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(54) **TOW BAND FOR ELECTRONIC CIGARETTE TIP, ELECTRONIC CIGARETTE TIP, AND PRODUCTION METHOD OF TOW BAND FOR ELECTRONIC CIGARETTE TIP**

(57) Provided is a band for a heated tobacco product tip, the band being a cellulose acetate band formed by layering and crimping a plurality of filaments in a bundle

shape. Each of the filaments has a hollow cross-sectional shape with a core part hollowed and a peripheral portion surrounding the core part.

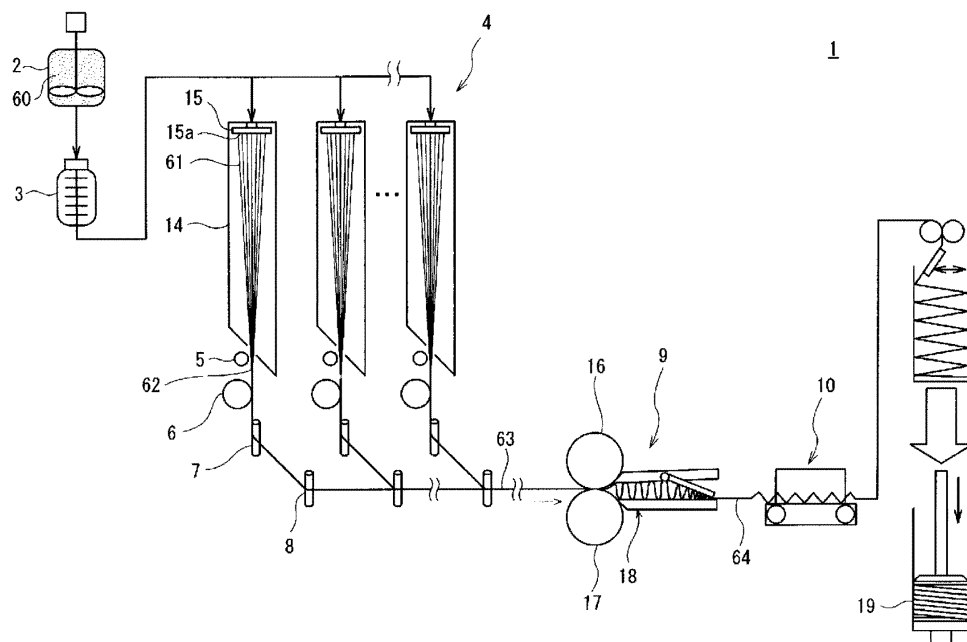


FIG. 1

Description

Technical Field

5 **[0001]** The present invention relates to a band for a heated tobacco product tip, a heated tobacco product tip, and a method of producing a band for a heated tobacco product tip.

Background Art

10 **[0002]** In the present specification, terms defined as described below are used. TD: An abbreviation for total denier, which refers to the denier (the number of grams per 9000 m) of an assembly of tows (bands).

[0003] FD: An abbreviation for a single fiber denier (filament denier), which refers to the denier (the number of grams per 9000 m) of a single fiber (one piece of filament). Also referred to as the single fiber denier.

15 **[0004]** Filament: A continuous long fiber. In particular, the term filament refers to a single fiber extruded from a spinneret hole of a spinneret.

[0005] Spinneret hole (orifice): A hole formed in a spinneret of a cabinet, and from which a filament is extruded (spun).

[0006] Band: A product formed by layering and crimping tows, which are an assembly of filaments (single fibers) extruded from each of a plurality of cabinets, with the TD set to a predetermined value. The tows that are layered with the TD set to a predetermined numeric value are crimped. The crimped tows (assembly of filaments) are called a band.
20 That is, the band has a TD and a crimp-index. The band is packed in a bale form.

[0007] Tow: An assembly of a plurality of filaments extruded from spinneret holes. An end and a yarn are each an aspect of the tow.

[0008] End: An assembly of filaments having a predetermined total denier formed by layering a plurality of filaments extruded from spinneret holes of a plurality of cabinets.

25 **[0009]** Yarn: A bundle of filaments extruded from one cabinet. Thus, the yarn is an assembly of filaments before layering.

[0010] Feret area: An index that can be used to evaluate the shape-irregularity of a cross section of a filament. The Feret area is obtained as follows: at any position of the filament, the filament is cut in a direction perpendicular to the long-axis direction of the filament to obtain a cross section of the filament. A parallelogram circumscribing this cross section is then imagined. In this imaginary parallelogram, one of two pairs of opposite sides is formed by two parallel lines that circumscribe the cross section of the filament and have an inter-line distance that is a maximum value (a so-called "maximum Feret diameter"). In this imaginary parallelogram, the other pair of the two pairs of opposite sides is two parallel lines that circumscribe the cross-section of the filament and have an inter-line distance that is a minimum value (what is called a "minimum Feret diameter"). The Feret area is an area ratio determined by dividing the cross-sectional area of the filament by the area of the imaginary parallelogram, or in other words, is the occupancy ratio of the filament cross section in the imaginary parallelogram.
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[0011] Tip: A filter through which tobacco components are passed when a user smokes a cigarette or uses a heated tobacco product. The tip is configured, for example, by forming a predetermined air-permeable material into a rod shape, and winding a rolled paper around the outer circumference thereof.

[0012] Filaments made from cellulose acetate, and particularly cellulose diacetate, are useful as a material for tips of cigarettes, including heated tobacco products. In such an application, cellulose acetate bands configured from crimped filaments of long-fiber cellulose acetate are used.
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[0013] The band used in a cigarette tip is required to have an appropriate amount of pressure drop (PD). For this reason, Patent Document 1 for example discloses, as a band used in a cigarette tip, a band in which the pressure drop is adjusted by setting the filament denier to a value not less than 5.0 and setting the Feret area of the filament to a value not less than 0.5.
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[0014] In recent years, heated tobacco products have become popular. As disclosed in, for example, Patent Document 2, an aerosol-generating article includes a substrate containing a volatile component that is a tobacco component, a heating element that is configured to heat the substrate, a cooling element that is configured to cool and condensate volatile components from the heated substrate to form an aerosol, and a tip for filtering the aerosol that has passed through the cooling unit.
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[0015] The tip is held in the mouth of the smoker during use of the heated tobacco product. The tip is produced, for example, using a cellulose acetate band (hereinafter, also referred to simply as a band). In this case, the filaments of the band are opened, a plasticizer is applied thereto, and the material is molded into a rod shape. Then, a rolled paper is wound around the outer circumference of the molded article of the band, and the molded article and rolled paper are cut to a predetermined size to thereby produce the tip.
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Citation List

Patent Document

5 **[0016]**

Patent Document 1: WO 2015/136573

Patent Document 2: JP 2015-503335 A

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Summary of Invention

Technical Problem

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[0017] In heated tobacco products, the tobacco components are contained in the aerosol, and therefore the filtration degree of the aerosol at the tip is preferably low so that a smoker can easily inhale and savor the aerosol that has passed through the tip. Also, in heated tobacco products, the pressure drop of the tip is preferably low to allow the smoker to easily inhale the aerosol.

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[0018] With a heated tobacco product, it is also desirable to obtain an inhalation sensation that is close to that of a normal cigarette. Thus, the tip of the heated tobacco product preferably has an appropriate level of hardness like the tip of an ordinary cigarette.

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[0019] Here, when the number of filaments of the band included in the tip is reduced in order to suppress a pressure drop in the tip and the filtration degree of the aerosol, the hardness of the tip is reduced. This makes it difficult for a user to experience an inhalation sensation like that of a normal cigarette, and may cause the aerosol to pass through the tip while the temperature of the aerosol is not sufficiently cooled.

[0020] Therefore, an object of the present invention is to enable the suppression of the pressure drop and filtration degree of the aerosol while also suppressing a reduction in hardness of a heated tobacco product tip.

Solution to Problem

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[0021] In a heated tobacco product tip, the aerosol collides with the filaments of the band and is collected. Here, from research by the present inventors, it was found that the aerosol collecting capacity of a filament is approximately equivalent to the aerosol collecting capacity of an imaginary filament having the imaginary parallelogram described above as a cross-sectional shape. As the shape-irregularity of the cross section of the filament increases, the Feret area decreases, and the aerosol collection performance of the filament increases. Also, as the shape-irregularity of the cross section of the filament decreases, the Feret area increases, and the aerosol collection performance of the filament decreases. The following aspects of the present invention were accomplished on the basis of such perspectives.

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[0022] To solve the problems described above, a band for a heated tobacco product tip according to one aspect of the present invention is a cellulose acetate band formed by layering and crimping a plurality of filaments in a bundle shape with each filament having a hollow cross-sectional shape with a core portion hollowed and a peripheral portion surrounding the core portion.

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[0023] According to the above configuration, the filament has a hollow cross-sectional shape, and therefore the Feret area can be increased compared to filaments having, for example, a Y-shaped cross section. This configuration enables adjustment of the shape-irregularity of the filaments to an appropriate value. Thus, in a heated tobacco product tip using a band containing the filaments thereof, the filtration degree of the aerosol can be appropriately suppressed, and the amount of aerosol that is collected can be reduced. Also, adjustment of the shape-irregularity of the filaments to an appropriate value improves flow of gas in the heated tobacco product tip, and can suppress a pressure drop of the heated tobacco product tip.

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[0024] Also, the number of filaments of the band included in the heated tobacco product tip need not be reduced in order to suppress the filtration degree of the aerosol, and therefore a decrease in hardness of the heated tobacco product tip due to a reduction in the number of filaments can be suppressed.

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[0025] Moreover, for a given cross-sectional area of the filament, the diameter of the filament can be larger than that of a filament having a solid core portion, and therefore the bending moment of the filament can be increased. Thereby, the rigidity of the filament can be increased, and a decrease in hardness of the tip can be favorably suppressed.

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[0026] The filament denier may be set to a value in a range of not less than 5.0 and less than 30.0. With this configuration, a gap between fibers can be prevented from becoming excessively large. Thus, for example, the matter of a foreign substance entering into the gap between fibers and passing therethrough can be prevented. Also, if capsules containing a flavor component are dispersed in the heated tobacco product tip, fragments of the capsules are prevented from

flowing through the gap between fibers, and the contents of the capsules are prevented from passing through the tip all at once. Setting the filament denier to such a value also prevents the aerosol from flowing through the gap between fibers and passing through the tip without being sufficiently cooled.

[0027] An opening portion that communicates with the core portion from the outside may be formed in the peripheral portion. Additionally, a porosity (%) represented by $(L1 / L0) \times 100$ is set to a value in a range of not less than 0 and not greater than 20. Herein, L0 is a circumferential length of the peripheral portion in a cross section of the filament, and L1 is a circumferential length of the opening portion in the cross section of the filament. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the filament can be easily adjusted.

[0028] The circumferential length of the opening portion in the cross section of the filament may be set to a value in a range of not greater than 1/3 of the diameter of the filament. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the filament can be easily adjusted, and the rigidity of the filament can be easily ensured.

[0029] A total denier may be set to a value in a range of not less than 5000 and not greater than 50000. With this configuration, the number of filaments during crimping is set to a relatively large number, and thereby each filament can be stably crimped.

[0030] A heated tobacco product tip according to one aspect of the present invention is provided with a molded article formed by molding any of the bands described above into a rod shape, and a rolled paper wound around the circumferential surface of the molded article.

[0031] According to the above configuration, with the band described above, a heated tobacco product tip can be favorably realized with a suppressed pressure drop and a suppressed filtration degree of the aerosol while a decrease in hardness is suppressed.

[0032] A method for producing a band for a heated tobacco product tip according to one aspect of the present invention includes spinning a plurality of filaments, and layering and crimping in a bundle shape the plurality of filaments that have been spun, and in the spinning, filaments are spun with each of the filaments having a hollow cross-sectional shape with a core portion hollowed and a peripheral portion surrounding the core portion.

[0033] According to the above method, each of the filaments that are spun in the spinning has a hollow cross-sectional shape, and therefore the Feret area can be increased compared to a filament having a Y cross-section, for example. With this configuration, the shape-irregularity of the filaments can be adjusted to an appropriate value. Thus, in a heated tobacco product tip using a band containing the filaments thereof, the filtration degree of the aerosol can be appropriately suppressed, and the amount of aerosol that is collected can be reduced. Also, adjusting the shape-irregularity of the filaments to an appropriate value improves flow of gas in the heated tobacco product tip, thereby suppressing a pressure drop of the heated tobacco product tip.

[0034] Also, the number of filaments of the band included in the heated tobacco product tip need not be reduced to suppress the filtration degree of the aerosol, and therefore a decrease in hardness of the heated tobacco product tip due to a reduction in the number of filaments can be suppressed.

[0035] Moreover, for a given cross-sectional area of the filament, the diameter of the filament can be larger than that of a filament having a solid core portion, and therefore the bending moment of the filament can be increased. Thereby, the rigidity of the filament can be increased, and a decrease in hardness of the tip can be favorably suppressed.

[0036] The filaments that are spun in the spinning may be filaments having a filament denier that is set to a value in a range of not less than 5.0 and less than 30.0. With this configuration, the matter of the gap between fibers becoming excessively large in the band after production can be prevented. Thus, for example, the matter of a foreign substance entering into the gap between fibers and passing therethrough can be prevented. Also, if capsules containing a flavor component are dispersed in the heated tobacco product tip, fragments of the capsules are prevented from flowing through the gap between fibers, and the contents of the capsules are prevented from passing through the tip all at once. Setting the filament denier to such a value also prevents the aerosol from flowing through the gap between fibers and passing through the tip without being sufficiently cooled.

[0037] The filaments that are spun in the spinning may be filaments each having an opening portion that is formed in the peripheral portion and communicates with the core portion from the outside. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the filament can be easily adjusted.

[0038] In the spinning, each of the filaments may be spun by extruding, in an atmosphere set at a temperature in a range of not lower than 40°C and not higher than 80°C, a spinning dope from an orifice having a circular edge shape.

[0039] With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the each of the filaments can be easily adjusted, and by adjusting the temperature while using a typical spinning device, the filaments each having a hollow cross-sectional shape with a core portion hollowed and a peripheral portion surrounding the core portion can be favorably spun.

[0040] In the spinning, each of the filaments may be spun by extruding the spinning dope from an orifice having an edge shape with a notch in a part of the edge. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of each of the filaments can be easily adjusted by extruding the spinning dope from an orifice having an edge shape with a notch in a part of the edge. In addition, when a typical spinning device replaced with the spinneret

having an orifice of the shape described above is used, filaments each having a hollow cross-sectional shape and with a core portion hollowed and a peripheral portion surrounding the core portion can be favorably spun.

[0041] In the spinning, each of the filaments having a porosity (%), represented by $(L1 / L0) \times 100$, set to a value in a range of not less than 0 and not greater than 20 may be spun. Herein, L0 is a circumferential length of the peripheral portion in a cross section of the filament after production, and L1 is a circumferential length of the opening portion in the cross section of the filament after production. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the filament can be easily adjusted.

[0042] In the spinning, the filaments may be spun with the each of the filaments having, in a cross section after production, a circumferential length of the opening portion set to a value in a range of not greater than 1/3 of the diameter of the filament. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the filament can be easily adjusted, and the rigidity of the filament can be easily ensured.

[0043] In the spinning, the filaments may be spun, with a total denier set to a value in a range of not less than 5000 and not greater than 50000. With this configuration, the number of filaments during crimping is set to a relatively large number, and thereby each filament can be stably crimped.

Advantageous Effects of Invention

[0044] According to each aspect of the present invention, the pressure drop and filtration degree of the aerosol can be suppressed while a decrease in the hardness in the heated tobacco product tip being suppressed.

Brief Description of Drawings

[0045]

FIG. 1 is an overall view of a band production apparatus according to a first embodiment.

FIG. 2 is a cross-sectional view of a cellulose acetate filament of FIG. 1.

FIG. 3 is an overall view of a tip production apparatus according to the first embodiment.

FIG. 4 is a cross-sectional view of a heated tobacco product according to the first embodiment.

FIG. 5 is a diagram for describing cave-in of a heated tobacco product tip.

FIG. 6 is a front view of an orifice formed in a spinneret according to a second embodiment.

FIG. 7 is a front view of an orifice formed in a spinneret according to a third embodiment.

FIG. 8 is a cross-sectional view of a cellulose acetate filament spun by the orifice of FIG. 7.

FIG. 9 is a front view of an orifice formed in a spinneret according to a fourth embodiment.

FIG. 10 is a cross-sectional view of a cellulose acetate filament spun by the orifice of FIG. 9.

Description of Embodiments

[0046] Various embodiments of the present invention are described with reference to the drawings.

(First Embodiment)

[Cellulose Acetate Band Production Apparatus]

[0047] FIG. 1 is an overall view of a cellulose acetate (hereinafter, also referred to as CA) band production apparatus 1. FIG. 2 is a cross-sectional view of a CA filament 61 of FIG. 1. As illustrated in FIG. 1, the CA band production apparatus 1 spins CA filaments 61 by dry spinning. Furthermore, the CA band production apparatus 1 produces, from the CA filaments 61, a yarn 62, an end 63, and a CA band 64.

[0048] The CA band production apparatus 1 is provided with a mixing device 2, a filtering device 3, a spinning unit 4, a lubrication unit 5, a godet roll 6, guide pins 7, 8, a crimping device 9, and a drying device 10.

[0049] In the CA band production apparatus 1, a spinning dope 60 is used in which CA flakes such as cellulose diacetate are dissolved in an organic solvent at a predetermined concentration (for example, a weight concentration value in a range of not less than 20 wt.% and not greater than 30 wt.% of the spinning dope 60).

[0050] The spinning dope 60 is mixed using the mixing device 2, and then filtered by a filtering device 3. The spinning dope 60 that has passed through the filtering device 3 is extruded from a plurality of orifices 15a of a spinneret 15 provided on a cabinet 14 of the spinning unit 4.

[0051] The orifice 15a has a circular edge shape. The diameter of the orifice 15a is set, as appropriate, in accordance with the FD of the CA filament 61 after production. The spinning dope 60 extruded from each orifice 15a is heated at an atmospheric temperature (temperature inside the cabinet 14) in a range of not lower than 40°C and not higher than 80°C

and the organic solvent vaporized, by hot air supplied into the cabinet 14 from a drying unit (not illustrated), whereby the spinning dope 60 is dried. The temperature of the hot air blown into the cabinet 14 is set to a value in a range of not lower than 70°C and not higher than 80°C, for example. With this configuration, a solid CA filament 61 is formed.

[0052] Here, the cross-sectional shape of the produced CA filament 61 varies depending on the relationship between an evaporation rate and a diffusion rate, the evaporation rate being defined as the rate at which the organic solvent evaporates from the surface of the spinning dope 60 that has passed through the orifice 15a, and the diffusion rate being defined as the rate at which the organic solvent diffuses to the surface of the spinning dope 60 from the center in the radial direction of the spinning dope 60 that has passed through the orifice 15a.

[0053] When an evaporation surface area defined as the surface area of the spinning dope 60 that has passed through the orifice 15a is relatively large, the evaporation rate becomes faster than the diffusion rate. In this case, after the surface of the spinning dope 60 has solidified and a skin layer has been formed, the organic solvent diffuses from the inside to the surface of the spinning dope 60. As a result, the cross-sectional shape of the CA filament 61 after production easily becomes irregular.

[0054] In the present embodiment, the cross-sectional shape of the spinning dope 60 immediately after passing through the orifice 15a is circular. When the temperature of the atmosphere inside the cabinet 14 is set to the range described above, the diffusion rate increases at a portion in the circumferential direction in a cross section of the spinning dope 60, and the organic solvent diffuses from the center in the radial direction of the spinning dope 60 toward the surface of the spinning dope 60.

[0055] As a result, internal drying of the spinning dope 60 proceeds via the portion in the circumferential direction as the skin layer is formed. As illustrated in FIG. 2, consequently, though shape-irregularity is suppressed as a whole, a portion of the filament corresponding to the portion of the spinning dope 60 in the circumferential direction caves in towards the radial center of the spinning dope 60, making the cross-sectional shape of the CA filament 61 to be C-shape.

[0056] Here, as presented in Comparative Example 1 described below, in a case where the orifice has a circular edge shape, the excessively high temperature of the hot air blown into the cabinet 14 (in other words, the maximum temperature of the atmosphere in the cabinet 14) may increase the Feret area, and reduce the shape-irregularity of the CA filaments, for example. As a result, the cross-sectional shape of the CA filament to be spun is different from the cross-sectional shape of the CA filament 61.

[0057] Note that the disclosure of the Patent Document 2 can be referenced for details regarding the basic method for spinning the CA filaments 61 having a target shape by adjusting the value of the Feret area of the CA filament 61.

[0058] As illustrated in FIG. 1, a plurality of the CA filaments 61 that have passed through one cabinet 14 are gathered by the guide pins 7, 8, thereby forming a yarn 62. After the lubricant is applied by the lubrication unit 5, the yarn 62 is wound by the godet roll 6. The yarn 62 is then taken up by a predetermined winding device.

[0059] A series of units for producing the yarn 62, namely, the spinning unit 4 that extrudes the spinning dope 60 from the spinneret 15 and spins the CA filaments 61, the drying unit, the lubrication unit 5, and a winding unit having the godet roll, is collectively referred to as a station. Typically, a plurality of stations are arranged in a line.

[0060] The yarn 62 is taken up from the circumferential surface of the godet roll 6 by the winding device. The yarn 62 that has passed through each station is conveyed along the arrangement direction of the stations and sequentially accumulated or stacked. With this configuration, a plurality of the yarns 62 are layered to form an end (a tow) 63, which is a flat assembly of the yarns 62. The end 63 is formed by layering the plurality of yarns 62, and is set to a predetermined TD. The end 63 is conveyed and guided to a crimping device 9.

[0061] The crimping device 9 has a pair of nip rolls 16, 17 and a stuffing box (crimping box) 18. The end 63 is passed between the pair of nip rolls 16, 17, and then pushed into the stuffing box 18. The pair of nip rolls 16 pushes the end 63 into the stuffing box 18 with a force larger than the resistance that occurs when the end 63 is pushed into the stuffing box 18, and thereby crimping is imparted to the end 63. The CA band 64 is thus produced.

[0062] The CA band 64 that has passed through the crimping device 9 is dried with the drying device 10. The CA band 64 that has passed through the drying device 10 is accumulated and then subjected to compression packing in a packaging container 19 to form a bale. FIG. 1 illustrates a cross-sectional structure of the packaging container 19.

[0063] As illustrated in FIG. 2, the CA filament 61 included in the CA band 64 has a hollow cross-sectional shape with a core portion 61a hollowed and a peripheral portion 61b surrounding the core portion 61a. As one example, this hollow cross-sectional shape is annular. Here, the term annular is not limited to a perfect circle in which the circumference is completely closed, and also includes a circular ring in which a portion of the circumference is open, or a circular ring in which the shape is slightly distorted. As an example, the CA filament 61 of the present embodiment has an opening portion 61c that is formed in the peripheral portion 61b and communicates with the core portion 61a from the outside.

[0064] In this manner, the method for producing the CA band 64 of the present embodiment includes spinning a plurality of CA filaments 61, and layering and crimping a plurality of spun CA filaments 61 in a bundle shape.

[0065] In the spinning, the CA filament 61 having a hollow cross-sectional shape and with a core portion 61a hollowed and a peripheral portion 61b that surrounds the core portion 61a is spun. Furthermore, in the spinning, as one example, the spinning dope 60 is extruded from the orifice 15a having a circular edge shape, in an atmosphere set to a temperature

in a range of not lower than 40°C and not higher than 80°C, and thereby a CA filament 61 is spun with an opening portion 61c that communicates with the core portion 61a from the outside and is formed in the peripheral portion 61b.

[0066] Also as an example, in the spinning, a CA filament 61 with a porosity (%) defined by $(L1 / L0) \times 100$ is set to a value in a range of not less than 0 and not greater than 20 is spun. Here, L0 is a circumferential length of the peripheral portion 61b in a cross section of the CA filament 61 after production, and L1 is a circumferential length of the opening portion 61c in the cross section of the CA filament 61 after production.

[0067] Also as an example, in the spinning, the CA filament 61 is spun to have, in a cross section of the CA filament 61 after production, a circumferential length of the opening portion 61c set to a value in a range of not greater than 1/3 of the diameter of the CA filament 61. Also as an example, in the spinning, the CA filament 61 is spun to have a total denier set to a value in a range of not less than 5000 and not greater than 50000.

[0068] Production of the CA filament 61 by the method described above results in a value of the porosity (%) defined by $(L1 / L0) \times 100$ in a range of not less than 0 and not greater than 20. Additionally, production of the CA filament 61 by the method described above results in the circumferential length of the opening portion 61c in the cross section of the CA filament 61 in a range of not greater than 1/3 of the diameter of the CA filament 61.

[0069] The FD of the CA band 64 is set to a value in a range of not less than 5.0 and less than 30.0. Moreover, the TD of the CA band 64 is set to a value in a range of not less than 5000 and not greater than 50000. The Feret area of the CA filament 61 is set to a value less than 0.7.

[0070] Here, the circumferential length L1 can be set as appropriate, and is preferably set to a value in a range of not greater than 1/4 the diameter of the circumferential length L0, and is more preferably set to a value in a range of not greater than 1/5 the diameter of the circumferential length L0. The value of the FD of the CA filament 61 can be set as appropriate, but is preferably a value in a range of not less than 7.0 and not greater than 28.0, and more preferably a value in a range of not less than 8.0 and not greater than 20.0.

[0071] Note that the peripheral portion 61b of the CA filament 61 may be closed, and therefore the opening portion 61c need not be provided. That is, the CA filament 61 may be a hollow fiber. In other words, the core portion 61a of the CA filament 61 may be isolated from the outside in the radial direction of the CA filament 61.

[Tip Production Apparatus]

[0072] FIG. 3 is an overall view of a tip production apparatus 20 according to an embodiment. As illustrated in FIG. 3, the tip production apparatus 20 is provided with a layering ring 21, a first filament opening unit 22, a turn baffle 23, a second filament opening unit 24, a pair of pre-tension rolls 25, a pair of first filament opening rolls 26, a pair of second filament opening rolls 27, a third filament opening unit 28, a plasticizer application device 29, a pair of conveying rolls 30, a transport jet 31, a transport stuffer unit 32, and a cutting device 33. FIG. 3 illustrates a cross-sectional structure of the packaging container 19.

[0073] In the tip production apparatus 20, after the CA band 64 fed out from the packaging container 19 has been passed through the layering ring 21, the CA band 64 is subjected to filament opening in the width direction by pressurized air in the first filament opening unit 22. The CA band 64 is then guided by the turn baffle 23.

[0074] Next, after the CA band 64 is subjected to further filament opening in the width direction using pressurized air at the second filament opening unit 24, the filaments of the CA band 64 are opened in the conveyance direction thereof by passing the CA band 64 between the pair of pre-tension rolls 25, the pair of first filament opening rolls 26, and the pair of second filament opening rolls 27, in this order.

[0075] The CA band 64 that has passed between the pair of second filament opening rolls 27 is further opened in the width direction by pressurized air at the third filament opening unit 28, and then a plasticizer is applied by the plasticizer application device 29.

[0076] The CA band 64 that has passed through the plasticizer application device 29 is passed between the pair of conveying rolls 30, after which capsules 74 (see FIG. 4) are added by a predetermined addition device. The CA band 64 is then introduced into the transport jet 31 and conveyed into the transport stuffer unit 32 by a jet air flow.

[0077] The transport stuffer unit 32 has a funnel 41, a tongue 42, and a garniture 43. The CA band 64 conveyed into the transport stuffer unit 32 is spirally wound at the funnel 41 and molded into a rod shape. As a result, a molded article 65 is formed in which the CA band 64 is molded into a rod shape.

[0078] Also, the rolled paper 40 is guided toward the molded article 65 by the tongue 42. The molded article 65 is conveyed by the garniture 43, and the rolled paper 40 is wound around the molded article 65. Then, the rolled paper is fixed on the outer circumference of the molded article 65. The cutting device 33 cuts the molded article 65 at intervals. With this configuration, a plug 66 is produced. The plug 66 is further cut, and a tip 67 is produced.

[Heated Tobacco Product Tip]

[0079] FIG. 4 is a cross-sectional view of a heated tobacco product 50 according to an embodiment. As illustrated in

FIG. 4, the heated tobacco product 50 has a long shape and is provided with a heated tobacco product unit 51 and an aerosol generating article 52. The heated tobacco product unit 51 has an enclosure 53, a power supply 54, a display unit 55, a control unit 56, a heating unit 57, and an operation unit 58.

[0080] The enclosure 53 is formed in a long shape. The power supply 54, the control unit 56, and the heating unit 57 are housed in the enclosure 53. The display unit 55 and the operation unit 58 are disposed on an outer surface of the enclosure 53 (here, a side surface of the enclosure 53, which is on the far side of the enclosure 53 in the view). In the present embodiment, the shape of the enclosure 53 is a straight tubular shape in which one end in the longitudinal direction of the heated tobacco product unit 51 is closed.

[0081] The control unit 56 is connected to the power supply 54, the display unit 55, and the heating unit 57 by a wire 68. The control unit 56 is, as one example, a single-chip microcomputer, and accepts operation input by the smoker from the operation unit 58. With this configuration, the control unit 56 is configured to control the power supply circuit of the heated tobacco product unit 51 to supply power of the power supply 54 to the heating unit 57 at a predetermined timing, or to stop the supply of power to the heating unit 57. The control unit 56 is configured to control the display unit 55 to display predetermined information for the smoker.

[0082] As one example, the power supply 54 is a secondary battery, and is a lithium ion battery in the present embodiment. The display unit 55 is an LCD, but may also be configured to not display characters. If the display unit 55 does not display characters, the display unit 55 may be a lamp such as an LED lamp, for example.

[0083] The heating unit 57 is configured to heat the substrate 70 of the aerosol generating article 52 using power supplied from the power supply 54. The heating unit 57 is disposed in the heated tobacco product unit 51 such that it is in contact with the substrate 70. The heating unit 57 of the present embodiment has a blade 70a, which is inserted into the substrate 70 and is configured to heat the substrate 70 internally by Joule heat. A path 59 is provided between the enclosure 53 and the heating unit 57. The path 59 is configured to flow outside air toward the substrate 70 from a gap between an insertion port 51a and the aerosol generating article 52 when the heated tobacco product 50 is in use.

[0084] The aerosol generating article 52 is inserted into the insertion port 51a formed in the other end of the heated tobacco product unit 51 in the longitudinal direction, during use of the heated tobacco product 50. The aerosol generating article 52 has a rod-like shape, and has the substrate 70, a separator pipe 71, an aerosol generating unit 72, a tip 67, and a rolled paper 73. In the aerosol generating article 52, the substrate 70, the separator pipe 71, the aerosol generating unit 72, and the tip 67 are arranged in this order from one end to the other end of the aerosol generating article 52 in the longitudinal direction. The rolled paper 73 is integrally wrapped around the outer circumference of these elements 66, 70, 71, and 72.

[0085] The substrate 70 is disposed at one end of the aerosol generating article 52 in the longitudinal direction. The substrate 70 contains a volatile component that is a tobacco component, and is inserted into the interior of the heated tobacco product unit 51 from the insertion port 51a of the heated tobacco product unit 51. The substrate 70 is heated by the heating unit 57 when the heated tobacco product 50 is in use, and thereby a volatile component is generated.

[0086] The substrate 70 contains a flavoring material, e.g. nicotine, that generates a volatile component. Specifically, the substrate 70 preferably includes at least any of tobacco leaves, tobacco ribs, expanded tobacco, homogenized tobacco, and herbal leaves. These materials may be included, for example, in a solid form, such as in any shape including a narrow fragment, a powder, a thread, or a band, or may be included in the form of a liquid, or may be included in both solid and liquid forms. When the material is included in the form of a liquid, the liquid of the material may be encapsulated in a capsule. Such capsules are heated and melted during use of the heated tobacco product 50.

[0087] The substrate 70 may also include a flavoring material other than nicotine. The flavoring material may be held on a thermally stable carrier. The flavoring material may also be held on the carrier in the form of a sheet, foam, gel, or slurry. The flavoring material may also be uniformly contained in the entire substrate 70 or may be contained unevenly in the substrate 70.

[0088] The separator pipe 71 extends in the longitudinal direction of the aerosol generating article 52 and is disposed between the substrate 70 and the aerosol generating unit 72, and thereby functions as a separator separating the substrate 70 and the aerosol generating unit 72. With this configuration, when the aerosol generating article 52 is inserted into the interior of the heated tobacco product unit 51 from the insertion port 51a, the separator pipe 71 prevents the aerosol generating article 52 from being compressed in the longitudinal direction, and the substrate 70 from being crushed to the extent of contact with the aerosol generating unit 72.

[0089] The separator pipe 71 of the present embodiment is formed into a hollow rod shape. In the hollow portion of the separator pipe 71, the volatile components generated from the substrate 70 when the heated tobacco product 50 is in use flow towards the tip 67. As an example, the separator pipe 71 is constituted from cellulose diacetate, but is not limited thereto, and may be constituted from other materials such as polypropylene.

[0090] The aerosol generating unit 72 extends in the longitudinal direction of the aerosol generating article 52 and is configured to generate the aerosol by cooling and condensing volatile components, which are from the substrate 70 and have passed through the separator pipe 71.

[0091] The aerosol generating unit 72 may include, for example, a band-shaped sheet body wound in the circumferential

direction of the aerosol generating article 52, or a band-shaped sheet body that is finely folded up with each fold extending in the longitudinal direction of the aerosol generating article 52. In the aerosol generating unit 72, a flow path for aerosol is formed by a gap between the wound or finely folded-up sheet bodies.

[0092] The sheet body of the aerosol generating unit 72 may include, for example, any material such as polyethylene, polypropylene, polyvinyl chloride, PETG (high strength polyethylene terephthalate (polyethylene terephthalate copolymer)), polylactic acid, cellulose acetate, starch-based polyester, porous paper, aluminum foil, and the like. Considering that the aerosol generating article 52 is a disposable article, the sheet body is preferably constituted from a material such as a biodegradable polylactic acid or porous paper.

[0093] The tip 67 of the present embodiment is produced by the tip production apparatus 20 using the CA band 64 produced by the CA band production apparatus 1. The tip 67 is disposed at the other end of the aerosol generating article 52 in the longitudinal direction.

[0094] The tip 67 includes a molded article 65 and a rolled paper 40 wound around the circumferential surface of the molded article 65. The tip 67 is held in the mouth of the smoker when the heated tobacco product 50 is in use, and filters the aerosol that has passed through the aerosol generating unit 72. As an example, capsules 74 containing a flavoring component or the like are dispersed inside the tip 67, but the tip 67 need not contain the capsules 74.

[0095] Here, the inhalation sensation of the heated tobacco product is preferably close to that of a normal cigarette. Thus, similar to the tip of a normal cigarette, the tip 67 is constituted by a CA band 64 formed by layering and crimping a plurality of CA filaments 61 in a bundle shape.

[0096] The length of the tip 67 (the dimension of the tip 67 in the insertion direction with respect to the insertion port 51a of the heated tobacco product 50) can be set as appropriate, and for example, is set to a value in a range of not less than 5 mm and not greater than 35 mm, for example. In addition, the length of the tip 67 can be set to a value in a range with a lower limit of any one of 5 mm, 7 mm, or 10 mm and an upper limit of any one of 17 mm, 20 mm, 25 mm, 28 mm, 30 mm, or 35 mm.

[0097] The pressure drop (PD) of the tip 67 is proportional to the length of the tip 67. Therefore, the pressure drop of the tip 67 to be produced can be calculated by comparing the length of the tip 67 to the length of a tip 67 with a known pressure drop. The circumferential length of the tip 67 can be set as appropriate, and as one example, is set to a value greater than 19 mm as an example. In the present embodiment, the circumferential length is set to 24.5 mm.

[0098] When using the heated tobacco product 50, a smoker inserts the aerosol generating article 52 into the interior of the heated tobacco product unit 51 from the insertion port 51a and operates the operation unit 58 to turn on the heated tobacco product unit 51.

[0099] As a result, the control unit 56 controls the power supply circuit to heat the heating unit 57 by the power from the power supply 54. When a predetermined amount of time has passed while the heating unit 57 is heated to a predetermined temperature, the control unit 56 is configured to notify the smoker through the display unit 55 that the heated tobacco product 50 can be smoked.

[0100] The smoker then holds the tip 67 in the smoker's mouth and inhales, and thereby volatile components volatilized from the substrate 70 heated by the heating unit 57 flow through the separator pipe 71. The volatile components that have passed through the separator pipe 71 are cooled and condensed when flowing through the gap of the aerosol generating unit 72. As a result, an aerosol (droplets) containing volatile components is generated.

[0101] Aerosol that has passed through the aerosol generating unit 72 is properly filtered in the tip 67 and inhaled by the smoker. The collision of the aerosol with the CA band 64 used in the tip 67 further reduces the temperature of the aerosol, which is then inhaled by the smoker.

[0102] Here, the CA filament 61 contained in the tip 67 has a hollow cross-sectional shape, and therefore the Feret area of the CA filament 61 can be increased compared to filaments having, for example, a Y-shaped cross section. As a result, the shape-irregularity of the CA filament 61 can be adjusted to an appropriate value. Thus, with the tip 67 that uses a CA band 64 containing the CA filaments 61, the filtration degree of the aerosol can be appropriately suppressed, and the amount of aerosol that is collected can be reduced. In addition, adjusting the shape-irregularity of the CA filament 61 to a suitable value improves flow of gas within the tip 67, thereby suppressing the PD of the tip 67.

[0103] Also, the number of CA filaments 61 of the CA band 64 included in the tip 67 need not be reduced to suppress the filtration degree of the aerosol, and therefore a decrease in hardness of the tip 67 due to a reduction in the number of CA filaments 61 can be suppressed.

[0104] Moreover, for a given cross-sectional area of the filament, the diameter of the CA filament 61 can be larger than that of a filament having a solid core portion, and therefore the bending moment of the CA filament 61 can be increased. Thereby, the rigidity of the CA filament 61 can be increased, and a decrease in hardness of the tip 67 can be favorably suppressed.

[0105] The filament denier is set to a value in a range of not less than 5.0 and less than 30.0, thereby preventing the gap between fibers from being excessively large. Thus, for example, the matter of a foreign substance entering into the gap between fibers and passing therethrough can be prevented. Also, if the capsules 74 containing a flavoring component are dispersed in the tip 67, fragments of the capsules 74 are prevented from flowing through the gaps between fibers,

and the contents of the capsules 74 are prevented from passing through the tip 67 all at once. Setting the filament denier to such a value also prevents the aerosol from flowing through the gap between fibers and passing through the tip 67 without being sufficiently cooled.

[0106] In addition, in the CA filament 61, an opening portion 61c that communicates with the core portion 61a from the outside is formed in the peripheral portion 61b. The porosity (%) of the CA filament 61 is set to a value in a range of not less than 0 and not greater than 20. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the CA filament 61 can be easily adjusted.

[0107] Moreover, the circumferential length L1 of the CA filament 61 is set to a value in a range of not greater than 1/3 of the diameter of the CA filament 61. With this configuration, the surface area, cross-sectional area, and cross-sectional shape of the CA filament 61 can be easily adjusted, and the rigidity of the CA filament 61 can be easily ensured.

[0108] The total denier may be set to a value in a range of not less than 5000 and not greater than 50000. Thus, the number of filaments during crimping is set to a relatively large number, and thereby each filament can be stably crimped.

[0109] Furthermore, with the tip 67, the use of the CA band 64 described above can realize a heated tobacco product tip in which the pressure drop and filtration degree of the aerosol are suppressed while a decrease in hardness is also suppressed.

[0110] In a heated tobacco product tip, capsules may be included as in the present embodiment. However, the inclusion of capsules may increase the PD. In the tip 67 of the present embodiment, the use of the CA filament 61 suppresses the PD, and therefore the PD is less likely to increase even if the capsules 74 are included in the CA band 64. Accordingly, the addition of the capsule 74 can enhance the design flexibility of the tip 67.

[0111] Furthermore, the shape of the cross section of the CA filament 61 is annular, and the plurality of CA filaments 61 in the tip 67 are in surface contact with each other at the circumferential surface and firmly bonded to each other by a plasticizer. As a result, the tip 67 has better strength and hardness compared to a tip in which a plurality of filaments having a typical Y-shaped cross section are bonded.

[0112] Furthermore, in the spinning, the CA filament 61 which has the opening portion 61c that communicates with the core portion 61a from the outside, the opening portion 61c being formed in the peripheral portion 61b, is spun, and therefore the surface area, cross-sectional area, and cross-sectional shape of the CA filament 61 can be easily adjusted.

[0113] Also, in the spinning, the CA filament 61 is spun by extruding the spinning dope 60 from the orifices 15a having a circular edge shape, in an atmosphere set at a temperature in a range not lower than 40°C and not higher than 80°C. As a result, the surface area, cross-sectional area, and cross-sectional shape of the CA filament 61 can be easily adjusted, and by adjusting the temperature while using a typical spinning device, the CA filaments 61 can be favorably spun.

[Tip cave-in]

[0114] FIG. 5 is a diagram for describing the cave-in of a heated tobacco product tip 167. The heated tobacco product tip 167 is configured by winding a rolled paper 40 around a crimped band 164 that has been formed into a rod shape as described above. Inside the rolled paper 40, a force that expands in the radial direction of the tip 167 and a force that contracts in the axial direction of the tip 167 act on the band 164.

[0115] Here, in a case where the force that the band 164 expands in the radial direction of the tip 167 is sufficiently large, the band 164 is pressed against the inner circumferential surface of the rolled paper 40, and thereby generating a frictional force. The frictional force causes the band 164 to counter the contraction force of the tip 167 in the axial direction, thereby preventing a positional deviation of the band 164 with respect to the rolled paper 40.

[0116] However, in a case where the force that the band 164 expands in the radial direction of the tip 167 is small, the frictional force generated by the band 164 being pressed against the inner circumferential surface of the rolled paper 40 also decreases. As illustrated in FIG. 5, a decrease in frictional force makes it difficult for the band 164 to counter the contraction force of the tip 167 in the axial direction. As a result, cave-in may occur when both end surfaces of the band 164 in the axial direction of the tip 167 shift inward relative to the both ends of the rolled paper 40 in the axial direction of the tip 167.

[0117] Such problems become significant when the shape-irregularity of the filaments of the band 164 become too small, for example, when the amount of the bands 164 packed into the tip 167 is reduced in order to suppress the PD of the tip 167.

[0118] In contrast, the CA filament 61 of the present embodiment has the cross-sectional shape described above, thereby maintaining the appropriate shape-irregularity. As a result, the pressure drop in the tip 67 is reduced, and therefore a good inhalation sensation can be obtained even without reducing the amount of CA bands 64 packed into the tip 67. Thus, the frictional force generated by the CA band 64 being pressed against the inner circumferential surface of the rolled paper 40 is not too small, and the cave-in described above can be prevented. Accordingly, the tip 67 can be produced with excellent appearance while maintaining a constant level of quality.

[0119] A heated tobacco product tip has a shorter length than an ordinary cigarette tip. Therefore, in a case where

capsules are to be included in the tip, when the packing amount of the band in the tip is low, cave-in may occur, and it may be difficult to uniformly arrange the capsules in the length direction of the tip. However, in the present embodiment, cave-in of the tip 67 is prevented, and therefore the capsules 74 can be evenly arranged in the longitudinal direction of the tip 67. Another embodiment will be described below focusing on differences from the first embodiment.

(Second Embodiment)

[0120] FIG. 6 is a front view of an orifice 115a formed in a spinneret 115 according to a second embodiment. According to the second embodiment, in the spinning, the spinning dope 60 is extruded from the orifice 115a having an edge shape with a notch 115b in a part of the edge, and thereby the CA filament 61 (see FIG. 2) is spun with the opening portion 61c that communicates with the core portion 61a from the outside, the opening portion 61c being formed in the peripheral portion 61b.

[0121] The orifice 115a has an edge shape corresponding to a boundary of a shape enclosed by line segments corresponding to two radius r_1 and an arc M therebetween, in a first imaginary circle having the radius r_1 and centered on a point O1. As an example, a center angle θ of the orifice 115a is set to a value (240° in the present embodiment) in a range of greater than 180° and less than 270° .

[0122] With this type of production method as well, a CA filament 61 similar to that of the first embodiment can be obtained. In addition, the surface area, cross-sectional area, and cross-sectional shape of the CA filament 61 can be easily adjusted by extruding the spinning dope 60 from the orifices 115a having an edge shape with a notch 11b in a part of the edge. Furthermore, when a typical spinning device, in which the spinneret is replaced with the spinneret having an orifice of the shape described above, is used, CA filament 61 having a hollow cross-sectional shape and with a core portion 61a hollowed and a peripheral portion 61b surrounding the core portion 61a can be favorably spun.

(Third Embodiment)

[0123] FIG. 7 is a front view of a orifice 215a formed in a spinneret 215 according to a third embodiment. The orifice 215a has a cross section, an edge shape of the cross section corresponding to a boundary of a remaining portion of a second imaginary circle centered on a point O2, the remaining portion being formed by linearly cutting out a portion of the second imaginary circle. As a result, the edge shape of the orifice 215a has a notch 215b in a part of the edge. A distance D1 between one end and the other end of the notch 215b is smaller than a diameter D2 of the second imaginary circle. As an example, the distance D1 is set to a value in a range of greater than $1/2$ of the diameter $D/2$ and less than $4/5$ of diameter D2.

[0124] FIG. 8 is a cross-sectional view of a CA filament 161 spun by the orifice 215a in FIG. 7. The filament 161 has a cross section, an edge shape of the cross section corresponding to a boundary of a remaining portion of a third imaginary circle having a radius r_2 and centered on a point O3, the remaining portion being formed by cutting out a portion of a periphery of the third imaginary circle by a fourth imaginary circle of a diameter D4. In this edge shape, an open end of the portion cut out by the fourth imaginary circle has a smooth curved shape. The radius r_2 is greater than the diameter D4. With this configuration, the filament 161 has a core portion 161a hollowed and an opening portion 161c.

(Fourth Embodiment)

[0125] FIG. 9 is a front view of an orifice 315a formed in a spinneret 315 according to a fourth embodiment. The orifice 315a has an edge shape corresponding to a boundary of an overall shape formed by each of the following remaining portions, the remaining portions being disposed to maximize an area of the overall shape while aligning linear edge portions of each remaining portions to be in mutually parallel. The remaining portions include: a remaining portion formed by linearly cutting out a portion of a fifth imaginary circle centered on a point O4; a remaining portion formed by linearly cutting out a portion of a sixth imaginary circle centered on a point O5; and a remaining portion formed by linearly cutting out a portion of a seventh imaginary circle centered on a point O6.

[0126] A diameter D6 of the fifth imaginary circle is greater than a diameter D7 of the sixth imaginary circle and greater than a diameter D8 of the seventh imaginary circle. As a result, the edge shape of the orifice 315a is smooth as a whole and has a notch 315b in a part of the edge. As an example, the diameter D7 and the diameter D8 are the same.

[0127] FIG. 10 is a cross-sectional view of a CA filament 261 spun by the orifice 315a of FIG. 9. Similar to the CA filament 61, the CA filament 261 has a hollow cross-sectional shape with a core portion 261a hollowed and a peripheral portion 261b that surrounding the core portion 261a. The CA filament 261 has an opening portion 261c. Thus, even when the orifice 315a is used, a CA filament 261 having the same cross-sectional shape as that of the first embodiment can be obtained.

(Confirmation Test)

[0128] A confirmation test will be described next, but the present invention is not limited to the examples introduced below.

[0129] A CA filament 61 according to Example 1 was produced through the following procedure. Namely, first, cellulose diacetate having an average degree of acetylation of 55.2% was dissolved in acetone and a spinning dope 60 having a concentration of approximately 25 mass% was prepared.

[0130] The spinning dope 60 was then supplied to the spinneret 15 of the first embodiment with the spinning dope 60 adjusted to a temperature from 50 to 60°C. The spinning dope 60 was extruded into the cabinet 14 from the orifices 15a of the spinneret 15, the orifices 15a having a circular edge shape, and CA filaments 61 having an FD of 8.6 and a cross-sectional shape as illustrated in FIG. 2 (C-shape) were spun. The temperature of the atmosphere inside the spinning cabinet 14 was set to a value in a range of not lower than 40°C and not higher than 80°C.

[0131] An oil emulsion was applied by a lubrication unit 5 to a yarn 62 discharged from the cabinet 14, and the yarn 62 was wound by a godet roll 6. An end 63 formed by layering the yarns 62 was crimped by a crimping device 9 and dried by a drying device 10. As a result, a CA band 64 of Example 1 was obtained.

[0132] A CA filament according to Comparative Example 1 was obtained in the same manner as Example 1 with the exception that the temperature at which hot air was blown into the cabinet 14 and the temperature of the atmosphere inside the cabinet 14 were set to each of the values shown in Table 1. As a result, the cross-sectional shape of the CA filament of Comparative Example 1 was set to a shape with a Feret area of 7.7 (hereinafter, also referred to as an "R" shape). Using this CA filament, a band of Comparative Example 1 was obtained with the same method as that of Example 1.

[0133] A CA filament according to Comparative Example 2 was obtained in the same manner as Example 1 with the exception that a spinneret having orifices having a triangular edge shape was used, and the temperature at which hot air was blown into the cabinet 14 and the temperature of the atmosphere inside the cabinet 14 were set to each of the values shown in Table 1. As a result, the cross-sectional shape of the CA filament of Comparative Example 2 was set to a Y-shape. Using this CA filament, a band of Comparative Example 2 was obtained with the same method as that of Example 1.

[Feret Area]

[0134] Filament samples were prepared from the CA bands of Example 1 and Comparative Examples 1 and 2 through the following procedure. Namely, fiber bundles were partially picked from the CA band, the fiber bundles were arranged as a long core, and the outer circumference of the core was embedded with paraffin. The filament samples thus prepared were cut with a microtome to a thickness in a range of not thinner than 1 μm and not thicker than 10 μm , and sample slices were obtained.

[0135] The sample slices were observed under an optical microscope ("BX-51", available from Olympus Corporation), and images obtained from the observation were input into an image processing device. In the image processing device, an imaginary parallelogram circumscribing a cross section of one CA filament included in the image was set, and the cross-sectional area of the CA filament and the area of the imaginary parallelogram were measured. The Feret area of the CA filament was calculated from the measurements obtained for the cross-sectional area of the CA filament and the area of the imaginary parallelogram.

[S/W Ratio]

[0136] The sample slices of Example 1 and Comparative Examples 1 and 2 were observed using the optical microscope, and the images obtained by the observation were input into the image processing device. A cross-sectional area S of one CA filament included in the image and a maximum dimension W, a maximum value of the diameter in the cross-section were measured with the image processing device. The maximum dimension W was the dimension at which the linear distance across the cross section was the greatest. The S/W ratio of the CA filament was calculated from the measurements for the cross-sectional area S and the maximum dimension W of the CA filament.

[Pressure Drop]

[0137] Filter rod (plug) samples were prepared using the CA bands of Example 1 and Comparative Examples 1 and 2 through the following procedure. Namely, the CA bands of Example 1 and Comparative Examples 1 and 2 produced using the CA band production apparatus were gathered to a bundle with a predetermined diameter using a tip production apparatus. Each CA band was molded into a rod shape, a rolled paper was wound around the outer circumference thereof, and the rolled paper was fixed to the CA band, and thereby a filter rod sample was obtained.

[0138] The filter rod sample was set to a length of the rod of 140 mm, a circumferential length of 22.62 mm, and a packing amount (net tow weight) of 0.52 g/rod. The produced filter rod sample was stored in an air-conditioned room set to a temperature of 20°C and a humidity of 65% for 24 hours to thereby acclimate the filter rod sample.

[0139] Next, air adjusted to a temperature of $22 \pm 1^\circ\text{C}$ and a humidity of $60 \pm 10\%$ was passed longitudinally through the filter rod sample at a flow rate of 17.5 cc per second. The pressure difference [mmWG] (millimeter water gauge) between both ends of the filter rod sample at this time was measured as the pressure drop. Note that the filter rod sample did not have a through-hole penetrating through the rolled paper.

[Nicotine Filtration Rate]

[0140] Cigarette samples were prepared from the CA bands of Example 1 and Comparative Examples 1 and 2 through the following procedure. Specifically, each filter rod sample was cut in the radial direction, and a tobacco leaf portion of a cigarette with a filter ("Peace Light" available from Japan Tobacco Inc.) was connected to the cut piece to thereby fabricate a cigarette sample having a tip (length of 25 mm).

[0141] This cigarette sample was smoked using a rotary smoking machine ("MR20D", available from Borgwaldt KC), and the volatile components containing nicotine were filtered through a Cambridge filter placed on the tip of the cigarette sample and on a mouth-end side. The total amount of volatile components from the tobacco leaf portion in the cigarette sample was measured from the weight difference of the tip and the Cambridge filter before and after smoking.

[0142] Thirty ml of methanol and 4 mL of an anethole (0.65 g)/methanol (1000 mL) mixed solution were mixed, the tip and the Cambridge filter were immersed in the mixture and subjected to an ultrasonic waves for 30 minutes using an ultrasonic washer, and the volatile components were extracted. The moisture content in each of the extracts was measured using a moisture meter ("Karl Fischer Moisture Meter (model CA-06)" available from Nippon Sokki Co., Ltd.).

[0143] The amount of nicotine was measured using a gas chromatograph ("GC-2014 Gas Chromatograph" available from Shimadzu Corporation). Using the following equation, the nicotine filtration rate was calculated from the measurements obtained for the total volatile component amount, water content, and amount of nicotine. Nicotine Filtration Rate = $\text{FTN}/(\text{FTN} + \text{CFN})$

[0144] FTN is the amount of nicotine at the tip, and CFN is the amount of nicotine at the Cambridge filter.

[Filament Rigidity]

[0145] The secondary (bending) moment of the CA filaments was calculated from the images of the sample slices of Example 1 and Comparative Examples 1 and 2. The secondary moment was calculated by calculating the area of the CA filament appearing in the image, and then multiplying a coefficient to the square of the calculated area.

[Packing Amount]

[0146] The packing amount of the CA band was measured when the tips of the cigarette samples of Example 1 and Comparative Examples 1 and 2 were produced. Table 1 shows the CA band properties, the filter rod sample (cigarette sample) properties, and measurement results for Examples 1 and Comparative Examples 1 and 2. In Table 1, the rigidity of the CA filament and the amount of the CA band packed into the tip are denoted as relative values with respect to the values of Comparative Example 2.

[Table 1]

	Example 1	Comparative Example 1	Comparative Example 2
Hot air blowing temperature (°C)	Values in a range not lower than 70 and not higher than 80	97	97
Temperature (°C) of atmosphere in cabinet	Values in a range not lower than 40 and not higher than 80	Values in a range not lower than 50 and not higher than 97	Values in a range not lower than 50 and not higher than 97
Cross-sectional shape of CA filament	FIG. 2	R-shape	Y-shaped
Feret area	0.58	0.71	0.42
S/W (when FD is 8.6)	21	23	17

(continued)

	Example 1	Comparative Example 1	Comparative Example 2
PD (mmWG)	Equivalent to Comparative Example 1	97	150
Nicotine filtration rate (%)	Equivalent to Comparative Example 1	20	28.5
CA filament rigidity (when Comparative Example 2 is 15)	12	10	15
Packing amount (when Comparative Example 2 is 100)	110	120	100

[0147] As shown in Table 1, the Feret area of Example 1 was found to be a value between the Feret areas of Comparative Example 1 and Comparative Example 2. It was also found that the PD and nicotine filtration rates of Example 1 were both equivalent to the values of Comparative Example 1, and were significantly suppressed compared to the values of Comparative Example 2.

[0148] In Example 1, it is thought that the suppression of the Feret area compared to Comparative Example 1 resulted in an improvement in the flow of the aerosol inside the tip 67 and in a reduction in the PD and nicotine filtration rate.

[0149] The CA filament 61 of Example 1 exhibited a rigidity value that was between the rigidity values of the CA filaments of Comparative Example 1 and Comparative Example 2, and the packing amount of Example 1 was found to be a value between the packing amounts of Comparative Example 1 and Comparative Example 2.

[0150] From these results, in Example 1, the rigidity of the CA filament 61 was greater than the rigidity of the CA filament of Comparative Example 1, and therefore it is thought that the CA filament 61 can be favorably crimped while preventing the occurrence of cracking or fluffing (flying) of the CA filament 61 when crimping is performed, and that the hardness of the tip 67 can be maintained at a high level.

[0151] Furthermore, in Example 1, it is thought that the relatively low PD made it possible to achieve a packing amount that was greater than the packing amount of Comparative Example 2 and comparable to the packing amount of Comparative Example 1. It is also thought that as a result, in Example 1, it was possible to favorably maintain the hardness of the tip 67 while preventing the occurrence of cave-in.

[0152] Next, a CA filament 61 of Example 2 was obtained in the same manner as in Example 1 with the exception that the spinneret 115 illustrated in FIG. 6 was used, and the temperature at which hot air was blown into the cabinet 14 and the temperature of the atmosphere inside the cabinet 14 were set to the values shown in Table 2.

[0153] A CA filament 161 according to Example 3 was obtained in the same manner as in Example 1 with the exception that the spinneret 215 illustrated in FIG. 7 was used, and the temperature at which hot air was blown into the cabinet 14 and the temperature of the atmosphere inside the cabinet 14 were set to the values shown in Table 2.

[0154] A CA filament 261 according to Example 4 was obtained in the same manner as Example 1 with the exception that the spinneret 315 illustrated in FIG. 9 was used, and the temperature at which hot air was blown into the cabinet 14 and the temperature of the atmosphere inside the cabinet 14 were set to the values shown in Table 2. The maximum diameter of the orifices, the FD, and the diameter of the CA filaments set in Examples 2 to 4 are shown in Table 2.

[Table 2]

	Example 2	Example 3	Example 4
Hot air blowing temperature (°C)	97	Values in a range not lower than 70 and not higher than 80	97
Temperature (°C) of atmosphere in cabinet	Values in a range not lower than 50 and not higher than 97	Values in a range not lower than 40 and not higher than 80	Values in a range not lower than 50 and not higher than 97
Maximum diameter (μm) of orifice	120	70	143
Edge shape of orifice	FIG. 6	FIG. 7	FIG. 9

(continued)

	Example 2	Example 3	Example 4
Cross-sectional shape of CA filament	FIG. 2	FIG. 8	FIG. 10
FD	15	7	20
Diameter (μm) of CA filament	45	25	45

[0155] As shown in Table 2, from the results of Examples 2 to 4, it was confirmed that the CA filaments 61, 161 and 261 were spun with an FD set to a value in a range of not less than 7 and not greater than 20 and a diameter set to a value in a range of not smaller than 25 μm and not greater than 45 μm .

[0156] The present invention is not limited to these embodiments, and the configuration and the method thereof can be changed, added, or deleted within a scope that does not depart from the spirit of the present invention. In the first embodiment, the CA band 64 was used in the tip 67. However, the CA band 64 may be used in a configuration other than the tip 67 of the aerosol generating article 52 (for example, in at least a portion of the separator pipe 71 or aerosol generating unit 72).

Industrial Applicability

[0157] As described above, the present invention has an excellent effect of being able to suppress the pressure drop and the filtration degree of the aerosol while suppressing a decrease in the hardness in a heated tobacco product tip. Accordingly, the present invention is beneficial in a broad range of applications that can exhibit the significance of this effect including in a band for a heated tobacco product tip, a heated tobacco product tip, and a method for producing a heated tobacco product tip band.

Reference Signs List

[0158]

15a, 115a, 215a, 315a Orifice
 40 Rolled paper
 50 Heated tobacco product
 61, 161, 261 CA filament
 61a, 161a, 261a Core portion
 61b, 261b Peripheral portion
 61c, 161c, 261c Opening portion
 64 CA band
 65 Molded article
 67 Heated tobacco product tip
 115b, 215b, 315b Notch

Claims

1. A band for a heated tobacco product tip, the band being a cellulose acetate band formed by layering and crimping a plurality of filaments in a bundle shape, wherein each of the filaments has a hollow cross-sectional shape with a core portion hollowed and a peripheral portion surrounding the core portion.
2. The band for a heated tobacco product tip according to claim 1, wherein a filament denier is set to a value in a range of not less than 5.0 and less than 30.0.
3. The band for a heated tobacco product tip according to claim 1 or 2, wherein an opening portion that communicates with the core portion from outside is formed in the peripheral portion.

4. The band for a heated tobacco product tip according to claim 3, wherein a porosity (%) defined by $(L1 / L0) \times 100$ is set to a value in a range of not less than 0 and not greater than 20, L0 being a circumferential length of the peripheral portion in a cross section of the filament after production, and L1 being a circumferential length of the opening portion in the cross section of the filament after production.
5. The band for a heated tobacco product tip according to claim 3 or 4, wherein the circumferential length of the opening portion in the cross section of the filament is set to a value in a range of not greater than 1/3 of the diameter of the filament.
6. The band for a heated tobacco product tip according to any one of claims 1 to 5, wherein a total denier is set to a value in a range of not less than 5000 and not greater than 50000.
7. A heated tobacco product tip comprising:
 - a molded article formed by molding the band described in any one of claims 1 to 6 into a rod shape; and
 - a rolled paper wound around a circumferential surface of the molded article.
8. A method for producing a band for a heated tobacco product tip, the method comprising:
 - spinning a plurality of filaments; and
 - layering and crimping, in a bundle shape, the plurality of filaments that have been spun; wherein in the spinning, the filaments are spun, each of the filaments having a hollow cross-sectional shape with a core portion hollowed and a peripheral portion surrounding the core portion.
9. The method for producing a band for a heated tobacco product tip according to claim 8, wherein in the spinning, the filaments are spun, each of the filaments having a filament denier set to a value in a range of not less than 5.0 and less than 30.0.
10. The method for producing a band for a heated tobacco product tip according to claim 8 or 9, in the spinning, the filaments are spun, each of the filaments having an opening portion that communicates with the core portion from outside and is formed in the peripheral portion.
11. The method for producing a band for a heated tobacco product tip according to claim 10, wherein, in the spinning, the filaments are spun by extruding a spinning dope from an orifice having a circular edge shape, in an atmosphere set at a temperature in a range of not lower than 40°C and not higher than 80°C.
12. The method for producing a band for a heated tobacco product tip according to claim 10, wherein, in the spinning, the filaments are spun by extruding the spinning dope from an orifice having an edge shape with a notch in a part of the edge.
13. The method for producing a band for a heated tobacco product tip according to any one of claims 10 to 12, wherein, in the spinning, the filaments are spun, each of the filaments having a porosity (%) defined by $(L1 / L0) \times 100$ that is set to a value in a range of not less than 0 and not greater than 20, L0 being a circumferential length of the peripheral portion in a cross section of the filament after production, and L1 being a circumferential length of the opening portion in the cross section of the filament after production.
14. The method for producing a band for a heated tobacco product tip according to any one of claims 10 to 13, wherein, in the spinning, the filaments are spun, each of the filaments having, in a cross section of the filament after production, a circumferential length of the opening portion set to a value in a range of not greater than 1/3 of the diameter of the filament.
15. The method for producing a band for a heated tobacco product tip according to any one of claims 8 to 14, wherein, in the spinning, the filaments are spun, each of the filaments having a total denier set to a value in a range of not less than 5000 and not greater than 50000.

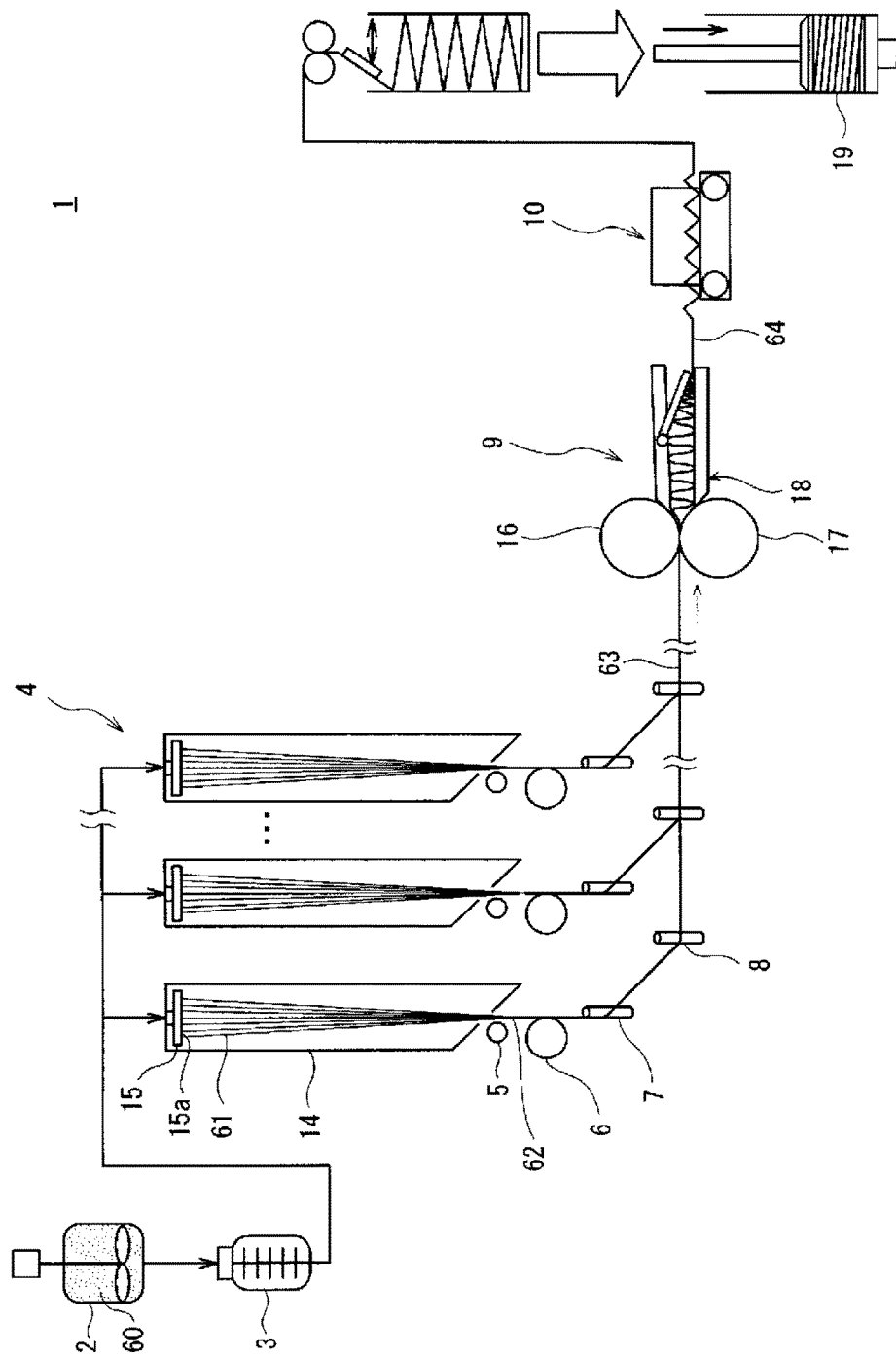


FIG. 1

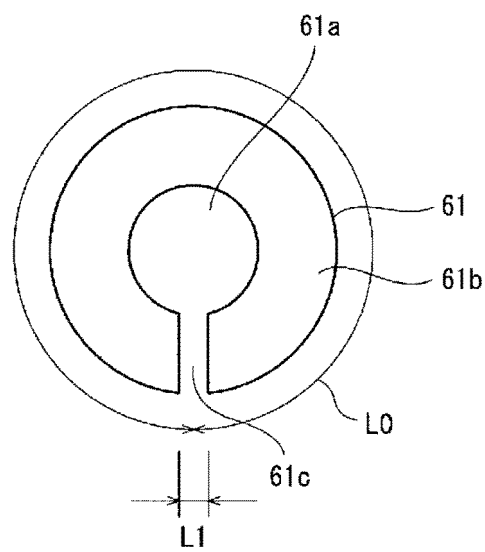


FIG. 2

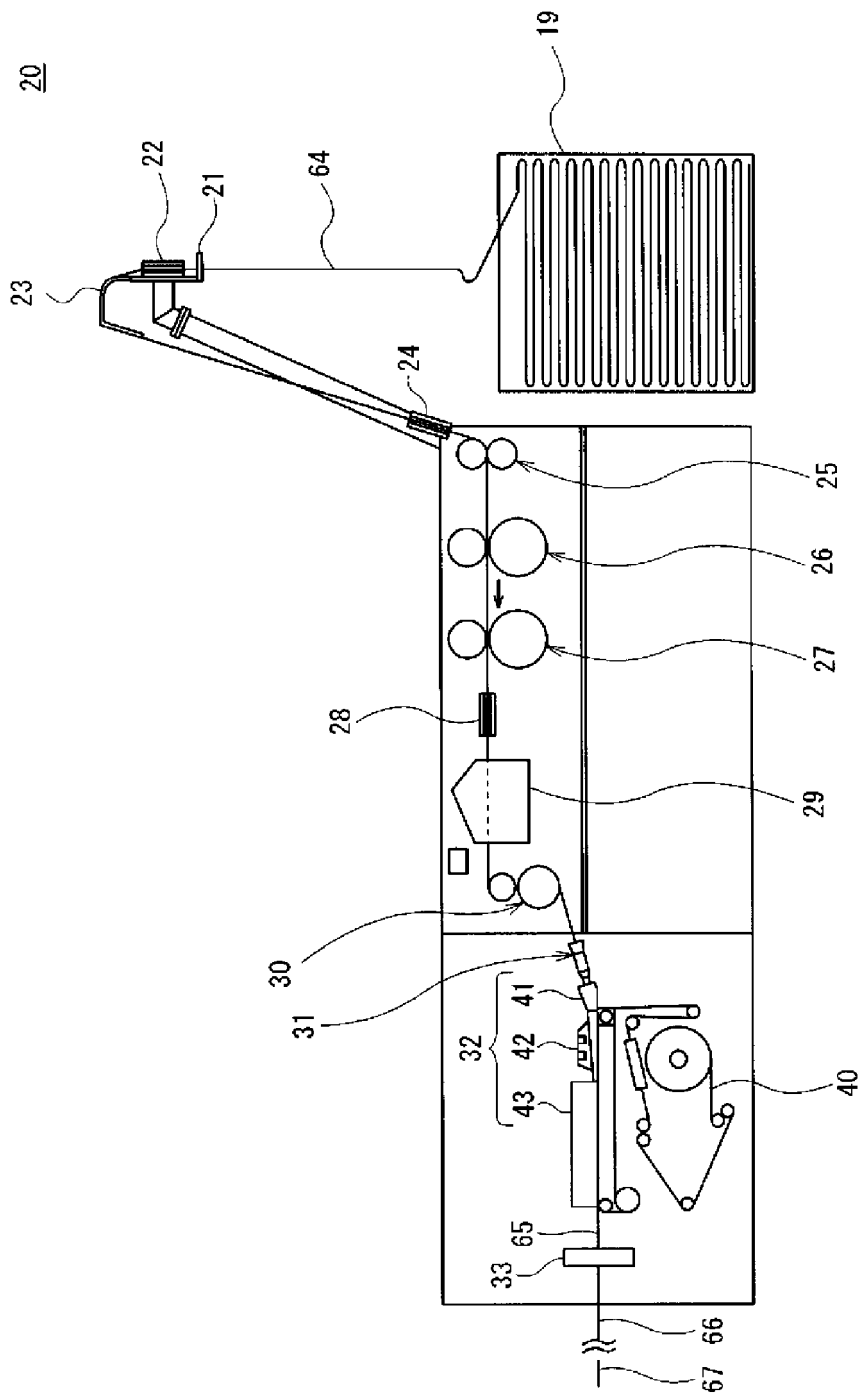


FIG. 3

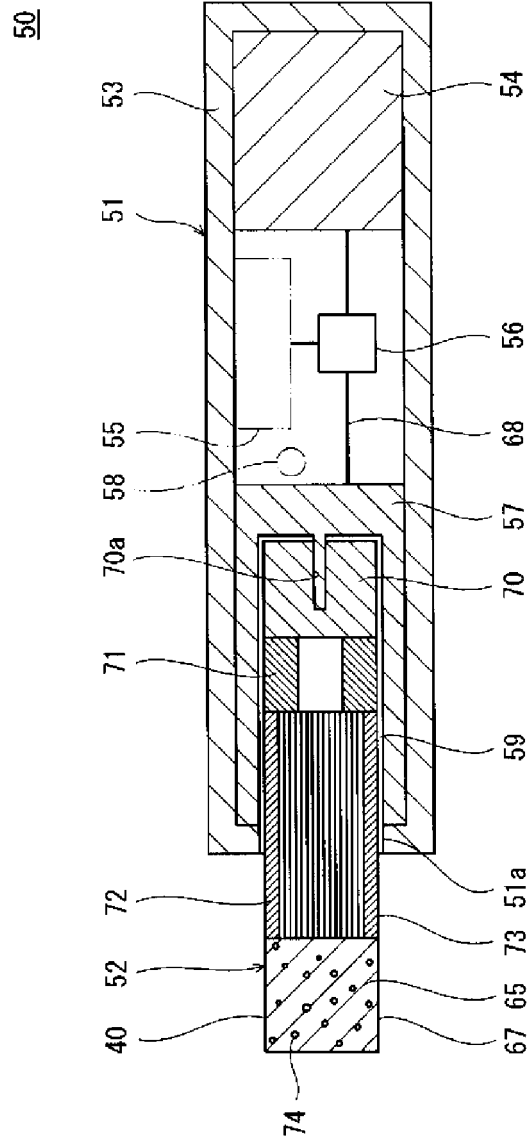


FIG. 4

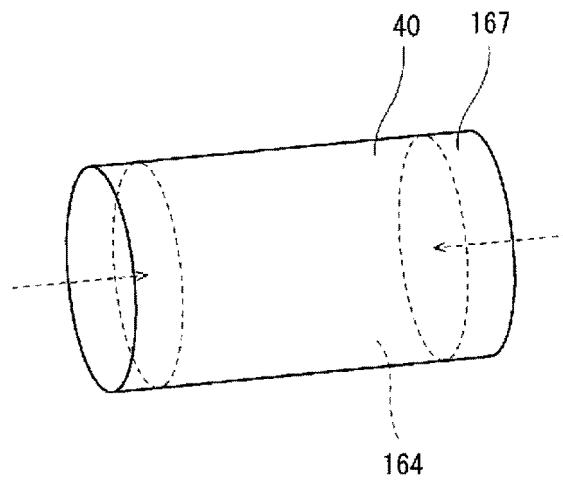


FIG. 5

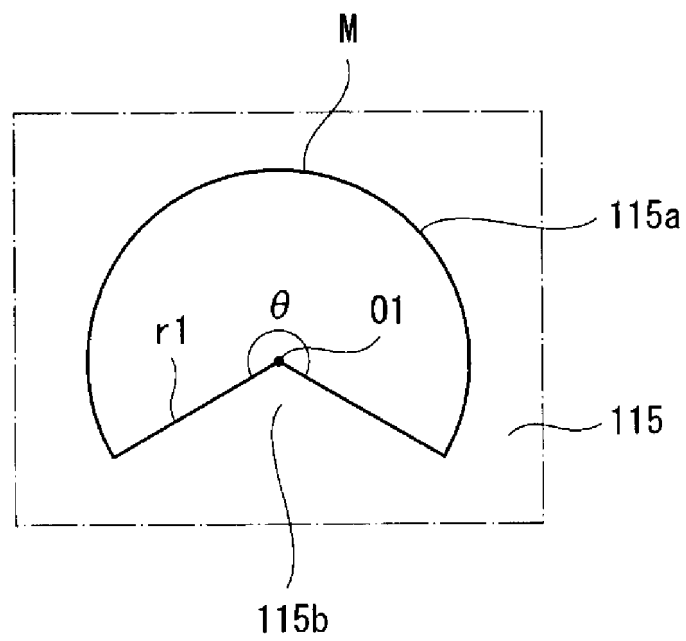


FIG. 6

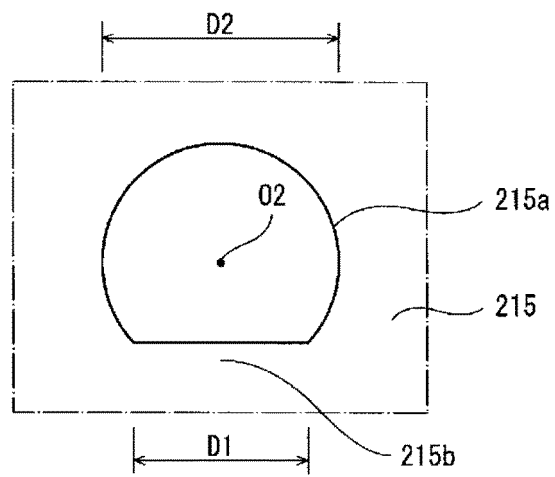


FIG. 7

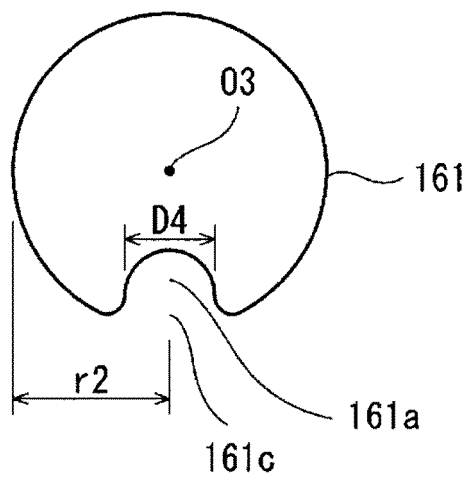


FIG. 8

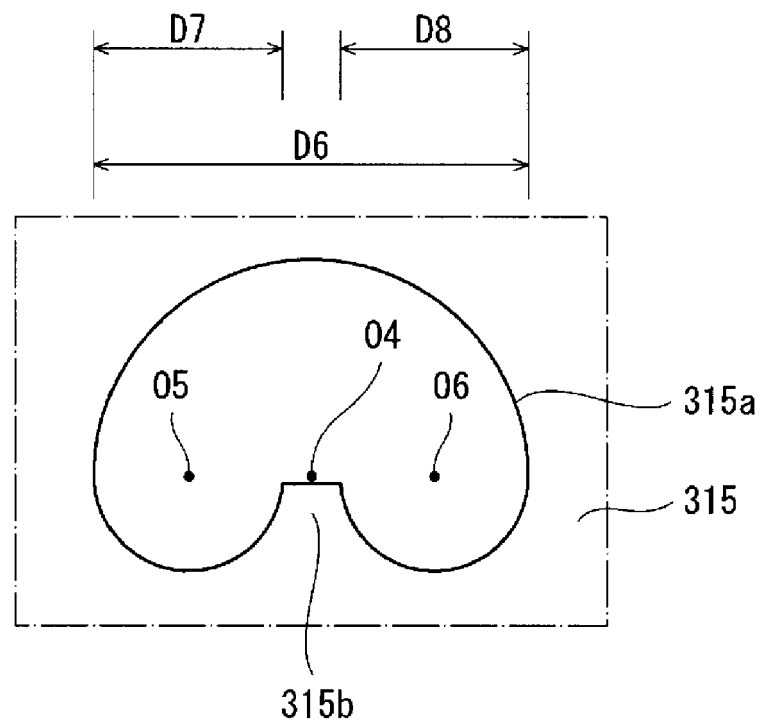


FIG. 9

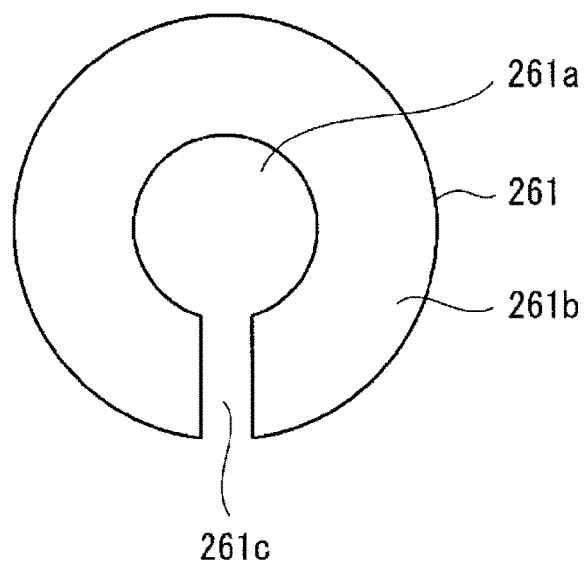


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/026470

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. A24F47/00 (2006.01) i, A24D3/10 (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)

Int.Cl. A24F47/00, A24D3/10

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

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	JP 2010-535024 A (PHILIP MORRIS PRODUCTS S.A.) 18 November 2010, paragraphs [0010]-[0013], fig. 3 & US 2009/0032037 A1, paragraphs [0015]-[0018], fig. 3 & WO 2009/016513 A2 & EP 2170110 A & KR 10-2010-0045412 A & CN 101742932 A	1, 3, 8, 10, 12
Y	JP 58-31981 A (DAICEL CHEM IND LTD.) 24 February 1983, page 2, upper left column, line 19 to lower right column, line 5, fig. 1 & US 4619279 A, column 2, line 4 to column 3, line 10, fig. 1, 2 & DE 3303645 A	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
05.09.2018Date of mailing of the international search report
18.09.2018Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/026470

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2015/136573 A1 (DAICEL CORPORATION) 17 September 2015, paragraphs [0002], [0016]-[0021] & US 2017/0006912 A, paragraphs [0002], [0017]-[0021] & EP 3117724 A & KR 10-2016-0007689 A & CN 106102486 A	1-15
A	WO 2013/116558 A1 (ALTRIA CLIENT SERVICES INC.) 08 August 2013, paragraphs [0115]-[0122], fig. 19-25 & JP 2015-513393 A & US 2013/0192615 A1 & EP 2809186 A & CN 104284606 A & KR 10-2015-0005514 A	1-15
A	US 2015/0128964 A1 (CELANESE ACETATE LLC) 14 May 2015, entire text, all drawings & JP 2015-508992 A & WO 2013/067511 A2 & EP 2773230 A & KR 10-2014-0088590 A & CN 104159460 A	1-15

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2015136573 A [0016]
- JP 2015503335 A [0016]