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(54) **PAPER FILTER FOR FLAVOR INHALATION PRODUCT**

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(57)

ABSTRACT

Provided is a paper filter for a flavor inhalation product, the paper filter having a rod-form filter medium and a rolled paper that rolls up the filter medium, wherein: the filter medium includes a wave-shaped paper sheet in which peaks and troughs are arranged in an alternating manner and so as to be continuous in a long-axis direction; the draw resistance in an airflow direction ranges from 0.2 mm H₂O/mm to 1.0 mm H₂O/mm; and the hardness in a direction perpendicular to the long axis ranges from 80.0% to 95.0%.

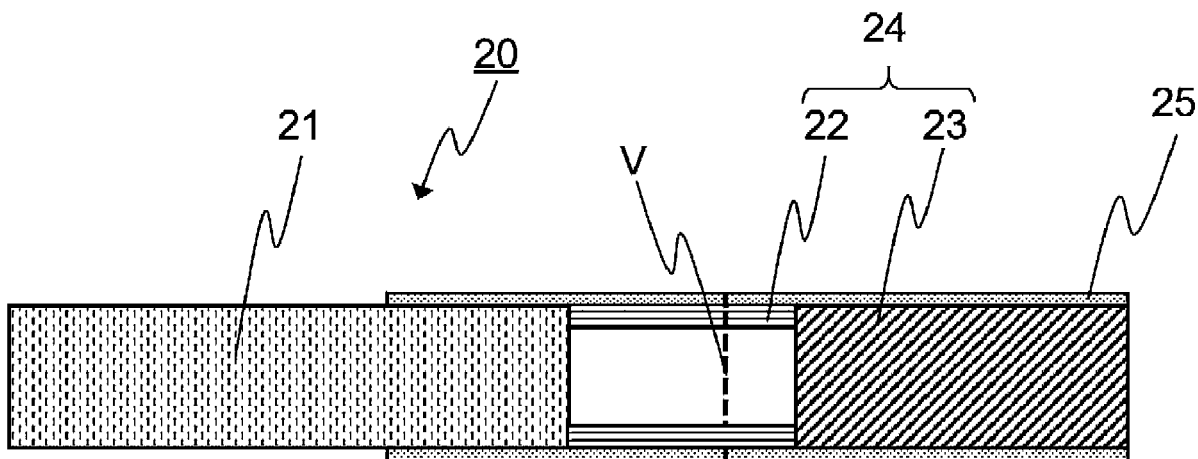


FIG. 1

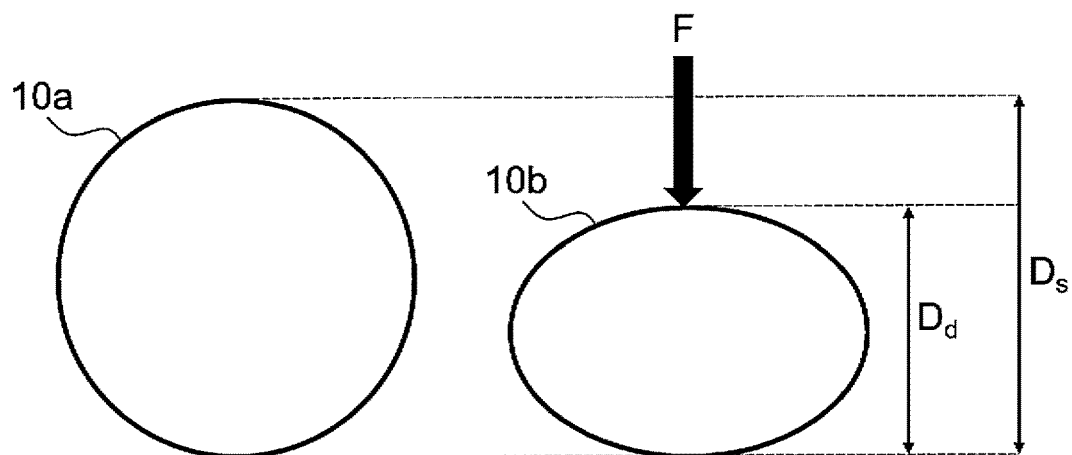


FIG. 2

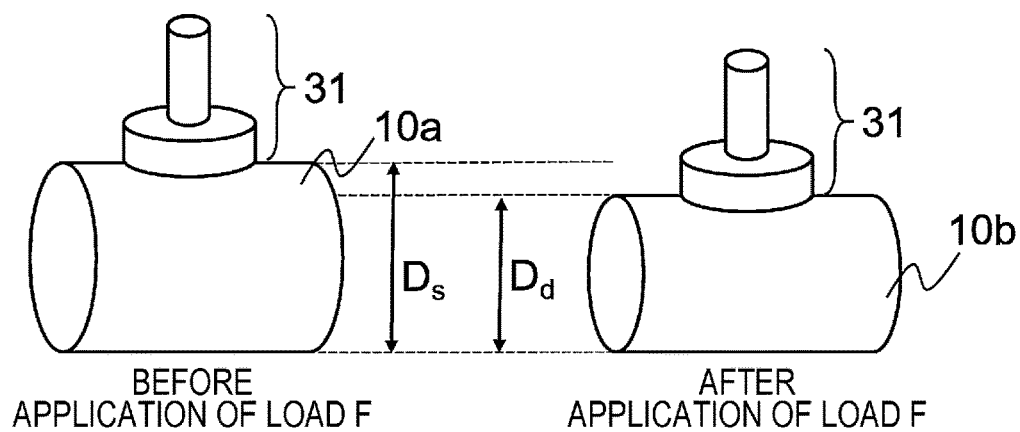


FIG. 3

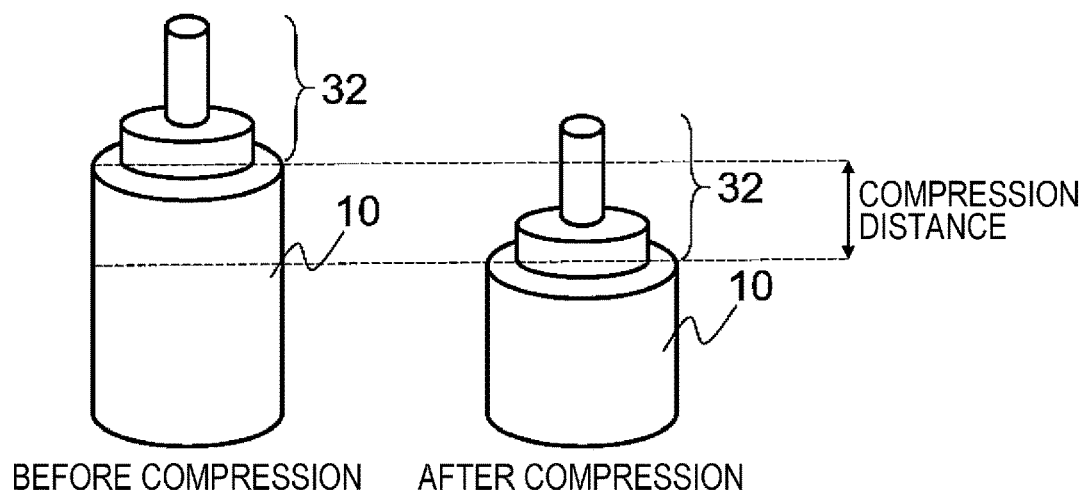


FIG. 4

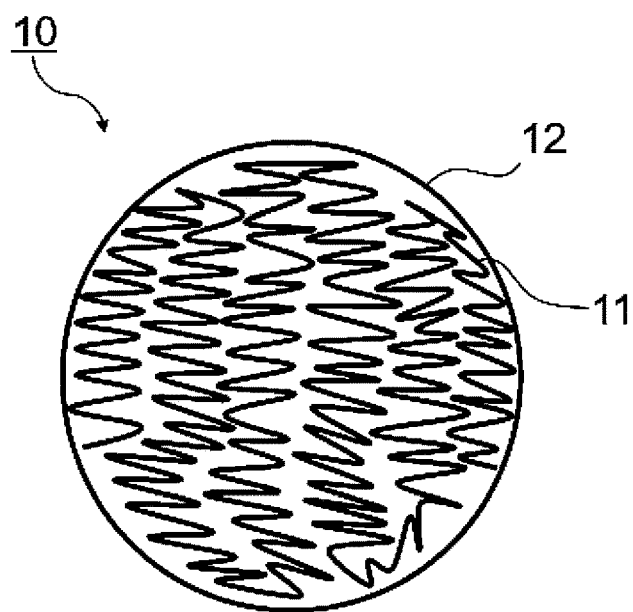


FIG. 5

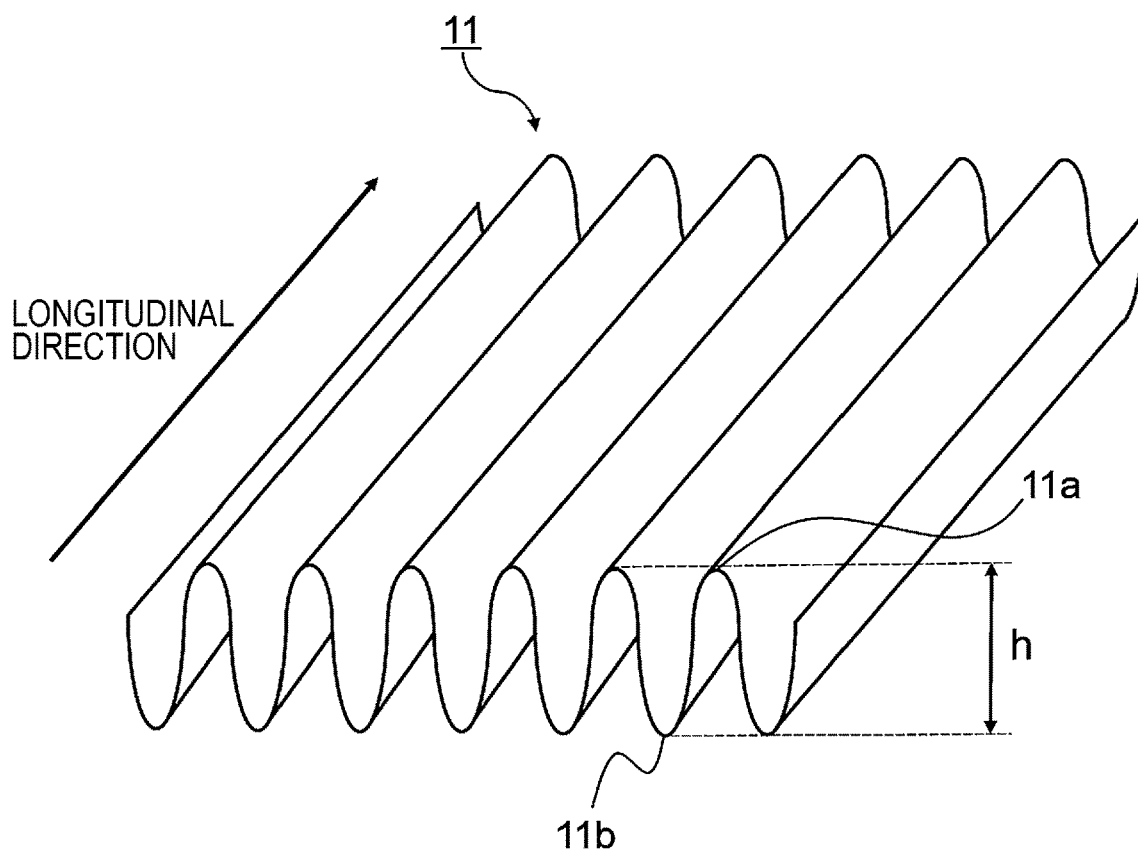


FIG. 6

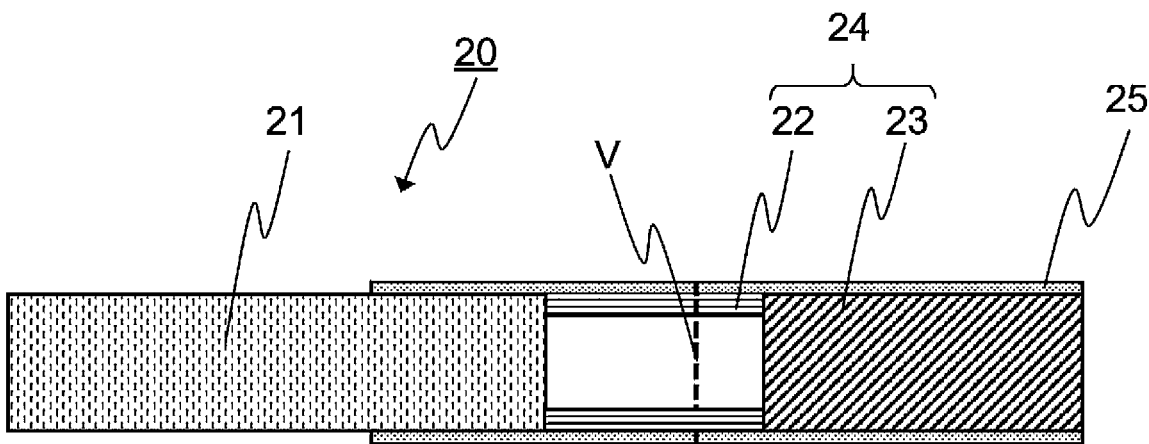
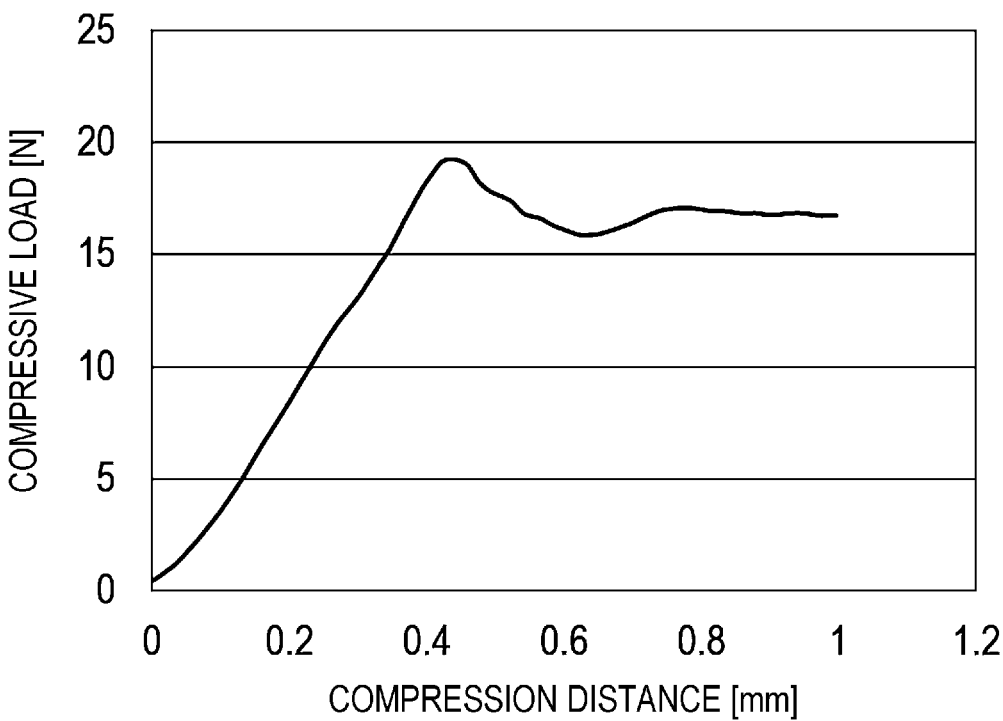


FIG. 7



PAPER FILTER FOR FLAVOR INHALATION PRODUCT

TECHNICAL FIELD

[0001] The present invention relates to a paper filter for flavor inhalation products.

BACKGROUND ART

[0002] As filters for flavor inhalation products, acetate filters made by processing synthetic fibers, such as cellulose acetate tow, into a rod shape are commonly used. At the same time, paper filters have been developed, which are made by wrapping a filter element, such as a paper (pure pulp) filter element, with a plug wrapping paper.

[0003] Patent Documents 1 and 2 each describe a paper filter that is made by folding a corrugated paper and wrapping it with a wrapping paper.

[0004] Paper filters are advantageous, for example, in environmental aspects, supply stability, cost reduction, and heat resistance, and demand for them is expected to grow.

CITATION LIST

Patent Document

[0005] Patent Document 1: Japanese Unexamined Patent Application Publication No. 9-294576

[0006] Patent Document 2: Japanese Unexamined Patent Application Publication No. 9-294577

SUMMARY OF INVENTION

Technical Problem

[0007] Acetate filters commonly used in flavor inhalation products require changing, for example, the thickness and number of fibers to adjust the draw resistance. Paper filters are advantageous in that the draw resistance of the filter can be adjusted by a simple technique, such as adjusting the width of paper forming the filter element.

[0008] A problem with conventional paper filters is that when the draw resistance is set within an appropriate range, the resulting lack of hardness causes inconvenience, such as buckling during use. For example, if the draw resistance of the filter is too high in a non-combustion-heating-type flavor inhalation product inserted into and used with an electric heating device, flavor components are accidentally removed together with unwanted fine particles. Although it is preferable to reduce the draw resistance of the paper filter, the hardness of the paper filter decreases as the draw resistance decreases. As a result, the paper filter buckles during insertion into the electric heating device and cannot be properly used. Patent Documents 1 and 2 do not deal with a technique that not only reduces the draw resistance but also achieves hardness that can avoid such a problem, and there is still room for improvement.

[0009] Accordingly, an object of the present invention is to provide a paper filter for flavor inhalation products that has a low draw resistance and a sufficient hardness.

Solution to Problem

[0010] The present inventors have found from various studies that the low draw resistance and sufficient hardness of the paper filter can be achieved by using a filter element

that includes a corrugated paper sheet with alternate ridges and grooves extending continuously in the longitudinal direction. The present inventors thus have completed the present invention. The present invention is summarized below.

[1]

[0011] A paper filter for flavor inhalation products, the paper filter comprising:

[0012] a rod-shaped filter element; and

[0013] a wrapping paper with which to wrap the filter element,

[0014] wherein the filter element includes a corrugated paper sheet with alternate ridges and grooves extending continuously in a longitudinal direction;

[0015] a draw resistance of the paper filter in an airflow direction is greater than or equal to 0.2 mm H₂O/mm and less than or equal to 1.0 mm H₂O/mm; and

[0016] a hardness of the paper filter in a direction perpendicular to a long axis is greater than or equal to 80.0% and less than or equal to 95.0%, the hardness being represented by Equation (1):

$$\text{hardness (\%)} = \frac{\text{in the direction perpendicular to the long axis}}{(D_s/D_a) \times 100} \quad \text{Equation (1),}$$

[0017] where D_s (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction before application of a load F , and D_a (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction after application of the load F , the load F being a compressive load of 3 N/mm applied to the paper filter for a compression time of 10 seconds in the direction perpendicular to the long axis.

[2]

[0018] A paper filter for flavor inhalation products, the paper filter comprising:

[0019] a rod-shaped filter element; and

[0020] a wrapping paper with which to wrap the filter element,

[0021] wherein the filter element includes a corrugated paper sheet with alternate ridges and grooves extending continuously in a longitudinal direction;

[0022] a draw resistance of the paper filter in an airflow direction is greater than or equal to 0.2 mm H₂O/mm and less than or equal to 1.0 mm H₂O/mm; and

[0023] a maximum compressive load measured while the paper filter is being compressed in the longitudinal direction at a compression velocity of 20 mm/min is greater than or equal to 15 N and less than or equal to 30 N.

[3]

[0024] The paper filter for flavor inhalation products according to [1] or [2], wherein a difference between a maximum height of the ridges and a maximum depth of the grooves is greater than or equal to 50 μ m and less than or equal to 500 μ m.

[4]

[0025] The paper filter for flavor inhalation products according to any one of [1] to [3], wherein the corrugated paper sheet is a creped sheet of a raw material sheet which has a basis weight of greater than or equal to 40 gsm and less than or equal to 120 gsm, a thickness of greater than or equal to 30 μ m and less than or equal to 130 μ m, and a width of greater than or equal to 70 mm and less than or equal to 200 mm; and

[0026] the width is a length in a direction perpendicular to a direction corresponding to a longitudinal direction of the filter element including the corrugated paper sheet produced from the raw material sheet.

[5]

[0027] The paper filter for flavor inhalation products according to any one of [1] to [4], wherein a density of the filter element is greater than or equal to 0.16 g/cm^3 and less than or equal to 0.34 g/cm^3 .

[6]

[0028] The paper filter for flavor inhalation products according to any one of [1] to [5], wherein the wrapping paper has a basis weight of greater than or equal to 30 gsm and less than or equal to 100 gsm, and a thickness of greater than or equal to $30 \text{ }\mu\text{m}$ and less than or equal to $130 \text{ }\mu\text{m}$.

[7]

[0029] A filter segment for flavor inhalation products, the filter segment comprising the paper filter for flavor inhalation products according to any one of [1] to [6].

[8]

[0030] A rod-shaped flavor inhalation product comprising:

[0031] a tobacco rod portion; and

[0032] a mouthpiece portion,

[0033] wherein the mouthpiece portion includes the paper filter for flavor inhalation products according to any one of [1] to [6].

[9]

[0034] A method for manufacturing the paper filter for flavor inhalation products according to any one of [1] to [6], the method comprising:

[0035] a creping step of creping a raw material sheet to form the corrugated paper sheet;

[0036] a compacting step of compacting the corrugated paper sheet to form the filter element; and

[0037] a wrapping step of wrapping the filter element with the wrapping paper.

Advantageous Effects of Invention

[0038] The present invention can provide a paper filter for flavor inhalation products that has a low draw resistance and a sufficient hardness.

[0039] A preferred embodiment of the present invention can provide a paper filter having a hardness that is enhanced by the use of a paper material forming the filter element, not by increasing the thickness and the basis weight of the wrapping paper.

BRIEF DESCRIPTION OF DRAWINGS

[0040] FIG. 1 is a diagram illustrating elements for defining a hardness of a paper filter in the direction perpendicular to the long axis.

[0041] FIG. 2 is a schematic diagram illustrating how a hardness of a paper filter in the direction perpendicular to the long axis is measured.

[0042] FIG. 3 is a schematic diagram illustrating how a hardness of a paper filter in the longitudinal direction is measured.

[0043] FIG. 4 is a schematic cross-sectional view of a paper filter according to first and second embodiments of the present invention.

[0044] FIG. 5 is a schematic diagram of a corrugated paper sheet forming a filter element of the paper filter according to the first and second embodiments of the present invention.

[0045] FIG. 6 is a schematic diagram of a flavor inhalation product including the paper filter according to the first and second embodiments of the present invention.

[0046] FIG. 7 is a graph showing a relation between a compression distance and a compressive load in the longitudinal direction of a paper filter obtained in Example 1.

DESCRIPTION OF EMBODIMENTS

[0047] Embodiments of the present invention will now be described in detail. Note that the embodiments of the present invention described herein are an example (or typical example) thereof. The present invention is not limited to the embodiments, as long as it does not depart from the gist thereof.

[0048] In the present specification, an expression including “to” between numerical values or physical property values is used to indicate that the range defined by the expression includes the values before and after the “to”. When the lower and upper limits of a numerical range are described individually, the numerical range may be considered as a combination of any lower limit and any upper limit.

[0049] In the present specification, the term “a plurality of” refers to two or more, unless otherwise specified.

<Paper Filter>

[0050] A paper filter according to a first embodiment of the present invention is a paper filter for flavor inhalation products that includes a rod-shaped filter element and a wrapping paper with which to wrap the filter element. The filter element includes a corrugated paper sheet with alternate ridges and grooves extending continuously in a longitudinal direction. A draw resistance of the paper filter in the airflow direction (which may hereinafter be simply referred to as “draw resistance”) is greater than or equal to $0.2 \text{ mm H}_2\text{O/mm}$ and less than or equal to $1.0 \text{ mm H}_2\text{O/mm}$. A hardness of the paper filter in a direction perpendicular to a long axis is greater than or equal to 80% and less than or equal to 95%. The hardness is represented by Equation (1):

$$\text{hardness (\% in the direction perpendicular to the long axis)} = (D_s/D_a) \times 100 \quad \text{Equation (1),}$$

[0051] where D_s (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction before application of a load F , and D_a (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction after application of the load F . The load F is a compressive load of 3 N/mm applied to the paper filter for a compression time of 10 seconds in the direction perpendicular to the long axis.

[0052] A paper filter according to a second embodiment of the present invention is the same as the paper filter according to the first embodiment of the present invention, except that instead of being characterized in that the hardness in the direction perpendicular to the long axis is greater than or equal to 80.0% and less than or equal to 95.0%, the paper filter according to the second embodiment of the present invention is characterized in that the maximum compressive load thereon measured while the paper filter is being compressed in the longitudinal direction at a compression velocity of 20 mm/min (which may hereinafter be referred to as “hardness in the longitudinal direction”) is greater than or equal to 15 N and less than or equal to 30 N .

[0053] The paper filter according to the first and second embodiments of the present invention has a hardness that

satisfies user's taste and comfort during use, as well as having a draw resistance in a range appropriate for successfully delivering flavor components, such as nicotine, menthol, glycerine, and propylene glycol while removing unwanted components, such as tar, in the airflow.

[0054] The draw resistance that allows successful delivery of flavor components while removing unwanted components varies from one flavor inhalation product to another depending on, for example, the type of components in air passing through the paper filter and the length of the paper filter in the longitudinal direction. The draw resistance, described above, is generally greater than or equal to 0.2 mm H₂O/mm, preferably greater than or equal to 0.25 mm H₂O/mm, and more preferably greater than or equal to 0.3 mm H₂O/mm and is also generally less than or equal to 1.0 mm H₂O/mm, preferably less than or equal to 0.8 mm H₂O/mm, more preferably less than or equal to 0.6 mm H₂O/mm, and still more preferably less than or equal to 0.5 mm H₂O/mm.

[0055] The draw resistance of the paper filter according to the first and second embodiments of the present invention is measured in accordance with the ISO standard (ISO 6565) by using, for example, a device for measuring the filter's draw resistance, manufactured by Cerulean. The draw resistance of the paper filter refers to a difference in air pressure between one end face (first end face) and the other end face (second end face) of the paper filter measured when air is passed through at a predetermined airflow rate (17.5 cc/min) from the first end face to the second end face, with the side surface of the paper filter not allowing air to pass there-through.

[0056] In the present specification, a hardness that satisfies user's taste and comfort during use is, for example, a hardness that does not cause a sense of incongruity when the user is holding the product with fingers or in the mouth. For a non-combustion-heating-type flavor inhalation product inserted into and used with an electric heating device, the hardness described above is one that allows insertion into the electric heating device without bending. For a combustion-type flavor inhalation product, the hardness described above is one that does not allow deformation when the user drops ashes or presses a burning portion against an ashtray to extinguish the flame. Hereinafter, the hardness of the paper filter according to the first and second embodiments of the present invention will be described.

[0057] In the paper filter according to the first embodiment of the present invention, the hardness in the direction perpendicular to the long axis is generally greater than or equal to 80.0% and preferably greater than or equal to 88.0%, and is also generally less than or equal to 95.0% and preferably less than or equal to 92.0%. The hardness of the paper filter in the direction perpendicular to the long axis is adjusted by setting, for example, the basis weight, thickness, and width of the corrugated paper sheet in the filter element or of the raw material sheet forming the corrugated paper sheet, or the density of the filter element, within a range described below. Preferably, the hardness of the paper filter in the direction perpendicular to the long axis is adjusted by appropriately setting at least one selected from the basis weight, thickness, and width of the corrugated paper sheet in the filter element or of the raw material sheet.

[0058] The hardness of the paper filter in the direction perpendicular to the long axis will now be described. The hardness is represented by Equation (1):

$$\text{hardness (\% in the direction perpendicular to the long axis of the paper filter)} = (D_d/D_s) \times 100 \quad \text{Equation (1)}$$

[0059] As illustrated in FIG. 1, D_s represents the cross-sectional diameter of a paper filter **10a** in the direction perpendicular to the longitudinal direction before application of the load F, and D_d represents the cross-sectional diameter of a paper filter **10b** in the direction perpendicular to the longitudinal direction after application of the load F. The load F is a compressive load of 3 N/mm applied to the paper filter for a compression time of 10 seconds in the direction perpendicular to the long axis. The harder the paper filter is in the direction perpendicular to the long axis, the closer the hardness is to 100.0%.

[0060] The hardness of the paper filter in the direction perpendicular to the long axis is calculated by the following steps (i) to (iii):

[0061] (i) The cross-sectional diameter D_s of the paper filter **10a** in the direction perpendicular to the longitudinal direction, before application of the load F, is determined;

[0062] (ii) The load F or a compressive load of 3 N/mm is applied to the paper filter **10a** for a compression time of 10 seconds in the direction perpendicular to the long axis, and D_d is determined which is a value obtained by subtracting, from D_s , a depth by which the paper filter **10a** is depressed by the load F. As illustrated in FIG. 2, the load F is applied to the paper filter **10a** by pressing a plunger **31** of a device, such as a SODIM-H hardness module (manufactured by SODIM SUS), against the paper filter **10a**; and

[0063] (iii) The hardness in the direction perpendicular to the long axis is calculated from D_s and D_d on the basis of Equation (1).

[0064] In the paper filter according to the second embodiment of the present invention, the hardness in the longitudinal direction is generally greater than or equal to 15 N, preferably greater than or equal to 17 N, and more preferably greater than or equal to 20 N and is also generally less than or equal to 50 N, preferably less than or equal to 35 N, and more preferably less than or equal to 30 N. The hardness of the paper filter in the longitudinal direction can be adjusted by setting, for example, the basis weight, thickness, and width of the corrugated paper sheet in the filter element or of the raw material sheet forming the corrugated paper sheet, or the density of the filter element, within a range described below. Preferably, the hardness of the paper filter in the longitudinal direction is adjusted by appropriately setting the basis weight of the raw material sheet and/or the density of the filter element. As described in EXAMPLES below, the hardness of the paper filter in the longitudinal direction is correlated with the density of the filter element. Therefore, by selecting the density of the filter element, the hardness of the paper filter in the longitudinal direction can be easily and favorably adjusted within the range described above.

[0065] In the present specification, the hardness of the paper filter in the longitudinal direction refers to the maximum value of compressive loads measured while the paper filter is being compressed at a compression velocity of 20 mm/min in the longitudinal direction. In other words, the hardness of the paper filter in the longitudinal direction is a compressive load in the longitudinal direction required for buckling of the paper filter.

[0066] The compressive load on the paper filter is measured with a rheometer, such as a CR-3000EX (manufac-

tured by Sun Scientific Co., Ltd.). More specifically, as illustrated in FIG. 3, the compressive load is measured by pressing a plunger 32 of the rheometer against a paper filter 10 to compress the paper filter 10 at a compression velocity of 20 mm/min. Generally, the compressive load increases as the compression distance increases, and gradually decreases after reaching the maximum value. Although the compression distance required to identify the maximum compressive load depends on the size of the paper filter, it is about 1.0 mm when the cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction is 7.0 mm and the length of the paper filter in the longitudinal direction is 18.0 mm, as described in EXAMPLES below.

[0067] The paper filter according to the first embodiment of the present invention may have the same hardness in the longitudinal direction as the paper filter according to the second embodiment of the present invention. That is, in the paper filter according to the first embodiment of the present invention, the hardness in the longitudinal direction may be greater than or equal to 15 N and less than or equal to 30 N and a preferred range of the hardness in the longitudinal direction is also the same as that in the second embodiment of the present invention.

[0068] The paper filter according to the second embodiment of the present invention may have the same hardness in the direction perpendicular to the long axis as the paper filter according to the first embodiment of the present invention. That is, in the paper filter according to the second embodiment of the present invention, the hardness in the direction perpendicular to the long axis may be greater than or equal to 80.0% and less than or equal to 95.0% and a preferred range of the hardness in the direction perpendicular to the long axis is also the same as that in the first embodiment of the present invention.

[0069] The draw resistance and the hardness, described above, can be adjusted by selecting mainly the wrapping paper and the corrugated paper sheet included in the filter element. In the first and second embodiments of the present invention, as described below, the draw resistance and the hardness are preferably adjusted by using a commonly used wrapping paper in the filter for flavor inhalation products and selecting the corrugated paper sheet, not the wrapping paper.

[0070] The paper filter according to the first and second embodiments of the present invention will now be described with reference to FIGS. 4 and 5.

[0071] FIG. 4 is a cross-sectional view as viewed in the longitudinal direction of an exemplary paper filter according to the first and second embodiments of the present invention. The paper filter 10 includes a filter element made by folding a corrugated paper sheet 11, and a wrapping paper 12 with which the filter element is wrapped and the folded corrugated paper sheet 11 is fixed in a rod shape. Although the corrugated paper sheet 11 illustrated in FIG. 4 is folded, the corrugated paper sheet may be rolled up.

[0072] As illustrated in FIG. 5, the corrugated paper sheet 11 forming the filter element has alternate ridges 11a and grooves 11b extending continuously in the longitudinal direction. This forms an air passage that allows air to flow from one end face (first end face) to the other end face (second end face) of the paper filter.

[0073] The type of wood pulp used in the corrugated paper sheet 11 is not particularly limited and any wood pulp, such as softwood pulp or hardwood pulp, may be used.

[0074] As described below, the corrugated paper sheet 11 can be made by creping a non-corrugated, flat raw material sheet to form the ridges 11a and the grooves 11b.

[0075] The basis weight, thickness, and width of the mw material sheet are simply required to be appropriately selected in accordance with the intended hardness and draw resistance of the paper filter and the perimeter of the paper filter, and are not particularly limited.

[0076] Specifically, the basis weight of the raw material sheet is generally greater than or equal to 40 gsm, preferably greater than or equal to 50 gsm, and more preferably greater than or equal to 60 gsm and is also generally less than or equal to 120 gsm, preferably less than or equal to 110 gsm, and more preferably less than or equal to 100 gsm. The basis weight of the raw material sheet is measured in accordance with ISO 536:2019.

[0077] The thickness of the raw material sheet is generally greater than or equal to 30 μm , preferably greater than or equal to 50 μm , and more preferably greater than or equal to 70 μm and is also generally less than or equal to 150 μm , preferably less than or equal to 140 μm , and more preferably less than or equal to 130 μm . The thickness of the mw material sheet is measured in accordance with ISO 534:2011.

[0078] The width of the raw material sheet is generally greater than or equal to 60 mm, preferably greater than or equal to 70 mm, and more preferably greater than or equal to 80 mm and is also generally less than or equal to 200 mm, preferably less than or equal to 150 mm, and more preferably less than or equal to 100 mm. Note that the width of the raw material sheet is a length in the direction perpendicular to the longitudinal direction in which the ridges and grooves in the corrugated paper sheet extend continuously. In other words, the width of the raw material sheet is a length in the direction perpendicular to the direction corresponding to the longitudinal direction of the filter element obtained by processing the corrugated paper sheet.

[0079] Since the mw material sheet is under tension when subjected to creping, the basis weight and thickness of the corrugated paper sheet may be several percent lower than the basis weight and thickness of the raw material sheet. The basis weight and thickness of the corrugated paper sheet are, however, substantially the same as the basis weight and thickness of the raw material sheet. Note that the basis weight and thickness of the corrugated paper sheet are values measured, with the corrugated paper sheet extended, in a manner similar to that in which the basis weight and thickness of the raw material sheet are measured.

[0080] A difference h between the maximum height of the ridges 11a and the maximum depth of the grooves 11b in the corrugated paper sheet 11 is simply required to be appropriately set in accordance with, for example, the draw resistance and hardness of the paper filter and the thickness and basis weight of the raw material sheet. The difference h , described above, is generally greater than or equal to 50 μm , preferably greater than or equal to 90 μm , and more preferably greater than or equal to 100 μm and is also generally less than or equal to 700 μm , preferably less than or equal to 500 μm , and more preferably less than or equal to 300 μm .

[0081] The density of the filter element calculated by Equation (2) is not particularly limited. From the perspective of achieving desired draw resistance and hardness, however, the density of the filter element is generally greater than or equal to 0.16 g/cm³, preferably greater than or equal to 0.18

g/cm³, and more preferably greater than or equal to 0.20 g/cm³ and is also generally less than or equal to 0.34 g/cm³, preferably less than or equal to 0.32 g/cm³, and more preferably less than or equal to 0.30 g/cm³.

$$\text{Density of filter element} = \frac{\text{weight of corrugated paper sheet} \times *1}{\text{volume of filter element} \times *2} \quad \text{Equation (2)}$$

[0082] *1: weight of corrugated paper sheet=basis weight of corrugated paper sheet×width of corrugated paper sheet×length of corrugated paper sheet in longitudinal direction

[0083] *2: volume of filter element=cross-sectional area of filter element×length of filter element in longitudinal direction

[0084] The filter element may include not only the corrugated paper sheet, but also a crushable additive release container (e.g., capsule) with a crushable shell, such as a gelatinous shell. The type of the capsule (also referred to as “additive release container” in the present technical field) is not particularly limited, and any known type may be used. For example, a crushable additive release container with a crushable shell, such as a gelatinous shell may be used. In this case, when the capsule is crushed by the user of the flavor inhalation product before, during, or after use, a liquid or substance (typically flavoring agent) contained in the capsule is released. Then, the liquid or substance is transmitted by airflow passing through the flavor inhalation product during use of the flavor inhalation product, and is transmitted to the surrounding environment after the use.

[0085] The form of the capsule is not particularly limited. For example, the capsule may be an easily breakable capsule and is preferably spherical in shape. An additive contained in the capsule may be any of the additives described above, but it is particularly preferable that an additive selected from flavoring agents and activated carbons be contained. At least one type of material that contributes to filtration of unwanted components, such as tar, may be added as an additive. The form of the additive is not particularly limited, but is typically a liquid or solid. The use of a capsule containing an additive is known in the present technical field. The easily breakable capsule and a method for manufacturing it are known in the present technical field.

[0086] A wrapping paper (hereinafter also referred to as “filter plug wrapping paper”) with which to wrap the filter element is not particularly limited. A wrapping paper commonly used to wrap a filter element, such as acetate tow, may be used.

[0087] The form of the wrapping paper is not particularly limited, and may have a seam with at least one line of adhesive. Examples of the adhesive may include a hot-melt adhesive, and the hot-melt adhesive may contain a polyvinyl alcohol. The paper filter may include a filter element other than the filter element including the corrugated paper sheet. That is, the paper filter may be constituted by a plurality of filter elements. When the paper filter is constituted by a plurality of filter elements, the wrapping paper is preferably one with which the plurality of filter elements are wrapped together.

[0088] The material of the wrapping paper is not particularly limited, and any known wood pulp material, such as softwood or hardwood pulp material, may be used. The wrapping paper may contain a filler, such as a calcium carbonate.

[0089] The wrapping paper may be either coated or uncoated. From the perspective of adding capabilities other

than strength and structural stiffness, the wrapping paper is preferably coated with a desired material.

[0090] The thickness and basis weight of the wrapping paper are not particularly limited. When a wrapping paper having a thickness and a basis weight that are greater than normal (such as a wrapping paper having a basis weight of greater than 100 gsm) is used, the hardness of the paper filter can be improved. However, the user’s comfort in holding the product with fingers or in the mouth may be degraded, or the user may get a sense of incongruity during use. From the perspective of availability, it is preferable to use a wrapping paper commonly used in filters for flavor inhalation products.

[0091] That is, in the first and second embodiments of the present invention, the basis weight of the wrapping paper is generally greater than or equal to 30 gsm, preferably greater than or equal to 40 gsm, and more preferably greater than or equal to 50 gsm and is also generally less than or equal to 100 gsm, preferably less than or equal to 80 gsm, and more preferably less than or equal to 60 gsm. The basis weight of the wrapping paper is measured in accordance with ISO 536:2019.

[0092] The thickness of the wrapping paper is generally greater than or equal to 30 μm, preferably greater than or equal to 50 μm, and more preferably greater than or equal to 70 μm and is also generally less than or equal to 130 μm, preferably less than or equal to 120 μm, and more preferably less than or equal to 110 μm. The thickness of the wrapping paper is measured in accordance with ISO 534:2011.

[0093] The paper filter according to the first and second embodiments of the present invention has a substantially circular cross-section in the direction perpendicular to the long axis. The diameter of the substantially circular cross-section of the paper filter can be appropriately changed in accordance with the shape of the flavor inhalation product to be used. The diameter is generally greater than or equal to 4.0 mm, preferably greater than or equal to 4.5 mm, and more preferably greater than or equal to 5.0 mm and is also generally less than or equal to 9.0 mm, preferably less than or equal to 8.5 mm, and more preferably less than or equal to 8.0 mm. When the cross-section of the paper filter is not circular, the diameter of an assumed circle having the same area as the cross-section of the paper filter, described above, serves as the cross-sectional diameter of the paper filter.

[0094] In the paper filter according to the first and second embodiments of the present invention, the perimeter of the cross-section of the paper filter in the direction perpendicular to the long axis can be appropriately changed in accordance with the size of the flavor inhalation product to be used. The perimeter is generally greater than or equal to 14.0 mm, preferably greater than or equal to 15.0 mm, and more preferably greater than or equal to 16.0 mm and is also generally less than or equal to 27.0 mm, preferably less than or equal to 26.0 mm, and more preferably less than or equal to 25.0 mm.

[0095] In the paper filter according to the first and second embodiments of the present invention, the length of the paper filter in the longitudinal direction can be appropriately changed in accordance with the size of the flavor inhalation product to be used. The length of the paper filter in the longitudinal direction may be greater than or equal to 5.0 mm, greater than or equal to 10.0 mm, greater than or equal to 15.0 mm, greater than or equal to 17.5 mm, or greater than or equal to 20.0 mm and may be less than or equal to 40.0

mm, less than or equal to 35.0 mm, less than or equal to 32.5 mm, or less than or equal to 30.0 mm.

<Method for Manufacturing Paper Filter>

[0096] A method for manufacturing the paper filter according to the first and second embodiments of the present invention is not particularly limited, and a method based on a known method is applicable. Examples of the known method include one that is described in Japanese Unexamined Patent Application Publication No. 9-294576 or Japanese Unexamined Patent Application Publication No. 9-294577. More specifically, the known method is a manufacturing method that includes a creping step of creping a raw material sheet to form a corrugated paper sheet, a compacting step of compacting the corrugated paper sheet to form a filter element, and a wrapping step of wrapping the filter element with a wrapping paper.

[0097] In the creping step, the raw material sheet passes through the nip between a pair of creping rollers. The creping rollers each have, on the surface thereof, a plurality of teeth extending parallel to the circumferential direction. The two creping rollers are disposed, with the plurality of teeth thereof engaging with each other. The raw material sheet is pressed by the plurality of teeth into a corrugated paper sheet with alternate ridges and grooves extending continuously in the longitudinal direction. The difference h between the maximum height of the ridges and the maximum depth of the grooves in the corrugated paper sheet is determined by the pitch and the tooth width of the plurality of teeth. The difference h , described above, can thus be adjusted by selecting the pitch and the tooth width of the teeth of the creping rollers.

[0098] In the compacting step, the way of compacting the corrugated paper sheet is not particularly limited. That is, the corrugated paper sheet may be folded as illustrated in FIG. 4, or may be rolled up.

[0099] The wrapping step is a step that involves wrapping the corrugated paper sheet with a wrapping paper in such a way that the corrugated paper sheet can maintain the rod shape of the filter element. In the wrapping step, wrapping the filter element with the wrapping paper may be followed by gluing overlaps of the wrapping paper.

<Flavor Inhalation Product>

[0100] The paper filter according to the first and second embodiments of the present invention is used in a flavor inhalation product.

[0101] In the present specification, the term “flavor inhalation product” collectively refers to an inhalation product the user uses to enjoy a flavor, such as a tobacco flavor. Specifically, examples of the flavor inhalation product include a combustion-type flavor inhalation product that provides the user with a flavor by burning a flavor source, a non-combustion-heating-type flavor inhalation product that provides the user with a flavor by heating a flavor source without burning it, and a non-combustion, non-heating-type flavor inhalation product that provides the user with a flavor generated from a flavor source without heating or burning the flavor source.

[0102] Examples of the flavor inhalation product include a rod-shaped flavor inhalation product including a tobacco rod portion and a mouthpiece portion, and in particular a combustion-type flavor inhalation product and a non-combus-

tion-heating-type flavor inhalation product. As a preferred example of the flavor inhalation product, a non-combustion-heating-type flavor inhalation product will be described with reference to FIG. 6.

[0103] Referring to FIG. 6, a non-combustion-heating-type flavor inhalation product 20 includes a tobacco rod portion 21 and a mouthpiece portion 24.

[0104] The tobacco rod portion 21 contains dried tobacco leaves.

[0105] The mouthpiece portion 24 includes a filter segment 23 including the paper filter according to the first and second embodiments of the present invention. The mouthpiece portion 24 preferably includes not only the filter segment 23, but also a cooling segment 22. The cooling segment 22 and the filter segment 23 are disposed adjacent to each other.

[0106] The non-combustion-heating-type flavor inhalation product 20 illustrated in FIG. 6 is a rod-shaped non-combustion-heating-type flavor inhalation product that includes the tobacco rod portion 21, the mouthpiece portion 24, and a tipping paper 25 with which to wrap the tobacco rod portion 21 and the mouthpiece portion 24. The mouthpiece portion 24 includes the cooling segment 22 and the filter segment 23 including the paper filter according to the first or second embodiment of the present invention. The cooling segment 22 may be held between the tobacco rod portion 21 and the filter segment 23 that are adjacent to the cooling segment 22 in the longitudinal direction of the non-combustion-heating-type flavor inhalation product 20. At the same time, the cooling segment 22 may have a concentric perforation V in the circumferential direction of the cooling segment 22 (or in the direction perpendicular to the long axis). The perforation V is generally a series of holes that facilitates the inflow of air from the outside when the user inhales. The inflow of air can reduce the temperatures of components and air that flow in from the tobacco rod portion 21.

[0107] The filter segment 23 may include a center hole segment having one or more hollow portions, as well as the paper filter according to the first and second embodiments of the present invention. Generally, the center hole segment is disposed closer to the cooling segment than the paper filter is, and is preferably disposed adjacent to the cooling segment.

[0108] The center hole segment includes a packed layer having one or more hollow portions, and an inner plug wrapper (inner wrapping paper) covering the packed layer. For example, the center hole segment includes a packed layer having a hollow portion, and an inner plug wrapper covering the packed layer. Because of high filling density of fibers in the packed layer, air and aerosol flow only through the hollow portion during inhalation, and barely flow in the packed layer. Since the packed layer inside the center hole segment is a fiber packed layer, the user is less likely to get a sense of incongruity when touching from the outside during use. The center hole segment may include no inner plug wrapper and the shape of the center hole segment may be kept by thermoforming.

[0109] The center hole segment and the paper filter may be connected together, for example, by an outer plug wrapper (outer wrapping paper). The outer plug wrapper may be, for example, a cylindrical paper wrapper. The tobacco rod portion 21, the cooling segment 22, and the combination of the center hole segment and the paper filter already con-

nected together may be connected, for example, by a mouthpiece lining paper. These connections can be made, for example, by applying glue, such as vinyl acetate glue, to the inside of the mouthpiece lining paper, and wrapping, with the mouthpiece lining paper, the tobacco rod portion **21**, the cooling segment **22**, and the combination of the center hole segment and the paper filter already connected together. These components may be connected separately (not at a time) with multiple pieces of lining paper.

[0110] From the perspective of improving strength and structural stiffness, the filter segment **23** may be provided with a filter plug wrapping paper with which to wrap the paper filter. The form of the filter plug wrapping paper is not particularly limited, and may have a seam with at least one line of adhesive. Examples of the adhesive may include a hot-melt adhesive, and the hot-melt adhesive may contain polyvinyl alcohol. When the filter segment **23** includes two or more segments, it is preferable that the two or more segments be wrapped together in the filter plug wrapping paper.

[0111] The cross-sectional shape of the filter segment **23** in the direction perpendicular to the long axis is substantially a circle, whose diameter can be appropriately changed in accordance with the size of the flavor inhalation product. The diameter is generally greater than or equal to 4.0 mm, preferably greater than or equal to 4.5 mm, and more preferably greater than or equal to 5.0 mm and is also generally less than or equal to 9.0 mm, preferably less than or equal to 8.5 mm, and more preferably less than or equal to 8.0 mm. When the cross-section of the filter segment **23** is not circular, the diameter of an assumed circle having the same area as the cross-section of the filter segment **23** serves as the cross-sectional diameter of the filter segment **23**.

[0112] The perimeter of the cross-sectional shape of the filter segment **23** in the direction perpendicular to the long axis can be appropriately changed in accordance with the size of the flavor inhalation product. The perimeter is generally greater than or equal to 14.0 mm, preferably greater than or equal to 15.0 mm, and more preferably greater than or equal to 16.0 mm and is also generally less than or equal to 27.0 mm, preferably less than or equal to 26.0 mm, and more preferably less than or equal to 25.0 mm.

[0113] The length of the filter segment **23** in the longitudinal direction can be appropriately changed in accordance with the size of the flavor inhalation product. The length of the filter segment **23** in the longitudinal direction may be greater than or equal to 15.0 mm, greater than or equal to 17.5 mm, or greater than or equal to 20.0 mm and may be less than or equal to 40.0 mm, less than or equal to 35.0 mm, less than or equal to 32.5 mm, or less than or equal to 30.0 mm.

[0114] To keep the shape and dimensions of the filter segment **23** within the range described above, the shape and dimensions of the paper filter according to the first and second embodiments of the present invention can be adjusted appropriately.

EXAMPLES

[0115] The present invention will now be further described using Examples. The present invention is not limited to Examples described herein, as long as it does not depart from the gist thereof.

Example 1

[0116] A paper filter was made in accordance with the method described in Japanese Unexamined Patent Application Publication No. 9-294577.

[0117] Specifically, a raw material sheet unwound from a roll of a raw material sheet (Glassine manufactured by Nippon Paper Papyrus Co., Ltd.) having a basis weight of 40 gsm, a thickness of 30 μ m, and a width of 140 mm was passed through the nip between a pair of creping rollers. The creping rollers in the pair are rollers each having, on the surface thereof, a plurality of teeth extending parallel to the circumferential direction, and the plurality of teeth have a pitch of 1.0 mm and a tooth width of 0.3 mm. The width of the raw material sheet refers to a length in the direction perpendicular to the roll winding direction in which the raw material sheet is wound.

[0118] By passing the raw material sheet through the nip between the pair of creping rollers, a corrugated paper sheet was obtained which has alternate ridges and grooves continuously formed in the direction in which the rolled raw material sheet is unwound. The difference h between the maximum height of the ridges and the maximum depth of the grooves was 200 μ m.

[0119] The resulting corrugated paper sheet was compacted into a rod shape in such a way that the longitudinal direction of the rod shape is the direction in which the rolled raw material sheet is unwound. A filter element was thus obtained. The density of the filter element calculated on the basis of Equation (2) is shown in Table 1.

[0120] The filter element was then wrapped with a wrapping paper (552-7000 manufactured by Nippon Paper Papyrus Co., Ltd.) having a basis weight of 52 gsm and a thickness of 110 μ m. A paper filter having a cross-sectional diameter of 7 mm in the direction perpendicular to the longitudinal direction and a length of 18 mm in the longitudinal direction was thus obtained.

Examples 2 to 3, Comparative Examples 1 and 2

[0121] Paper filters were obtained in the same manner as Example 1, except that the raw material sheet was replaced with those detailed in Table 1.

[0122] Note that the difference h between the maximum height of the ridges and the maximum depth of the grooves in each of the corrugated paper sheets according to Examples 2 and 3 and Comparative Examples 1 and 2 is as shown in Table 1.

<Measurement of Draw Resistance>

[0123] The draw resistance of the paper filter was measured in accordance with the ISO standard (ISO 6565) by using a device for measuring the filter's draw resistance, manufactured by Cerulean. The draw resistance of the paper filter refers to a difference in air pressure between one end face (first end face) and the other end face (second end face) of the paper filter measured when air is passed through at a predetermined airflow rate (17.5 cc/min) from the first end face to the second end face, with the side surface of the paper filter not allowing air to pass therethrough. The result is shown in Table 1.

<Measurement of Hardness in Direction Perpendicular to Long Axis>

[0124] First, the cross-sectional diameter D_s of the paper filter in the direction perpendicular to the longitudinal direction, before application of the load F , was measured. Next, by using a SODIM-H hardness module (manufactured by SODIM SUS, with a plunger diameter of 12 mm), a load F (compressive load) of 3 N/mm was applied to the paper filter for a compression time of 10 seconds in the direction perpendicular to the long axis, and D_d was determined which is a value obtained by subtracting, from D_s , the depth by which the paper filter is depressed by the load F . Then, from D_s and D_d , the hardness of the paper filter in the direction perpendicular to the long axis was calculated on the basis of Equation (1). The result is shown in Table 1.

<Measurement of Hardness in Longitudinal Direction>

[0125] By using a rheometer (CR-3000EX manufactured by Sun Scientific Co., Ltd., with a plunger diameter of 5 mm), a compressive load on the paper filter was measured while the paper filter was being compressed in the longitudinal direction at a compression velocity of 20 mm/min. The maximum compressive load measured was determined as the hardness of the paper filter in the longitudinal direction. FIG. 7 shows a relation between the compression distance of and the compressive load on the paper filter obtained in Example 1. The hardnesses in the longitudinal direction of the paper filters, obtained in Examples 1 to 3 and Comparative Examples 1 and 2, are shown in Table 1.

basis weight of the raw material sheet can increase the hardness of the paper filter in the direction perpendicular to the long axis. This result suggests that the basis weight of the raw material sheet has a greater effect on the hardness in the direction perpendicular to the long axis than the thickness of the raw material sheet.

[0127] Table 1 also shows that the hardness of the paper filter in the longitudinal direction is correlated with the density of the filter element. The hardness in the longitudinal direction of the paper filter obtained in Example 2 is thus estimated to be about 23 N to 26 N, which is greater than that of the paper filter obtained in Example 1 and smaller than that of the paper filter obtained in Example 3. As in the case of the hardness of the paper filter in the direction perpendicular to the long axis, the basis weight of the raw material sheet is likely to have a great effect on the hardness of the paper filter in the longitudinal direction. Accordingly, the hardness in the longitudinal direction of the paper filter obtained in Comparative Example 1 is estimated to be smaller than that of the paper filter obtained in Example 3 and greater than that of the paper filter obtained in Comparative Example 2.

[0128] The hardness in the longitudinal direction of the paper filter obtained in Comparative Example 2 is as small as 4.2 N and this causes various problems. For example, the user gets a sense of incongruity when holding the product with fingers or in the mouth. Also, when the paper filter is used in a non-combustion-heating-type flavor inhalation product inserted into and used with an electric heating

TABLE 1

Raw Material Sheet or Corrugated Paper Sheet					Paper Filter			
					Airflow Resistance (mm H ₂ O/mm)	Hardness in Direction Perpendicular to Long Axis (%)	Hardness in Longitudinal Direction (N)	Density of Filter Element (g/cm ³)
Trade Name	Basis Weight (gsm)	Thickness (μm)	Width (mm)	h (μm)				
Example 1	Glassine	40	30	140	200	0.22	83.3	17.3
Example 3	Glassine	40	30	180	200	0.37	92.0	—*
Example 3	Glatz	100	125	80	200	0.24	89.5	27.1
Comparative Example 1	Glassine	40	30	120	200	0.13	69.0	—*
Comparative Example 2	37 white	37	41	140	200	0.22	76.9	4.2
								0.15

*: Not measured

[0126] Table 1 shows that by appropriately setting the basis weight, thickness, and width of the raw material sheet and the difference between the maximum height of the ridges and the maximum depth of the grooves in the corrugated paper sheet, a paper filter having a sufficient hardness can be obtained even when the draw resistance in the airflow direction is set to be greater than or equal to 0.2 mm H₂O/mm. For example, a comparison between Examples 1 and 3 having substantially the same draw resistance shows that even when the width of the raw material sheet is small, increasing the basis weight and the thickness of the raw material sheet can increase the hardness of the paper filter in the direction perpendicular to the long axis. Also, a comparison between Example 1 and Comparative Example 2 having the same draw resistance shows that even when the thickness of the raw material sheet is small, increasing the

device, the paper filter cannot be inserted into the electric heating device without being bent. Also, when the paper filter is used in a combustion-type flavor inhalation product, the user cannot drop ashes or extinguish the flame without deformation. Accordingly, the paper filter obtained in Comparative Example 2 is not comfortable to use, and it is difficult to use the paper filter in the flavor inhalation product without inconvenience.

[0129] In Examples 1 and 3, the draw resistances of the paper filters in the airflow direction are substantially the same as that in the Comparative Example 2. However, the problems described above are less likely to occur in Examples 1 and 3, because the hardnesses of the paper filters in the longitudinal direction are as high as 15 N or more. Accordingly, using these paper filters in the flavor inhalation product can not only give the user a good flavor, but also

satisfy the user's taste and comfort and give the user reassurance that a sequence of actions in using the flavor inhalation product can be stably carried out.

REFERENCE SIGNS LIST

- [0130] 10 paper filter
- [0131] 10a paper filter (under no load)
- [0132] 10b paper filter (under load)
- [0133] 11 corrugated paper sheet
- [0134] 11a ridge
- [0135] 11b groove
- [0136] 12 wrapping paper
- [0137] 20 non-combustion-heating-type flavor inhalation product
- [0138] 21 tobacco rod portion
- [0139] 22 cooling segment
- [0140] 23 filter segment
- [0141] 24 mouthpiece portion
- [0142] 25 tipping paper
- [0143] V perforation
- [0144] 31 plunger
- [0145] 32 plunger

1. A paper filter for flavor inhalation products, the paper filter comprising:

- a rod-shaped filter element; and
- a wrapping paper with which to wrap the filter element, wherein the filter element includes a corrugated paper sheet with alternate ridges and grooves extending continuously in a longitudinal direction;
- a draw resistance of the paper filter in an airflow direction is greater than or equal to 0.2 mm H₂O/mm and less than or equal to 1.0 mm H₂O/mm; and
- a hardness of the paper filter in a direction perpendicular to a long axis is greater than or equal to 80.0% and less than or equal to 95.0%, the hardness being represented by Equation (1):

$$\text{hardness (\%)} = \frac{D_s}{D_d} \times 100 \quad \text{Equation (1),}$$

where D_s (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction before application of a load F, and D_d (mm) is a cross-sectional diameter of the paper filter in the direction perpendicular to the longitudinal direction after application of the load F, the load F being a compressive load of 3 N/mm applied to the paper filter for a compression time of 10 seconds in the direction perpendicular to the long axis.

2. A paper filter for flavor inhalation products, the paper filter comprising:

- a rod-shaped filter element; and
- a wrapping paper with which to wrap the filter element, wherein the filter element includes a corrugated paper sheet with alternate ridges and grooves extending continuously in a longitudinal direction;
- a draw resistance of the paper filter in an airflow direction is greater than or equal to 0.2 mm H₂O/mm and less than or equal to 1.0 mm H₂O/mm; and
- a maximum compressive load measured while the paper filter is being compressed in the longitudinal direction at a compression velocity of 20 mm/min is greater than or equal to 15 N and less than or equal to 30 N.

3. The paper filter for flavor inhalation products according to claim 1, wherein a difference between a maximum height

of the ridges and a maximum depth of the grooves is greater than or equal to 50 μm and less than or equal to 500 μm .

4. The paper filter for flavor inhalation products according to claim 1, wherein the corrugated paper sheet is a creped sheet of a raw material sheet which has a basis weight of greater than or equal to 40 gsm and less than or equal to 120 gsm, a thickness of greater than or equal to 30 μm and less than or equal to 130 μm , and a width of greater than or equal to 70 mm and less than or equal to 200 mm; and

the width is a length in a direction perpendicular to a direction corresponding to a longitudinal direction of the filter element including the corrugated paper sheet produced from the raw material sheet.

5. The paper filter for flavor inhalation products according to claim 1, wherein a density of the filter element is greater than or equal to 0.16 g/cm³ and less than or equal to 0.34 g/cm³.

6. The paper filter for flavor inhalation products according to claim 1, wherein the wrapping paper has a basis weight of greater than or equal to 30 gsm and less than or equal to 100 gsm, and a thickness of greater than or equal to 30 μm and less than or equal to 130 μm .

7. A filter segment for flavor inhalation products, the filter segment comprising the paper filter for flavor inhalation products according to claim 1.

8. A rod-shaped flavor inhalation product comprising:

- a tobacco rod portion; and
 - a mouthpiece portion,
- wherein the mouthpiece portion includes the paper filter for flavor inhalation products according to claim 1.

9. A method for manufacturing the paper filter for flavor inhalation products according to claim 1, the method comprising:

- a creping step of creping a raw material sheet to form the corrugated paper sheet;
- a compacting step of compacting the corrugated paper sheet to form the filter element; and
- a wrapping step of wrapping the filter element with the wrapping paper.

10. The paper filter for flavor inhalation products according to claim 2, wherein a difference between a maximum height of the ridges and a maximum depth of the grooves is greater than or equal to 50 μm and less than or equal to 500 μm .

11. The paper filter for flavor inhalation products according to claim 2, wherein the corrugated paper sheet is a creped sheet of a raw material sheet which has a basis weight of greater than or equal to 40 gsm and less than or equal to 120 gsm, a thickness of greater than or equal to 30 μm and less than or equal to 130 μm , and a width of greater than or equal to 70 mm and less than or equal to 200 mm; and

the width is a length in a direction perpendicular to a direction corresponding to a longitudinal direction of the filter element including the corrugated paper sheet produced from the raw material sheet.

12. The paper filter for flavor inhalation products according to claim 2, wherein a density of the filter element is greater than or equal to 0.16 g/cm³ and less than or equal to 0.34 g/cm³.

13. The paper filter for flavor inhalation products according to claim 2, wherein the wrapping paper has a basis weight of greater than or equal to 30 gsm and less than or equal to 100 gsm, and a thickness of greater than or equal to 30 μm and less than or equal to 130 μm .

14. A filter segment for flavor inhalation products, the filter segment comprising the paper filter for flavor inhalation products according to claim 2.

15. A rod-shaped flavor inhalation product comprising:

a tobacco rod portion; and

a mouthpiece portion,

wherein the mouthpiece portion includes the paper filter for flavor inhalation products according to claim 2.

16. A method for manufacturing the paper filter for flavor inhalation products according to claim 2, the method comprising:

a creping step of creping a raw material sheet to form the corrugated paper sheet;

a compacting step of compacting the corrugated paper sheet to form the filter element; and

a wrapping step of wrapping the filter element with the wrapping paper.

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