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(54) **PAPER PLUG AND FLAVOR INHALATION ARTICLE**

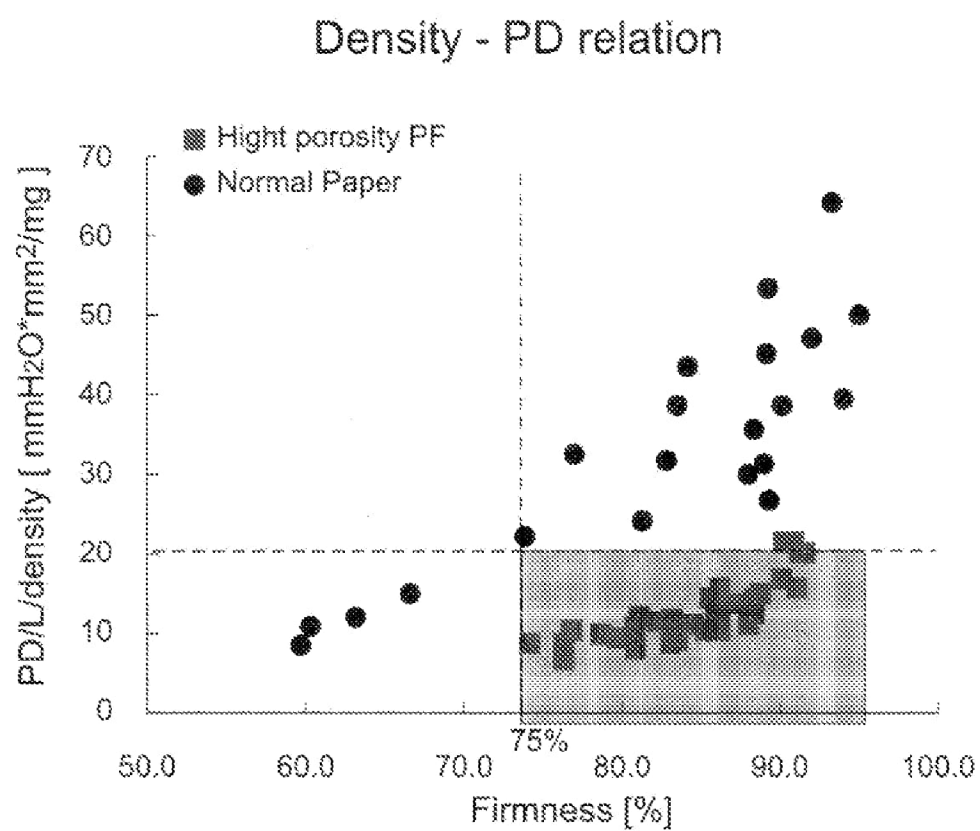
(57) The present disclosure provides a paper plug comprising: a filler material, and an inner plug wrap wrapped around the filler material, wherein the average of areas of pores formed in a cross section perpendicular to a major axis is smaller than 0.15 mm², the firmness in a direction perpendicular to the major axis, which is defined in formula (1), is greater than 75%, and formula (2) is satisfied.

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

$$\text{Pressure drop per 1 mm length in major axis direction/filling density of filler material} < 22 \text{ mmH}_2\text{O} \times \text{mm}^2/\text{mg} \quad (2)$$

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[Fig. 10]



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 filler 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] The paper filter needs to have a preferred airflow resistance and sufficient firmness, while also ensuring that channels (small holes) therein are not noticeable, from the viewpoint of appearance. In order to ensure a favorable appearance and firmness of a paper filter, it is feasible to apply crimping or to increase the amount of paper sheet filling, or similar, but with existing methods, there might be an increase in airflow resistance beyond the desired range.

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 airflow resistance within a predetermined range and sufficient firmness, while also having a desirable appearance, and also provides 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 average of areas of pores formed in a cross section perpendicular to a major axis is smaller than 0.15 mm^2 , the firmness in a direction perpendicular to the major axis, which is defined in formula (1), is greater than 75%, and formula (2) is satisfied.

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

$$\text{Pressure drop per 1 mm length in major axis direction/filling density of filler material} < 22 \text{ mmH}_2\text{O} \times \text{mm}^2/\text{mg} \quad (2)$$

(In formula (1):

D_s (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,

D_d (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 $\phi 12 \text{ mm}$, and a compression time of 10 seconds.)

[0007] In the first aspect, the paper plug has a firmness in a direction perpendicular to the major axis of greater than 75%, and high-porosity paper is used as the filler material. The paper plug filled with high-porosity paper has channels that are not noticeable and also has the desired airflow resistance. The first aspect therefore makes it possible to provide a paper plug having airflow resistance within a predetermined range and sufficient firmness, while also having a desirable appearance.

[0008] A second aspect of the present disclosure, which is in accordance with the first aspect, is a paper plug in

which the filler material is formed from one or more crimped sheets, and the porosity of the sheet is greater than 15,000 CORESTA units.

[0009] In the second aspect, high-porosity paper having an airflow resistance of at least 15,000 CORESTA units is used as the filler material of the paper plug. The second aspect therefore makes it possible to provide a paper plug capable of properly demonstrating the advantage of high-porosity paper.

[0010] A third aspect of the present disclosure, which is in accordance with the first and second aspects, is a paper plug in which the crimp depth of the sheet is 0.4 mm or greater.

[0011] In the third aspect, a crimp depth of 0.4 mm or greater is applied to the sheet forming the filler material which fills the paper plug. A desirable airflow resistance and firmness are ensured in the paper plug which is filled with a filler material formed from high-porosity paper to which a crimp depth of 0.4 mm or greater has been applied. The third aspect therefore makes it possible to provide a paper plug in which a desirable airflow resistance and firmness are ensured.

[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 basis weight of the sheet is 15 g/m²-40 g/m².

[0013] In the fourth aspect, the high-porosity paper sheet serving as the filler material of the paper plug has a basis weight of 15 g/m²-40 g/m². A desirable appearance is ensured in a paper plug filled with such a filler material. The fourth aspect therefore makes it possible to provide a paper plug in which a desirable appearance is ensured.

[0014] A fifth aspect of the present disclosure, which is in accordance with any of the first to fourth aspects, is a paper plug in which the porosity of the sheet before crimping is greater than 7000 CORESTA units.

[0015] In the fifth aspect, the porosity before crimping of the sheet forming the filler material which fills the paper plug is greater than 7000 CORESTA units. A paper plug filled with a filler material produced by crimping such a high-porosity paper has channels that are not noticeable and has the desired airflow resistance. The fifth aspect therefore makes it possible to provide a paper plug having airflow resistance within a predetermined range while also having a desirable appearance.

[0016] A sixth aspect of the present disclosure is a flavor inhalation article comprising: the paper plug as disclosed in the first to fifth aspects 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.

[0017] In the sixth aspect, a flavor inhalation article is constructed so as to include: a paper plug filled with a filler material employing high-porosity paper and also having a firmness of greater than 75% in a direction perpendicular to the major axis; a second plug containing a flavor source; and a tipping paper wrapped around the first plug and the second plug. The sixth aspect therefore makes it possible to produce a flavor inhalation article which has an airflow resistance within a predetermined range and sufficient firmness, while also having a desirable appearance.

[0018] A seventh aspect of the present disclosure, which is in accordance with the sixth aspect, is a flavor inhalation article in which the paper plug is disposed on an upstream side of the second plug.

[0019] In the seventh 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. According to the seventh aspect, vapor or aerosol generated by the flavor source can be inhibited from leaking out to the upstream side of the flavor inhalation article by means of the paper plug.

BRIEF DESCRIPTION OF DRAWINGS

[0020]

[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. 3] is a schematic diagram showing a paper sheet which has been crimped.

[Fig. 4A] is a schematic diagram of a ventilation structure in a filter rod employing a paper sheet produced from normal paper.

[Fig. 4B] is a diagram showing the appearance of filter rods employing a paper sheet produced from normal paper.

[Fig. 5A] is a schematic diagram of a ventilation structure in a filter rod employing a paper sheet produced from high-porosity paper.

[Fig. 5B] is a diagram showing the appearance of filter rods employing a paper sheet produced from high-porosity paper.

[Fig. 6] is a graph showing the relationship between filling density of a filter rod and airflow resistance in a ventilation direction, for filter rods produced using high-porosity paper or normal paper as the base roll of the paper sheet.

[Fig. 7A] is a graph showing the distribution of channels of different areas in an overall cross section perpendicular to a longitudinal direction, for filter rods filled with paper sheets employing crimped normal paper as the base roll.

[Fig. 7B] is a graph showing the distribution of channels of different areas in an overall cross section perpendicular to a longitudinal direction, for filter rods filled with paper sheets employing crimped high-porosity paper as the base roll.

[Fig. 8] is a graph showing the results of an investigation into the relationship between average channel area and crimp depth.

[Fig. 9] is a diagram showing data obtained from fig. 6 after excluding samples included in the oval shape at the bottom of fig. 6 which have an undesirable appearance.

[Fig. 10] is a diagram in which, for each sample in fig. 9, a slope (vertical-axis value/horizontal-axis value) is plotted along the vertical axis, and the firmness (%) of each sample is plotted along the horizontal axis.

[Fig. 11] is a graph showing porosity in the Examples and Comparative Examples 1-3 after a 0.5 mm crimping treatment

[Fig. 12] is a schematic view in side section showing an example of a flavor inhalation article employing a paper filter.

[Fig. 13] 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. 14] is a schematic diagram showing a method for measuring firmness of a filter rod.

EMBODIMENTS OF THE INVENTION

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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. 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.

[0025] 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.

[0026] 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.

[0027] 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 21.4 mm. Assuming $\pi=3.14$, the radius of the filter rod 10 is therefore:

$$21.4 \text{ mm}/(3.14 \times 2) = 3.40764 \text{ (approximated hereinafter)}$$

$\approx 3.41 \text{ mm}$.

[0028] 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:

$$21.4 \text{ mm} \times 3.41 \text{ mm} / 2 = 36.487 \text{ mm}^2.$$

[0029] In addition, the volume of the filter rod 10 is:

$$120 \text{ mm} \times 36.487 \text{ mm}^2 = 4378.44 \text{ mm}^3$$

$$\approx 4378 \text{ mm}^3.$$

[0030] Crimp depth will be described here. Fig. 3 is a schematic diagram showing a paper sheet 12 which has been crimped.

[0031] As shown in fig. 3, 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 crimp depth of the paper sheet 12. As an example, the crimp 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).

[0032] In addition, the inventors of the present disclosure took various measurements for high-porosity paper and normal paper having lower porosity, and found the following differences between the normal paper and the high-porosity paper. Fig. 4A is a schematic diagram of a ventilation structure in a filter rod 10 employing a paper sheet 12 produced from normal paper. Fig. 4B is a diagram showing the appearance of filter rods 10 employing a paper sheet 12 produced from normal paper. Fig. 5A is a schematic diagram of a ventilation structure in a filter rod 10 employing a paper sheet 12 produced from high-porosity paper. Fig. 5B is a diagram showing the appearance of filter rods 10 employing a paper sheet 12 produced from high-porosity paper.

[0033] The bends in the paper sheets 12 in fig. 4A and fig. 5B schematically show the crimping treatment applied to the paper sheets 12. As schematically shown in fig. 4A, in a filter rod 10 employing a paper sheet 12 produced from normal paper, air is thought to transit in the longitudinal direction through a passage structure formed inside the paper sheet 12 which fills the filter rod 10. Fig. 4A and 5A are schematic because the mountain and valley structures produced by the crimping are formed so as to follow a width direction of the paper sheet 12, as shown in fig. 3. The large arrows in fig. 4A schematically show air flow paths passing through the passage structure formed inside the filling paper sheet 12. Meanwhile, a filter rod 10 employing a paper sheet 12 produced from normal paper has low porosity, so the flow of air in a direction perpendicular to the air flow paths is thought to be small. The small arrows in fig. 4A schematically show the flow of air in a direction perpendicular to the passage structure.

[0034] On the other hand, as schematically shown in fig. 5A, in a filter rod 10 employing a paper sheet 12 produced from high-porosity paper, the flow of air in a direction perpendicular to the longitudinal direction of the paper sheet 12 which fills the filter rod 10 is thought to mainly contribute to the passage of air in the longitudinal direction of the filter rod 10. This is because air can easily flow in that direction of a paper sheet 12 produced from high-porosity paper having high porosity. The large arrows in fig. 5A schematically show the flow of air in a direction perpendicular to the paper sheet 12. Meanwhile, in a filter rod 10 employing a paper sheet 12 produced from high-porosity paper, a large passage structure such as shown in fig. 4A is not thought to be formed. The small arrows in fig. 5A schematically show the air flow paths along the passage structure.

[0035] The present inventors took further measurements for high-porosity paper and normal paper in order to investigate conditions for a filter rod 10 having a desirable airflow resistance and appearance while ensuring firmness.

[0036] Fig. 6 is a graph showing the relationship between filling density of the filter rod 10 and airflow resistance (per 120 mm length) in a ventilation direction, for filter rods 10 produced using high-porosity paper or normal paper as the base roll of the paper sheet 12. Fig. 7A is a graph showing the distribution of channels of different areas in an overall cross section perpendicular to the longitudinal direction, for filter rods 10 filled with paper sheets 12 employing crimped normal paper as the base roll. Fig. 7B is a graph showing the distribution of channels of different areas in an overall cross section perpendicular to the longitudinal direction, for filter rods 10 filled with paper sheets 12 employing crimped high-porosity paper as the base roll. Fig. 8 is a graph showing the results of an investigation into the relationship between average channel area and crimp depth. Fig. 9 is a diagram showing data obtained from fig. 6 after excluding samples included in the oval shape at the bottom of fig. 6 which have an undesirable appearance. Fig. 10 is a diagram in which, for each sample in fig. 9, a slope (vertical-axis value/horizontal-axis value) is plotted along the vertical axis, and the firmness (%) of each sample is plotted along the horizontal axis.

[0037] In fig. 6, normal paper samples are denoted by circles (Normal PF) and high-porosity paper samples are denoted by squares (HPP PF). As shown in fig. 6, it can be seen that, when normal paper is used as the paper sheet 12 filling the filter rod 10, an increase in the filling amount produces a group with a large increase in airflow resistance and a group with no increase. The oval shape at the top of fig. 6 encloses the group with a large increase in airflow resistance. The typical appearance of the filter rods 10 in this case has been added to the oval shape, and channels

(small holes) are not noticeable in this case, as shown in fig. 6. Meanwhile, the oval shape at the bottom of fig. 6 encloses the group with no large increase in airflow resistance, even if the filling amount is increased. The typical appearance of the filter rods 10 in this case has been added to the oval shape, and channels are noticeable in this case, leading to an undesirable appearance, as shown in fig. 6. That is to say, the difference in airflow resistance when normal paper is used as the paper sheet 12 filling the filter rod 10 corresponds to the difference in appearance.

[0038] Data from the samples shown in fig. 6 is given in Tables 1 and 2 below.

[Table 1-1]

High-porosity paper (1)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O × mm ² /mg
0.5	21.5	18943.3	300	91.3	0.17780 3896	326	2.71456 5984	15.2671 9065
0.7	21.5	18943.3	300	91.2	0.17741 1478	421	3.49708 9585	19.7117 4372
1	21.5	18943.3	300	91.1	0.17731 8562	450	3.74504 2424	21.1204 2671
0.5	21.5	18943.3	240	85.5	0.14115 678	171	1.42552 1426	10.6988 5197
0.7	21.5	18943.3	240	87.3	0.14098 044	224	1.86756 4288	13.2469 7444
1	21.5	18943.3	240	86.3	0.14081 7554	263	2.18968 1826	15.5497 7892
0.5	21.5	18943.3	200	80.8	0.11797 1667	106	0.88335 2541	7.48783 6375
0.7	21.5	18943.3	200	80.9	0.11758 2367	144	1.19678 448	10.1782 6488
1	21.5	18943.3	200	81.8	0.11836 512	162	1.34947 4235	11.4009 4514
1	21.5	18943.3	180	76.9	0.10531 8481	129	1.07122 3292	10.1712 7559
0.5	21.5	18943.3	180	75.5	0.10538 3205	81	0.67462 5703	5.40164 3414
0.9	25	15328.2	240	88.7	0.16090 6545	279	2.32437 5101	14.4454 877
0.7	25	15328.2	240	88.3	0.16005 6586	273	2.27642 8047	14.2226 4528
0.5	25	15328.2	240	88.4	0.16026 6226	235	1.95931 4896	12.2253 7613

[Table 1-2]

High-porosity paper (2)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O × mm ³ /mg
0.9	25	15328.2	200	83.9	0.13498 2746	173	1.43839 0057	10.8561 0308
0.7	25	15328.2	200	84.3	0.13362 6644	170	1.41213 0746	10.5677 3542
0.5	25	15328.2	200	83.4	0.13310 8052	148	1.23109 5202	9.24884 0974
0.5	25	15328.2	240	88.1	0.16034 6057	241	2.00852 3895	12.5261 8205
0.45	25	15328.2	240	87.9	0.15992 6874	209	1.74261 7896	10.8963 4185
0.5	25	15328.2	220	85.6	0.14659 4234	181	1.50970 1814	10.2985 0749
0.47	25	15328.2	220	86.1	0.14752 2198	178	1.48231 3071	10.0480 6799
0.8	25	15328.2	200	83.2	0.13351 5789	179	1.48845 1367	11.1481 2992
0.5	25	15328.2	200	83.2	0.13353 7949	142	1.18415 6076	8.86756 2243
0.5	23	8712.3	300	90.2	0.18870 4916	379	3.15165 6629	16.6935 4611
0.7	23	8712.3	300	91.6	0.18924 324	448	3.72964 4035	19.7082 9219
1	23	8712.3	300	90.6	0.18942 0184	479	3.99140 5271	21.0716 9992

[Table 1-3]

High-porosity paper (3)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O× mm ² /mg
0.5	23	8712.3	240	86.0	0.15190 2277	209	1.74038 8848	11.4572 5975
0.7	23	8712.3	240	85.6	0.15101 6201	257	2.13502 4363	14.1377 1735
1	23	8712.3	240	86.1	0.15161 2669	267	2.22262 9173	14.6599 1716
0.5	23	8712.3	200	79.9	0.12510 3238	138	1.14482 1913	9.15101 6223
0.7	23	8712.3	200	81.6	0.12520 5732	167	1.38807 2969	11.0863 372
1	23	8712.3	200	81.0	0.12557 716	178	1.48081 8828	11.7921 9316
0.5	23	8712.3	180	76.5	0.11233 5649	109	0.90367 9823	8.04446 1671
0.5	23	8712.3	240	83.8	0.14629 668	190	1.57992 2268	10.7998 8327
0.4	23	8712.3	240	83.1	0.14696 4817	153	1.27472 8245	8.67369 6636
0.5	23	8712.3	200	78.8	0.12303 6354	142	1.17778 3742	9.57264 8245
0.4	23	8712.3	200	74.1	0.11644 1056	120	0.99964 3699	8.58497 6248

[Table 2-1]

Normal paper (1)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O × mm ² /mg
0.31	35	2957.839	180	82.4	0.16795 1063	231	1.92061 2404	11.4355 4775
0.3	35	2957.839	180	82.2	0.16910 8077	196	1.62771 2121	9.62527 7196
0.25	35	2957.839	180	79.6	0.16776 5561	126	1.04632 6297	6.23683 6061
0.2	35	2957.839	180	75.7	0.16376 1029	77	0.82892 5798	3.90157 4141
0.6	35	2957.839	110	66.5	0.10180 4172	183	1.52484 8914	14.9782 5568
0.5	35	2957.839	110	63.2	0.10141 8598	151	1.25389 2727	12.3635 3838
0.4	35	2957.839	110	59.8	0.10012 9004	102	0.84806 1709	8.46969 0878
0.45	35	2957.839	110	60.2	0.09796 1946	129	1.07585 661	10.9823 9319
0.34	35	2957.839	180	85.4	0.17179 9684	252	2.09450 7615	12.1922 9721
0.2	35	2957.839	180	79.2	0.17118 4107	64	0.53462 5352	3.12310 1659
0.25	35	2957.839	180	82.1	0.17164 0336	120	1.00228 709	5.83946 1238
0.7	35	2957.839	180	89.6	0.17131 154	648	5.39881 6102	31.5146 9875
0.3	25	2014.714	180	63.3	0.12073 7908	103	0.85517 2896	7.08288 6482
0.3	35	2957.839	240	91.8	0.22569 425	605	5.04576 6003	22.3566 341

[Table 2-2]

Normal paper (2)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O× mm ² /mg
0.5	25	2014.714	180	73.8	0.12008 2271	320	2.66496 0809	22.1927 9148
0.7	25	2014.714	180	77.0	0.12012 6552	473	3.93105 9552	32.7243 1843
0.35	25	2014.714	180	67.7	0.11936 6124	154	1.27978 5771	10.7215 1572
0.3	25	2014.714	220	71.5	0.14662 9531	173	1.44173 8704	9.90004 3587
0.5	25	2014.714	220	82.8	0.14753 0377	559	4.65423 8674	31.5476 4315
0.7	25	2014.714	220	84.2	0.14681 5928	771	6.41339 5975	43.6832 4369
0.31	25	2014.714	220	75.5	0.14640 2684	206	1.71211 3386	11.6945 7649
0.3	30	1136	180	72.6	0.14355 5759	137	1.14102 608	7.94831 2796
0.5	30	1136	180	81.3	0.14295 5402	413	3.43588 4802	23.8677 0315
0.7	30	1136	180	83.5	0.14292 6606	661	5.50156 7643	38.4922 5696
0.32	30	1136	180	73.9	0.14370 9067	152	1.26410 903	8.79630 7029
0.3	30	1136	220	81.5	0.17598 969	249	2.06732 6871	11.7669 2199
0.5	30	1136	220	88.3	0.17560 2392	752	6.26330 6787	35.6675 4833
0.7	30	1136	220	89.1	0.17635 1384	1127	9.37983 908	53.1883 6317

[Table 2-3]

Normal paper (3)								
Crimp depth mm	Basis weight g/m ²	Porosity CORESTA units	Width mm	Firmness %	Density mg/mm ³	Airflow resistance mmH ₂ O	Airflow resistance per 1 mm mmH ₂ O /mm	Airflow resistance per 1 mm / density mmH ₂ O× mm ² /mg
0.25	30	1136	220	78.6	0.17542 7991	150	1.24678 2729	7.10709 1206
0.3	35	653	180	81.8	0.16903 3071	198	1.64921 5677	9.75735 4979
0.5	35	653	180	88.2	0.16896 4359	615	5.11538 1371	30.2749 1359
0.7	35	653	180	89.2	0.16851 8751	912	7.59221 068	45.0526 1671
0.29	35	653	180	81.6	0.16838 5101	186	1.54818 6945	9.19432 2624
0.3	35	653	220	87.6	0.20494 4892	370	3.07352 7662	15.0066 0801
0.5	35	653	220	91.9	0.20539 4596	1167	9.71701 3316	47.3090 0187
0.7	35	653	220	93.1	0.20714 6939	1597	19.8007 4827	64.2092 4364
0.23	35	653	220	84.5	0.20480 16	195	1.81654 3414	7.89321 6703
0.3	40	519	180	84.2	0.19219 894	205	1.70615 526	8.87702 1922
0.5	40	519	180	89.3	0.19212 101	619	5.18346 4008	26.8246 5219
0.7	40	519	180	90.1	0.19153 4516	888	7.38960 5322	38.5810 6342
0.3	40	519	220	90.6	0.23848 4093	446	3.70990 7179	15.5562 0976
0.5	40	519	220	94.0	0.23965 3273	1133	9.42734 2531	39.3374 0807
0.7	40	519	220	95.0	0.23976 9443	1441	11.9929 9885	50.0188 7103

[0039] In the data shown in Tables 1 and 2, the values of airflow resistance per 1 mm (mmH₂O/mm) do not strictly match the values obtained by dividing the airflow resistance (mmH₂O) by the length (120 mm) of the filter rod 10. It is difficult to prepare samples of exactly 120 mm when the filter rods 10 are produced, and the measured length value is 120.3 mm, for example, so the airflow resistance per 1 mm (mmH₂O/mm) is obtained by dividing the airflow resistance by the measured value.

[0040] Furthermore, the inventors of the present disclosure investigated the relationship between the average channel area in the filter rod 10 filled with normal paper as the paper sheet 12 of the filter rod 10, and the crimp depth applied to (the base roll of) the paper sheet 12. Specifically, the four types of paper shown in Table 3 below were investigated.

[Table 3]

	Basis weight g/m ²	Width mm	Porosity CORESTA units	Filler material weight g
Normal paper 1	35	180	3000	0.757
Normal paper 2	35	140	3000	0.588
High-porosity paper 1	25	240	12000	0.720
High-porosity paper 2	25	200	12000	0.601

[0041] Fig. 7A shows the distribution of channels of different areas in an overall cross section perpendicular to the longitudinal direction, for filter rods 10 filled with paper sheets 12 employing, as the base roll, normal paper 1 with a crimp depth of 0 mm, 0.1 mm, 0.2 mm, 0.33 mm and 0.4 mm, and normal paper 2 with a crimp depth of 0.49 mm. This cross section is specifically a longitudinal end face of the filter rod 10. The horizontal axis in fig. 7A denotes the area (mm²), and the vertical axis denotes the number of channels.

[0042] For reference, fig. 7A also shows the value for a filter rod 10 having an acetate filter (12YAF) inserted, instead of being filled with the paper sheet 12. As shown in fig. 7A, only channels having a smaller area than 0.1 mm² were present in the cross section of the filter rod 10 having an acetate filter inserted.

[0043] Meanwhile, channels having an area of 0.1 mm² or greater were present in the cross section of the filter rod 10 filled with a paper sheet 12 of uncrimped normal paper 1 (i.e., having a crimp depth of 0 mm). It can be said from the results shown in fig. 7A that the channels tend to become smaller as the crimps become deeper. It should be noted that in fig. 7A, this tendency appears to be reversed in the area region of 0.133-0.2 mm² for "SDP35 180 0.33" and "SDP35 140 0.49" (the sample with a crimp depth of 0.33 mm has more channels than the sample with a crimp depth of 0.49 mm), but this is due to the samples both having different filling amounts of paper (different widths of base roll of 180 mm and 140 mm), and does not negate the trend above.

[0044] Fig. 7B shows the distribution of channels of different areas on the longitudinal end face of filter rods 10 filled with paper sheets 12 employing, as the base roll, high-porosity paper 1 and high-porosity paper 2 each treated to crimp depths of 0.5 mm, 0.7 mm and 0.9 mm. The horizontal axis in fig. 7B denotes the area (mm²), and the vertical axis denotes the number of channels. As shown in fig. 7B, the filter rods filled with paper sheets 12 comprising high-porosity paper also tended to have smaller channels when deeper crimping was applied to (the base roll of) the paper sheets 12.

[0045] Fig. 8 shows the results of an investigation into the relationship between average channel area (mm²) and crimp depth (mm). The average area (mm²) of channels formed on the end face of the filter rod 10 is preferably 0.15 mm² or less, from an esthetic perspective. As shown in fig. 8, the average channel area decreases as the crimp depth applied increases for both high-porosity paper and normal paper. For high-porosity paper in particular, judging from the graph shown in fig. 8, the critical value of crimp depth for ensuring that the average area of channels formed in the end face of the filter rod 10 is 0.15 mm² or less is thought to be around 0.4 mm for high-porosity paper. That is, an average area of 0.15 mm² or less is ensured for channels formed in the end face of the filter rod 10 when the filling is high-porosity paper with a crimp depth of 0.4 mm or greater. Variations in airflow resistance are also generally inhibited with deeper crimps, so it can be said that a crimp depth of 0.5 mm or greater is more preferably applied.

[0046] Data from the samples shown in fig. 8 is given in Tables 4 and 5 below.

[Table 4-1]

Normal paper: SDP35					
Basis weight (g/m ²)	35	35	35	35	35
Paper width (mm)	180	180	180	180	180
Crimp depth (mm)	0	0.1	0.2	0.33	0.4
Average area (mm ²)	0.99379	0.72201	0.31304	0.14739	0.10940

[Table 4-2]

Normal paper: SDP35					
Basis weight (g/m ²)	35	35	35	35	35
Paper width (mm)	180	180	180	180	180
Crimp depth (mm)	0.2	0.25	0.3	0.35	0.45
Average area (mm ²)	0.32830	0.22793	0.14122	0.14727	0.10441

[Table 5]

High-porosity paper: P12000M						
Basis weight (g/m ²)	25	25	25	25	25	25
Paper width (mm)	240	240	240	240	240	240
Crimp depth (mm)	0.1	0.2	0.3	0.5	0.7	1
Average area (mm ²)	0.82777	0.49808	0.24578	0.11475	0.09781	0.07654

[0047] Fig. 9 is a diagram showing data obtained from fig. 6 after excluding samples included in the oval shape at the bottom of fig. 6 which have an undesirable appearance (after excluding the samples with an average channel area exceeding 0.15 mm²). However, the vertical axis is changed to a numerical value for air permeability per 1 mm length. As shown in fig. 9, it can be seen that samples of the filter rod 10 filled with normal paper and samples filled with high-porosity paper have different slopes (vertical-axis value/horizontal-axis value) [mmH₂O×mm²/mg] in fig. 9. Moreover, the two straight lines in the graph of fig. 9 serve as a reference to illustrate typical slopes of each, and they are not strict statistical values such as average values of each.

[0048] Fig. 10 is a diagram in which, for each sample in fig. 9, a slope (vertical-axis value/horizontal-axis value) [mmH₂O×mm²/mg] is plotted along the vertical axis, and the firmness (%) in a direction perpendicular to the major axis of each sample is plotted along the horizontal axis. 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.

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

[0049] 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/mm in a direction perpendicular to the major axis, 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 Papyrus Co., Ltd. For measurements of firmness in the present disclosure, measurements made hereinafter will employ this paper as the first plug wrap 14.

[0050] 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 75% or greater.

[0051] The region where the firmness is 75% or greater in fig. 10 will therefore be considered. This is the region on the right hand side defined by the vertical dotted line. This region includes samples of the filter rod 10 filled with paper sheets 12 of normal paper and samples of filter rods 10 filled with paper sheets 12 of high-porosity paper. As shown in fig. 10, if we take 22 [mmH₂O×mm²/mg] as a value on the vertical axis, it is clear that samples filled with normal paper at the top and samples filled with high-porosity paper at the bottom can be separated.

[0052] The following can be said from looking at the findings above. A filter rod 10 filled with a paper sheet 12 of

high-porosity paper and having a preferred airflow resistance and sufficient firmness while also having a desirable appearance can be characterized by the following conditions: (1) the firmness in a direction perpendicular to the major axis of the filter rod 10 is 75% or greater; (2) the average area of channels formed in a cross section perpendicular to the ventilation direction of the filter rod 10 is smaller than 0.15 mm²; and (3) the pressure drop per 1 mm length in the major axis direction of the filter rod 10/filling density of filler material is smaller than 22 mmH₂O × mm²/mg]. A range satisfying the three conditions above corresponds to the region at the bottom right of the four regions defined by the vertical and horizontal dotted lines in fig. 10.

[0053] The inventors of the present disclosure took careful measurements of filter rods 10 filled with paper sheets 12 produced from base rolls serving as the two examples and four comparative examples shown Table 6. Fig. 11 is a graph showing porosity in the Examples and Comparative Examples 1-3 after a 0.5 mm crimping treatment.

[Table 6]

	Basis weight g/m ²	Width mm	Porosity CORESTA units	Thickness μ m	Filler material weight g
Example 1	21.5	240	18943	70	0.620
Example 2	23	240	8712	65	0.663
Comparative Example 1	25	220	2015	54	0.661
Comparative Example 2	30	180	1136	63	0.649
Comparative Example 3	40	140	519	69	0.673
Comparative Example 4	40	140	0	40	0.673

[0054] It should be noted that the porosity of the base roll (and paper sheet 12 produced therefrom) generally increases when the crimping treatment has been performed. Table 7 shows results from the examples and comparative examples when a 0.5 mm crimping treatment was performed in each and the porosity was measured by stacking four sheets.

[Table 7]

	N=1	N=2	N=3	N=4	Average	Standard deviation	Coefficient of variation
Example 1	20680.9 3	23021.2 7	24895.3	23986.3	23145.9 5	1812.75 9	7.83186 1
Example 2	20557.1 2	24529.8 6	21789.8 9	23108.9	22496.4 4	1709.78 4	7.60024
Comparative Example 1	13435.3 5	13835.4 8	13342.5 4	13631.6 9	13561.2 7	218.973 9	1.61470 1
Comparative Example 2	8445.25	9135.57	9369.09	9941.5	9289.60 3	653.621	7.03610 4
Comparative Example 3	8850.43	7009.65	6840	7093.23	8948.17 8	123.831 4	1.78221 4

[0055] As shown in fig. 11, the porosity in Examples 1 and 2 after the 0.5 mm crimping treatment was approximately 23,000 and approximately 22,000 CORESTA units, respectively, and both exceeded 15,000 CORESTA units. Meanwhile, the porosity in Comparative Examples 1-3 after the 0.5 mm crimping treatment was approximately 13,000, approximately 9000, and approximately 7000 CORESTA units, respectively, and all were below 15,000 CORESTA units.

[0056] It should be noted that in the two examples, the width of the base roll of the paper sheet 12 was 240 mm, and the basis weight was 21.5 g/m²-23 g/m². 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.

[0057] The basis weight of the base roll of the paper sheet 12 is 15 g/m²-40 g/m².

[Configuration of flavor inhalation article]

[0058] 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. 12 is a schematic view in side section showing an

example of a flavor inhalation article 110 employing a paper filter. Fig. 13 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.

[0059] In the example shown in fig. 12, 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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. 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.

[0064] 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.

[0065] 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.

[0066] Furthermore, the paper plug 20 is used in order to construct the filter portion 115 of the flavor inhalation article 110 in fig. 12, 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. 13, 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).

[0067] As shown in fig. 13, 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.

[0068] 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 the first plug of the present disclosure.

[0069] 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.

[0070] 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.

[0071] 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.

[0072] 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.

[0073] It should be noted that the position of the first filter 241 is not limited to the position shown in fig. 13, 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.

[0074] 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.

[0075] 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.

[0076] 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. 14, 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.

[0077] 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>

Firmness (%) in direction perpendicular to major axis = $(D_d/D_s) \times 100$

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>

[0078] Pressure: 300 g, pressurization time: 10 seconds, pressure jig head diameter: ϕ 12 mm, number of testpieces during measurement: 1

(Action of this embodiment)

[0079] In this embodiment, the filter rod 10 has a firmness of greater than 75% in a direction perpendicular to the major axis, and employs the paper sheet 12 made of high-porosity paper as the filler material of the paper plug 20 (which is obtained by cutting the filter rod 10 to predetermined lengths in the longitudinal direction). The paper plug 20 filled with the high-porosity paper sheet 12 has channels that are not noticeable and also has the desired airflow resistance. This embodiment therefore makes it possible to provide a paper plug 20 having airflow resistance within a predetermined range and sufficient firmness, while also having a desirable appearance.

[0080] Furthermore, in this embodiment, high-porosity paper having an airflow resistance of 15,000 CORESTA units is used as the base roll of the paper sheet 12 filling the paper plug 20. This embodiment therefore makes it possible to provide a paper plug 20 capable of properly demonstrating the advantage of a high-porosity paper filler material.

[0081] Furthermore, in this embodiment, a crimp depth of 0.4 mm or greater is applied to the paper sheet 12 filling the paper plug 20. A desirable airflow resistance and firmness are ensured in the paper plug 20 which is filled with the high-porosity paper sheet 12 to which a crimp depth of 0.4 mm or greater has been applied. This embodiment therefore makes it possible to provide a paper plug 20 in which a desirable airflow resistance and firmness are ensured.

[0082] Furthermore, in this embodiment, the paper sheet 12 made of high-porosity paper that fills the paper plug 20 has a basis weight of 15 g/m²-40 g/m². A desirable appearance is ensured in a paper plug 20 filled with such a paper sheet 12. This embodiment therefore makes it possible to provide a paper plug 20 in which a desirable appearance is ensured.

[0083] Furthermore, in this embodiment, the porosity before crimping of the paper sheet 12 filling the paper plug 20 is greater than 7000 CORESTA units. The paper plug 20 filled with such a high-porosity paper sheet 12 has channels that are not noticeable and also has the desired airflow resistance. This embodiment therefore makes it possible to provide a paper plug 20 having airflow resistance within a predetermined range, while also having a desirable appearance.

[0084] Furthermore, in this embodiment, the flavor inhalation article 110 is constructed so as to include: the paper plug 20 which is filled with the paper sheet 12 made of high-porosity paper and also has a firmness of greater than 75% in a direction perpendicular to the major axis; 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. This embodiment therefore makes it possible to produce a flavor inhalation article 110 which has an airflow resistance within a predetermined range and sufficient firmness, while also having a desirable appearance.

[0085] 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.

[0086] 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)

[0087] A first aspect of the present disclosure relates to a paper plug comprising a filler material and an inner plug wrap wrapped around the filler material, wherein the average of areas of pores formed in a cross section perpendicular to a major axis is smaller than 0.15 mm², the

firmness in a direction perpendicular to the major axis, which is defined in formula (1), is greater than 75%, and formula (2) is satisfied.

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

$$\text{Pressure drop per 1 mm length in major axis direction/filling density of filler material} < 22 \text{ mmH}_2\text{O} \times \text{mm}^2/\text{mg} \quad (2)$$

[0088] (In formula (1):

D_s (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,

D_d (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)

[0089] A second aspect of the present disclosure, which is in accordance with the first aspect, is a paper plug in which the filler material is formed from one or more crimped sheets, and the porosity of the sheet is greater than 15,000 CORESTA units.

(Addendum 3)

[0090] A third aspect of the present disclosure, which is in accordance with the first and second aspects, is a paper plug in which the crimp depth of the sheet is 0.4 mm or greater.

(Addendum 4)

[0091] A fourth aspect of the present disclosure, which is in accordance with the first to third aspects, is a paper plug in which the basis weight of the sheet is 15 g/m²-40 g/m².

(Addendum 5)

[0092] A fifth aspect of the present disclosure, which is in accordance with any of the first to fourth aspects, is a paper plug in which the porosity of the sheet before crimping is greater than 7000 CORESTA units.

(Addendum 6)

[0093] A sixth aspect of the present disclosure is a flavor inhalation article comprising: the paper plug as disclosed in the first to fifth aspects 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 7)

[0094] A seventh aspect of the present disclosure, which is in accordance with the sixth aspect, is a flavor inhalation article in which the paper plug is disposed on an upstream side of the second plug.

REFERENCE SIGNS LIST

[0095]

- 10 Filter rod
- 12 Paper sheet
- 12a Mountain portion
- 12b Valley portion

14	First plug wrap
20	Paper plug
30	Measurement device
32	Jig
5	110 Flavor inhalation article
	111 Smokable material
	112 Cigarette paper
	113 Tipping paper
	114 Tubular member
10	115 Filter portion
	116 Hollow filter portion
	117 Lip-release agent
	200 Flavor inhalation article
	201 First end
15	202 Second end
	210 First segment
	211 Plug portion
	220 Flavor-generating segment
	221 Flavor source
20	230 Cooling segment
	231 Hollow tube
	232 Through-hole
	240 Second segment
	241 First filter
25	242 Second filter
	248 Cigarette paper
	250 Second tipping paper
	260 Tipping paper
	310 Filler material
30	320 First inner plug wrap
	330 Filling layer
	340 Second inner plug wrap
	350: Outer plug wrap

35 Claims

1. A paper plug comprising:
a filler material, and

40 an inner plug wrap wrapped around the filler material,
wherein
the average of areas of pores formed in a cross section perpendicular to a major axis is smaller than 0.15
mm²,
the firmness in a direction perpendicular to the major axis, which is defined in formula (1), is greater than 75%,
45 and
formula (2) is satisfied.

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

$$\text{Pressure drop per 1 mm length in major axis direction/filling density of filler material} < 22 \quad (2)$$

mmH₂O×mm²/mg

(In formula (1):

55 D_s (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,
D_d (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 $\varnothing$ 12 mm, and a
compression time of 10 seconds.)

- 5
2. The paper plug as claimed in claim 1, wherein the filler material is formed from one or more crimped sheets, and
the porosity of the sheet is greater than 15,000 CORESTA units.
- 10
3. The paper plug as claimed in claim 1 or 2, wherein a crimp depth of the sheet is 0.4 mm or greater.
4. The paper plug as claimed in any one of claims 1 to 3, wherein the basis weight of the sheet is 15 g/m²-40 g/m².
- 15
5. The paper plug as claimed in any one of claims 1 to 4, wherein the porosity of the sheet before crimping is greater
than 7000 CORESTA units.
6. A flavor inhalation article comprising:
the paper plug as claimed in any one of claims 1 to 5 serving as a first plug;
- 20
- a second plug containing a flavor source; and
a tipping paper wrapped around the first plug and the second plug.
7. The flavor inhalation article as claimed in claim 6, wherein the paper plug is disposed on an upstream side of the
second plug.

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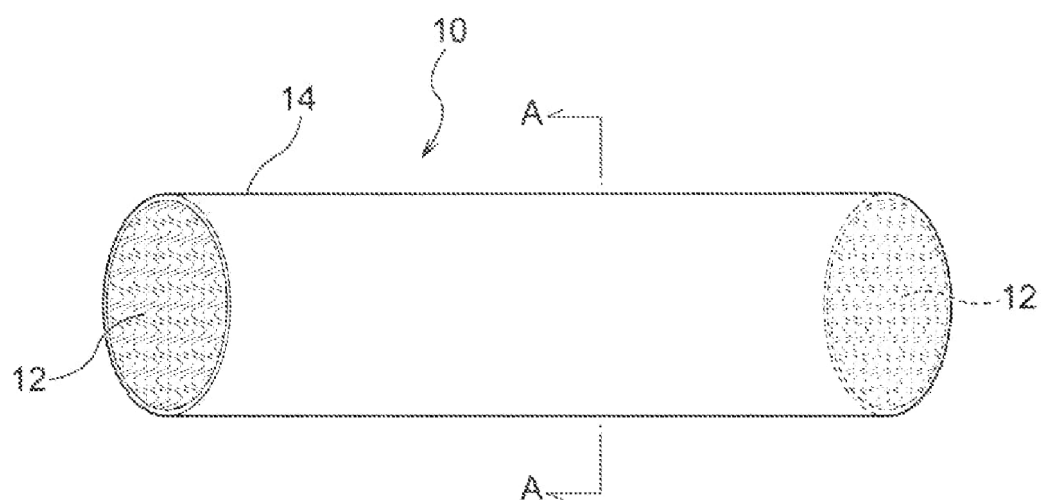
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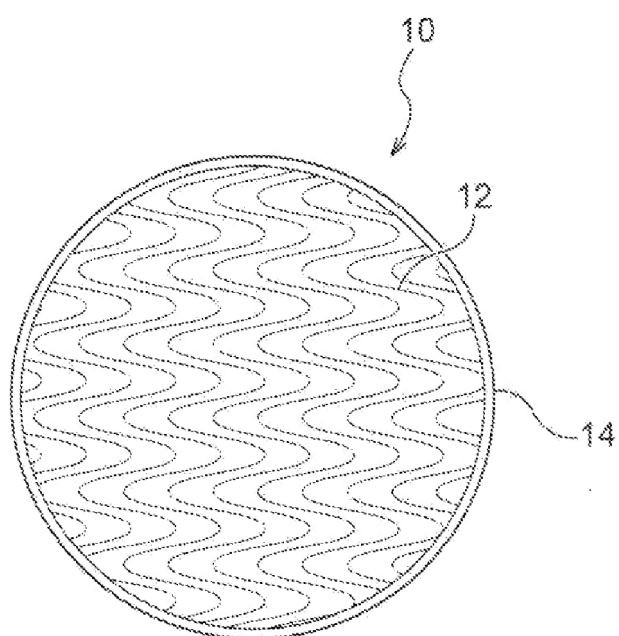
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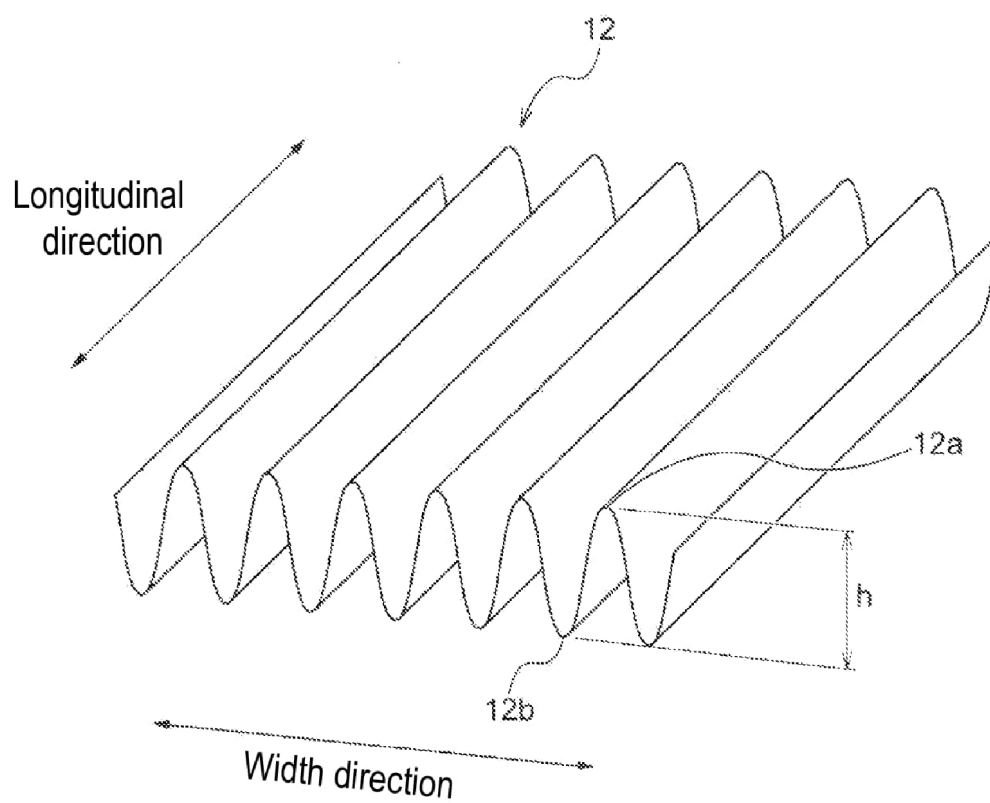
[Fig. 1]



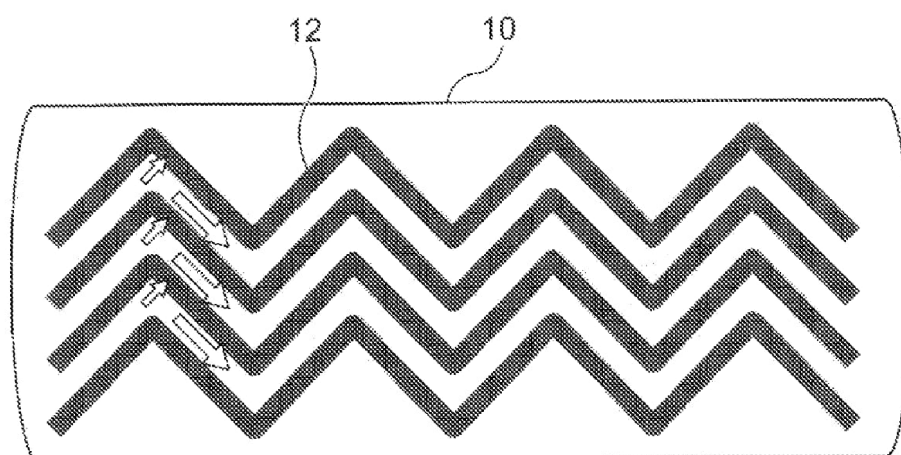
[Fig. 2]



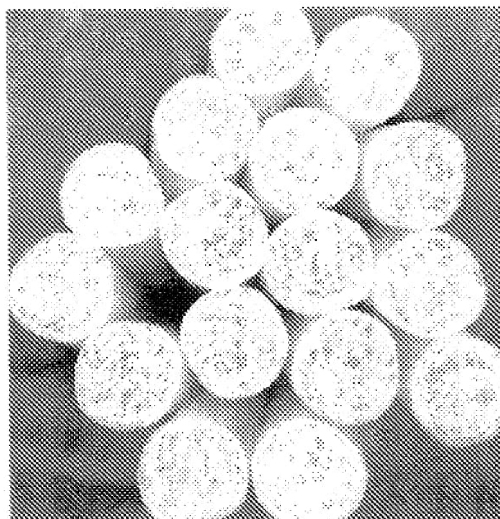
[Fig. 3]



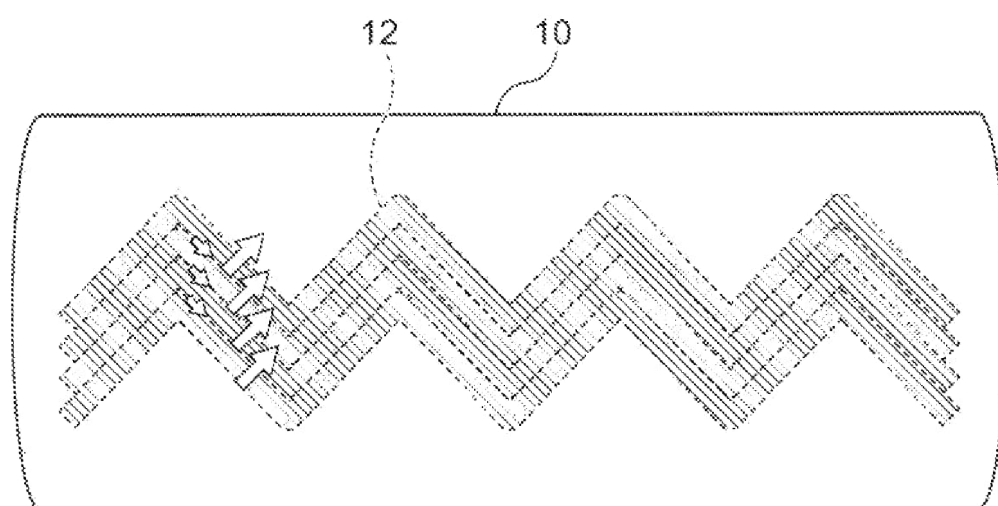
[Fig. 4A]



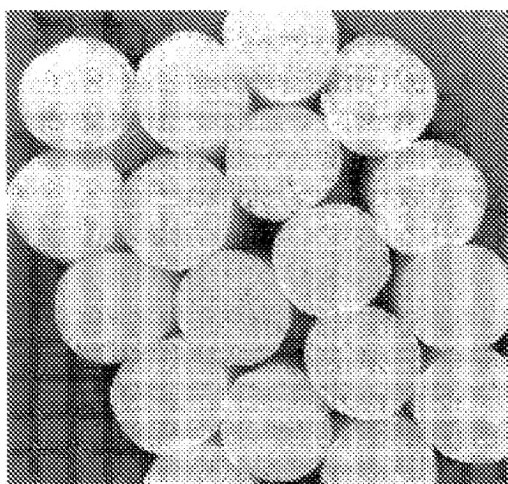
[Fig. 4B]



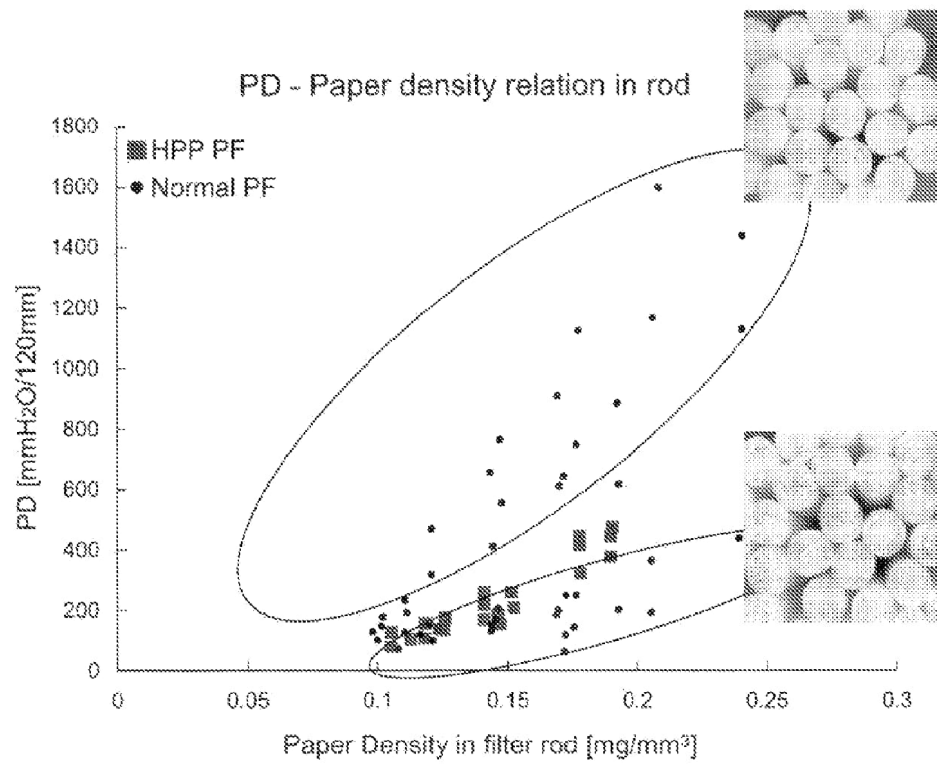
[Fig. 5A]



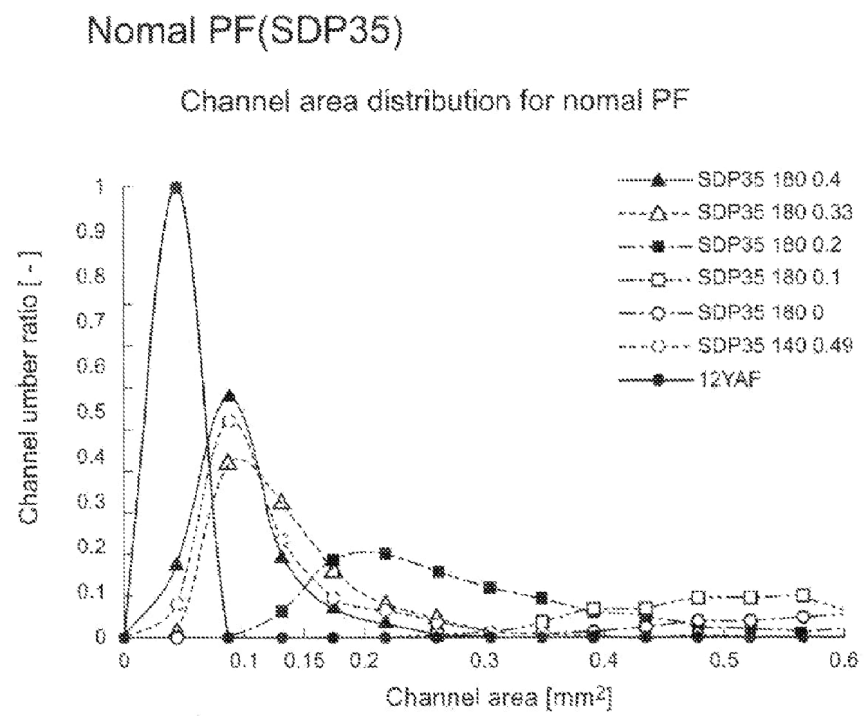
[Fig. 5B]



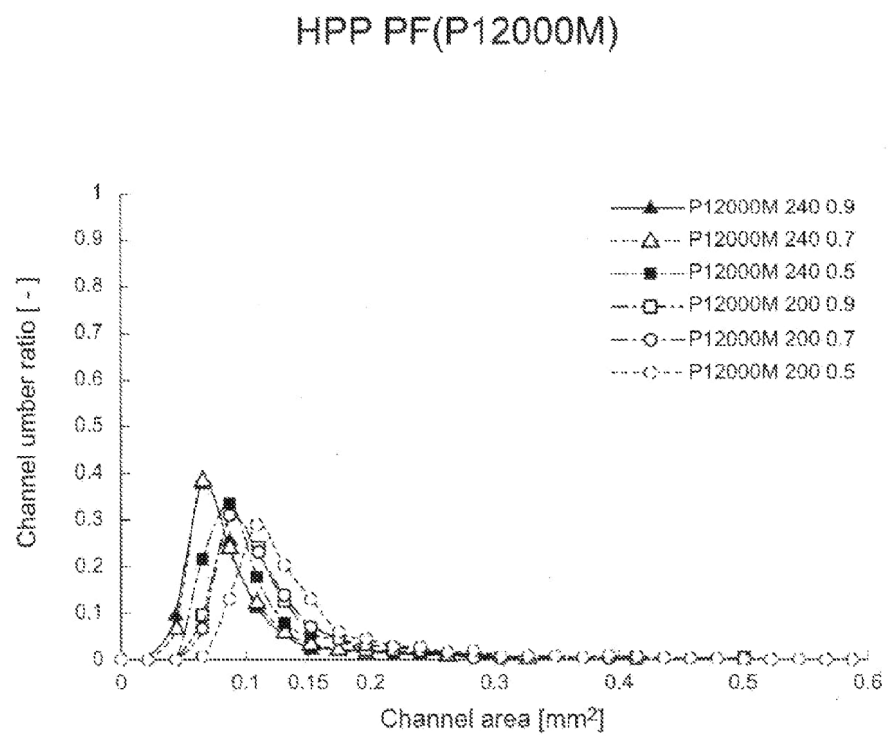
[Fig. 6]



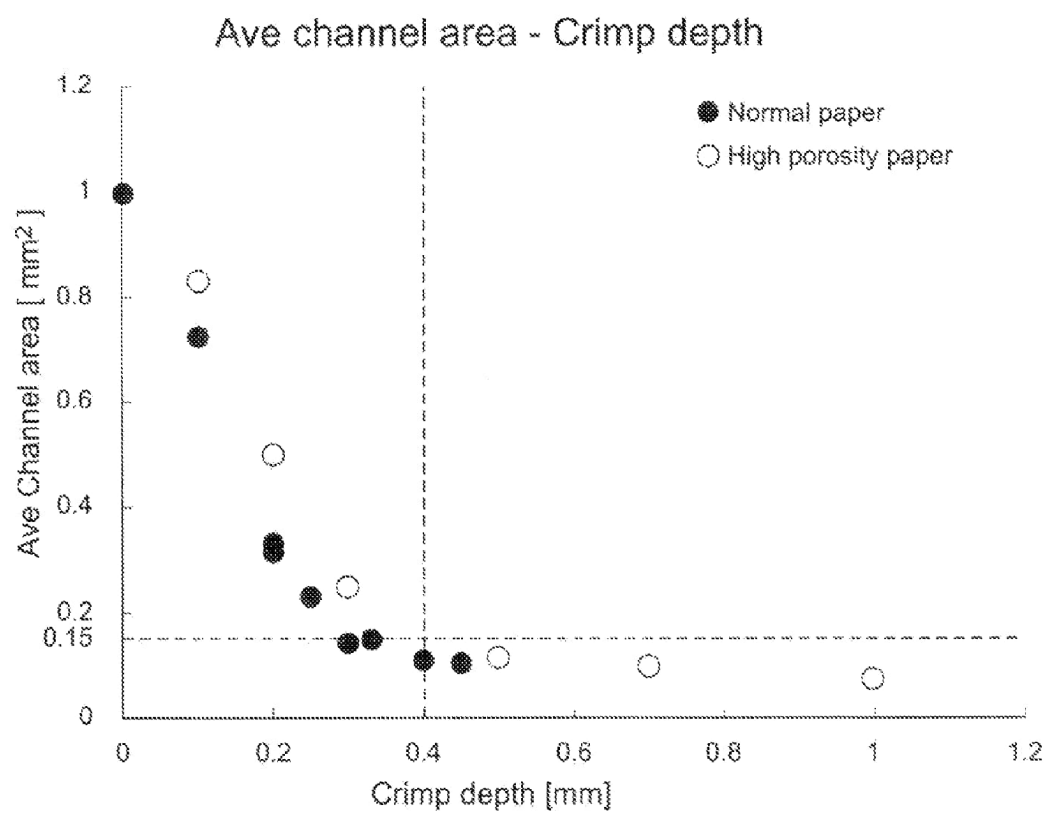
[Fig. 7A]



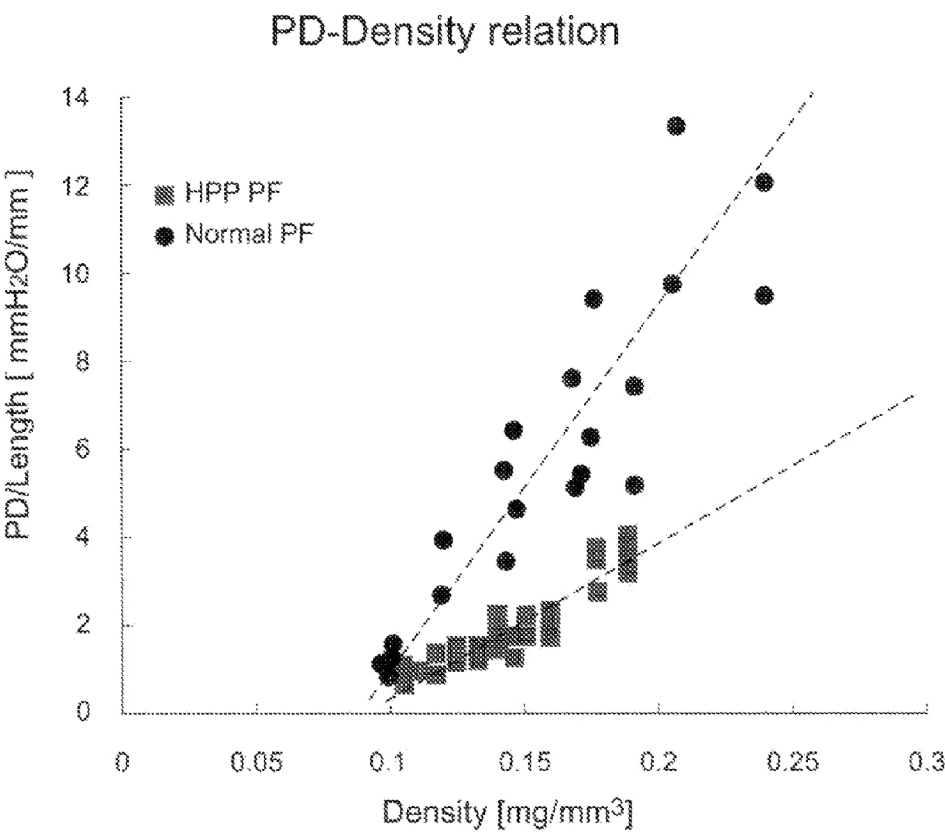
[Fig. 7B]



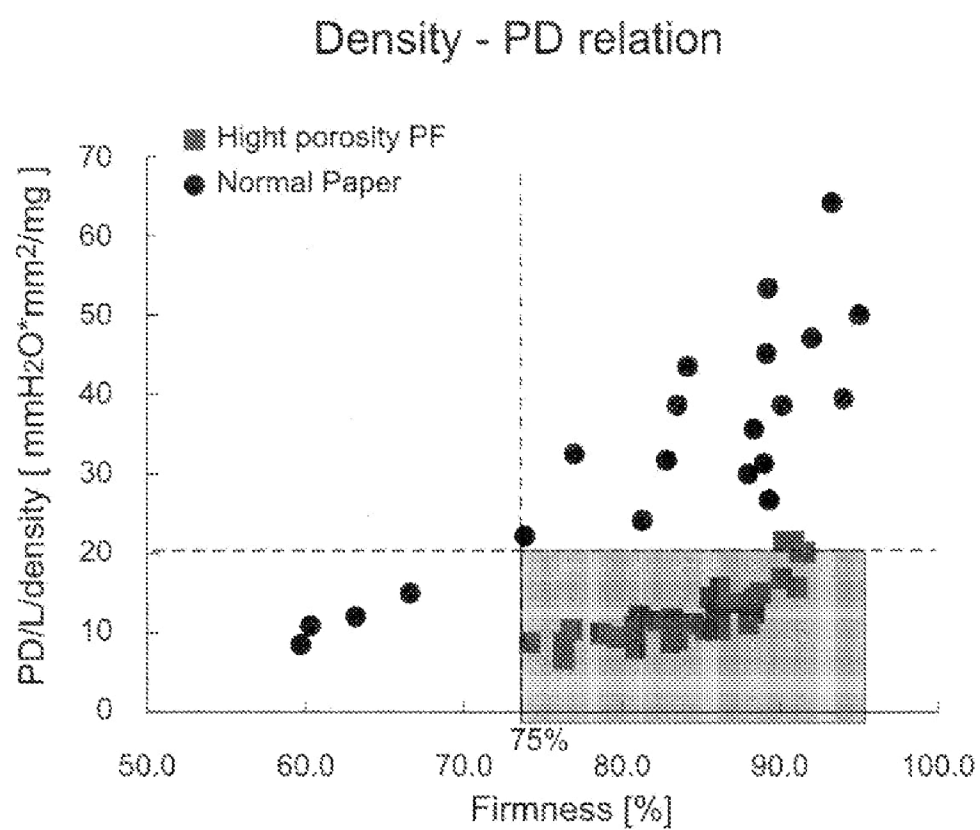
[Fig. 8]



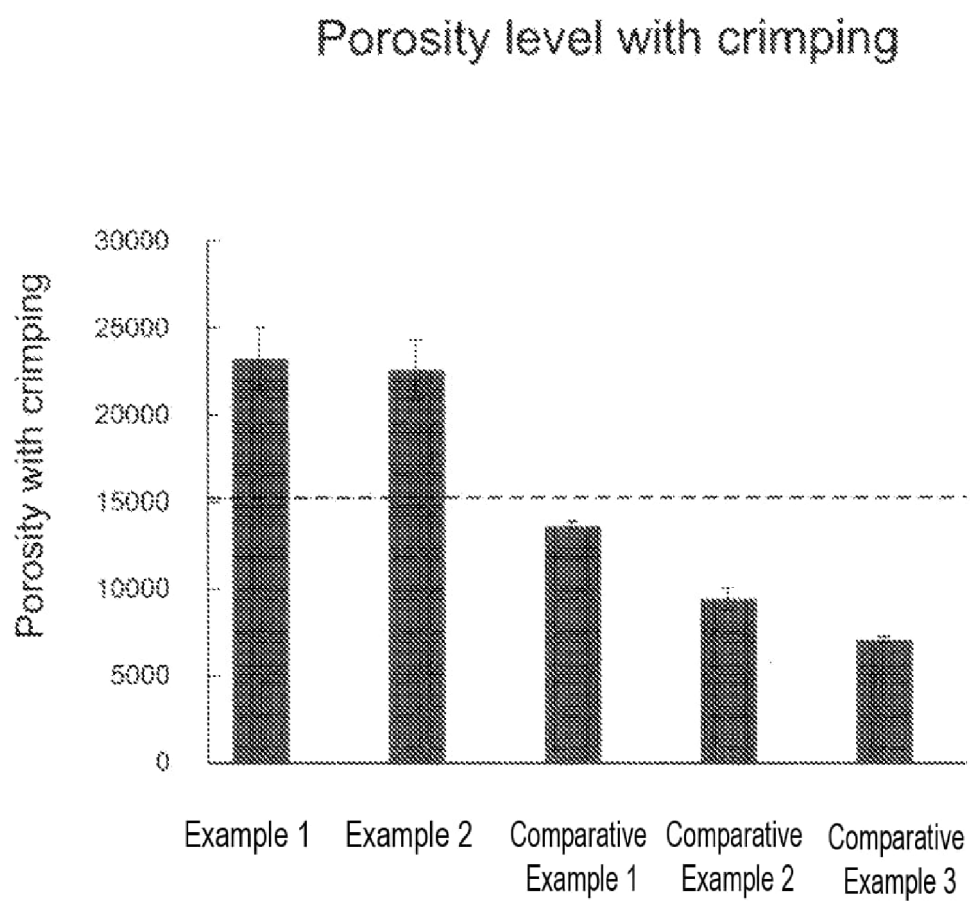
[Fig. 9]



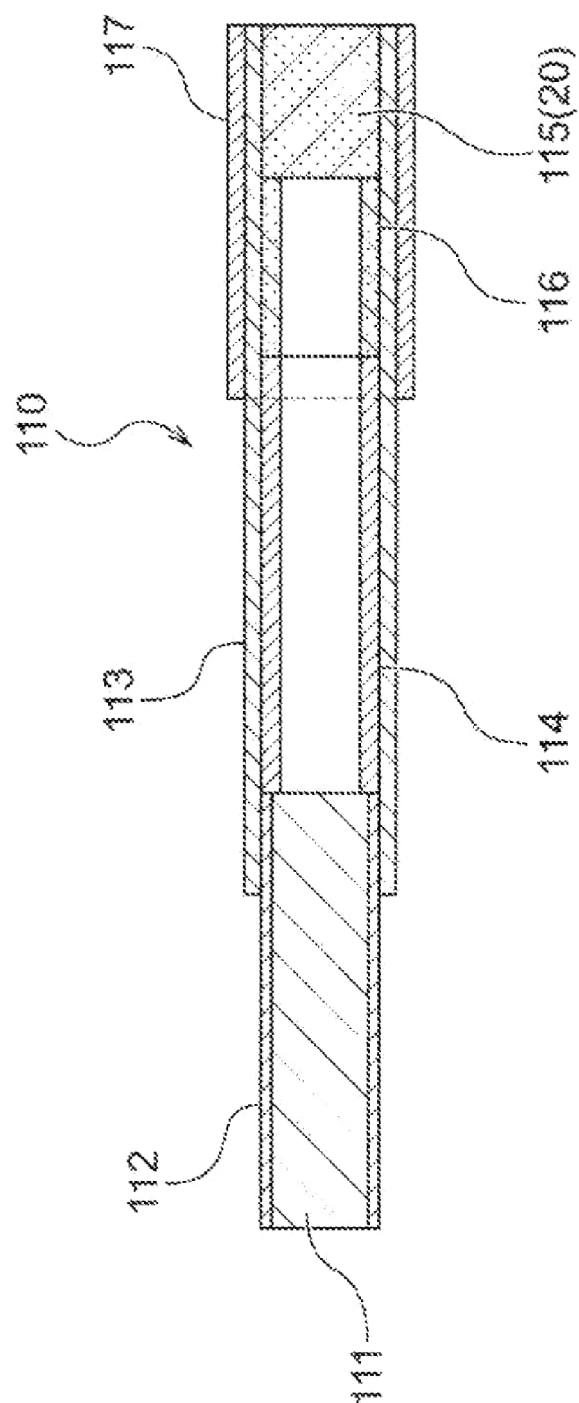
[Fig. 10]



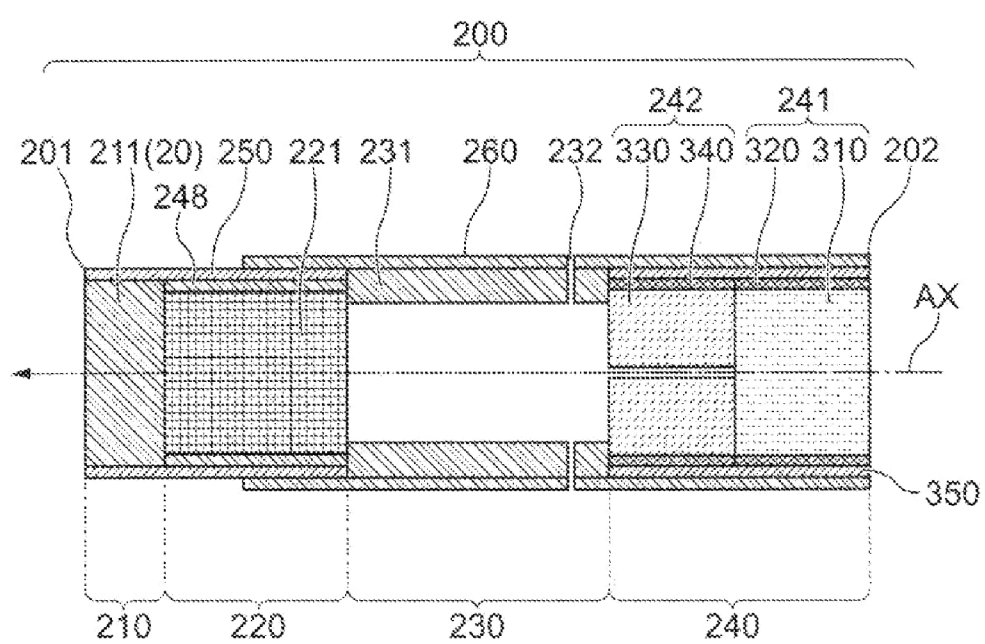
[Fig. 11]



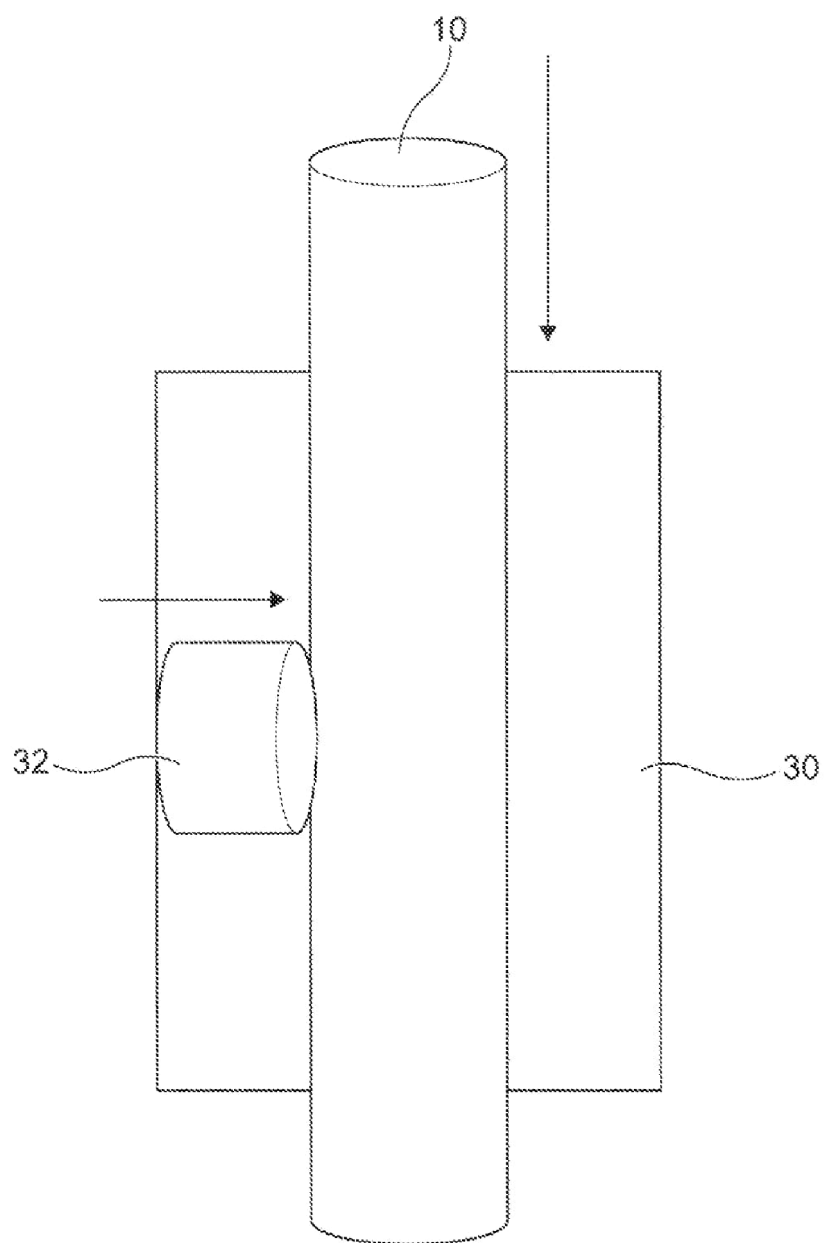
[Fig. 12]



[Fig. 13]



[Fig. 14]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/039767

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 1971-2024
 Registered utility model specifications of Japan 1996-2024
 Published registered utility model applications of Japan 1994-2024

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.
Y	WO 2022/230408 A1 (JAPAN TOBACCO INC.) 03 November 2022 (2022-11-03) paragraphs [0018]-[0019], [0031], [0058]-[0063]	1-5
Y	paragraphs [0050]-[0053]	6-7
Y	WO 2021/176527 A1 (JAPAN TOBACCO INC.) 10 September 2021 (2021-09-10) paragraphs [0028], [0032]-[0036], [0052], fig. 7A-7C	1-7
Y	JP 2023-507503 A (NICOVENTURES TRADING LTD.) 22 February 2023 (2023-02-22) paragraphs [0265]-[0266], [0280]-[0281], fig. 3	6-7
A	paragraphs [0158]-[0167], [0182]-[0194], [0209]-[0213]	1-5
A	JP 2017-524368 A (PHILIP MORRIS PRODUCTS S.A.) 31 August 2017 (2017-08-31) abstract	1
A	WO 2011/118042 A1 (JAPAN TOBACCO INC.) 29 September 2011 (2011-09-29) abstract, fig. 1-2	1-7

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

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“&” document member of the same patent family

Date of the actual completion of the international search

22 November 2024

Date of mailing of the international search report

10 December 2024

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.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/039767

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				paragraphs [0016]-[0017], [0080], [0107]-[0109], [0116]-[0124]			
				EP	4331394	A1	
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				paragraphs [0028], [0032]-[0036], [0052], fig. 7A-7C			
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				paragraphs [0170]-[0179], [0194]-[0206], [0221]- [0226], [0279]-[0280], [0294]-[0295], fig. 3			
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				abstract, fig. 1-2			
				KR	10-2012-0107531	A	

REFERENCES CITED IN THE DESCRIPTION

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