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

(11) **EP 4 825 195 A1**

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

(43) Date of publication:
21.10.2026 Bulletin 2026/43

(21) Application number: **24903498.4**

(22) Date of filing: **27.11.2024**

(51) International Patent Classification (IPC):
A24D 3/04 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A24D 3/04

(86) International application number:
PCT/JP2024/041930

(87) International publication number:
WO 2025/126840 (19.06.2025 Gazette 2025/25)

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

(30) Priority: **15.12.2023 PCT/JP2023/045108**

(71) Applicant: **Japan Tobacco Inc.**
Tokyo 105-6927 (JP)

(72) Inventor: **MOTODAMARI, Tetsuya**
Tokyo 130-8603 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(54) PAPER PLUG AND FLAVOR INHALATION ARTICLE

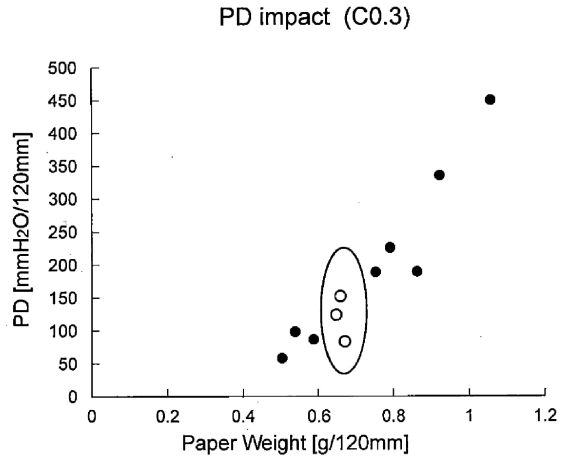
(57) The present disclosure provides a paper plug comprising a filler material and an inner plug wrap wrapped around the filler material, wherein the firmness in a direction perpendicular to a major axis, which is represented by formula (1) below, is equal to or greater than 70.0%.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100 \quad (1)$$

(In formula (1): Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the paper plug before a load F is applied, Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the paper plug when the load F has been applied, and the load F is a load applied to the paper plug under conditions of a compressive load of 3 N in a direction perpendicular to the major axis of the paper plug, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds.)

EP 4 825 195 A1

[Fig. 8A]


PD impact (C0.3)
PD [mmH2O/120mm]
500
450
400
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a paper plug and to a flavor inhalation article.

BACKGROUND ART

[0002] Paper filters obtained by wrapping a filtration material such as paper (pure pulp) with a plug wrap are used as filters for flavor inhalation articles in place of acetate filters obtained by processing synthetic fibers of cellulose acetate tow or the like into a rod shape. For example, PTL 1 discloses a paper filter for a flavor inhalation article.

[0003] Segments such as the paper filter which constitute the flavor inhalation article need to have sufficient firmness for smooth processing in an existing manufacturing system in the process of producing the flavor inhalation article. Furthermore, the segments constituting the flavor inhalation article preferably also have sufficient firmness in order to impart a sense of high quality to the flavor inhalation article as a product.

CITATION LIST

PATENT LITERATURE

[0004] PTL 1: WO 2022/230408 A1

SUMMARY OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] The present disclosure provides a paper plug having sufficient firmness, and a flavor inhalation article comprising the paper plug.

SOLUTION TO PROBLEM

[0006] One aspect of the present disclosure is a paper plug comprising a filler material and an inner plug wrap wrapped around the filler material, wherein the firmness in a direction perpendicular to a major axis, which is represented by formula (1) below, is equal to or greater than 70.0%.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100 \quad (1)$$

(In formula (1): Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the paper plug before a load F is applied, Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the paper plug when the load F has been applied, and the load F is a load applied to the paper plug under conditions of a compressive load of 3 N in a direction perpendicular to the major axis of the paper plug, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds.)

[0007] In the first aspect, the firmness of the paper plug in a direction perpendicular to the major axis, which is defined in formula (1) above, is equal to or greater than 70.0%. Accordingly, the first aspect makes it possible to provide a paper plug having sufficient firmness, therefore enabling smooth processing in the process of producing a flavor inhalation article while also contributing to imparting a sense of high quality to the flavor inhalation article.

[0008] A second aspect of the present disclosure, which is in accordance with the first aspect, is a paper plug in which a ratio of the width (mm) and basis weight (g/m^2) of a base roll of the filler material is in a range represented by formula (2) below.

$$2.2 < \text{width (mm)}/\text{basis weight } (g/m^2) < 8.8 \quad (2)$$

[0009] In the second aspect, the ratio of the width and basis weight of the base roll of the filler material satisfies formula (2) above. A paper plug obtained by wrapping a filler material produced from a base roll having such a width and basis weight has suitable airflow resistance for use in a flavor inhalation article. Furthermore, a paper plug having desired airflow resistance while also ensuring a firmness of 70.0% or greater is obtained by selecting a suitable numerical value within this range. Specifically, it is possible to increase the airflow resistance of the paper plug by

selecting a base roll of the filler material so that the ratio of width and basis weight of this base roll is a larger value, and it is possible to reduce the airflow resistance of the paper plug by selecting a base roll with a smaller ratio. Accordingly, the second aspect makes it possible to provide a paper plug having suitable firmness and airflow resistance by adjusting the ratio of width and basis weight of the base roll of the filler material.

[0010] A third aspect of the present disclosure, which is in accordance with the first and second aspects, is a paper plug in which a filling density of the filler material in the paper plug is equal to or greater than 0.138 mg/mm^3.

[0011] In the third aspect, the filling density of the filler material in the paper plug is equal to or greater than 0.138 mg/mm^3. A paper plug with such a configuration has suitable firmness. Accordingly, the third aspect makes it possible to provide a paper plug having suitable firmness.

[0012] A fourth aspect of the present disclosure, which is in accordance with the first to third aspects, is a paper plug in which the filler material is formed from a crimped sheet comprising cellulose.

[0013] In the fourth aspect, the filler material is formed from a crimped sheet comprising cellulose. The firmness of a paper plug generally increases and the airflow resistance is higher when the filler material is produced from a crimped sheet comprising cellulose. Furthermore, by means of a crimping treatment, channels (small holes) formed within a cross section perpendicular to the longitudinal direction of the paper plug become less noticeable, and there are fewer variations in airflow resistance among the paper plugs produced. Accordingly, the fourth aspect makes it possible to easily increase the firmness and airflow resistance of the paper plug while also making the channels less noticeable and stabilizing airflow resistance, by subjecting the sheet forming the base roll of the filler material to a crimping treatment.

[0014] A fifth aspect of the present disclosure, which is in accordance with the fourth aspect, is a paper plug in which a crimping depth of the sheet is 0.3 mm or greater.

[0015] In the fifth aspect, the sheet comprising cellulose that serves as the base roll of the filler material is subjected to a crimping treatment so that the crimping depth is 0.3 mm or greater. Channels formed within the cross section perpendicular to the longitudinal direction of the paper plug fall within a permissible range when a sheet with a crimping depth of 0.3 mm or greater is used. Accordingly, the fifth aspect makes it possible to provide a paper plug which is desirable in terms of appearance.

[0016] A sixth aspect of the present disclosure, which is in accordance with the first to fifth aspects, is a paper plug in which the width of the base roll of the filler material is 110 mm-220 mm, and the basis weight of the base roll of the filler material is 25 g/m^2-50 g/m^2.

[0017] In the sixth aspect, the base roll of the filler material has a width of 110 mm-220 mm, and a basis weight of 25 g/m^2-50 g/m^2. A paper plug constructed by wrapping a filler material produced from such a base roll has suitable firmness and airflow resistance. Accordingly, the sixth aspect makes it possible to provide a paper plug having suitable firmness and airflow resistance.

[0018] A seventh aspect of the present disclosure, which is in accordance with the first to sixth aspects, is a paper plug in which the airflow resistance per 1 mm in a ventilation direction is 0.7 mmH_2O/mm-3.5 mmH_2O/mm, the paper plug being used in a flavor inhalation article.

[0019] In the seventh aspect, the airflow resistance of the paper plug in the ventilation direction is 0.7 mmH_2O/mm-3.5 mmH_2O/mm, and the paper plug is used in a flavor inhalation article. Accordingly, the seventh aspect makes it possible to provide a paper plug having suitable firmness and airflow resistance for use in a flavor inhalation article.

[0020] An eighth aspect of the present disclosure, which is in accordance with the seventh aspect, is a paper plug in which the base roll of the filler material comprises an additive for adjusting flavor.

[0021] In the eighth aspect, the base roll of the filler material of the paper plug used in a flavor inhalation article comprises an additive for adjusting flavor. Accordingly, the eighth aspect makes it possible to provide a paper plug that forms part of a flavor inhalation article for generating a suitable flavor when heated.

[0022] A ninth aspect of the present disclosure, which is in accordance with the eighth aspect, is a paper plug in which the additive comprises a phenol-reducing material and/or a flavoring.

[0023] In the ninth aspect, the base roll of the filler material of the paper plug used in a flavor inhalation article comprises a phenol-reducing material and/or a flavoring. Accordingly, the ninth aspect makes it possible to provide a paper plug that forms part of a flavor inhalation article for generating a more suitable flavor.

[0024] A 10th aspect of the present disclosure is a flavor inhalation article comprising: the paper plug as claimed in any one of claims 1 to 9 serving as a first plug; a second plug containing a flavor source; and a tipping paper wrapped around the first plug and the second plug.

[0025] In the 10th aspect, a flavor inhalation article is constructed so as to include: a paper plug serving as a first plug having a firmness of 70.0% or greater in a direction perpendicular to the major axis, defined in formula (1) above; a second plug containing a flavor source; and a tipping paper wrapped around the first plug and the second plug. As an example, the first plug may function as a paper filter in a flavor inhalation article. Accordingly, the 10th aspect makes it possible to produce a flavor inhalation article comprising various forms of paper plugs with sufficient hardness

ensured.

[0026] An 11th aspect of the present disclosure, which is in accordance with the 10th aspect, is a flavor inhalation article in which the paper plug is disposed on an upstream side of the second plug.

[0027] In the 11th aspect, the paper plug serving as a first plug is disposed on the upstream side of a second plug containing a flavor source inside a flavor inhalation article through which air flows from upstream to downstream when a user inhales. In particular, the first plug can also constitute a tip end on the upstream side of the flavor inhalation article (the opposite side to a downstream end portion from which the user inhales). Accordingly, the 11th aspect makes it possible to inhibit vapor or aerosol generated by the flavor source from leaking out to the upstream side of the flavor inhalation article by means of the paper plug.

BRIEF DESCRIPTION OF DRAWINGS

[0028]

[Fig. 1] is an overall oblique view of a filter rod according to the embodiment.
[Fig. 2] is a view in cross section of the filter rod seen along the arrows A-A in fig. 1.
[Fig. 3A] is a graph showing the relationship between weight of a filter rod and firmness in a major axis direction, when a paper sheet is crimped to a depth of 0.3 mm.
[Fig. 3B] is a graph showing the relationship between weight of a filter rod and firmness in the major axis direction, when a paper sheet is crimped to a depth of 0.5 mm.
[Fig. 3C] is a graph showing the relationship between weight of a filter rod and firmness in the major axis direction, when a paper sheet is crimped to a depth of 0.7 mm.
[Fig. 4] is a schematic diagram showing a paper sheet which has been crimped.
[Fig. 5A] is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.3 mm was performed in Examples 1-3.
[Fig. 5B] is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.5 mm was performed in the examples.
[Fig. 5C] is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.7 mm was performed in the examples.
[Fig. 6] is a graph showing the relationship between crimping depth and firmness in the major axis direction in the examples.
[Fig. 7] is a diagram showing the relationship between crimping depth and appearance in the examples.
[Fig. 8A] is a graph showing filling weight and airflow resistance of filter rods, when a plurality of paper sheets including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.3 mm.
[Fig. 8B] is a graph showing filling weight and airflow resistance of filter rods, when a plurality of paper sheets including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.5 mm.
[Fig. 8C] is a graph showing filling weight and airflow resistance of filter rods, when a plurality of paper sheets including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.7 mm.
[Fig. 9] is a diagram showing the relationship between crimping depth and appearance for filter rods comprising paper sheets produced from predetermined base rolls.
[Fig. 10] is a graph showing the relationship between crimping depth, and area and number of channels (small holes) for the filter rods in fig. 9.
[Fig. 11] is a schematic view in side section showing an example of a flavor inhalation article employing a paper filter.
[Fig. 12] is a schematic view in side section showing another example of the flavor inhalation article employing a paper plug obtained by cutting a filter rod in the longitudinal direction.
[Fig. 13] is a schematic diagram showing a method for measuring firmness of a filter rod.

EMBODIMENTS OF THE INVENTION

[0029] Embodiments of the present disclosure will be described below with reference to the drawings. In the drawings described below, identical or corresponding components are assigned the same reference symbols and duplicate descriptions will not be given.

[0030] Fig. 1 is an overall oblique view of a filter rod 10 according to the embodiment. Fig. 2 is a view in cross section of the filter rod 10 seen along the arrows A-A in fig. 1.

[0031] The filter rod 10 is a material of a paper filter constituting a portion of a flavor inhalation article. A paper filter (paper plug 20 which will be described later) can be obtained by cutting the filter rod 10 so as to have a predetermined length in a longitudinal direction.

[0032] As shown in fig. 1, the filter rod 10 is cylindrical and comprises a paper sheet 12, and a first plug wrap 14 wrapped around the paper sheet 12. The paper sheet 12 is a sheet which is formed by cutting a predetermined cellulose-containing base roll to a predetermined length and performing a suitable crimping treatment, then the crimped sheet is folded and accommodated inside the first plug wrap 14 which has been wound in a cylindrical shape. It should be noted that the paper sheet 12 may equally be wound rather than folded before being accommodated inside the first plug wrap 14. Moreover, the paper sheet 12 will be described hereinafter as a single sheet, but it may equally be a set of multiple sheets. That is, the base roll may be cut to a predetermined length to obtain a paper sheet 12, which is then further cut in half lengthwise, for example, and the resulting set of two sheets may likewise be considered as the paper sheet 12. The paper sheet 12 is an example of a filler material of the present disclosure. The first plug wrap 14 is an example of an inner plug wrap of the present disclosure.

[0033] The material of the first plug wrap 14 may comprise pulp as the main component, for example. A sheet of pulp may be formed using wood pulp such as softwood pulp or hardwood pulp, or produced with an admixture of non-wood pulp which is typically used for the wrapping paper for tobacco products, such as flax pulp, hemp pulp, sisal pulp, or esparto. These pulps may be used alone, or several types of pulps may be combined in any proportions for use. The material may furthermore comprise a filler such as calcium carbonate, etc.

[0034] There is no particular restriction on the form of the first plug wrap 14, and it may include a seam comprising one or more lines of adhesive. The adhesive may comprise a hot-melt adhesive, and further, the hot-melt adhesive may comprise polyvinyl alcohol. Furthermore, the adhesive may comprise a vinyl acetate-based adhesive. There is no particular restriction on the material of the first plug wrap 14, and a well-known material may be used, and it may furthermore include a filler such as calcium carbonate, etc. Furthermore, the first plug wrap 14 may be coated or uncoated, but is preferably coated with a desired material from the viewpoint of allowing functions such as strength and structural rigidity to be imparted. Moreover, the first plug wrap 14 may be an air-permeable porous paper having multiple pores.

[0035] As an example, it will be assumed hereinafter that the length of the cut base roll (that is, the longitudinal length of the filter rod 10) is 120 mm, and the circumference of the filter rod 10 is 21.3 mm. Assuming π=3.14, the radius of the filter rod 10 is therefore:

$$21.3\ \text{mm}/(3.14\times 2) = 3.391719\ \text{(approximated below)}$$

$$\approx 3.40\text{mm}.$$

Furthermore, the cross-sectional area in a cross section perpendicular to the longitudinal direction of the filter rod 10 (the face shown in fig. 2) is:

$$21.3\ \text{mm}\times 3.4\ \text{mm}/2 = 36.21\ \text{mm}^2.$$

In addition, the volume of the filter rod 10 is:

$$120\ \text{mm}\times 36.21\ \text{mm}^2 = 4345.2\ \text{mm}^3.$$

[0036] A paper filter (and the filter rod 10 serving as the material thereof) needs to have a certain level of firmness for smooth processing in an existing manufacturing system in the process of producing a flavor inhalation article. Specifically, the firmness in a direction perpendicular to the longitudinal direction of the filter rod 10 is preferably 70% or greater. The firmness in a direction perpendicular to the longitudinal direction of the filter rod 10 is more preferably 75% or greater, and even more preferably 80% or greater.

[0037] Fig. 3A is a graph showing the relationship between weight of the filter rod 10 and firmness in the major axis direction, when the paper sheet 12 is crimped to a depth of 0.3 mm. Fig. 3B is a graph showing the relationship between weight of the filter rod 10 and firmness in the major axis direction, when the paper sheet 12 is crimped to a depth of 0.5 mm. Fig. 3C is a graph showing the relationship between weight of the filter rod 10 and firmness in the major axis direction, when the paper sheet 12 is crimped to a depth of 0.7 mm.

[0038] It should be noted that the firmness (%) in a direction perpendicular to the longitudinal direction of the filter rod 10 is an amount obtained by means of the following formula.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds)\times 100$$

Here, Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the filter rod

10 before a load F is applied, Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the filter rod 10 when the load F has been applied, and the load F is a load applied to the filter rod 10 under conditions of a compressive load of 3 N in a direction perpendicular to the major axis, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds. It should be noted that the following paper was used as the first plug wrap 14. S52-7000 (basis weight: 52 gsm, air permeability: 7000 CORESTA units, thickness: 110 μm), manufactured by Nippon Paper Papylia Co., Ltd. For measurements of firmness in the present disclosure, measurements made hereinafter will employ this paper as the first plug wrap 14.

[0039] The inventor of the present disclosure prepared a plurality of filter rods 10 in the manner described above using various base rolls with different basis weights and widths, and investigated the relationship between filling weight of the paper sheet 12 in the filter rod 10, and firmness in the direction perpendicular to the longitudinal direction. A plurality of filter rods 10 were prepared in the manner described above using various base rolls with different basis weights and widths, and in particular the paper sheet 12 was crimped to the three depths of 0.3 mm, 0.5 mm and 0.7 mm.

[0040] As shown in fig. 3A-3C the firmness of the filter rod 10 in the direction perpendicular to the longitudinal direction generally tended to increase when the paper sheet 12 was subjected to deep crimping. However, crimping in all cases showed that firmness of 70% or greater perpendicular to the longitudinal direction was ensured as long as the filter rod 10 contained the paper sheet at a weight of 0.6 g or greater. Considering the filling density of the paper sheet 12 in the filter rod 10, the following threshold can be found, using the fact that the volume of the filter rod 10 is 4345.2 mm^3:

$$600\ \text{mg}/4345.2\ \text{mm}^3 = 0.13808\ \text{(approximated)}$$

$$\approx 0.138\ \text{mg}/\text{mm}^3.$$

That is, firmness of 70% or greater perpendicular to the longitudinal direction is ensured as long as the filling density of the paper sheet 12 in the filter rod 10 is 0.138 mg/mm^3. Furthermore, when the paper sheet 12 was crimped to a depth of 0.5 mm in particular, the threshold for the filling density of the paper sheet 12 to ensure firmness of 70% or greater perpendicular to the longitudinal direction was found to be 0.111 mg/mm^3, and the threshold when the paper sheet 12 was crimped to a depth of 0.5 mm was found to be 0.106 mg/mm^3.

[0041] Crimping depth will be described here. Fig. 4 is a schematic diagram showing a paper sheet 12 which has been crimped.

[0042] As shown in fig. 4, mountain portions 12a and valley portions 12b are formed when the flat paper sheet 12 is crimped. A difference h between the maximum height of the mountain portions 12a of the paper sheet 12 and the maximum depth of the valley portions 12b is referred to as the crimping depth of the paper sheet 12. As an example, the crimping depth is established in accordance with setting of a meshing depth (meshing amount) of a pair of rollers for performing the treatment to crimp the flat paper sheet 12 (or base roll thereof).

[EXAMPLES]

[0043] Based on the results above, the inventor of the present disclosure took thorough measurements for the three examples below. Fig. 5A is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.3 mm was performed in the examples. Fig. 5B is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.5 mm was performed in the examples. Fig. 5C is a graph showing firmness in the major axis direction and airflow resistance when a crimping treatment to a depth of 0.7 mm was performed in the examples. Fig. 6 is a graph showing the relationship between crimping depth and firmness in the major axis direction in the examples. Fig. 7 is a diagram showing the relationship between crimping depth and appearance in the examples.

[Table 1]

	Basis weight	Width
Example 1	2 5 g/m^2	220 mm
Example 2	30 g/m^2	1 8 0 mm
Example 3	40 g/m^2	140 mm

[0044] The three examples constitute filter rods 10 constructed to have a circumference of 21.3 mm using paper

sheets 12 obtained by cutting base rolls having the basis weight and width shown in Table 1 to lengths of 120 mm, as described above. Fig. 5A-5C show the filling weights of paper sheet in each rod. For example, in the case of Example 1, the base roll having a basis weight of 25 g/m^2 and a width of 220 mm was cut to a length of 120 mm, so the filling weight of paper sheet 12 contained in the filter rod 10 was determined as:

$$25\ \text{g/m}^2 \times 0.22\ \text{m} \times 0.12\ \text{m} = 0.66\ \text{g}.$$

Similarly, the filling weight in Example 2 was determined as 0.648 g, and the filling weight in Example 3 was determined as 0.672 g. When these numerical values are rounded to two decimal places, we obtain the filling weight of paper sheet in each rod indicated in fig. 5A-5C. In all of Examples 1-3, the filter rods 10 contained the paper sheet 12 at a weight of 0.6 g or greater.

[0045] As shown in fig. 5A, when crimping was performed to a depth of 0.3 mm, the firmness of the filter rod 10 in the major axis direction was measured as 71.5% in Example 1, 72.6% in Example 2, and 75.2% in Example 3. Meanwhile, the airflow resistance of the filter rods 10 in this case was measured as 152 mmH_2O in Example 1, 123 mmH_2O in Example 2, and 84 mmH_2O in Example 3. The airflow resistance per 1 mm length in Example 1 was determined as:

$$152\ \text{mmH}_2\text{O}/120\ \text{mm} = 1.266\ (\text{approx.})\ \text{mmH}_2\text{O/mm}.$$

Similarly, the values were 1.025 mmH_2O/mm in Example 2, and 0.7 mmH_2O/mm in Example 3. Moreover, as described above, S52-7000 (basis weight: 52 gsm, air permeability: 7000 CORESTA units, thickness: 110 μm), manufactured by Nippon Paper Papylia Co., Ltd., was used as the first plug wrap 14.

[0046] Moreover, the following value can be found for the filling density of the paper sheet 12 in the filter rod 10 of Example 1, using the fact that the volume of the filter rod 10 is 4345.2 mm^3:

$$660\ \text{mg}/4345.2\ \text{mm}^3 = 0.15189\ (\text{approximated below})\ \text{mg/mm}^3.$$

Similarly, the values were 0.153744 mg/mm^3 in Example 2, and 0.159439 mg/mm^3 in Example 3. In all of Examples 1-3, the filling density of paper sheet 12 in the filter rods 10 was 0.138 mg/mm^3 or greater. It can be understood from this (even before actually measuring the firmness in each example) that firmness of 70% or greater perpendicular to the longitudinal direction is ensured, as described above

[0047] Next, as shown in fig. 5B, when crimping was performed to a depth of 0.5 mm, the firmness of the filter rod 10 in the major axis direction was measured as 82.8% in Example 1, 81.3% in Example 2, and 80.4% in Example 3. Meanwhile, the airflow resistance of the filter rods 10 in this case was measured as 530 mmH_2O in Example 1, 378 mmH_2O in Example 2, and 269 mmH_2O in Example 3. The airflow resistance per 1 mm length in Example 1 was determined as:

$$530\ \text{mmH}_2\text{O}/120\ \text{mm} = 4.416\ \text{mmH}_2\text{O/mm}.$$

Similarly, the values were 3.15 mmH_2O/mm in Example 2, and 2.416 (approximated below) ≈ 2.42 mmH_2O/mm in Example 3.

[0048] As shown in fig. 5C, when crimping was performed to a depth of 0.7 mm, the firmness of the filter rod 10 in the major axis direction was measured as 84.2% in Example 1, 83.5% in Example 2, and 84.0% in Example 3. Meanwhile, the airflow resistance of the filter rods 10 in this case was measured as 710 mmH_2O in Example 1, 579 mmH_2O in Example 2, and 419 mmH_2O in Example 3. The airflow resistance per 1 mm length in Example 1 was determined as:

$$710\ \text{mmH}_2\text{O}/120\ \text{mm} = 6\ \text{mmH}_2\text{O/mm}.$$

Similarly, the values were 4.825 ≈ 4.83 mmH_2O/mm in Example 2, and 3.4916 (approximated below) ≈ 3.49 mmH_2O/mm in Example 3.

[0049] The measurement results above are summarized in Table 2 below.

[Table 2]

	Example 1	Example 2	Example 3
Filling weight (g)	0.66	0.648	0.672
Filling density (mg/mm^2)	0.15189	0.153744	0.159439
Ratio of width (mm) and basis weight (g/m^2)	8.8	6	3.5
Firmness in major axis direction (%)	Crimp 0.3 71.5 Crimp 0.5 82.8 Crimp 0.7 84.2	Crimp 0.3 72.6 Crimp 0.5 81.3 Crimp 0.7 83.5	Crimp 0.3 75.2 Crimp 0.5 80.4 Crimp 0.7 84.0
Airflow resistance (mmH_2O)	Crimp 0.3 152 Crimp 0.5 530 Crimp 0.7 710	Crimp 0.3 123 Crimp 0.5 378 Crimp 0.7 579	Crimp 0.3 84 Crimp 0.5 269 Crimp 0.7 419
Airflow resistance per 1 mm (mmH_2O/mm)	Crimp 0.3 1.266 Crimp 0.5 4.416 Crimp 0.7 6	Crimp 0.3 1.025 Crimp 0.5 3.15 Crimp 0.7 4.83	Crimp 0.3 0.7 Crimp 0.5 2.42 Crimp 0.7 3.49

[0050] The filling weight (g), filling density (mg/mm^3), and ratio of width (mm) and basis weight (g/m^2) are amounts determined from the width and basis weight of the base roll of the paper sheet 12, and are amounts specific to each example. The values actually measured in each example are firmness (%) in the major axis direction and airflow resistance (mmH_2O).

[0051] As shown in Table 2, a firmness of 70% or greater in the major axis direction was obtained for each example. As stated above, these measurement results are consistent with what was expected from the selection of width and basis weight of the base roll of the paper sheet 12 in each example. Furthermore, as shown in fig. 6, it was specifically confirmed that the firmness of the filter rod 10 in the direction perpendicular to the longitudinal direction increases when the depth of crimping of the paper sheet 12 increases.

[0052] Furthermore, as shown in fig. 7, it was found in all of Examples 1-3 that a smaller crimping depth makes channels (small holes) in the filter rod 10 more noticeable, leading to a less desirable appearance. As can be seen from fig. 7, a desirable appearance was obtained in Examples 1-3 by crimping the base roll of the paper sheet 12 to at least 0.3 mm. An even more desirable appearance was obtained in each example by crimping the base roll of the paper sheet 12 to at least 0.5 mm.

[0053] As shown in Table 1, the basis weight and width of the base roll of the paper sheet 12 were different in each of the three examples. As shown in Table 2, it can be seen that the airflow resistance value can be set at a desired value while ensuring firmness of 70% or greater in the major axis direction by suitably selecting the basis weight and width ratio of the base roll. Specifically, it can be seen that a filter rod 10 having high airflow resistance can be produced by selecting a smaller basis weight and a larger width of the base roll, and a filter rod 10 having low airflow resistance can be produced by selecting a larger basis weight and a smaller paper width of the base roll. Furthermore, in the examples, the ratio of width and basis weight of the base roll in Example 1 was determined as:

$$220\ (mm)/25\ (g/m2) = 8.8.$$

Similarly, this ratio was determined as 6 in Example 2, and 3.5 in Example 3. It is possible to increase the airflow resistance of the filter rod 10 by selecting a base roll of the paper sheet 12 so that the ratio of width and basis weight of this base roll is a larger value, and it is possible to reduce the airflow resistance of the filter rod 10 by selecting a base roll with a smaller ratio.

[0054] Fig. 8A is a graph showing filling weight and airflow resistance of filter rods 10, when a plurality of paper sheets 12 including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.3 mm. Fig. 8B is a graph showing filling weight and airflow resistance of filter rods 10, when a plurality of paper sheets 12 including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.5 mm. Fig. 8C is a graph showing filling weight and airflow resistance of filter rods 10, when a plurality of paper sheets 12 including the examples, with different basis weights and widths of base rolls, are crimped to a depth of 0.3 mm.

[0055] The three dots enclosed in the oval shape in fig. 8A-8C indicate Examples 1-3. Specifically, the dot at the top of those enclosed by the oval shape indicates Example 1, the dot in the middle indicates Example 2, and the dot at the bottom denotes Example 3. It can be seen from the results shown in fig. 8A-8C that the airflow resistance can be adjusted by modifying paper conditions (that is, width and basis weight of the base roll) even when comparable filling weights are maintained.

[0056] The measured values of airflow resistance in Examples 1-3 shown in Table 2 and fig. 8A-8C fall within a suitable range for filter rods 10 used in a flavor inhalation article which is heated in a flavor inhaler. Specifically, an airflow resistance in a range of 45-135 mmH_2O along the ventilation direction of the flavor inhalation article is known to be preferable for a flavor inhalation article which is heated in a heat-not-burn flavor inhaler. In particular, an airflow resistance of 60-120 mmH_2O is more preferable, and 80-110 mmH_2O is most preferable.

[0057] The airflow resistance of the flavor inhalation article can be considered as the sum of the airflow resistance of the flavor source positioned on the upstream side (the opposite side to a downstream end portion from which the user inhales), and the airflow resistance of the filter positioned downstream. Here, the air which flows into the flavor inhalation article can be divided into air flowing in from the tip end on the upstream side of the flavor inhalation article (the opposite side to the downstream end portion from which the user inhales), and air flowing in from a ventilation hole provided close to the filter further downstream. Of the air reaching the user's oral cavity, the air flowing in from the ventilation hole provided close to the filter downstream is expressed as Vf (%). The airflow resistance of the flavor source does not act on the air flowing in from the ventilation hole provided close to the filter downstream, and therefore not all of this airflow resistance contributes to the overall airflow resistance of the flavor inhalation article; the contribution is only the portion multiplied by 100-Vf (%).

[0058] As a specific example, consider a flavor article comprising a flavor source having an airflow resistance of 70 mmH_2O, where Vf is 60%, and a filter obtained by cutting a filter rod 10 having an airflow resistance per 1 mm length of 0.7 mmH_2O/mm into segments of 8 mm. The airflow resistance of the flavor article in this case is as follows:

$$70\ mmH_2O \times (1\text{-}0.6)$$

(contribution from flavor source) plus

$$0.7\ mmH_2O/mm \times 8\ mm$$

(contribution from filter), giving

$$28+5.6 = 33.6\ mmH_2O.$$

[0059] The details of the calculation will be omitted, but, to take an example, when Vf is 40%-60% and the airflow resistance of the flavor source is 70 mmH_2O-250 mmH_2O, the filter rod 10 used as the paper filter preferably has an airflow resistance per 1 mm length of 0.7 mmH_2O/mm-3.5 mmH_2O/mm in order for the overall airflow resistance of the flavor inhalation article to fall within the range of 45-135 mmH_2O. The values in the examples shown in Table 2 fall within this range, except where the crimping depth is 0.5 mm or 0.7 mm in Example 1, and where the crimping depth is 0.7 mm in Example 2.

[0060] As described above, the value of width (mm)/basis weight (g/m^2) of the base roll is 8.8 in Example 1, 6 in Example 2, and 3.5 in Example 3. The fact that the ratio of width and basis weight of the base roll of the paper sheet 12 defines the airflow resistance value of the filter rod 10 is considered to be generally applicable, so it can be said that a filter rod 10 with a suitable airflow resistance can be produced when the base roll of the paper sheet 12 satisfies 3.5 < width (mm)/basis weight (g/m^2) < 8.8. It is moreover clear that a suitable airflow resistance of the filter rod 10 can still be obtained even if the lower limit of the range is expanded as below:

$$2.2 < \text{width (mm)/basis weight } (g/m^2) < 8.8$$

[0061] It should be noted that in the three examples, the width of the base roll of the paper sheet 12 is 140 mm-220 mm, and the basis weight is 25 g/m^2-40 g/m^2. However, it is clear that filter rods 10 having a suitable airflow resistance

and firmness can still be produced if this range is expanded as below:

The width of the base roll of the paper sheet 12 is 110 mm-220 mm, and
The basis weight of the base roll of the paper sheet 12 is 25 g/m^2-50 g/m^2.

[Investigation of lower limit of crimping depth]

[0062] The inventor of the present disclosure investigated a desirable lower limit of the crimping depth. Fig. 9 is a diagram showing the relationship between crimping depth and appearance for filter rods 10 comprising paper sheets 12 produced from predetermined base rolls. Fig. 10 is a graph showing the relationship between crimping depth, and area and number of channels (small holes) for the filter rods 10 in fig. 9.

[0063] The base roll used here had a basis weight of 40 g/m^2 and a width of 280 mm, unlike in Examples 1-3 described above. As described above, measurements were taken for filter rods 10 constructed so as to have a circumference of 21.3 mm using a paper sheet 12 obtained by cutting the base roll to lengths of 120 mm.

[0064] As shown in fig. 9, when the crimping depth was 0.16 mm or 0.2 mm, there were noticeable channels in the filter rods 10, which is undesirable in terms of appearance. Meanwhile, when the crimping depth was 0.3 mm and 0.35 mm, it can be said that the channels formed in the filter rods 10 were within a permissible range.

[0065] Fig. 10 is a graph showing the results of image analysis carried out for the four types of filter rods 10 shown in fig. 9. The camera used in the image analysis shown in fig. 10 was a "High-performance 16× speed 0.47-megapixel monochrome camera CA-H048MX" manufactured by Keyence Corporation. The other equipment was as shown in Table 3 below.

[Table 3]

Equipment	Model (manufactured by Keyence Corporation)
Lens	CA-LH50
Close-up ring	OP-51612
Lighting	CA-DRW5
Image processing device	CV-X420F

[0066] The results obtained in fig. 10 are based on image analysis normally performed by a person skilled in the art. Specifically, the analysis was carried out according to the following processing flow: (1) a cross section perpendicular to the longitudinal direction of the filter rod 10 was imaged; (2) shading correction and binarization were performed as preprocessing; and (3) blob processing was performed to extract the areas of the black blob parts (corresponding to channels).

[0067] The vertical axis in fig. 10 represents the number of channels within the cross section of the filter rod 10, and the horizontal axis represents the number of pixels. Here, one pixel corresponds to an area of 0.000436 mm^2. In fig. 10, the black circles (12YAF) represent measured values for a conventional acetate filter rod. As shown in fig. 10, when the crimping depth was 0.16 mm or 0.2 mm, channels with a large area were formed within the cross section of the filter rod 10, and the shape of the graph differs considerably from that for the acetate filter rod. Meanwhile, when the crimping depth was 0.3 mm and 0.35 mm, the shape of the graph is close to that for the acetate filter rod.

[0068] It should be noted that the presence of the channels in the filter rod 10 is not only a problem in terms of esthetic appearance, it may also be a technical problem. Specifically, when channels are formed within the filter rod 10, the flavor source (for example cut tobacco leaves or cut tobacco sheet) may spill out from the tip end of the flavor inhalation article comprising the filter rod 10 and the flavor source, and there is also a possibility of sidestream smoke generated from the flavor source leaking out from the flavor inhalation article and possibly soiling the flavor inhaler.

[0069] Taking account of the measurement results above, a crimping depth of at least 0.3 mm is desirable in the paper sheet 12 used in the filter rod 10.

[Configuration of flavor inhalation article]

[0070] A flavor inhalation article can be constructed by using, as a filter, a paper plug obtained by cutting the filter rod 10 to predetermined lengths along the longitudinal direction. Fig. 11 is a schematic view in side section showing an example of a flavor inhalation article 110 employing a paper filter. Fig. 12 is a schematic view in side section of a flavor inhalation article 200 according to another example employing a paper plug 20 obtained by cutting the filter rod 10 in the longitudinal direction.

[0071] In the example shown in fig. 11, the flavor inhalation article 110 comprises a smokable material 111, a tubular member 114, a hollow filter portion 116, and a filter portion 115. The filter portion 115 is formed by the paper plug 20 obtained by cutting the filter rod 10 in the longitudinal direction. The filter portion 115 is an example of a first plug of the present disclosure.

[0072] The smokable material 111 is wrapped with a cigarette paper 112. The tubular member 114, the hollow filter portion 116, and the filter portion 115 are wrapped with a tipping paper 113 different from the cigarette paper 112, together with a portion of the smokable material 111 wrapped with the cigarette paper 112. The tipping paper 113 also wraps a portion of the cigarette paper 112 wrapped around the smokable material 111. This connects the tubular member 114, the hollow filter portion 116, and the filter portion 115 to the smokable material 111. The smokable material 111 wrapped with the cigarette paper 112 is an example of a second plug of the present disclosure.

[0073] An outer surface of the tipping paper 113 close to the end on the filter portion 115 side is coated with a lip-release agent 117 for facilitating separation of the user's lips from the tipping paper 113. The part of the flavor inhalation article 110 to which the lip-release agent 117 is applied functions as a mouthpiece of the flavor inhalation article 110.

[0074] Moreover, the tubular member 114 may be provided with concentric perforations in a circumferential direction of the tubular member 114. The perforations serve to promote an inflow of external air produced by user inhalation, and the inflow of air from the perforations makes it possible to reduce the temperature of components and air flowing in from the flavor inhalation article 110.

[0075] The smokable material 111 may contain a flavor source such as tobacco, and an aerosol source, for example. Furthermore, the cigarette paper 112 that wraps the smokable material 111 may be an air-permeable sheet member. The tubular member 114 may be a paper tube or a hollow filter, but is not particularly limited, and another material may be used. In the example shown in fig. 2, the flavor inhalation article 110 comprises the smokable material 111, the tubular member 114, the hollow filter portion 116, and the filter portion 115, but the configuration of the flavor inhalation article 110 is not limited thereto. For example, the hollow filter portion 116 may be omitted, and the tubular member 114 and filter portion 115 may be arranged adjacent to each other.

[0076] Moreover, the base roll of the paper sheet 12 may also be treated when the filter rod 10 is produced, in order to adjust the flavor in the flavor inhalation article. For example, at least one of a phenol-reducing material and a flavoring may be added to the base roll of the paper sheet 12.

[0077] The term "phenolic compound" means a type of compound in which one or more hydroxyl groups are bonded to an aromatic hydrocarbon group. Examples that may be cited include phenol, o-cresol, m-cresol, p-cresol, and catechol. Accordingly, a "phenol-reducing material" in the present disclosure is an additive that can reduce at least one phenolic compound such as, e.g. phenol, o-cresol, m-cresol, p-cresol, and/or catechol, when the paper plug 20 is used as the filter portion 115 of the flavor inhalation 110, as measurable using a standard smoking test, for example.

[0078] Moreover, the inventor of the present disclosure found that the paper plug 20 constituting the filter portion 115 should preferably have an airflow resistance per 1 mm in the ventilation direction of 0.7 mmH_2O/mm-3.5 mmH_2O, in order to construct a flavor inhalation article 110 to be used in a heat-not-burn flavor inhaler.

[0079] Furthermore, the paper plug 20 is used in order to construct the filter portion 115 of the flavor inhalation article 110 in fig. 11, but the usage of the paper plug 20 in the flavor inhalation article is not limited to a paper filter. For example, as shown in fig. 12, it is also possible to produce a flavor inhalation article 200 in which the paper plug 20 constitutes a tip end on the upstream side of the flavor inhalation article (the opposite side to a downstream end portion from which the user inhales).

[0080] As shown in fig. 12, the flavor inhalation article 200 comprises: a first segment 210, a flavor-generating segment 220, a cooling segment 230, and a second segment 240. The flavor inhalation article 200 comprises: a first end 201 inserted into the flavor inhaler, and a second end 102 on the opposite side to the first end 201. In the example shown in fig. 12, the flavor inhalation article 200 extends in the longitudinal direction along a center axis AX, with the first end 201 and the second end 202 being formed at each of the two ends thereof along the longitudinal direction. Hereinafter, the first end 201 side and the second end 202 side are referred to as the "upstream side" and the "downstream side", respectively. Furthermore, in the following, unless explicitly stated otherwise, the "radial direction" and "circumferential direction" denote the radial direction and circumferential direction of a rotational coordinate system centered on the center axis AX.

[0081] The first segment 210 is a segment disposed on the first end 101 side of the flavor-generating segment 220. The first segment 210 preferably extends from the first end 201 as far as the end portion of the flavor-generating segment 220 on the first end 201 side. The first segment 210 comprises a plug portion 211, and a cylindrical second tipping paper 250 covering the plug portion 211. The plug portion 211 is formed by the paper plug 20 obtained by cutting the filter rod 10 in the longitudinal direction. Furthermore, the second tipping paper 250 covers not only the plug portion 211 but also a flavor source 221 wrapped with a cigarette paper 248 (described later), and connects the first segment 210 and the flavor-generating segment 220. The plug portion 211 is an example of a first plug of the present disclosure.

[0082] The flavor-generating segment 220 comprises the flavor source 221 and the cylindrical cigarette paper 248 covering the flavor source 221. There is no particular limitation as to the flavor source 221 provided that it generates a flavor by means of heating, but the flavor source 221 is preferably a tobacco material. Examples of tobacco materials which may be cited include materials obtained by processing dried tobacco leaves, such as cut tobacco, or tobacco extracts (extracts obtained with water, organic solvents, or mixed solutions thereof). The flavor source 221 may be formed from one or more tobacco sheets. The tobacco sheet may be formed, for example, by processing dried tobacco leaves into a sheet which is homogenized using a well-known method such as a papermaking, slurry or rolling method (this sheet will be referred to below as a "homogenized sheet"). Furthermore, the flavor source 221 may be a cut tobacco sheet. The flavor source 221 may comprise at least one of a flavoring, a cooling agent and a flavoring agent instead of or as well as the tobacco material. The flavor-generating segment 220 (flavor source 221 wrapped with the cigarette paper 248) is an example of the second plug of the present disclosure.

[0083] The cooling segment 230 has a hollow tube 231 and a cylindrical tipping paper 260 covering the hollow tube 231. The hollow tube 231 may be a paper tube or the like, for example. The hollow tube 231 cools the vapor or aerosol generated by the flavor source 221. By arranging the hollow tube 231 downstream of the flavor source 221 in this way, it is possible to cool the vapor or aerosol generated by the flavor source 221. Moreover, as shown in fig. 12, the tipping paper 260 covers not only the hollow tube 231, but also a portion of the flavor source 221 wrapped with the second tipping paper 250 and the cigarette paper 248, and an outer plug wrap 350 (described later), and connects the flavor-generating segment 220, the cooling segment 230, and the second segment 240.

[0084] A plurality of circular through-holes 232 that radially penetrate wall faces of both the hollow tube 231 and the tipping paper 260 in a concentric manner in the circumferential direction of the hollow tube 231 are formed in the hollow tube 131 and the tipping paper 260. The through-holes 232 are holes for promoting an inflow of external air produced by the user drawing, and the vapor or aerosol generated by the flavor source 221 can be further cooled by means of this inflow of air.

[0085] The second segment 240 is a segment disposed on the second end 102 side of the cooling segment 230. The second segment 240 comprises: a first filter 241 and a second filter 242 arranged alongside each other in the longitudinal direction; and an outer plug wrap 350 covering the first filter 242 and the second filter 242. There is no particular restriction on the second segment 240, provided that it has the function of a filter for adjusting the flow of air during flavor inhalation and for adjusting the amount of flavor or other materials mixed in, etc. The second segment 240 may also function as a rear plug for preventing members on the first end 201 side of the second segment 240 from falling out.

[0086] It should be noted that the position of the first filter 241 is not limited to the position shown in fig. 12, and the positions of the first filter 241 and the second filter 242 may be switched, for example. Furthermore, the second filter 242 may be omitted from the flavor inhalation article 200, or the second segment 240 may include three or more filters.

[0087] The first filter 141 comprises: a filler material 310, and a cylindrical first inner plug wrap 320 wrapping the filler material 310. There is no particular limitation as to the filler material 310 provided that it is a filter material, and it may be a fibrous material or a porous material, etc. The filler material 310 may be, for example, cellulose acetate fibers, paper, or nonwoven fabric, etc. The filler material 310 may be formed by the paper plug 20 obtained by cutting the filter rod 10 in the longitudinal direction.

[0088] The second filter 242 is formed by a filling layer 330 having a hollow portion, and a second inner plug wrap 340 which covers the filling layer 330. The filling layer 330 may be, for example, a rod in which cellulose acetate fibers have been packed to a high density, and to which a triacetin-containing plasticizer has been added and cured. The second inner plug wrap 340 may be omitted.

[0089] Moreover, a method for measuring "firmness (%)" in the present disclosure will be described. The measurement device which is used may be a "SODIUM-H hardness module" (KORBER) or an alternative apparatus. As shown in fig. 13, a filter rod 10 having a length of 120 mm was inserted from vertically above into a predetermined part of a measurement device 30, and pressure was applied from the side by means of a cylindrical jig 32. The pressure was set at 300 g in this test. A jig with a diameter of φ 12 mm was used as the jig 32. In terms of the position of pressure application, the jig 32 was placed at a position at least 6 mm vertically above a vertically lower end of the filter rod 10, and pressure was applied.

[0090] The measurement conditions for the measurement device are described below.

Device: SODIUM-H hardness module
Operation: pressure was applied from the side face of the testpiece, and the value calculated from the diameter before and after pressurization was read as the firmness.

<Calculation formula>

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100$$

Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the filter rod 10 before pressure is applied, and
Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the filter rod 10 when the pressure has been applied.

<Measurement apparatus conditions>

[0091] Pressure: 300 g, pressurization time: 10 seconds, pressure jig head diameter: φ 12 mm, number of testpieces during measurement: 1

(Action of this embodiment)

[0092] In this embodiment, the firmness in a direction perpendicular to the major axis, defined in formula (1) below, is 70.0% or greater in the paper plug 20 (which is obtained by cutting the filter rod 10 to predetermined lengths in the longitudinal direction). Accordingly, this embodiment makes it possible to provide a paper plug 20 having sufficient firmness, therefore enabling smooth processing in the process of producing the flavor inhalation article 110 while also contributing to imparting a sense of high quality to the flavor inhalation article 110.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100 \quad (1)$$

(In formula (1): Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the paper plug before a load F is applied, Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the paper plug when the load F has been applied, and the load F is a load applied to the paper plug under conditions of a compressive load of 3 N in a direction perpendicular to the major axis of the paper plug, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds.)

[0093] Furthermore, in this embodiment, the ratio of the width and basis weight of the base roll of the paper sheet 12 satisfies formula (2) below.

$$2.2 < \text{width (mm)/basis weight (g/m2)} < 8.8 \quad (2)$$

A paper plug 20 obtained by wrapping a paper sheet 12 produced from a base roll having such a width and basis weight has suitable firmness and airflow resistance for use in the flavor inhalation article 110. Accordingly, this embodiment makes it possible to provide a paper plug 20 having suitable firmness and airflow resistance.

[0094] Furthermore, in this embodiment, the filling density of the paper sheet 12 in the paper plug 20 is equal to or greater than 0.138 mg/mm^3. A paper plug 20 with such a configuration has suitable firmness. Accordingly, this embodiment makes it possible to provide a paper plug 20 having suitable firmness.

[0095] Furthermore, in this embodiment, the paper sheet 12 is formed from a crimped sheet comprising cellulose. The firmness of a paper plug 20 generally increases and the airflow resistance is higher when the paper sheet 12 is produced from a crimped sheet comprising cellulose. Furthermore, by means of a crimping treatment, channels (small holes) formed within a cross section perpendicular to the longitudinal direction of the paper plug 20 become less noticeable, and there are fewer variations in airflow resistance among the paper plugs 20 produced. Accordingly, this embodiment makes it possible to easily increase the firmness and airflow resistance of the paper plug 20 while also making the channels less noticeable and stabilizing airflow resistance, by subjecting the sheet forming the base roll of the paper sheet 12 to a crimping treatment.

[0096] Furthermore, in this embodiment, the sheet comprising cellulose that serves as the base roll of the paper sheet 12 is subjected to a crimping treatment so that the crimping depth is 0.3 mm or greater. Channels formed within the cross section perpendicular to the longitudinal direction of the paper plug 20 fall within a permissible range when a sheet with a crimping depth of 0.3 mm or greater is used. Accordingly, this embodiment makes it possible to provide a paper plug 20 which is desirable in terms of appearance.

[0097] Furthermore, in this embodiment, the width of the base roll of the paper sheet 12 is 110 mm-220 mm, and the basis weight is 25 g/m^2-50 g/m^2. A paper plug 20 constructed by wrapping a paper sheet 12 produced from such a base roll has suitable firmness and airflow resistance. Accordingly, this embodiment makes it possible to provide a

paper plug 20 having suitable firmness and airflow resistance.

[0098] Furthermore, in this embodiment, the airflow resistance of the paper plug 20 in the ventilation direction is 0.7 mmH_2O/mm-3.5 mmH_2O/mm, and the paper plug 20 is used as the filter portion 115 in the flavor inhalation article 110. Accordingly, this embodiment makes it possible to provide a paper plug 20 having suitable firmness and airflow resistance for use as the filter portion 115 in the flavor inhalation article 110.

[0099] Furthermore, in this embodiment, the base roll of the filler material of the paper plug 20 used in the flavor inhalation article 110 comprises an additive for adjusting flavor. Accordingly, this embodiment makes it possible to provide a paper plug 20 that forms part of the flavor inhalation article 110 for generating a suitable flavor when heated.

[0100] Furthermore, in this embodiment, the base roll of the paper sheet 12 of the paper plug 20 used in the flavor inhalation article 110 comprises a phenol-reducing material and/or a flavoring. Accordingly, this embodiment makes it possible to provide a paper plug 20 that forms part of a flavor inhalation article for generating a more suitable flavor.

[0101] Furthermore, in this embodiment, the flavor inhalation article 110 is constructed so as to include: the paper plug 20 serving as the filter portion 115 having a firmness of 70.0% or greater in a direction perpendicular to the major axis, defined in formula (1) above; the smokable material 111 wrapped with the cigarette paper 112 and containing the flavor source; and the tipping paper 113 wrapped around the paper plug 20 and the smokable material 111 wrapped with the cigarette paper 112. Accordingly, this embodiment makes it possible to produce a flavor inhalation article 110 comprising a filter portion 115 with sufficient hardness ensured. Furthermore, the paper plug 20 may be used not only as a paper filter, but also as a member constituting the tip end on the upstream side of the flavor inhalation article (the opposite side to the downstream end portion from which the user inhales).

[0102] Furthermore, in this embodiment, the plug portion 211 formed by the paper plug 20 is disposed on the upstream side of the flavor-generating segment 220 (the flavor source 221 wrapped with the cigarette paper 248) inside the flavor inhalation article 200 through which air flows from upstream to downstream when the user inhales. According to this embodiment, vapor or aerosol generated in the flavor-generating segment 220 can be inhibited from leaking out to the upstream side of the flavor inhalation article 200 by means of the plug portion 211 formed by the paper plug 20.

[0103] Embodiments of the present disclosure have been described above, but the present disclosure is not limited to those embodiments, and various modifications are possible within the scope of the technical concept disclosed in the claims, specification and drawings. Moreover, any shape or material not directly stated in the specification or drawings is also within the scope of the technical concept of the present disclosure, provided that it exhibits the action of the present disclosure.

(Addendum 1)

[0104] One aspect of the present disclosure is a paper plug comprising a filler material and an inner plug wrap wrapped around the filler material, wherein the firmness in a direction perpendicular to a major axis, which is represented by formula (1) below, is equal to or greater than 70.0%.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100 \quad (1)$$

(In formula (1): Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the paper plug before a load F is applied, Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the paper plug when the load F has been applied, and the load F is a load applied to the paper plug under conditions of a compressive load of 3 N in a direction perpendicular to the major axis of the paper plug, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds.)

(Addendum 2)

[0105] A second aspect of the present disclosure, which is in accordance with the first aspect, is a paper plug in which a ratio of the width (mm) and basis weight (g/m^2) of a base roll of the filler material is in a range represented by formula (2) below.

$$2.2 < \text{width (mm)}/\text{basis weight } (g/m^2) < 8.8 \quad (2)$$

(Addendum 3)

[0106] A third aspect of the present disclosure, which is in accordance with the first and second aspects, is a paper plug in which a filling density of the filler material in the paper plug is equal to or greater than 0.138 mg/mm^3.

(Addendum 4)

[0107] A fourth aspect of the present disclosure, which is in accordance with the first to third aspects, is a paper plug in which the filler material is formed from a crimped sheet comprising cellulose.

(Addendum 5)

[0108] A fifth aspect of the present disclosure, which is in accordance with the fourth aspect, is a paper plug in which a crimping depth of the sheet is 0.3 mm or greater.

(Addendum 6)

[0109] A sixth aspect of the present disclosure, which is in accordance with the first to fifth aspects, is a paper plug in which the width of the base roll of the filler material is 110 mm-220 mm, and the basis weight of the base roll of the filler material is 25 g/m^2-50 g/m^2.

(Addendum 7)

[0110] A seventh aspect of the present disclosure, which is in accordance with the first to sixth aspects, is a paper plug in which the airflow resistance per 1 m in a ventilation direction is 0.7 mmH_2O/mm-3.5 mmH_2O/mm, the paper plug being used in a flavor inhalation article.

(Addendum 8)

[0111] An eighth aspect of the present disclosure, which is in accordance with the seventh aspect, is a paper plug in which the base roll of the filler material comprises an additive for adjusting flavor.

(Addendum 9)

[0112] A ninth aspect of the present disclosure, which is in accordance with the eighth aspect, is a paper plug in which the additive comprises a phenol-reducing material and/or a flavoring.

(Addendum 10)

[0113] A 10th aspect of the present disclosure is a flavor inhalation article comprising: the paper plug as claimed in any one of claims 1 to 9 serving as a first plug; a second plug containing a flavor source; and a tipping paper wrapped around the first plug and the second plug.

(Addendum 11)

[0114] An 11th aspect of the present disclosure, which is in accordance with the 10th aspect, is a flavor inhalation article in which the paper plug is disposed on an upstream side of the second plug.

REFERENCE SIGNS LIST

[0115]

10... Filter rod
12... Paper sheet
12a... Mountain portion
12b... Valley portion
14... First plug wrap
20... Paper plug
110... Flavor inhalation article
111... Smokable material
112... Cigarette paper
113... Tipping paper
114... Tubular member

115... Filter portion
116... Hollow filter portion
117... Lip-release agent
200... Flavor inhalation article
201... First end
202... Second end
210... First segment
211... Plug portion
220... Flavor-generating segment
221... Flavor source
230... Cooling segment
231... Hollow tube
232... Through-hole
240... Second segment
241... First filter
242... Second filter
248... Cigarette paper
250... Second tipping paper
260... Tipping paper
310... Filler material
320... First inner plug wrap
330... Filling layer
340... Second inner plug wrap
350: Outer plug wrap

Claims

1. A paper plug comprising a filler material and an inner plug wrap wrapped around the filler material, wherein the firmness in a direction perpendicular to a major axis, which is represented by formula (1) below, is equal to or greater than 70.0%.

$$\text{Firmness (\%) in direction perpendicular to major axis} = (Dd/Ds) \times 100 \quad (1)$$

(In formula (1):

Ds (mm) is the diameter of a cross section in a direction perpendicular to the major axis direction of the paper plug before a load F is applied,
Dd (mm) is the diameter of the cross section in the direction perpendicular to the major axis direction of the paper plug when the load F has been applied, and
the load F is a load applied to the paper plug under conditions of a compressive load of 3 N in a direction perpendicular to the major axis of the paper plug, a pressure jig head diameter of φ 12 mm, and a compression time of 10 seconds.)

2. The paper plug as claimed in claim 1, wherein
a ratio of the width (mm) and basis weight (g/m^2) of a base roll of the filler material is in a range represented by formula (2) below.

$$2.2 < \text{width (mm)}/\text{basis weight } (g/m^2) < 8.8 \quad (2)$$

3. The paper plug as claimed in claim 1 or 2, wherein
a filling density of the filler material in the paper plug is equal to or greater than 0.138 mg/mm^3.

4. The paper plug as claimed in any one of claims 1 to 3, wherein
the filler material is formed from a crimped sheet comprising cellulose.

5. The paper plug as claimed in claim 4, wherein
a crimping depth of the sheet is 0.3 mm or greater.

6. The paper plug as claimed in any one of claims 1 to 5, wherein
the width of the base roll of the filler material is 110 mm-220 mm, and
the basis weight of the base roll of the filler material is 25 g/m^2-50 g/m^2.

7. The paper plug as claimed in any one of claims 1 to 6, wherein
the airflow resistance per 1 m in a ventilation direction is 0.7 mmH_2O/mm-3.5 mmH_2O/mm,
the paper plug being used in a flavor inhalation article.

8. The paper plug as claimed in claim 7, wherein
the base roll of the filler material comprises an additive for adjusting flavor.

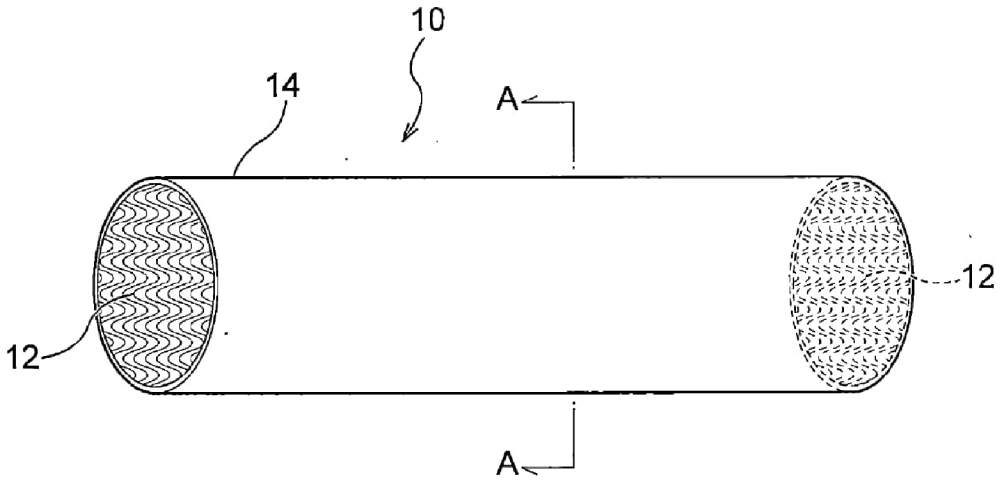
9. The paper plug as claimed in claim 8, wherein
the additive comprises a phenol-reducing material and/or a flavoring.

10. A flavor inhalation article comprising:
the paper plug as claimed in any one of claims 1 to 9 serving as a first plug;

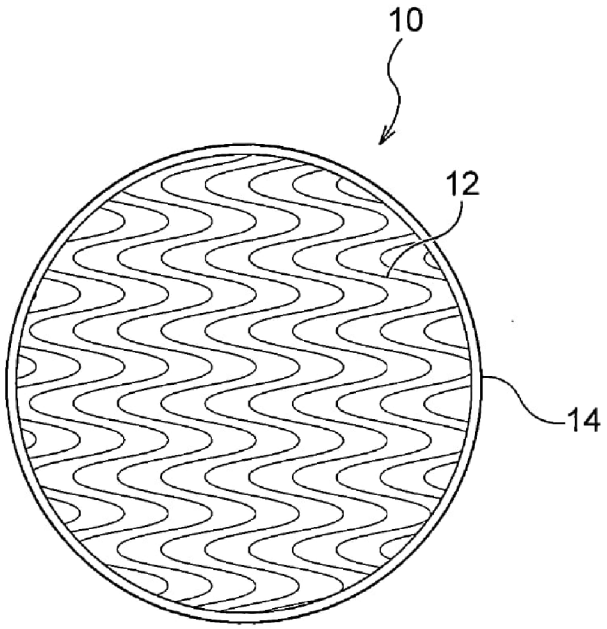
a second plug containing a flavor source; and
a tipping paper wrapped around the first plug and the second plug.

11. The flavor inhalation article as claimed in claim 10, wherein
the paper plug is disposed on an upstream side of the second plug.

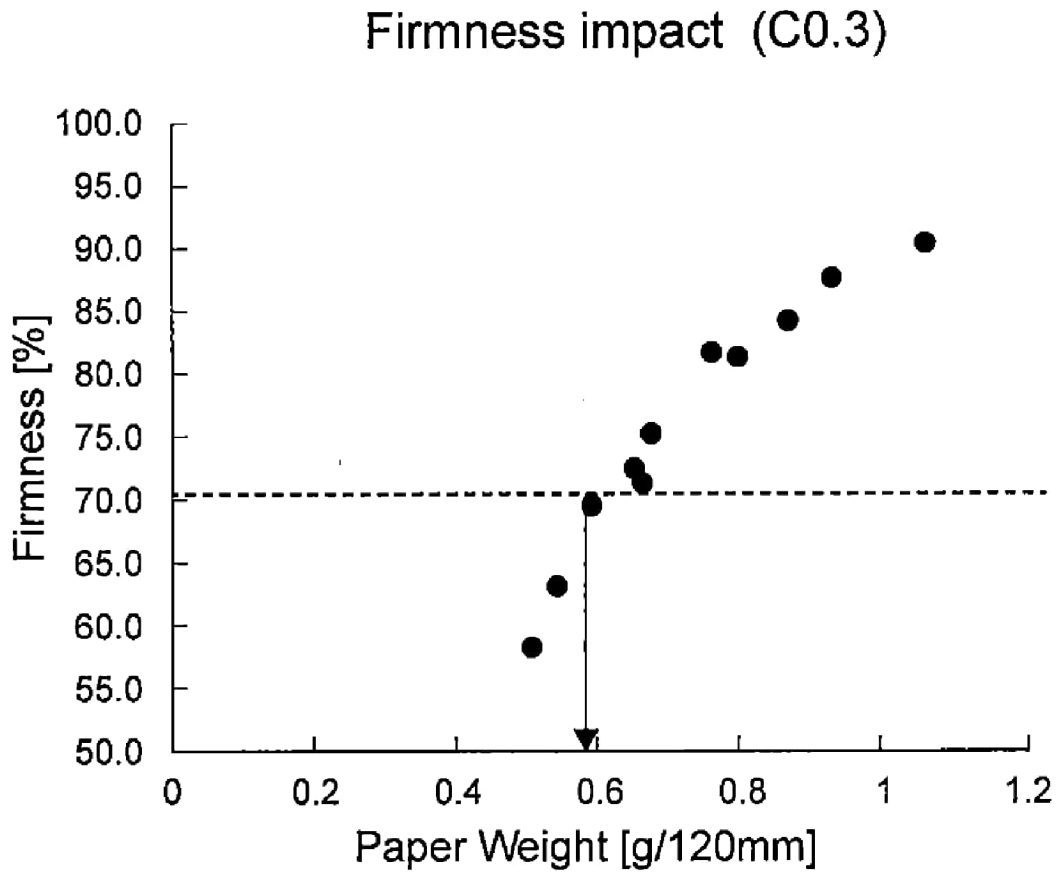
[Fig. 1]



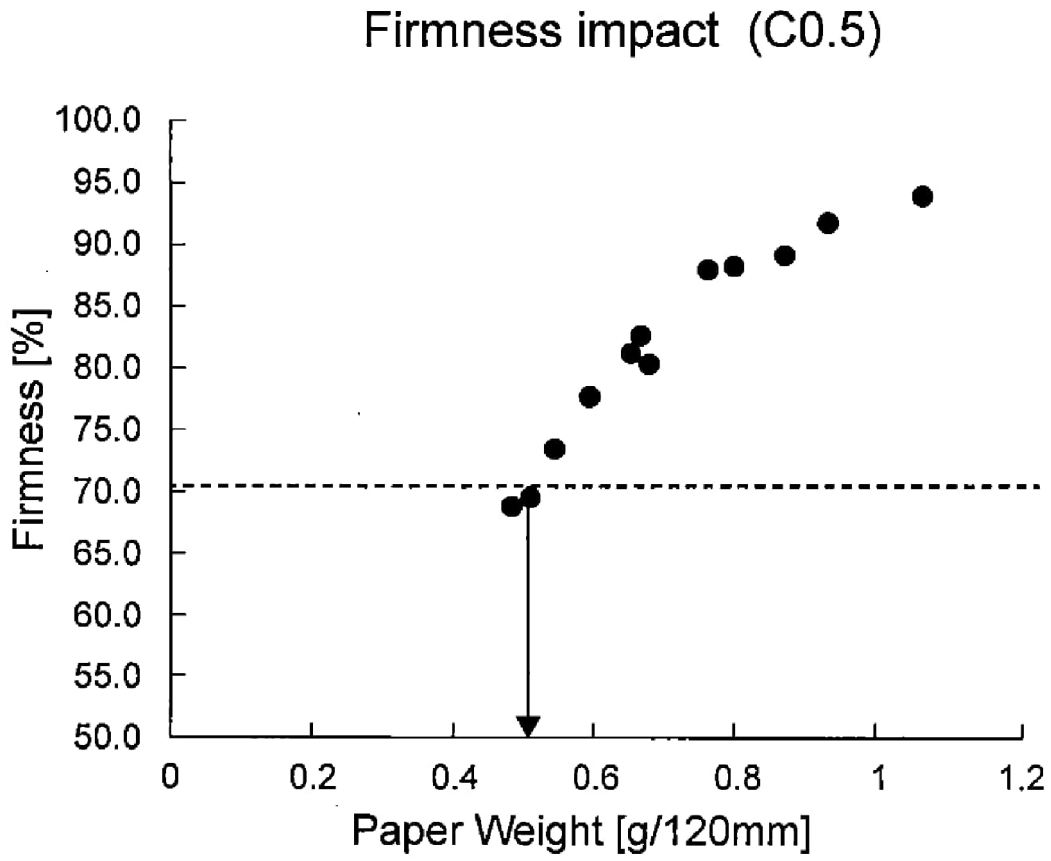
[Fig. 2]



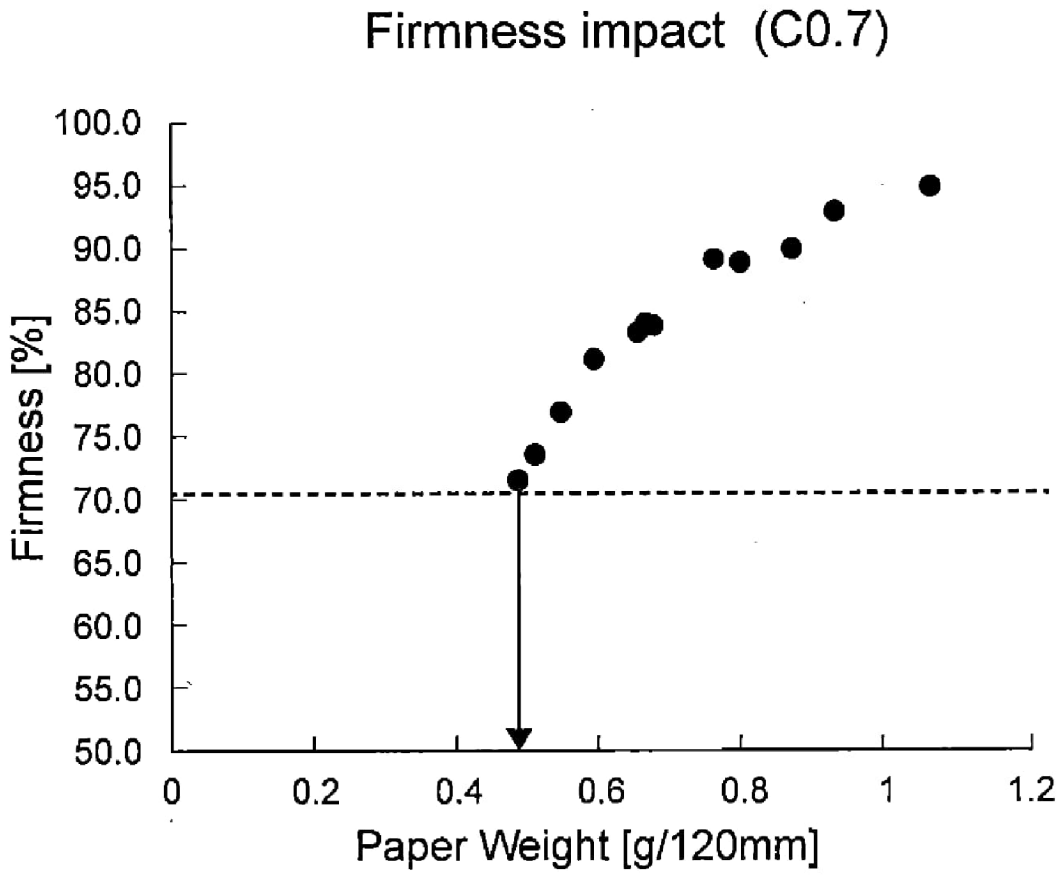
[Fig. 3A]


Firmness impact (C0.3)
Firmness [%]
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

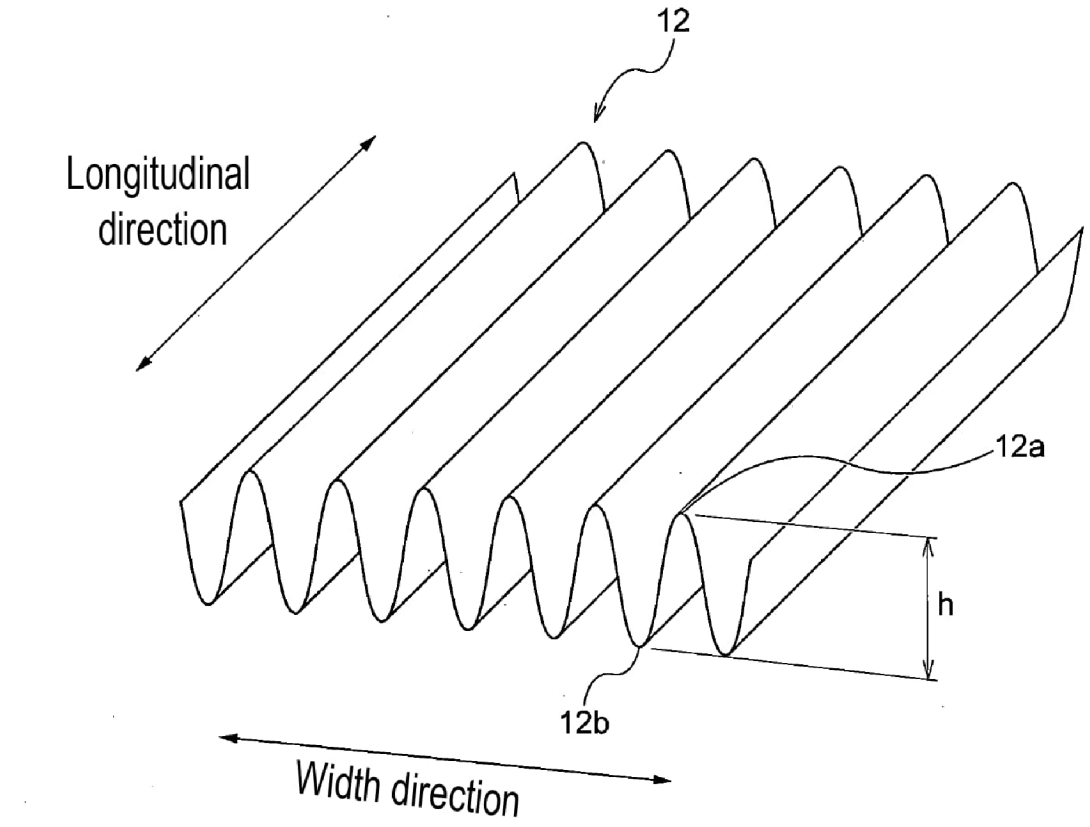
[Fig. 3B]


Firmness impact (C0.5)
Firmness [%]
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

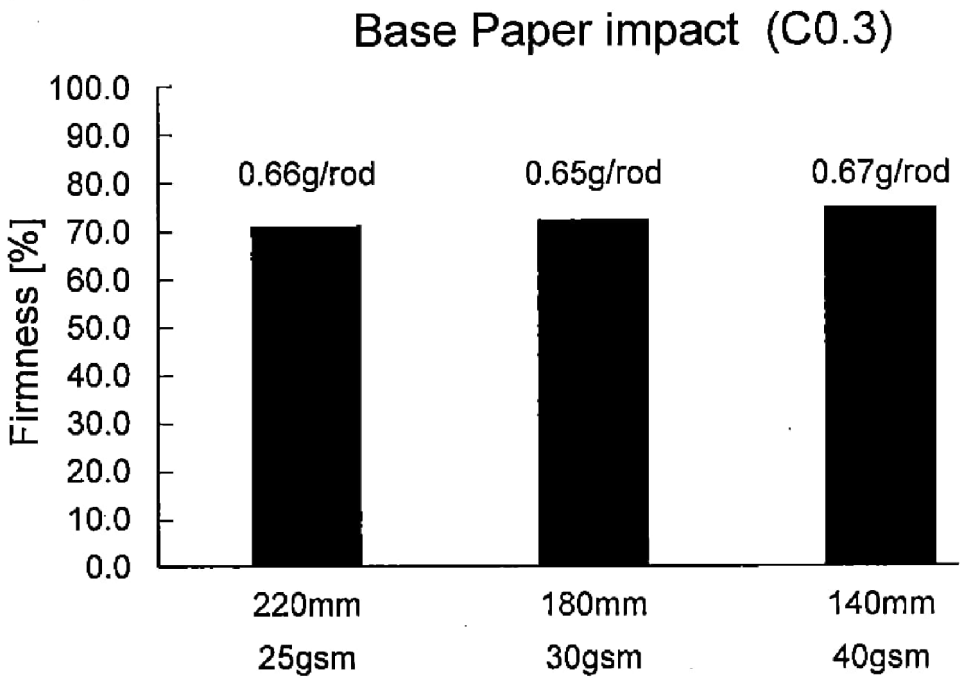
[Fig. 3C]

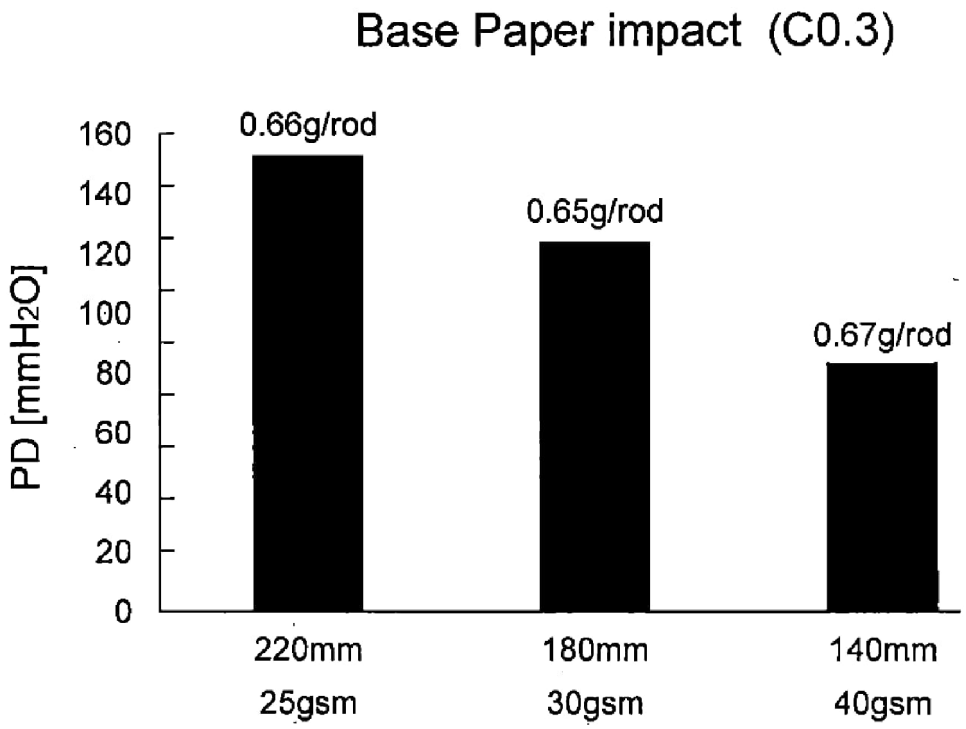

Firmness impact (C0.7)
Firmness [%]
100.0
95.0
90.0
85.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

[Fig. 4]

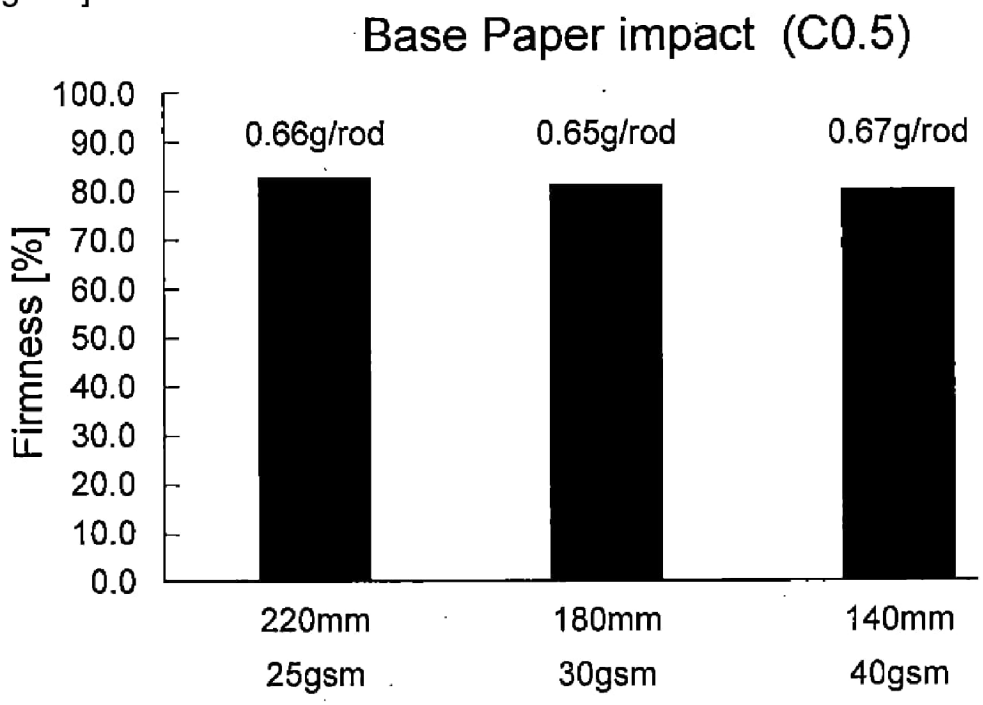


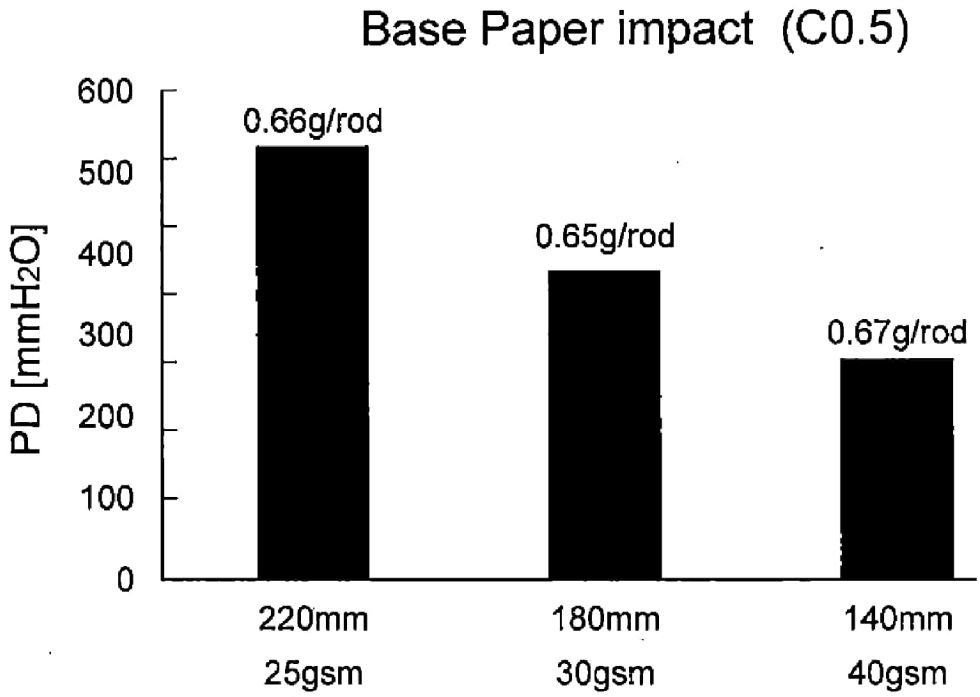
[Fig. 5A]


Base Paper impact (C0.3)
Firmness [%]
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm

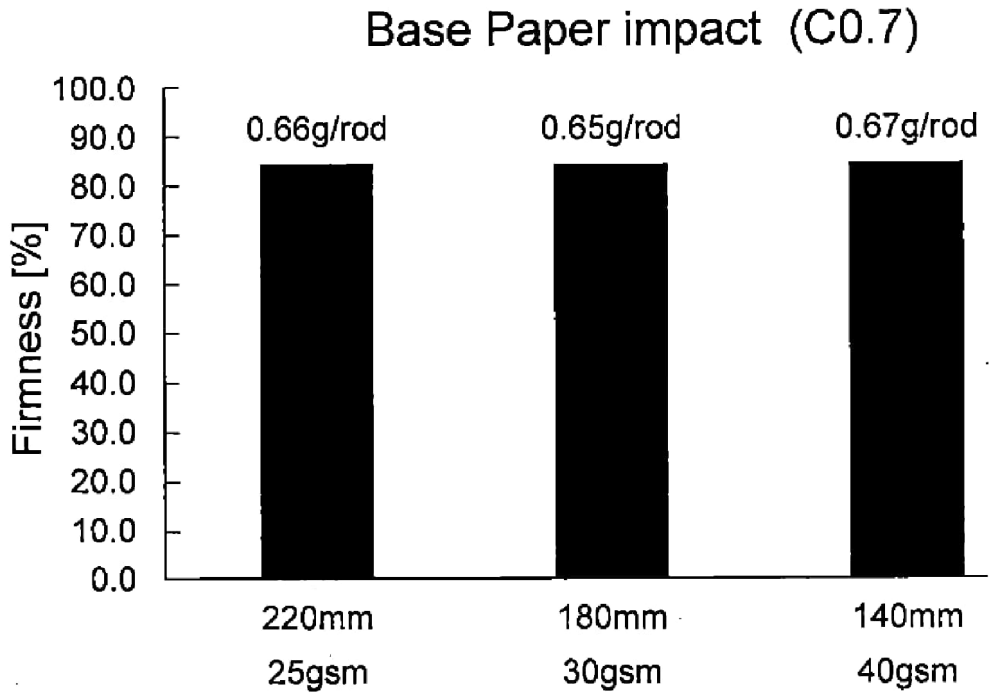

Base Paper impact (C0.3)
PD [mmH2O]
160
140
120
100
80
60
40
20
0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm

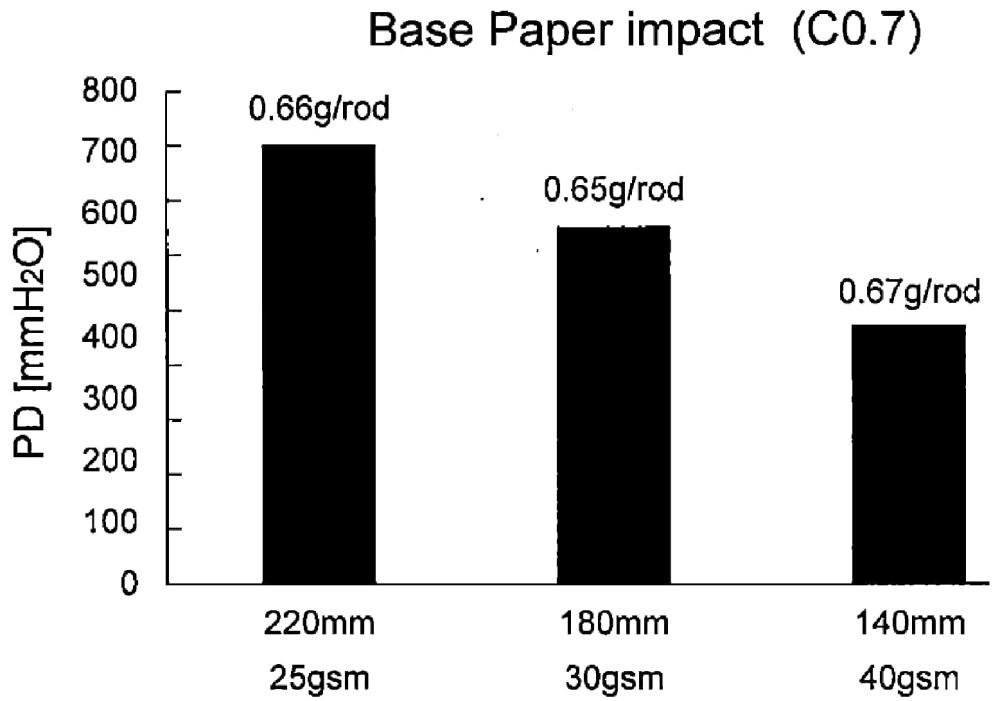
[Fig. 5B]


Base Paper impact (C0.5)
Firmness [%]
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm

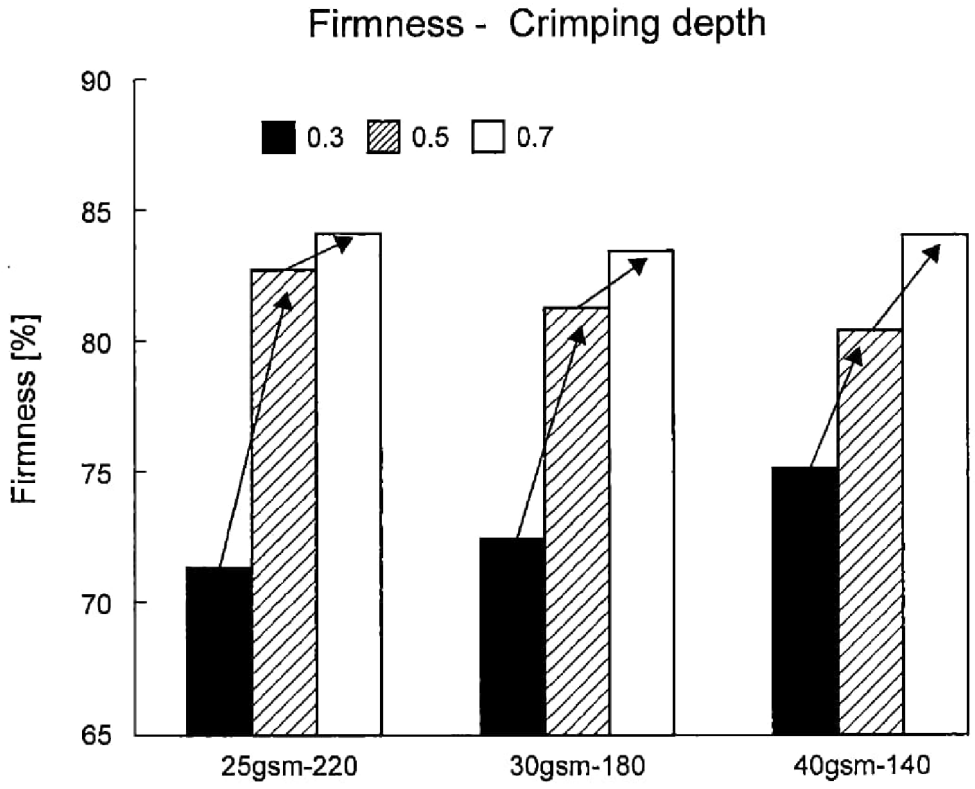

Base Paper impact (C0.5)
PD [mmH2O]
600
500
400
300
200
100
0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm

[Fig. 5C]

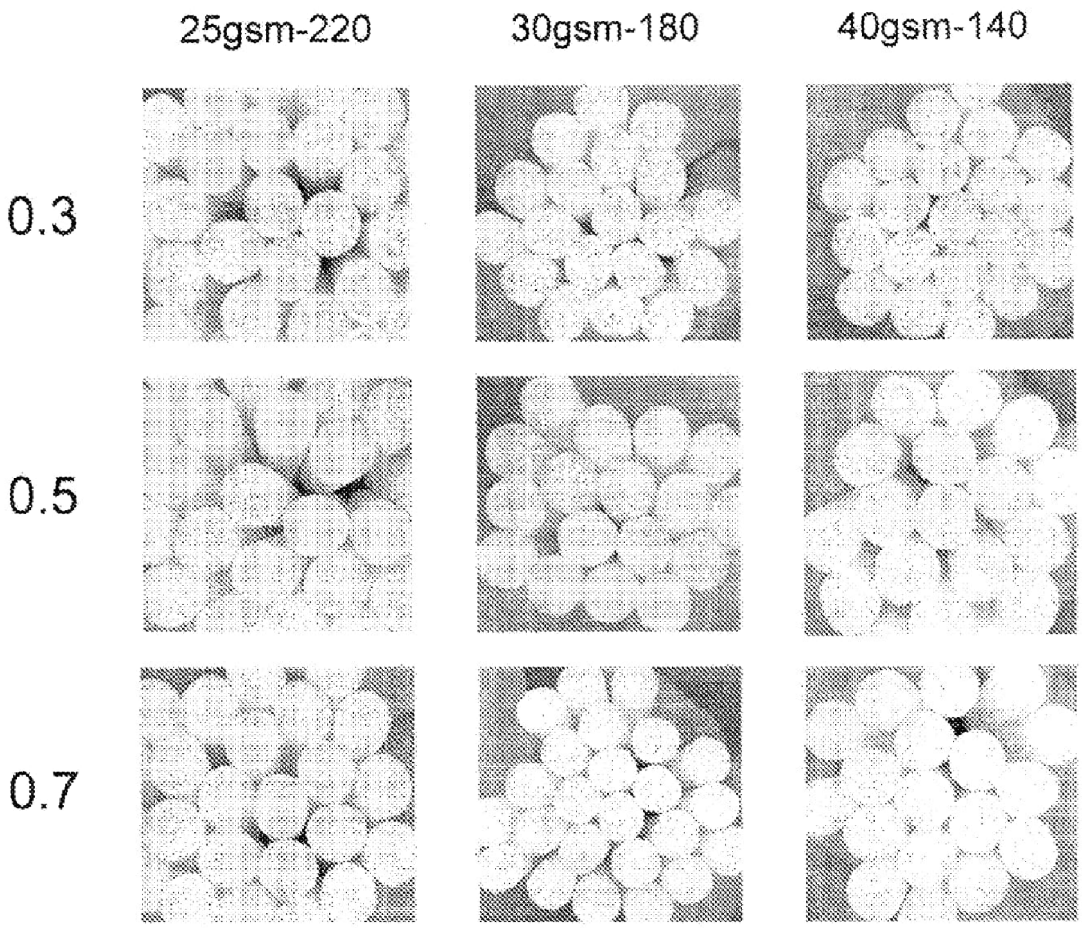

Base Paper impact (C0.7)
Firmness [%]
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm


Base Paper impact (C0.7)
PD [mmH2O]
800
700
600
500
400
300
200
100
0
0.66g/rod
0.65g/rod
0.67g/rod
220mm
25gsm
180mm
30gsm
140mm
40gsm

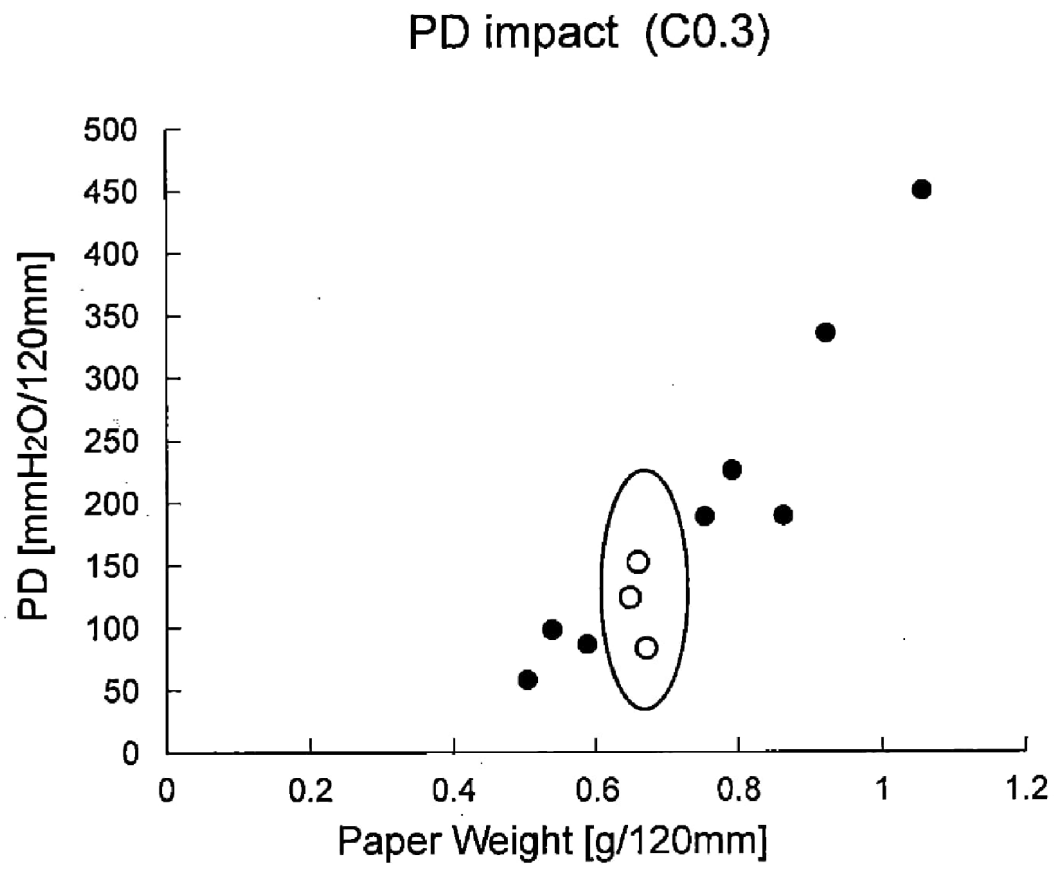
[Fig. 6]


Firmness - Crimping depth
0.3
0.5
0.7
Firmness [%]
90
85
80
75
70
65
25gsm-220
30gsm-180
40gsm-140

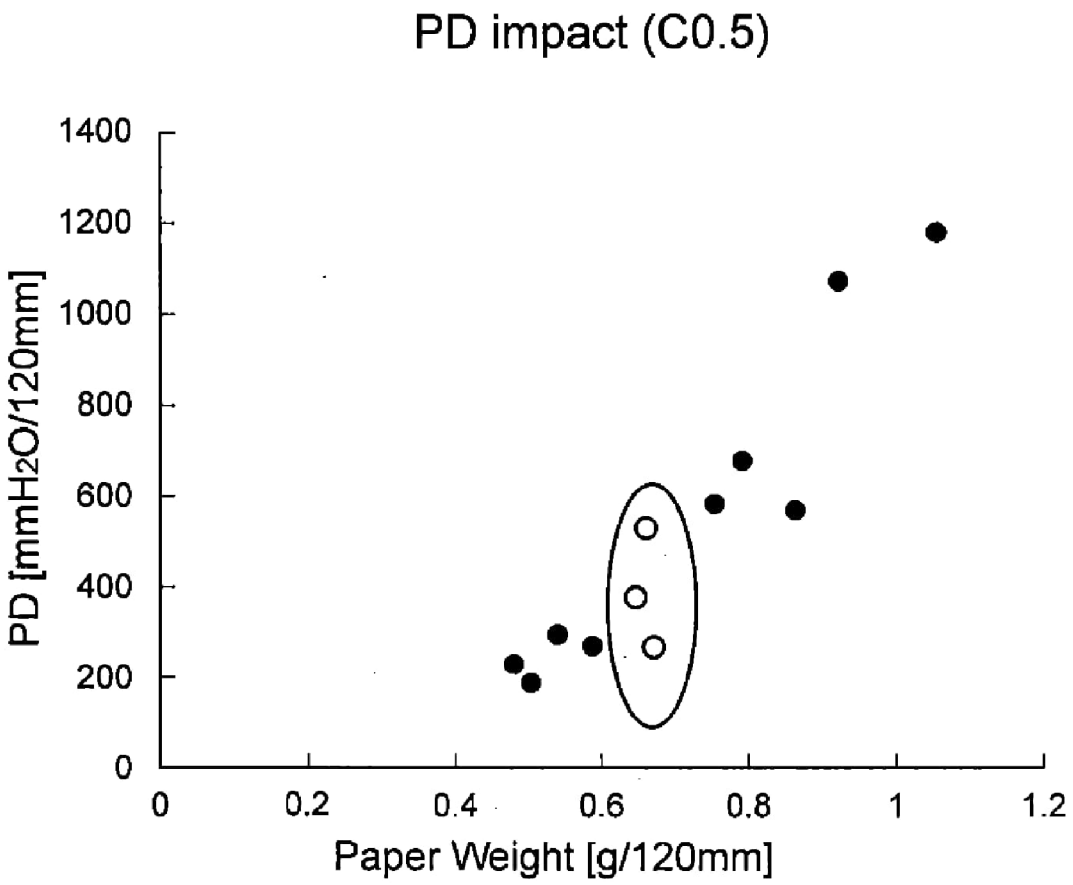
[Fig. 7]



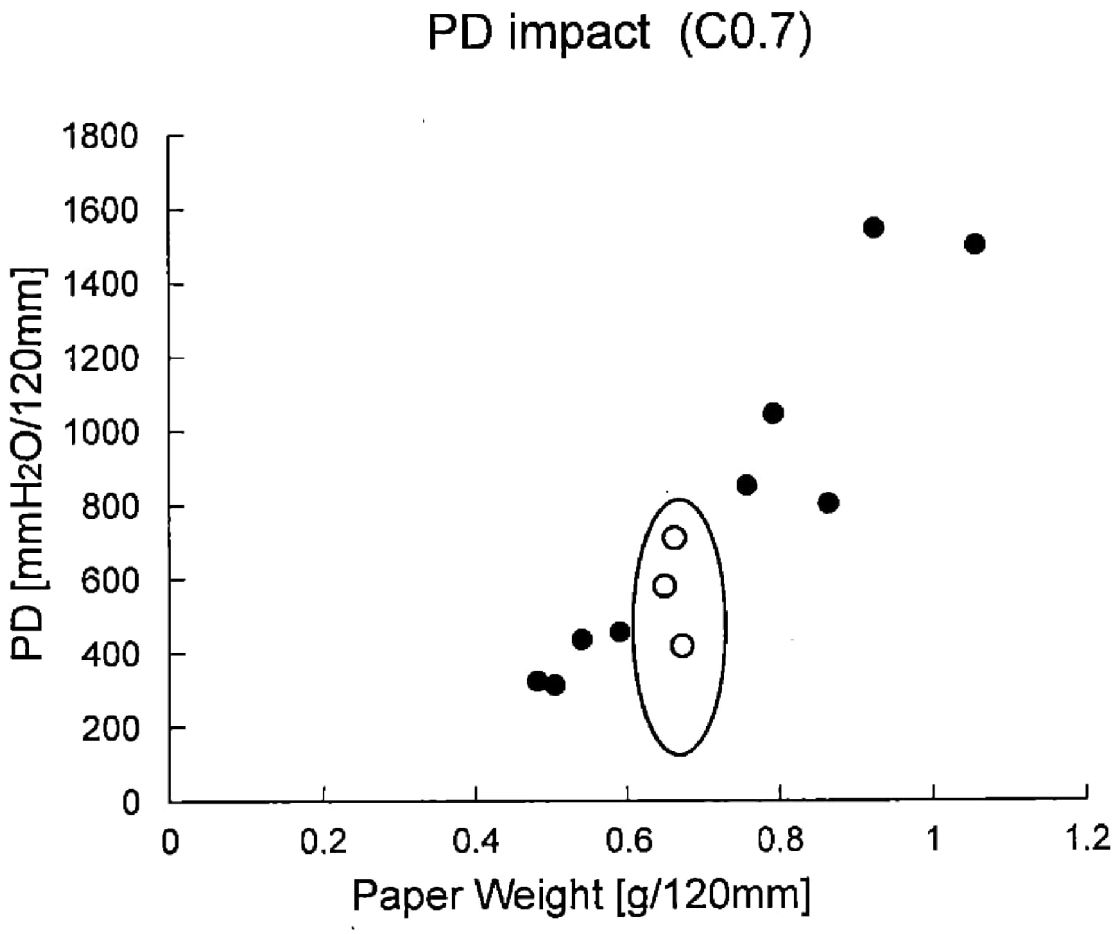
[Fig. 8A]


PD impact (C0.3)
PD [mmH2O/120mm]
500
450
400
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

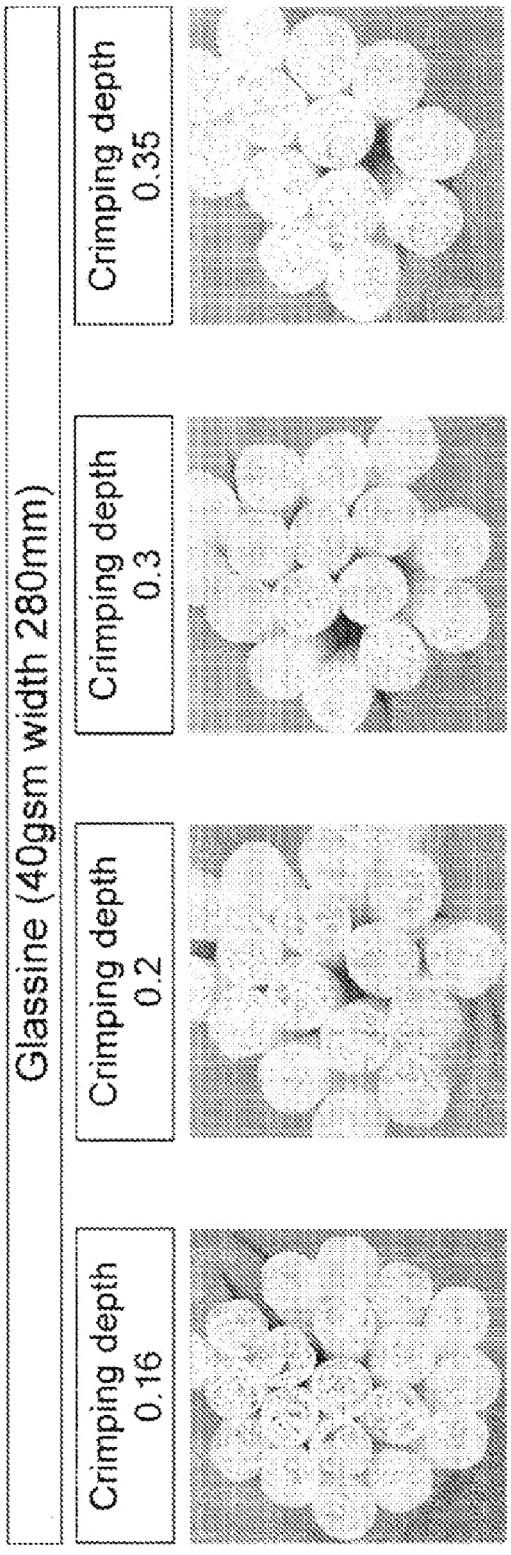
[Fig. 8B]


PD impact (C0.5)
PD [mmH2O/120mm]
1400
1200
1000
800
600
400
200
0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

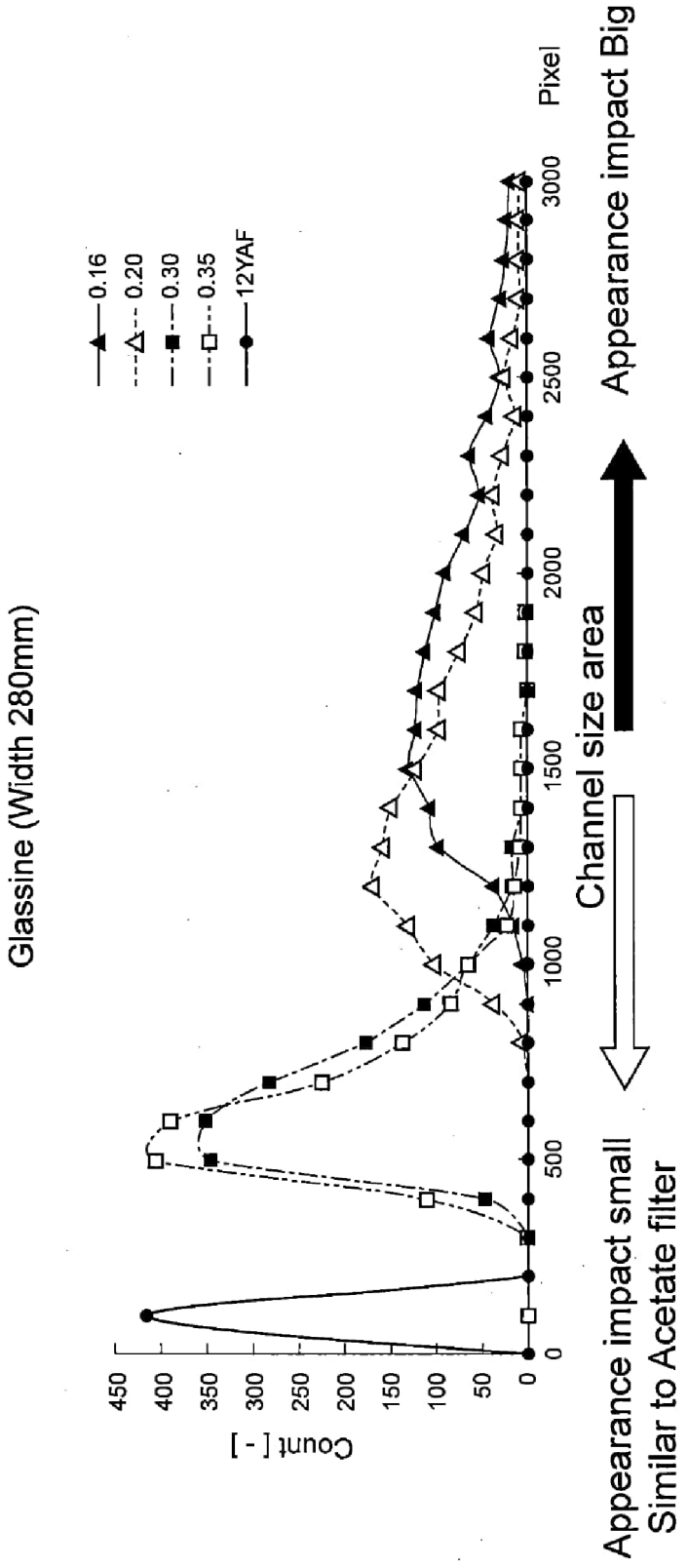
[Fig. 8C]


PD impact (C0.7)
PD [mmH2O/120mm]
1800
1600
1400
1200
1000
800
600
400
200
0
0
0.2
0.4
0.6
0.8
1
1.2
Paper Weight [g/120mm]

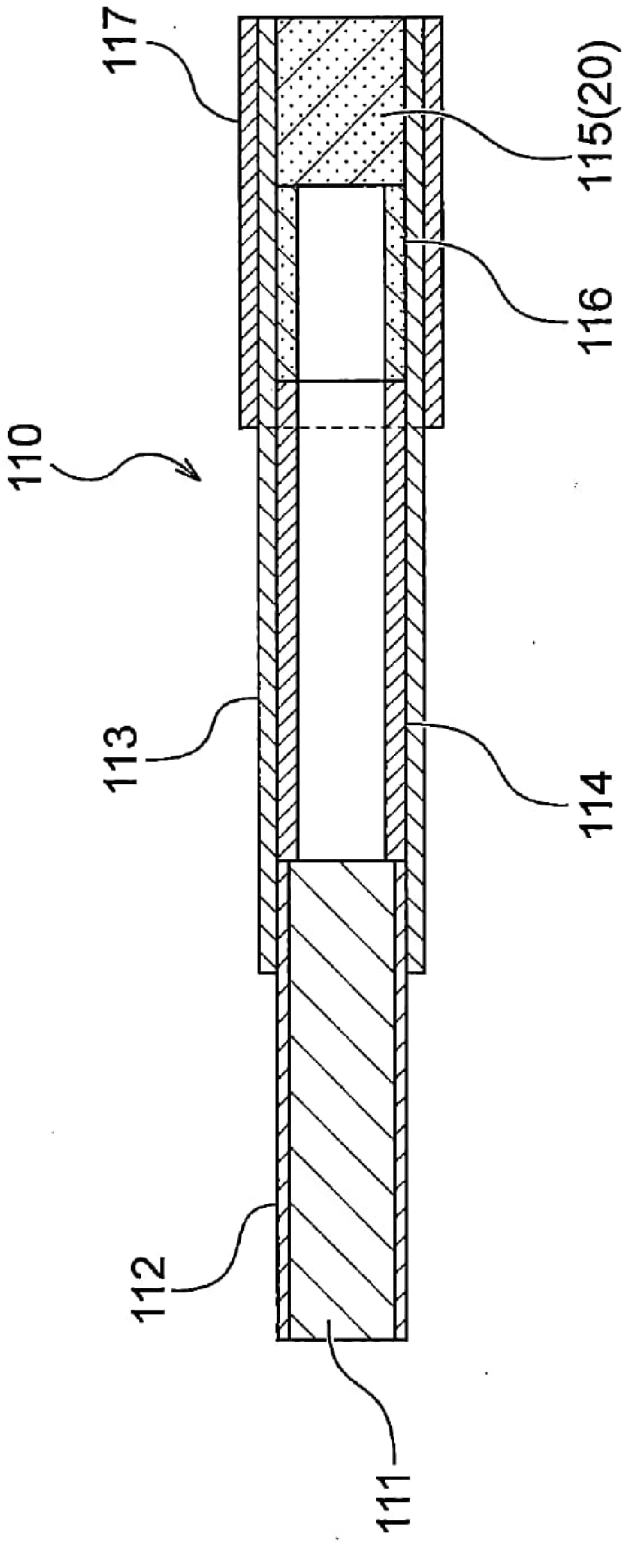
[Fig. 9]


Glassine (40gsm width 280mm)
Crimping depth 0.16
Crimping depth 0.2
Crimping depth 0.3
Crimping depth 0.35

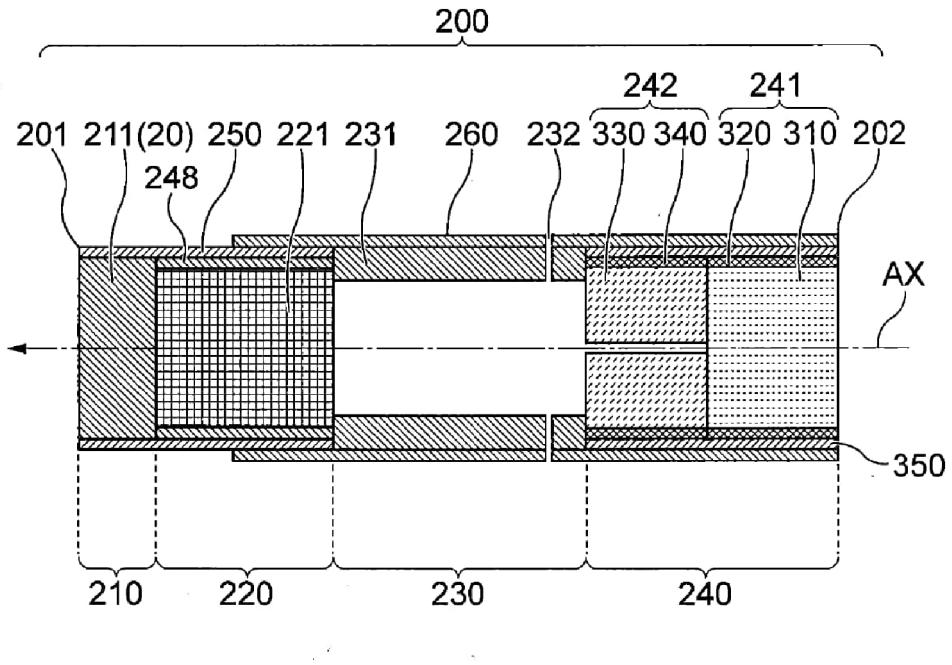
[Fig. 10]


Glassine (Width 280mm)
0.16
0.20
0.30
0.35
12YAF
Count [-]
0
50
100
150
200
250
300
350
400
450
0
500
1000
1500
2000
2500
3000
Pixel
Channel size area
Appearance impact Big
Appearance impact small
Similar to Acetate filter

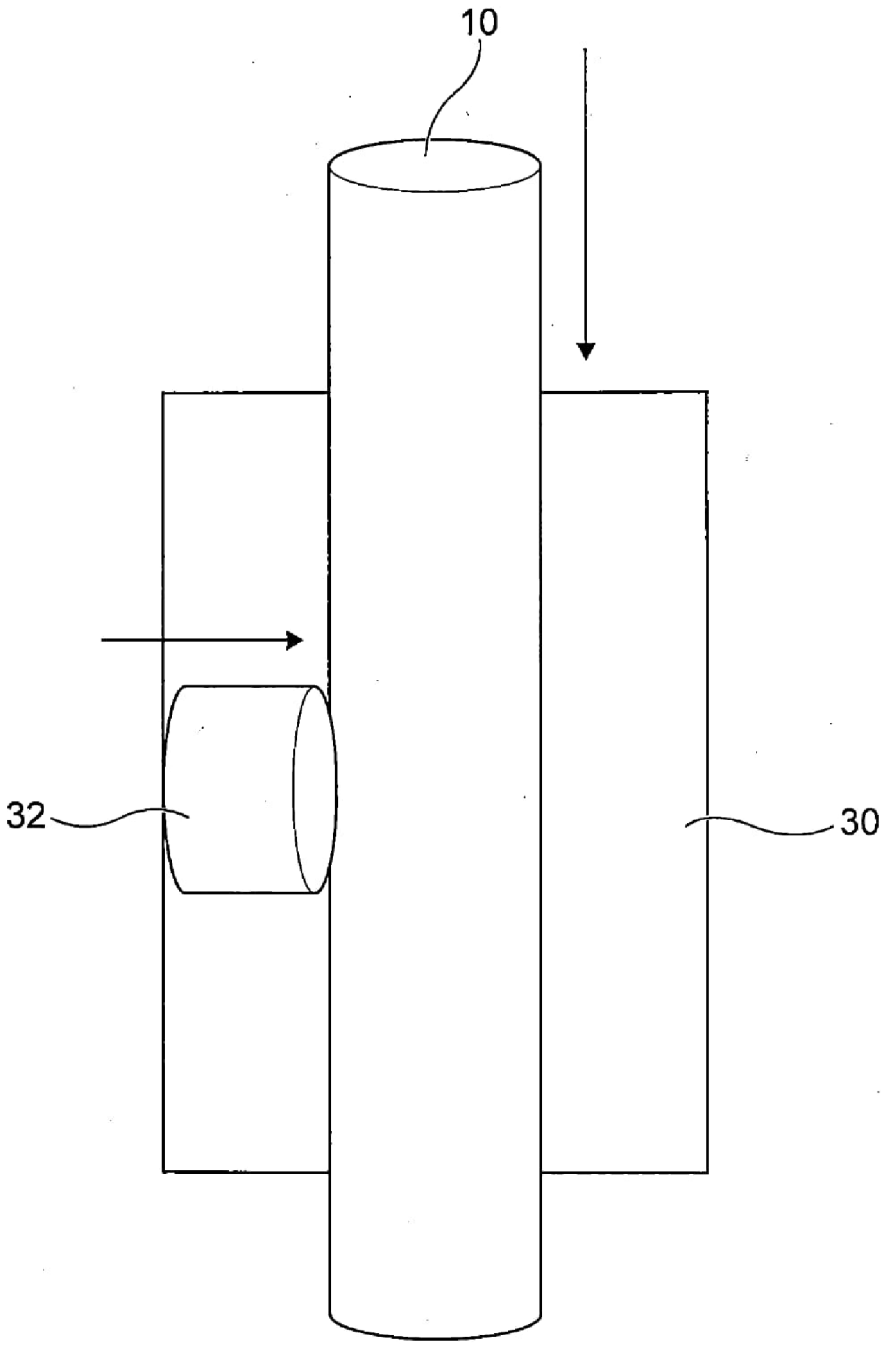
[Fig. 11]



[Fig. 12]


200
242
241
201
211(20)
250
221
231
260
232
330
340
320
310
202
248
AX
350
210
220
230
240

[Fig. 13]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/041930

A. CLASSIFICATION OF SUBJECT MATTER

A24D 3/04(2006.01)i
FI: A24D3/04

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)

A24D3/04

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 1971-2025
Registered utility model specifications of Japan 1996-2025
Published registered utility model applications of Japan 1994-2025

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	WO 2022/230408 A1 (JAPAN TOBACCO INC.) 03 November 2022 (2022-11-03) paragraphs [0011], [0016]-[0019], [0058]-[0063]	1-4, 6
X	paragraph [0031]	5
X	paragraph [0014]	7
X	paragraphs [0033]-[0034]	8-9
Y		10-11

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
28 January 2025	**10 February 2025**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/041930

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2023-507503 A (NICOVENTURES TRADING LIMITED) 22 February 2023 (2023-02-22) paragraphs [0132], [0158]-[0167], [0208]-[0213], [0266], [0289], fig. 3	10-11
X	paragraphs [0132], [0158]-[0167], [0208]-[0213], [0266], fig. 1, 3	1-3, 6
X	paragraphs [0163], [0182]	4
X	paragraphs [0183]-[0185]	5
X	paragraphs [0192]-[0194]	7
X	paragraphs [0163], [0168], [0285]	8-9
X	paragraphs [0266], [0289], fig. 3	10-11
A	WO 2018/235761 A1 (JAPAN TOBACCO INC.) 27 December 2018 (2018-12-27)	1-11
A	WO 2018/163253 A1 (JAPAN TOBACCO INC.) 13 September 2018 (2018-09-13)	1-11
A	JP 2016-523565 A (PHILIP MORRIS PRODUCTS S.A.) 12 August 2016 (2016-08-12)	1-11
A	WO 2009/078287 A1 (JAPAN TOBACCO INC.) 25 June 2009 (2009-06-25)	1-11
A	WO 2023/012937 A1 (JAPAN TOBACCO INC.) 09 February 2023 (2023-02-09)	1-11

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/041930

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2022/230408 A1	03 November 2022	US 2024/0049775 A1 paragraphs [0050]-[0063], [0080]-[0085], [0116]-[0122] EP 4331394 A1 CN 117241684 A KR 10-2023-0160879 A	
JP 2023-507503 A	22 February 2023	WO 2021/123843 A1 description, page 18, line 30 - page 19, line 5, page 24, line 1 - page 25, line 11, page 25, lines 13-24, page 27, lines 10-30, page 27, line 34 - page 28, line 2, page 28, lines 18-28, page 30, line 12 - page 31, line 10, page 43, lines 14-25, page 48, lines 5-8, page 48, lines 28-36, fig. 1, 3 US 2023/0025403 A1 EP 4076039 A1 KR 10-2022-0110223 A	
WO 2018/235761 A1	27 December 2018	US 2020/0107574 A1 EP 3643185 A1 KR 10-2019-0139315 A CN 110769705 A	
WO 2018/163253 A1	13 September 2018	US 2019/0387788 A1 EP 3586652 A1 CN 110381756 A KR 10-2019-0120804 A	
JP 2016-523565 A	12 August 2016	WO 2015/007400 A1 US 2016/0128378 A1 EP 3021698 A1 CN 105357993 A KR 10-2016-0032016 A	
WO 2009/078287 A1	25 June 2009	US 2010/0242977 A1 EP 2229827 A1 KR 10-2010-0076062 A CN 101896082 A	
WO 2023/012937 A1	09 February 2023	US 2024/0138467 A1 EP 4381964 A1 CN 117750892 A KR 10-2024-0023634 A	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- WO 2022230408 A1 **[0004]**