape, the average length (L) of the primary particles is 3.3 μm, the average aspect ratio of the primary particles is 8.0, and the secondary particles have a bur shape. Meanwhile, in the needle-shaped calcium carbonate, the

primary particles have a needle shape, the average length (L) of the primary particles is 4.8 μm, and the average aspect ratio of the primary particles is 6.7; however, the secondary particles does not have a bur shape. Thus, the bur-shaped calcium carbonate and the needle-shaped calcium carbonate in which the values of the lengths (L) of the primary particles are approximately close to each other are compared, whereby the influence of whether or not the secondary particles are in the form of a bur shape on the amount of visible sidestream smoke and the amount of carbon monoxide in the mainstream smoke can be verified.

Table 4

Examples	Cigarette paper					Cigarette	
	Calcium carbonate				Cigarette paper grammage (g/m^2)	CO amount in mainstream smoke (mg/puff)	Visible sidestream smoke amount/SBR (min/mm)
	Trade name	Shape of primary particle	Bur shape of secondary particle	Content (g/m^2)			
Example 9	Needle-shaped calcium carbonate	Needle-shape	Without	24.5	49.8	4.7	3.7×10^{-2}
Example 10	Bur-shaped calcium carbonate	Needle-shape	With	23.5	48.6	4.0	3.5×10^{-2}

[0064] As can be seen in the result shown in Table 4, in the cigarette paper using bur-shaped calcium carbonate in which the secondary particles have a bur shape, although the amount of visible sidestream smoke is substantially equivalent in comparison with the cigarette paper using needle-shaped calcium carbonate, the amount of carbon monoxide in the mainstream smoke is reduced. From this fact, the effect obtained when the calcium carbonate in which the secondary particles have a bur shape is used is confirmed. However, in the cigarette paper containing calcium carbonate in which the primary particles have a large length (L), since the density of the cigarette paper is not reduced, the effect of reducing the amount of carbon monoxide in the mainstream smoke can be less expected, and as the length (L) of the primary particles becomes small, the higher the carbon monoxide reduction effect that can be expected. Namely, in the cigarette paper using calcium carbonate in which the primary particles have a columnar shape or needle shape, the size of the primary particles is small, and the secondary particles have a bur shape, it is guessed that the density of the cigarette paper is reduced most, and the carbon monoxide amount in the mainstream smoke is reduced most.

[0065] In this example, although a cigarette having a circumference of 22.6 mm is used, a similar effect can be expected in a cigarette having a different circumference, and the invention does not limit the size of a cigarette.

Claims

1. A cigarette paper having a grammage of 40 to 55 g/m^2 and containing calcium carbonate in an amount of 18 g/m^2 or more.

2. The cigarette paper according to claim 1, **characterized in that** a primary particle of the calcium carbonate has a columnar shape or needle shape.

3. The cigarette paper according to claim 2, **characterized in that** the primary particle of the calcium carbonate has an average aspect ratio of not less than 4 and less than 10 and has an average length (L) of 0.1 to 1.5 μm.

4. The cigarette paper according to claim 2 or 3, **characterized in that** the secondary particle of the calcium carbonate is in the form of a bur shape.

5. The cigarette paper according to claim 4 having a density of 0.4 to 1.0 g/cm^3.

6. The cigarette paper according to any one of claims 1 to 5 containing a combustion regulating agent **characterized**

by comprising an alkali metal citrate.

7. The cigarette paper according to claim 6, containing the combustion regulating agent in an amount of 1.0 to 5.0% by weight.

8. A cigarette **characterized by** comprising:

a cigarette rod including tobacco shreds wrapped into a rod shape with the cigarette paper according to any one of claims 1 to 7; and
a filter coaxially connected to an end of the cigarette rod by a tipping paper.

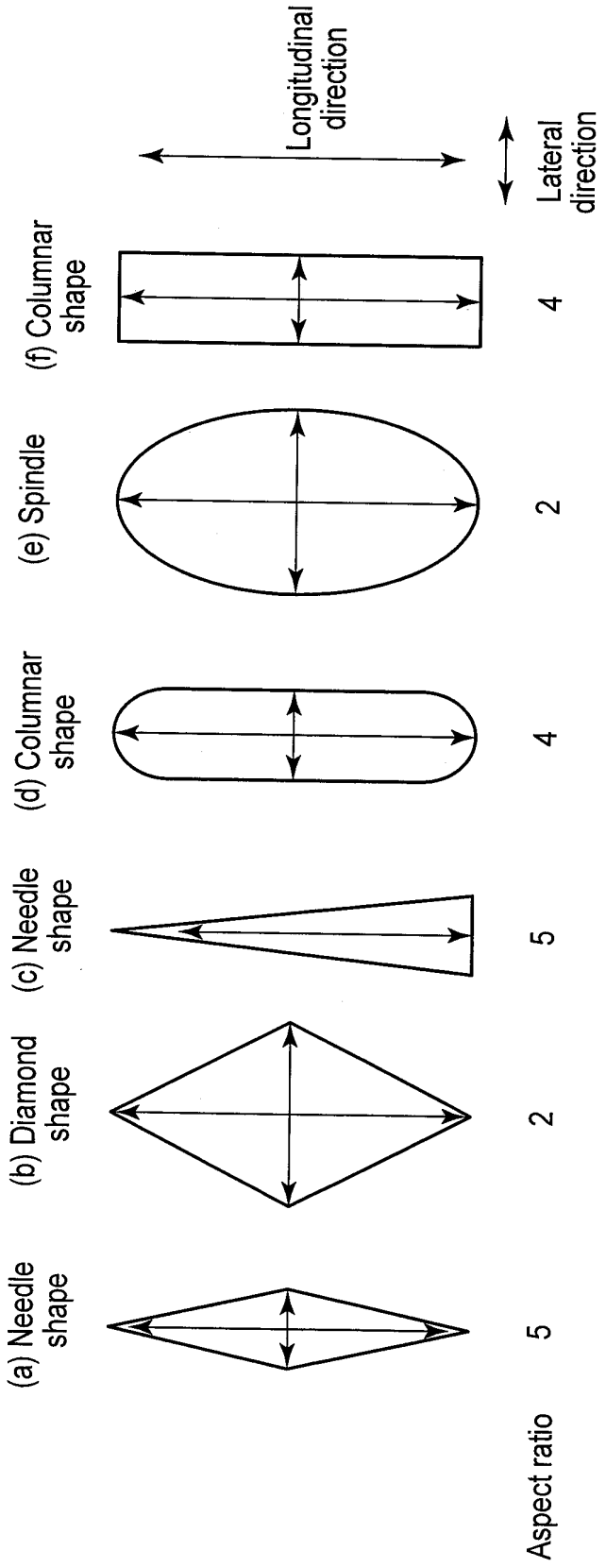
(a) Needle shape
(b) Diamond shape
(c) Needle shape
(d) Columnar shape
(e) Spindle
(f) Columnar shape
Aspect ratio
5
2
5
4
2
4
Longitudinal direction
Lateral direction

FIG. 1

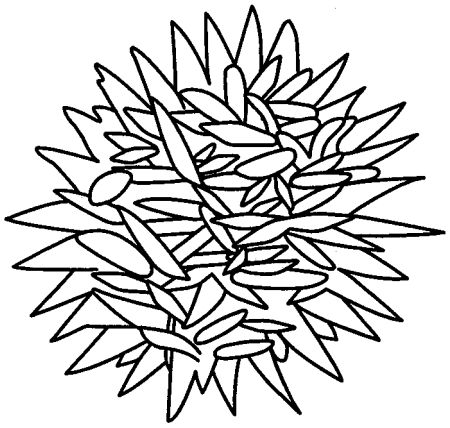

FIG. 2

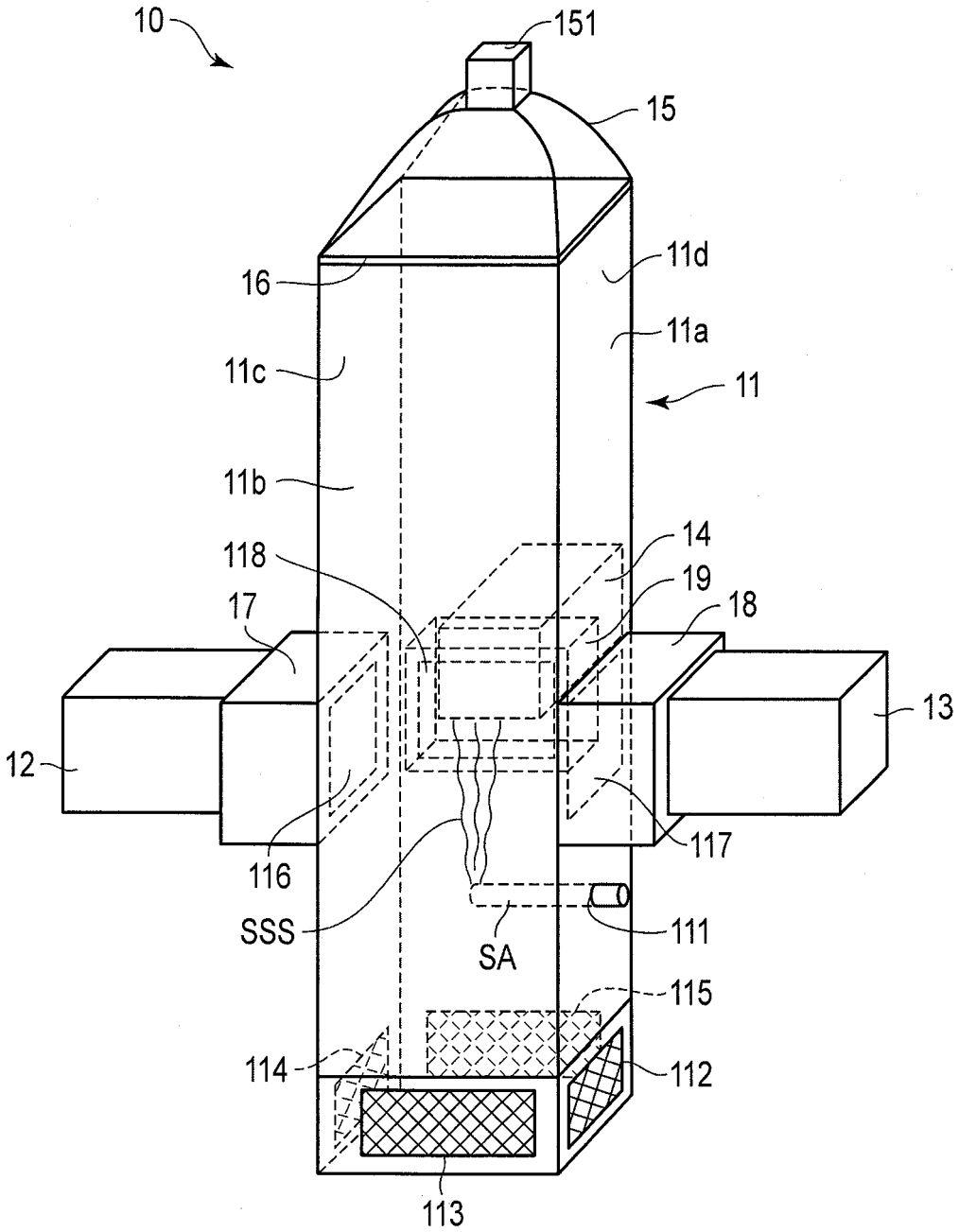
10
151
15
16
11d
11a
11c
11
11b
14
118
19
17
18
13
12
117
116
SSS
SA
111
115
114
112
113

FIG. 3

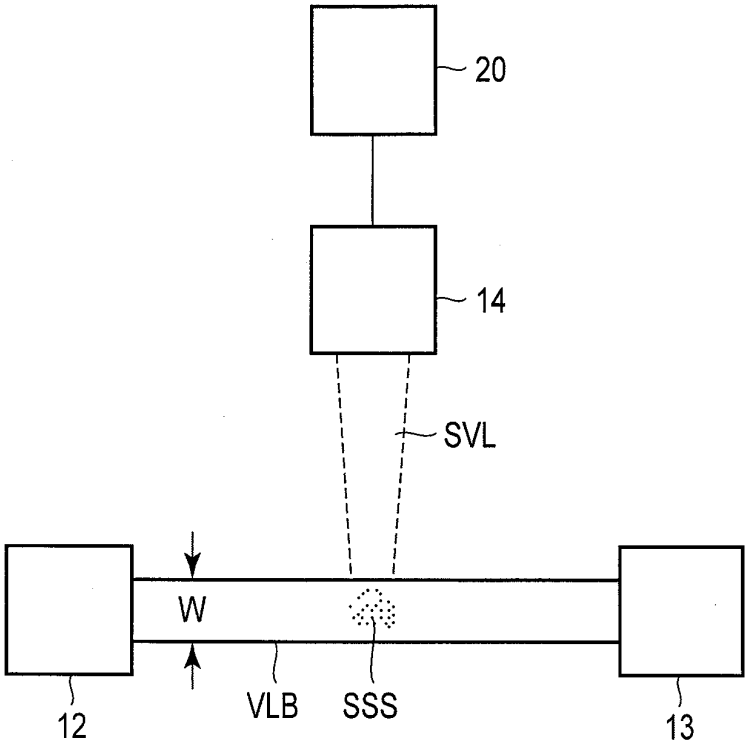

FIG. 4

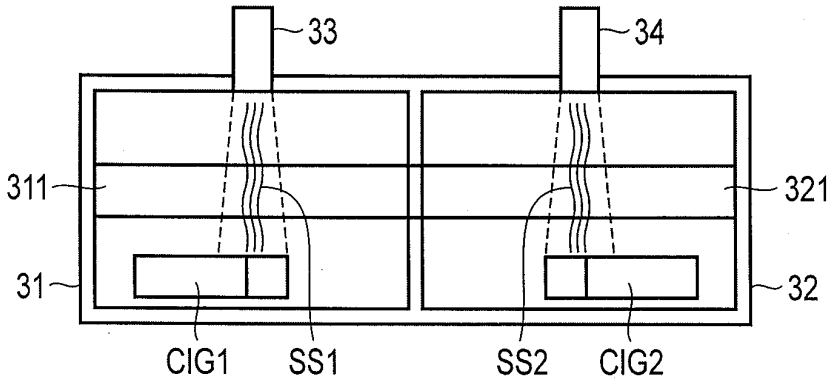

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/058622

A. CLASSIFICATION OF SUBJECT MATTER
D21H27/00(2006.01)i, *A24D1/02*(2006.01)i, *D21H17/67*(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)
D21B1/00-1/38, D21C1/00-11/14, D21D1/00-99/00, D21F1/00-13/12,
D21G1/00-9/00, D21H11/00-27/42, D21J1/00-7/00, A24D1/00-3/18,
A24B1/00-15/42

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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	WO 2002/092913 A1 (Japan Tobacco Inc.), 21 November 2002 (21.11.2002), claims 1 to 4; page 5, lines 3 to 24; page 15, line 17 to page 16, line 18; table 1 & EP 1403432 A1 claims 1 to 4; paragraphs [0013] to [0017], [0039], [0040]; table 1 & US 2004/0094174 A1 & JP 3897700 B2	1,6-8 2-5
Y	JP 05-279993 A (Japan Tobacco Inc.), 26 October 1993 (26.10.1993), claim 1; paragraphs [0003] to [0005], [0013], [0018], [0037] (Family: none)	2-5

☒ 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
30 May, 2012 (30.05.12)	12 June, 2012 (12.06.12)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2012/058622

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-239465 A (Nippon Paper Industries Co., Ltd.), 09 October 2008 (09.10.2008), paragraph [0011] (Family: none)	4,5
A	JP 2003-515356 A (British American Tobacco (Investments) Ltd.), 07 May 2003 (07.05.2003), claims 1, 29; fig. 1 & WO 2001/041590 A1 claims 1, 31; fig 1 & US 2002/0189625 A1 & EP 1237428 A	1-8
A	JP 59-094700 A (Honshu Paper Co., Ltd.), 31 May 1984 (31.05.1984), claim 1 (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

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

- JP 63037621 A **[0005]**
- JP 2730894 B **[0005]**
- JP 3897700 B **[0005] [0044]**
- JP 55040849 A **[0020]**
- JP 59094700 A **[0020]**
- JP 3683792 B **[0029] [0030]**