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(54) **NON-COMBUSTION SMOKING ARTICLE HAVING CARBONACEOUS HEAT SOURCE**

(57) There is provided a non-combustion smoking article **characterized by** comprising a carbonaceous heat source comprising a cylindrical outer wall and par-

titions disposed inside the outer wall, cross-sections of the partitions forming a grid, and having air passages defined by the partitions, and an aerosol generating section.

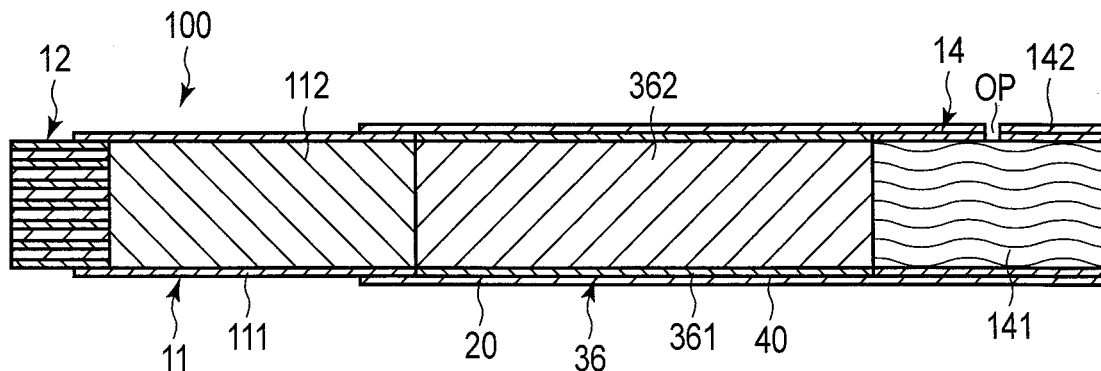


FIG. 2

EP 2 443 947 A1

Description

Technical Field

5 **[0001]** The present invention relates to a non-combustion smoking article having a carbonaceous heat source.

Background Art

10 **[0002]** In recent years, a non-combustion smoking article by which flavor is enjoyed without combusting tobacco has been developed instead of a cigarette. A non-combustion smoking article comprises a heat source section that is a heat generating element attached to the tip portion, and a flavor generating section comprising a flavor generating material that comprises a suitable substrate and a flavor component that is retained thereon. As the heat source section, a carbonaceous heat source is mainly used.

15 **[0003]** Conventional carbonaceous heat sources comprise a plurality of through-holes that are formed in the axial direction, which are formed so as to function as air passages during heating of an aerosol generating section to exert the initial burning property (U.S. Patent Nos. 4,881,556, 4,967,774, 4,989,619, 4,991,606 and 5,067,499). Alternatively, there is an example in which a heat source section is formed into a special structure (U.S. Patent No. 5,183,062). These many carbonaceous heat sources for non-combustion smoking articles are wrapped with a cigarette wrapper or a heat insulating material. Furthermore, it is considered that conventional carbonaceous heat sources advantageously comprise
20 more than 60% by weight, preferably more than 80% by weight of carbon.

Disclosure of Invention

25 **[0004]** The conventional carbonaceous heat sources have been certainly improved in that they transmit heat to the aerosol generating section efficiently. However, a heat source composed of an injection-molded product of a heat source composition is an article that is solid except for a plurality of air passages, and thus is more difficult to be ignited as compared to general cigarettes. In addition, since a large amount of carbon is used, the carbonaceous heat source may shrink and drop off from the smoking article during burning. Furthermore, the heat source section is covered with a heat insulating material or the like in most cases so as to transmit heat to the aerosol generating section efficiently and prevent
30 dropping off.

[0005] Therefore, an object of the present invention is to provide a non-combustion smoking article that has a carbonaceous heat source with an improved ignition property, which is hard to drop off during smoking and does not require a wrapping material such as a heat insulating material on the circumference of the heat source.

35 **[0006]** According to the present invention, there is provided a non-combustion smoking article characterized by comprising: a carbonaceous heat source comprising a cylindrical outer wall and partitions disposed inside the outer wall, cross-sections of the partitions forming a grid, and having air passages defined by the partitions; and an aerosol generating section.

Brief Description of Drawings

40 **[0007]**

FIG. 1 shows end views of the carbonaceous heat sources used for the non-combustion smoking article according to the present invention.

45 FIG. 2 is a cross-sectional view of the non-combustion smoking article according to the present invention.

FIG. 3 is a graph showing the relationship between the passage perimeter per cross-sectional area of the carbonaceous heat source and the ignition ratio of the non-combustion smoking article in an example of the present invention.

50 FIG. 4 is a graph showing the relationship between the passage perimeter per cross-sectional area of the carbonaceous heat source and the ignition ratio of the non-combustion smoking article in another example of the present invention.

Best Mode for Carrying Out the Invention

55 **[0008]** Hereinafter the present invention will be described in detail.

[0009] The non-combustion smoking article according to the present invention comprises a carbonaceous heat source having a cylindrical outer wall and partitions disposed inside the outer wall, cross-sections of the partitions forming a grid, and having air passages defined by the partitions; and an aerosol generating section.

[0010] The above-mentioned grid may be of any shape, and examples may include a tetragonal grid, hexagonal grid and trigonal grid. FIG. 1 shows the end views of the carbonaceous heat sources having partitions formed into a grid, where numeral 1 shows a tetragonal grid, numeral 2 shows a trigonal grid, numeral 3 shows a hexagonal grid and numeral 1 shows a radial grid. Alternatively, as shown in the carbonaceous heat source of 5 in FIG. 1, the cross-sections of the partitions disposed in the carbonaceous heat source does not have to be formed in uniform grids, and may be formed so as to comprise unevenly distributed grids.

[0011] The porosity of the carbonaceous heat source can be set to 50% or more. As used herein, the "porosity of the carbonaceous heat source" means a ratio of spaces per cross-sectional area of the heat source that are produced by being defined by the partitions in the cross-section of the heat source. When the porosity is less than 50%, the ignition property during ignition tends to be not improved significantly. The upper limit of the porosity is limited by the design of a mold used in extrusion molding of the heat source composition. The porosity of the carbonaceous heat source is preferably from 50 to 78%, more preferably from 60 to 78%. The non-combustion smoking article of the present invention that has a carbonaceous heat source having such high porosity has an improved ignition property.

[0012] The passage perimeter of the carbonaceous heat source is preferably 70 mm or more. When the passage perimeter is less than 70 mm, the ignition property tends to be deteriorated. The upper limit of the passage perimeter is also limited by design of the mold. As used herein, the "passage perimeter" means, for example, a total of the lengths of the partitions 10 facing the air passages that constitutes grids on the end surface of the heat source shown in FIG. 1.

[0013] The passage perimeter of the carbonaceous heat source is preferably from 100 to 180 mm.

[0014] The cross-sectional area of the carbonaceous heat source is preferably 9 mm² or more. When the cross-sectional area is less than 9 mm², it is not preferable in view of designing of the product.

[0015] The passage perimeter per cross-sectional area of the carbonaceous heat source is preferably 4 mm/mm² or more. As is described in detail below, it has been found that a certain relationship is recognized between the passage perimeter per cross-sectional area and the ignition ratio. It has been found that the ignition property is made poor in a conventional ignition method when the passage perimeter per cross-sectional area is less than 4 mm/mm².

[0016] The heat source composition that constitutes the above-mentioned carbonaceous heat source preferably comprises from 10 to 60% by weight of carbon. When the amount of carbon is less than 10% by weight, it is not preferable since the heat source has poor combustibility. When 60% by weight of carbon is contained, both the ignition property and combustibility are sufficient. The origin of the carbon to be used is not specifically limited, and known carbon can be used. Thus, the heat source composition that constitutes the carbonaceous heat source used for the non-combustion smoking article of the present invention has a sufficient ignition ratio even the amount of the carbon is low as compared to conventional ones.

[0017] Furthermore, the heat source composition can include calcium carbonate (particles) for decreasing the maximum temperature of the carbonaceous heat source to decrease the amount of generated carbon monoxide, and other inorganic additives. The inorganic additive can be blended generally in a ratio up to 98% by weight, preferably in a ratio up to 8.0% by weight, more preferably in a ratio from 0.100 to 3.75% by weight, with respect to 1% by weight of carbon.

[0018] A binder is contained so as to bind the calcium carbonate and carbon. The binder can be blended generally in a ratio from 0.010 to 50% by weight, preferably in a ratio from 0.017 to 2.0% by weight, more preferably in a ratio from 0.10 to 0.75% by weight, with respect to 1% by weight of carbon. As the binder, alginates, carboxymethyl cellulose or salts thereof, pectin or salts thereof, carrageenan or salts thereof, guar gum and the like can be used.

[0019] The heat source composition can include an aerosol generating substance such as a polyhydric alcohol so as to facilitate generation of an aerosol in initial puffs. The aerosol generating substance that may be included in the heat source composition can be blended generally in a ratio up to 98% by weight, preferably in a ratio up to 3.0% by weight, more preferably in a ratio of 1.5% by weight with respect to 1% by weight of carbon.

[0020] Furthermore, the heat source composition can also comprise pulp, tobacco fine powder and the like. The pulp and tobacco fine powder can be blended generally in a ratio up to 98% by weight, preferably in a ratio up to 3.0% by weight, more preferably in a ratio of 0.50% by weight, in total, with respect to 1% by weight of carbon.

[0021] Moreover, for the carbonaceous heat source, a catalyst for carbon monoxide-reduction such as boron, aluminum, silicon, titanium, iron, cobalt, nickel, zinc, germanium, zirconium, niobium, molybdenum, ruthenium, rhodium, palladium, silver, tin, cerium, hafnium, tantalum, tungsten, rhenium, osmium, iridium, platinum, gold, oxides thereof or mixtures thereof can be blended in a raw material before molding for the carbonaceous heat source.

[0022] For the above carbonaceous heat source, it is also possible to coat a part or entirety of the surfaces in the axial direction of the air passages with a desired substance. Specifically, it is also possible to make the carbonaceous heat source substantially air-impermeable by coating it with a layer of particles.

It is desirable that the coating substance has a low heat conductance, is thermally stable, and is noncombustible even at a temperature at which the carbonaceous heat source burns. Examples of the preferable coating substance may include clay and metal oxide such as iron oxide, alumina, titania, silica, silica-alumina, zirconia, ceria, zeolite, zirconium phosphate, other ceramics, and combinations thereof.

It is desirable that such coating substances comprise clay or iron oxide. Furthermore, such coating substances can also

comprise a catalyst with a function to promote an oxidation reaction from carbon monoxide to carbon dioxide. Examples of these catalysts may include platinum, palladium, other transition metals, and oxides thereof.

[0023] In order to coat a part or entirety of the surfaces of the air passages in the axial direction with a desired substance, various methods such as those described in U.S. Patent No. 5,040,551 can be used.

For example, a solution or suspension of the coating substance can be sprayed, wetted or painted. Alternatively, a liner composed of the coating substance may be inserted into a part or entirety of the surfaces of the air passages in the axial direction. For example, a hollow tube that is substantially air-impermeable may be inserted in each air passage in the axial direction.

[0024] The carbonaceous heat source used for the non-combustion smoking article of the present invention burns while keeping the form of the partitions whose cross-sections constitute grids. The reason is considered that, as described above, the amount of the carbon in the heat source composition is more reduced than those in conventional ones. Therefore, even the heat source is not covered with a heat insulating material or the like as described below, drop-off of the heat source from the smoking article in smoking can be prevented.

[0025] The above-mentioned carbonaceous heat source can be molded by a molding means such as extrusion molding by using a mold that corresponds to desired grids. The carbonaceous heat source used in the present invention does not require disposing a heat insulating material or cigarette wrapper on the circumference of the carbonaceous heat source as in the case of general non-combustion smoking articles, sufficiently burns in a bared state, and is difficult to drop off. Therefore, a step for disposing a heat insulating material or the like on the circumference of the carbonaceous heat source can be omitted, and this is also very advantageous in costs.

[0026] The non-combustion smoking article of the invention can comprise an aerosol generating section, for example, in a form in which the aerosol generating section is physically separated from the carbonaceous heat source. As the aerosol generating substance included in the aerosol generating section, for example, polyhydric alcohols such as glycerin, propylene glycol, triethylene glycol and tetraethylene glycol; and aliphatic esters of carboxylic acids such as methyl stearate, dimethyl dodecanoate and dimethyl tetradecanoate can be used. The aerosol generating substance is generally supported by a suitable carrier. As the carrier, porous materials such as paper and activated carbon can be used. An aerosol generating material is adjusted by absorbing or adsorbing the aerosol generating substance on the porous material. Alternatively, a glucan gel such as Curdlan described in Japanese Patent No. 3118462 can be used as the support. Namely, the aerosol generating substance is added to in-water dispersion of a heat-irreversibly coagulated glucan, casted on, for example, a belt made of stainless steel in a form of a thin film sheet, and then dried under heating to gelatinize the glucan. The glucan gel retaining the aerosol generating substance can be shredded or pulverized and used as the aerosol generating material.

[0027] The aerosol generating section can be constituted by housing the aerosol generating material in which the aerosol generating substance is retained on the support in a cylindrical body that is formed by a noncombustible material such as a paper sheet comprising glass fibers and a paper sheet lined with a ceramic or metal foil.

[0028] The smoking article of the present invention can additionally comprise a flavor generating section comprising a flavor generating material on the rear end of the aerosol generating section so as to impart flavor to the aerosol generated from the aerosol generating section. As a flavor generating material, cut tobacco, or the flavor generating medium described in Japanese Patent No. 3118462 can be used. The flavor generating material is housed in a cylindrical body that is similar to the cylindrical body of the aerosol generating section.

[0029] Furthermore, the smoking article of the present invention may have a filter that is used for a general cigarette at the backmost end portion.

[0030] Hereinafter an example of the non-combustion smoking article using the carbonaceous heat source composed of the carbonaceous heat source composition of the present invention is described with reference to FIG. 2.

[0031] The smoking article 100 shown in FIG. 2 comprises an aerosol generating section 11, a carbonaceous heat source 12 that is disposed on the tip of the aerosol generating section 11, a flavor generating section 36 disposed on the rear end of the aerosol generating section 11, and a filter section 14 that is disposed on the rear end of the flavor generating section 36.

[0032] The aerosol generating section 11 has a cylindrical body 111 that is formed of a noncombustible material, and for example, a particulate aerosol generating material 112 composed of a support that supports an aerosol generating substance is housed in the cylindrical body 111.

[0033] The carbonaceous heat source 12 has a circular outer shape, and may be in various geometries of grids as described above.

[0034] Next, the flavor generating section 36 has a cylindrical body 361 formed by a noncombustible material, and a flavor generating material 362 is housed in the cylindrical body 361.

[0035] The filter section 14 is constituted by a filter unit 141 that is used for general cigarettes (for example, cellulose acetate fiber tow), and the circumference thereof is wrapped with a plug wrap 142.

[0036] The aerosol generating section 11, the flavor generating section 36 and the filter section 14 are connected by a paper sheet 20 such as a cigarette wrapper that covers the circumference of the rear end portion of the aerosol

generating section 11 and the entirety of the circumferences of the flavor generating section 36 and the filter section 14.

[0037] It should be noted that the smoking article 100 can have an opening for taking in air during smoking so as to dilute mainstream smoke components (for example, carbon dioxide). In the smoking article 100 shown in FIG. 2, the opening OP that penetrates the paper sheet 20 and plug wrapper 142 is formed on the filter section 14.

[0038] Such non-combustion smoking article 100 may have an appearance of a general cigarette.

[0039] Hereinafter the present invention will be described in detail with reference to Examples, but the present invention is not construed to be limited by these.

Example 1

[0040] The relationship between the porosity of the carbonaceous heat source, the passage perimeter of the carbonaceous heat source, the cross-sectional area of the heat source and the passage perimeter per cross-sectional area of the heat source, and ignition property is evaluated.

[0041] A heat source composition is prepared by using the same composition as that of a heat source composition used for a conventional non-combustion smoking article (trade name; AIRS, manufactured by Japan Tobacco, Inc.), i.e., 59.6% by weight of carbon particles, 12% by weight of calcium carbonate, 8.4% by weight of graphite and 10% by weight of tobacco fine powder, as raw materials. The heat source composition is shaped by using various molds so as to have different wall thicknesses of the partitions and intervals of grids, whereby the carbonaceous heat sources of Samples 1 to 6 having the geometries of the end surface as shown in Table 1 are prepared.

[Table 1]

Specifications and basic physical properties of various heat sources							
Level	Prior Art 1	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Geometry of cross section							
Porosity	21%*	30%	40%	50%	60%	70%	78%
Passage perimeter [mm]	25.0	69.4	77.6	104	116	124	126
Cross-sectional area of heat source [mm ²]	10.7	30.9	26.5	22.1	17.7	13.2	9.7
Length of air passage per cross-sectional area of heat source [mm/mm ²]	2.3	2.2	2.9	4.7	6.6	9.4	13.0
*Comparative Example 1: The glass mat portion is not included							

[0042] Next, the heat source and the heat insulating material surrounding the heat source are removed from the above-mentioned AIRS product, and each of the carbonaceous heat sources of Samples 1 to 6 prepared as described above is inserted. Namely, the constitution of the smoking article except for the heat source is the same as that of the AIRS product.

Conventional Example 1

[0043] The above-mentioned non-combustion smoking article having a trade name of AIRS, manufactured by Japan Tobacco, Inc., is used as Conventional Example 1.

[0044] An ignition test is conducted as follows. The article is preheated with an electric lighter for 3 seconds, and is puffed by 35 ml/2 sec. The article is then puffed again after 58 seconds (namely, a smoking cycle of 60 seconds), and at that time, whether or not the entirety of the heat source glows is determined by visual observation, and the article that glows is evaluated as "ignitable" and the article that does not glow is evaluated as "not ignitable". For Samples 1 to 6 and Conventional Example 1, tests are conducted by using ten smoking articles for each sample, of which the number of the articles that are determined to be "ignitable" is defined as A, and an ignition ratio is calculated from "Ignition ratio = $A/10 \times 100(\%)$ ".

[0045] In the analysis of the ignition ratio, an ignition ratio with respect to the passage perimeter per cross-sectional area of the carbonaceous heat source is studied. The results are shown in FIG. 3. The circles show the ignition ratios of the carbonaceous heat sources of Samples 1 to 6, and the triangle shows the ignition ratio of the carbonaceous heat source of Conventional Example 1. Under the conditions, little difference is observed in the ignition ratios of Samples 1 and 2 from that of Conventional Example 1, whereas the ignition ratio is significantly improved to about 60% in Sample 3. Namely, it is found that designing of the respective parameters of the carbonaceous heat sources shown in Table 1 is important for improving the ignition property. Furthermore, it is found that the porosity and passage perimeter can be increased significantly as compared to a carbonaceous heat source having a conventional opening pattern, and the ignition property is improved as a result, by using a carbonaceous heat source having air passages that are defined by partitions having cross-sections constituting grids.

Example 2

[0046] In order to determine only the effect of the grid number (passage perimeter) among the respective parameters shown in the above-mentioned Table 1, tests are conducted by varying the passage perimeter while the porosity and the cross-sectional area of the heat source are kept constant.

[0047] Heat source compositions that are similar to Samples 1 to 6 are prepared, and the carbonaceous heat sources of Samples 7 to 11 as shown in Table 2 are prepared by using various molds. Namely, the passage perimeter is varied by changing the combination of the wall thicknesses and intervals of the grids so that the cross-sectional area of the heat source and the porosity are made constant.

[Table 2]

Specifications and basic physical properties of various heat sources					
Level	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Geometry of cross section					
Porosity	65%	65%	65%	65%	65%
Passage perimeter [mm]	73	94	121	151	172
Cross-sectional area of heat source [mm ²]	15.5	15.5	15.5	15.5	15.5
Length of air passage per cross-sectional area of heat source [mm/mm ²]	4.7	6.1	7.8	9.8	11.1
Openings of grids: Coarse → Fine					

[0048] Next, the heat source and the heat insulating material surrounding the heat source are removed from the AIRS product, and each of the prepared heat sources of Samples 7 to 11 is inserted. Namely, the constitution of the non-combustion smoking article except for the heat source is the same as that of the AIRS product.

[0049] In this Example, as an ignition property test, the article is preheated with an electric lighter for 2 seconds, and is puffed by 35 ml/2 sec. Since the carbonaceous heat sources in Example 2 are readily ignited and thus a difference is hard to be produced under the conditions in Example 1, the time for preheating is shortened from 3 seconds to 2 seconds so as to make the ignition ratio different.

[0050] FIG. 4 shows the relationship of the ignition ratio against the passage perimeter per cross-sectional area of the carbonaceous heat source. Here, the cases where 2 seconds and 3 seconds are used as times for preheating are shown respectively. As can be seen from FIG. 4, the ignition ratio in the case where the preheating is performed for 3 seconds is sufficiently high as 60% or more. Furthermore, in the articles for which the time for preheating is shortened to 2 seconds, a relationship in which the ignition ratio is increased according to increase in the "passage perimeter per cross-sectional area of the heat source" is confirmed as in Samples 1 to 6. In addition, it is also found that it is effective for improvement of the ignition property to increase the passage perimeter by reducing the thicknesses of the partitions as possible, and to narrow the intervals of the grids to increase the number of the grids, under conditions that the cross-sectional area of the heat source and the porosity are made almost constant.

Claims

1. A non-combustion smoking article **characterized by** comprising: a carbonaceous heat source comprising a cylindrical outer wall and partitions disposed inside the outer wall, cross-sections of the partitions forming a grid, and having air passages defined by the partitions; and an aerosol generating section.
2. The non-combustion smoking article according to claim 1, **characterized in that** the carbonaceous heat source has a porosity of 50% or more.
3. The non-combustion smoking article according to claim 1, **characterized in that** the carbonaceous heat source has a passage perimeter of 70 mm or more, the passage perimeter being a total of the lengths of the partitions facing the air passages.
4. The non-combustion smoking article according to claim 1, **characterized in that** the carbonaceous heat source has a cross-sectional area of 9 mm² or more.
5. The non-combustion smoking article according to claim 1, **characterized in that** the passage perimeter per cross-sectional area of the carbonaceous heat source is 4 mm/mm² or more.
6. The non-combustion smoking article according to claim 1, **characterized in that** a carbon content of a heat source composition constituting the carbonaceous heat source ranges from 10 to 60% by weight.

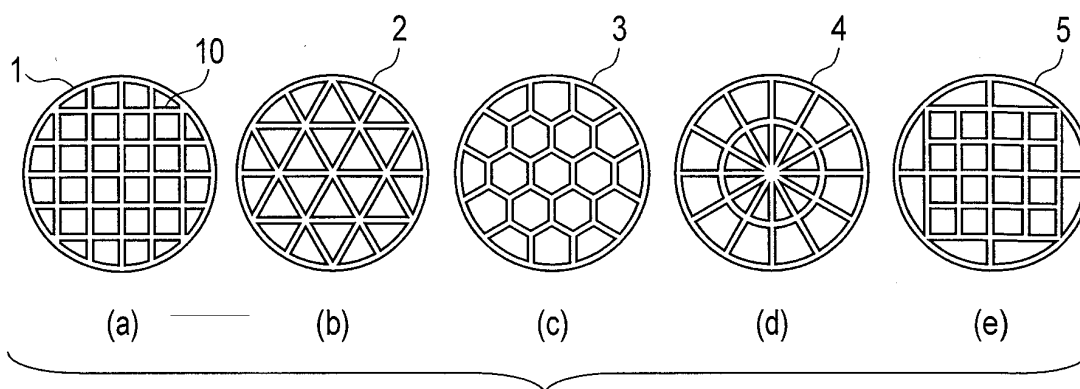


FIG. 1

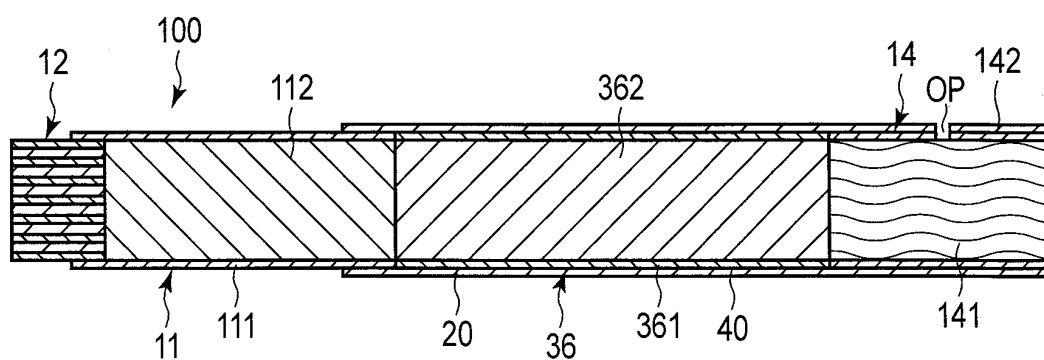


FIG. 2

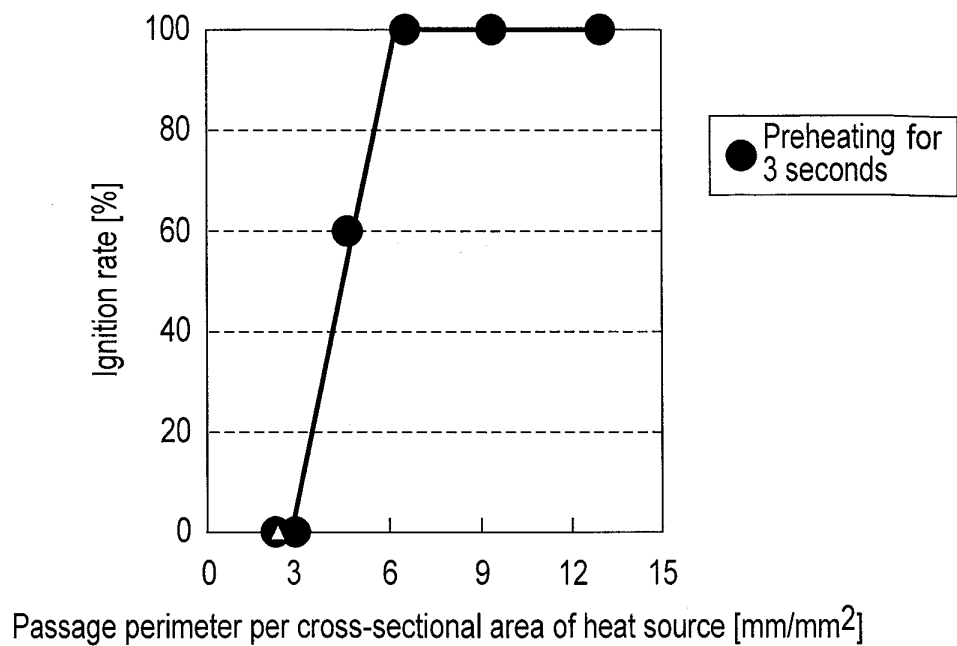


FIG. 3

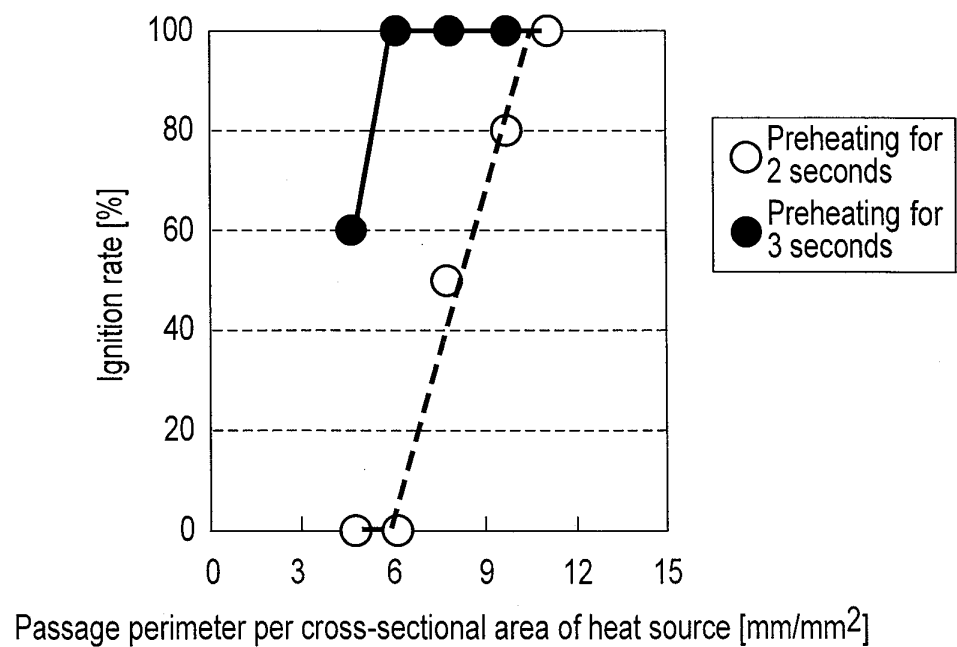


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/061125

A. CLASSIFICATION OF SUBJECT MATTER A24F47/00 (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) A24F47/00		
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) WPI		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☒ 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 15 September, 2009 (15.09.09)		Date of mailing of the international search report 29 September, 2009 (29.09.09)
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/061125

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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