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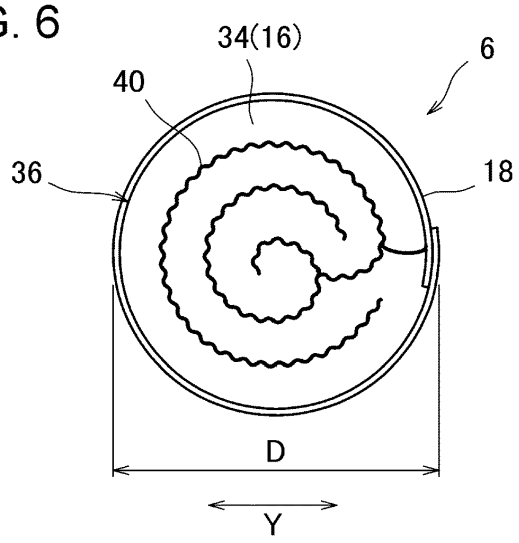
(54) **FILLING ELEMENT USED FOR FLAVOR INHALATION ARTICLE AND METHOD FOR MANUFACTURING FILLING ELEMENT**

(57) Provided is a filling element 6 used for a flavor inhalation article 1, the filling element 6 including: a sheet fill section 36 obtained by randomly gathering and reducing the diameter of one sheet 34 in a width direction Z that intersects the longitudinal direction X of the sheet 34; and, a roll paper 18 wrapped around the sheet fill section 36. The sheet 34 is a dry nonwoven fabric obtained by bonding plant-derived fibers together with a binder and drying the fibers.

FIG. 6



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Description

Technical Field

[0001] The present invention relates to a filling element used for a flavor inhaling article, and a manufacturing method therefor.

Background Art

[0002] PTL 1 describes a manufacturing method for a filter used for a cigarette. The filter is formed by stacking two or more sheets having a filtering function as a filter material with a displacement of a certain width, folding the stacked sheets into an S-shape or a Z-shape, and then squeezing and rolling the stacked sheets into a cylindrical shape.

Citation List

Patent Literature

[0003] PTL 1: Japanese Examined Patent Application Publication No. 44-003727

Summary of Invention

Technical Problem

[0004] The filter can be used not only for a flavor inhaling article including a combustion-heating-type cigarette described in PTL 1 but also for a non-combustion-heating-type flavor inhaling article. A packing density of filter material filling the filter significantly influences airflow resistance at the time when a user inhales a flavor inhaling article and, by extension, a smoke taste that the user obtains. When the packing density of the filter decreases, a gap or a void occurs in the filter element, with the result that the smoke taste and appearance of the flavor inhaling article are significantly impaired. In other words, the packing density of the filter element is an important factor to ensure the quality of the flavor inhaling article.

[0005] In the manufacturing method described in PTL 1, at the time of changing the specifications of a flavor inhaling article and a filter used for the flavor inhaling article, the number of sheets needs to be changed by preparing a plurality of sheets, a shift width of the stacked sheets needs to be adjusted, or the specifications of a sheet itself need to be changed, to adjust the packing density of the filter. In this way, in an existing art, there are a wide variety of filters to be formed by being filled with sheets, in other words, a wide variety of parameters for managing the packing density of a filling element used for a flavor inhaling article, so it is difficult to easily and highly accurately control the packing density of the filling element according to requested specifications.

[0006] Acetate tow frequently used as a filter material so far is the one obtained by working fibers of acetate resin, made from cellulose acetate, into a network structure and is defined as a plastic material. In these days, a reduction in the amount of use of plastic material is desired as an effort to achieve a goal 14th "Life Below Water" in SDGs (Sustainable Development Goals). Therefore, from the viewpoint of marine pollution, a review of a filter material, that is, a filling material, is needed.

[0007] The present invention is made in view of such a problem, and it is an object of the present invention to provide a filling element used for a flavor inhaling article and a manufacturing method therefor, which are capable of easily and highly accurately controlling a packing density while giving consideration to marine pollution.

Solution to Problem

[0008] To achieve the above object, a filling element according to an aspect is a filling element used for a flavor inhaling article and includes: a sheet filled part reduced in diameter by randomly gathering a sheet in a width direction intersecting with a longitudinal direction of the sheet; and a wrapping paper wrapping the sheet filled part. The sheet is a dry nonwoven fabric obtained by bonding plant-derived fibers to each other with a binder and drying the plant-derived fibers.

[0009] A manufacturing method for a filling element according to an aspect is a manufacturing method for a filling element used for a flavor inhaling article and includes: a sheet processing step of processing a serial sheet made of a dry nonwoven fabric obtained by bonding plant-derived fibers to each other with a binder and drying the plant-derived fibers, while conveying the serial sheet; a gathering step of forming a gathering rod reduced in diameter by gathering the sheet, processed in the sheet processing step, in a width direction intersecting with a longitudinal direction of the sheet in a course of conveying the sheet; a wrapping step of wrapping the gathering rod, formed in the gathering step, with a wrapping paper to form a filler rod; and a cutting step of cutting the filler rod, formed in the wrapping step, into the filling element.

Advantageous Effects of Invention

[0010] It is possible to easily and highly accurately control a packing density of a filling element while giving consideration to marine pollution.

Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a cross-sectional view of a non-combustion-heating-type flavor inhaling article.

[Fig. 2] Fig. 2 is a cross-sectional view of a non-combustion-heating-type flavor inhaling article according to a modification.

[Fig. 3] Fig. 3 is a cross-sectional view of a combustion-heating-type flavor inhaling article.
[Fig. 4] Fig. 4 is a cross-sectional view of a combustion-heating-type flavor inhaling article according to a modification.
[Fig. 5] Fig. 5 is a cross-sectional view of a combustion-heating-type flavor inhaling article according to another modification.
[Fig. 6] Fig. 6 is a longitudinal sectional view of a filling element.
[Fig. 7] Fig. 7 is a perspective view of a sheet before crimping.
[Fig. 8] Fig. 8 is a captured image of an enlarged cross section of a sheet before crimping.
[Fig. 9] Fig. 9 is a perspective view of a sheet subjected to crimping.
[Fig. 10] Fig. 10 is a captured image of an enlarged cross section of a sheet subjected to crimping.
[Fig. 11] Fig. 11 is a captured image of a cross section of a sheet of which a crimped depth is greater than that in the case of Fig. 10.
[Fig. 12] Fig. 12 is a schematic diagram of a manufacturing apparatus for a filling element.
[Fig. 13] Fig. 13 is a flowchart that illustrates a manufacturing method for a filling element.
[Fig. 14] Fig. 14 is a perspective view of a roller set sandwiching a sheet.
[Fig. 15] Fig. 15 is a table showing sheets of various specifications and the specifications of filler rods manufactured from the sheets.
[Fig. 16] Fig. 16 is a graph that shows changes in air-flow resistance PD of a filler rod when the crimped depth is varied in each sheet with a different sheet width.
[Fig. 17] Fig. 17 is a graph that shows changes in the coefficient of variation of air-flow resistance shown in Fig. 16.
[Fig. 18] Fig. 18 is a graph that shows sheet packing fractions of filling elements respectively manufactured from sheets with different specifications.
[Fig. 19] Fig. 19 is a captured image of an end face of a filling element of Sample A.
[Fig. 20] Fig. 20 is an image obtained by binarizing the captured image of Fig. 19. Fig. 20 is a captured image of the end face of the filling element of Sample A.
[Fig. 21] Fig. 21 is a captured image of an end face of a filling element of Sample E.
[Fig. 22] Fig. 22 is an image obtained by binarizing the captured image of Fig. 21.
[Fig. 23] Fig. 23 is a captured image of an end face of a filling element of Sample C.
[Fig. 24] Fig. 24 is an image obtained by binarizing the captured image of Fig. 23.

Description of Embodiments

<Flavor Inhaling Article>

[0012] Fig. 1 is a cross-sectional view of a non-combustion-heating-type flavor inhaling article 1 (hereinafter, also referred to as article). The article 1 is made up of a flavor element 2, a tubular element 4, and a filling element 6 in order from the left side in Fig. 1 (distal end side of the article 1). The flavor element 2 is formed so as to be filled with a flavor raw material 8.

[0013] A device (flavor inhaler) used to heat the flavor element 2 includes, for example, a needle-shaped heater 10. Only the heater 10 of the device is shown in Fig. 1. The article 1 is set in the device, and the heater 10 is inserted into the flavor element 2 to heat the flavor element 2. Thus, a flavor component of the flavor raw material 8 vaporizes. A conductive member, such as a metal sheet and metal particles, may be mixed in the flavor raw material 8 filled in the flavor element 2. The conductive member is heated by induced current when the device generates a magnetic field, and the heated conductive member heats the flavor element 2, with the result that the flavor component of the flavor raw material 8 vaporizes.

[0014] The flavor raw material 8 is, for example, cut tobacco, an article obtained by shredding a tobacco sheet, or an article obtained by gathering a tobacco sheet. The flavor raw material 8 may be an article obtained by adding a flavoring agent or a tobacco extract to a sheet made from wood pulp fibers not containing tobacco, an article obtained by shredding a sheet made from a non-tobacco plant, or an article obtained by gathering a sheet of any one of them. A peripheral surface of the flavor raw material 8 is wrapped with a wrapping paper 12.

[0015] The tubular element 4 defines an airflow path in the article 1 and is formed from, for example, a cylindrical paper core 14. The paper core 14 is formed from a single-ply or double-ply paper web. The filling element 6 is a filtrating body filled with the filling material 16. In the filling material 16, a sheet 34 made of nonwoven fabric is gathered, that is, gathered and bound. A peripheral surface of the filling element 6 is wrapped with a wrapping paper 18.

[0016] The elements 2, 4, 6 are coaxially arranged and disposed so as to be butted to each other in an axis direction X, with the result that a serial body is formed. The elements 2, 4, 6 are connected to each other by wrapping a peripheral surface of the serial body with a tipping paper 20. The tubular element 4 and the tipping paper 20 each have an air hole 22 for taking air into the article 1 during inhalation of the article 1. With air taken from outside into the article 1 via the air holes 22, a flavor component of the flavor element 2 and a volatile component of an additive (described later) are cooled, and aerosolization of these components is facilitated.

[0017] Fig. 2 is a cross-sectional view of a non-com-

bustion-heating-type article 1 according to a modification. The article 1 includes a filling element 6 as in the case of Fig. 1 and further includes a filling element 6 at a location adjacent to a side opposite to a tubular element 4 of the flavor element 2, that is, the distal end of the article 1. The distal-end filling element 6 is connected to the flavor element 2 by a wrapping paper 24. the heater 10 penetrates through the distal-end filling element 6 and is inserted into the flavor element 2.

[0018] At this time, the distal-end filling element 6 suppresses dropping of flavor raw material 8 out of the flavor element 2 toward the proximal end of the heater 10. In other words, the distal-end filling element 6 functions as a support segment for supporting the flavor raw material 8 filling the flavor element 2 such that the flavor raw material 8 does not drop toward the heater 10 side in the article 1. Thus, it is possible to suppress soiling of the heater 10 of the device around its proximal end with the dropped flavor raw material 8.

[0019] Fig. 3 is a cross-sectional view of a combustion-heating-type article 1. The article 1 is made up of a flavor element 2 and a filling element 6 in order from the distal end side. When the flavor element 2 is ignited and heated, a flavor component of the flavor raw material 8 volatilizes. Fig. 4 is a cross-sectional view of a combustion-heating-type article 1 according to a modification. The article 1 is made up of a flavor element 2, a filter element 26, and a filling element 6 in order from the distal end side. The filter element 26 is formed by wrapping a filter material 28 different from a filling material 16 of the filling element 6, for example, acetate tow, with a wrapping paper 30. The filter element 26 is connected to the filling element 6 by a wrapping paper 32.

[0020] Fig. 5 is a cross-sectional view of a combustion-heating-type article 1 according to another modification. The article 1 is made up of a flavor element 2, a filling element 6, and a filter element 26 in order from the distal end side. The article 1 is a pattern in which arrangement of the filter element 26 and filling element 6 of the article 1 of Fig. 4 is changed, and the remaining configuration is similar to that of the article 1 of Fig. 4.

<Filling Element>

[0021] Fig. 6 shows an end face of the filling element 6. The filling element 6 has a diameter D of 5.2 mm to 8.2 mm. The diameter D of the filling element 6 was measured with a filter rod measuring instrument (produced by SODIM, "SODIM-D diameter (laser)" of "SODILINE series"). The filling material 16 of the filling element 6 is a sheet 34.

[0022] The sheet 34 is a dry nonwoven fabric obtained by bonding plant-derived fibers, for example, wood pulp fibers to each other with a water-soluble binder. Examples of the binder include starch, carboxymethyl cellulose, polyvinyl alcohol, polyvinyl acetate, ethylene-vinyl acetate copolymer, vinyl acetate-acrylic copolymer, guar gum, and gellan gum. One of the above-described binders may be used or two or more of the above-described binders may be used in combination.

[0023] A large number of crimped parts 40 (described later) are formed in the sheet 34. The sheet 34 may contain an adsorbent, such as activated carbon, a flavoring agent component, a carrier supporting a flavoring agent component, a ground product of a herb plant, a ground product of a tobacco plant, and an extract of a tobacco plant, as additives. In this case, through heating with the above-described heater 10 or the conductive member, a flavor component contained in the above-described additives can be vaporized from not only the flavor element 2 but also the filling element 6. In other words, the filling element 6 using the sheet 34 made from nonwoven fabric containing the above-described additives has not only a function of a filter element serving as a filtrating body but also a function of the flavor element 2. The sheet 34 is randomly gathered in the width direction Z to reduce in diameter.

[0024] Thus, a gathering rod 84 (described later) is formed and further cut into a sheet filled part 36. The width direction Z is a direction that intersects with the longitudinal direction X (the same direction as the axis direction X) of the sheet 34 and is partially the same direction as a radial direction Y of the filling element 6 shown in Fig. 6. Fig. 6 schematically shows an example in which the sheet 34 is spirally gathered; however, gathering is randomly performed, so a mode of gathering the sheet 34 is not limited to the example shown in Fig. 6.

[0025] A peripheral surface of the sheet filled part 36 is wrapped with the wrapping paper 18, and wrapping is performed by applying adhesive to both ends of the wrapping paper 18. Thus, the filling element 6 is formed. When a sheet 34 is gathered to form the sheet filled part 36, by extension, the filling element 6, it is not necessary to prepare a plurality of sheets 34 and then change the number of the sheets 34, adjust a shift width of the stacked sheets 34, or change the specifications of the sheet 34 itself, unlike the existing art, in order to adjust the packing density of the filling element 6. Furthermore, when the sheet 34 is subjected to crimping to form crimped parts 40, it is possible optimize the packing density of the sheet 34 in the sheet filled part 36.

[0026] Fig. 7 is a perspective view of the sheet 34 before crimping. Fig. 8 is a captured image of an enlarged cross section of the sheet 34 before crimping. The sheet 34 has a basis weight of 30 g/m^2 to 100 g/m^2, a thickness t of 0.7 mm to 2.0 mm, and a sheet width Ws in the width direction Z of 40 mm to 350 mm. The basis weight was measured in compliant with ISO 9073-1: 1989, Textiles-Test methods for nonwovens-Part 1: Determination of mass per unit area. The thickness was measured in compliant with ISO 9073-2:1995, Textiles-Test methods for nonwovens-Part 2: Determination of thickness.

[0027] Since the sheet 34 is made from a web-like nonwoven fabric not interwoven but intertangled, the sheet 34 has a substantially irreversible extensibility in the longitudinal direction X and has a large number of

raised parts 38 on the front and back surfaces.

<Crimping of Sheet>

[0028] Fig. 9 is a perspective view of the sheet 34 subjected to crimping. Fig. 10 is a captured image of an enlarged cross section of the sheet 34 subjected to crimping. A predetermined number of recessed crimped parts 40 arranged in the width direction Y and extending in the longitudinal direction X are formed in the sheet 34. A recess depth (crimped depth) d of each crimped part 40 is less than or equal to 1.2 mm. Crimping means a crepe treatment in which projections and recesses are embossed on the sheet 34 at intervals.

[0029] The crimped parts 40 are projections and recesses formed in the sheet 34 and are defined as recessed portions recessed in various shapes and projected portions projected in various shapes on a flat surface of the sheet 34. In the case shown in Fig. 10, the crimped depth d of the crimped part 40 formed in the sheet 34 is 0.3 mm, the raised part 38 more remarkably occurs on the sheet 34 as compared to the case shown in Fig. 8 when the fibers of the sheet 34 are extended and split.

[0030] Fig. 11 is a captured image of a cross section of the sheet 34 of which the crimped depth d is greater than that in the case of Fig. 10. In the case shown in Fig. 11, the crimped depth d of the crimped part 40 formed in the sheet 34 is 1.0 mm, extension and split of fibers of the sheet 34 and occurrence of the raised part 38 are further more remarkable. The crimped parts 40 formed in the sheet 34 and extension, split, and the raised parts 38 of fibers, which occur as a result of formation of the crimped parts 40 increase the surface area of the sheet 34.

[0031] When the crimped parts 40 are formed in the sheet 34, intertangling of fibers of the sheet 34 when the sheet filled part 36 is formed is facilitated. When the crimped depth d of each crimped part 40 is adjusted, the sheet filled parts 36, by extension, the filling elements 6, having multiple types of packing densities, can be formed by using one type and single sheet 34. Therefore, in comparison with the existing art, it is possible to easily and highly accurately control the packing density of the filling element 6. It is possible to effectively suppress occurrence of gaps and voids in the filling element 6 and further improve the appearance of the end face of the filling element 6.

<Manufacturing Apparatus and Manufacturing Method for Filling Element>

[0032] Fig. 12 is a schematic diagram of a manufacturing apparatus 50 for the filling element 6. Fig. 13 is a flowchart for illustrating a manufacturing method for the filling element 6. The manufacturing apparatus 50 includes a sheet feeding section 52, a sheet processing section 54, a gathering section 56, a wrapping section 58, a cutting section 60, and the like. When manufacturing of the filling element 6 is started, the sheet feeding section 52 feeds the serial sheet 34 to a conveying path 62 (S1: sheet feeding step).

[0033] The sheet feeding section 52 includes a bobbin 64 around which the sheet 34 is wound, an S-roller set 66, and the like. The S-roller set 66 includes a pair of rollers 66a, 66b spaced apart up and down. The outer peripheries of the rollers 66a, 66b are knurled, so the rollers 66a, 66b are capable of unreeling the sheet 34 from the bobbin 64 in a gripped state without a slide. In the sheet feeding step S1, the sheet 34 unreeled from the bobbin 64 is spanned in an S-shape between the pair of rollers 66a, 66b and fed to the conveying path 62 (P1: S-feed process).

[0034] Through the S-feed process P1, the sheet 34 can be conveyed to the sheet processing section 54 in a state where the thickness t of the sheet 34 is maintained without flattening fibers including the raised parts 38 of the sheet 34. When the sheet 34 can be conveyed to the sheet processing section 54 in a state where the thickness t of the sheet 34 is maintained, a single roller of which the outer periphery is knurled may also be used instead of the pair of rollers 66a, 66b. Three or more similar rollers may be used. In any case, when a plurality of rollers is used, it is important not to nip the sheet 34 between rollers in order to maintain the thickness t of the sheet 34.

[0035] Subsequently, the sheet processing section 54 processes the sheet 34 while conveying the sheet 34 with the conveying path 62 (S2: sheet processing step). The sheet processing section 54 includes a roller set 68 and a control unit 70. The roller set 68 is made up of a first roller 72 and a second roller 74. The roller set 68 sandwiches the sheet 34 with the first and second rollers 72, 74 and conveys the sheet 34 along the conveying path 62.

[0036] A rotary shaft of at least one of the first and second rollers 72, 74 is coupled to a drive shaft of a motor (not shown) and is rotationally driven by the motor. The motor is electrically connected to the control unit 70. A rotation speed of each of the first and second rollers 72, 74 is controlled through the motor in accordance with a signal from the control unit 70.

[0037] Fig. 14 is a perspective view of the roller set 68 sandwiching the sheet 34. The first roller 72 has protruded projections (projected portions) 76 in a circumferential direction of its outer periphery. The second roller 74 has recesses (recessed portions) 78 meshing with the projections 76 in the circumferential direction of the outer periphery. When the roller set 68 conveys the sheet 34 while sandwiching the sheet 34, the first and second rollers 72, 74 respectively rotate in arrow directions shown in Fig. 14, with the result that the projections 76 and the recesses 78 mesh with each other via the sheet 34, and meshing parts 80 are formed in the roller set 68.

[0038] An intermeshing region 82 in which the predetermined number of meshing parts 80 are formed is formed in a region over the outer periphery of each of the first and second rollers 72, 74 in the circumferential

direction in the roller set 68. The intermeshing region 82 applies crimping with the meshing parts 80 to a region of the sheet 34 in the longitudinal direction X. Thus, a predetermined number of crimped parts 40 corresponding to the number of the meshing parts 80 are formed in the sheet 34 (P2: crimping process). When the height of the projections 76 and the depth of the recesses 78 in the meshing parts 80 are changed, the crimped depth d of the crimped parts 40 can be adjusted.

[0039] Subsequently, as shown in Figs. 12 and 13, in the gathering section 56, a gathering rod 84 is formed by gathering the sheet 34, crimped in the crimping process P2 of the sheet processing step S2, in the width direction Y to reduce in diameter in the course of conveying the sheet 34 along the conveying path 62 (S3: gathering step). When the gathering rod 84 is formed into a filler rod 94 and then cut into the filling element 6 in the following steps, the sheet filled part 36 is formed.

[0040] More specifically, the gathering section 56 is made up of a liquid adding booth 86, a granule adding unit 88, a trumpet guide 90, a tong 92, and the like in order from an upstream side of the conveying path 62 in a conveying direction. The liquid adding booth 86 sprays liquid additive to the sheet 34 before gathering (P3: liquid adding process). The additive is, for example, liquid containing a plasticizer and a flavoring agent. The granule adding unit 88 includes a hopper 88a and a spreading roller 88b.

[0041] Granules are stored in the hopper 88a. The spreading roller 88b spreads granules supplied from the hopper 88a onto the sheet 34 before gathering. The granules are granular additive and include, for example, particles of activated carbon and flavoring agent. The trumpet guide 90 and the tong 92 each have a cylindrical shape. The trumpet guide 90 is formed such that the inner periphery gradually reduces in diameter from the upstream side of the conveying path 62.

[0042] The trumpet guide 90 randomly gathers the sheet 34 conveyed along the conveying path 62 and reduces the diameter of the sheet 34 into a rod shape and discharges the sheet 34 toward the tong 92. When the gathered rod-shaped sheet 34 passes through the tong 92, the rod-shaped sheet 34 is further reduced in diameter to a gathering rod 84 with a diameter less than or equal to the diameter of the filling element 6.

[0043] Subsequently, the wrapping section 58 forms the filler rod 94 by wrapping the gathering rod 84 with the wrapping paper 18 fed (S4: wrapping step). Subsequently, the cutting section 60 forms the filling element 6 by cutting the filler rod 94 into a predetermined length (S5: cutting step).

[0044] Fig. 15 shows sheets 34 of various specifications and the specifications of filler rods 94 manufactured from the sheets 34. Fibers of NBSK (Nordic Bleached Softwood Kraft pulp) or SBSK (Southern Bleached Softwood Kraft pulp) as wood pulp were bonded with a binder of A (EVA/PVAc (a mixture of ethylene-vinyl acetate copolymer and polyvinyl acetate)) or B (poly vinyl acetate-acrylic copolymer) and dried to make the sheets 34 of Samples No. 1 to No. 4.

[0045] As shown in Fig. 15, among the samples, a weight ratio between wood pulp and binder that were components of the sheet 34 was varied, while the length of the sheet 34 in the longitudinal direction X and the length in sheet width Ws (length $\times$ width) were constant. Then, the thickness t, density, and air permeability of the sheet 34 in each sample in a state where crimping had not been performed were measured, and then the sheet 34 was fed to the manufacturing apparatus 50 to manufacture the filler rod 94.

[0046] Furthermore, a plurality of filler rods 94 with a predetermined length for each sample was prepared, and the weight, circumference, packing density, degree of complete round, PD (air-flow resistance), and hardness of each filler rod 94 were measured, and average values of these measurement values were calculated. A CV (coefficient of variation) of PD was calculated from an average value of PD and a standard deviation. As a result of checking these calculated values shown in Fig. 15, it was found that, even when the sheets 34 of various specifications were used, the filler rods 94 of specifications close enough to the existing ones could be manufactured by using the manufacturing apparatus 50 according to the embodiment. It was found that, when the manufacturing apparatus 50 was used, the specifications of the filler rod 94, by extension, the filling element 6 can be controlled by setting the specifications of the sheet 34 in advance.

[0047] Fig. 16 shows changes in air-flow resistance PD of the filler rod 94 when the crimped depth d is varied in each sheet 34 with a different sheet width Ws. For each of the sheets 34, fibers of SBSK were bonded with EVA/PVAc and dried to have a basis weight of 53 g/m^2 and a thickness t of 1.3 mm. The length of the filler rod 94 manufactured was 120 mm, and the circumference was 24.2 mm. Furthermore, five types of the sheets 34 in the range of a sheet width Ws of 100 mm to 150 mm were prepared, and the crimped depth d was changed in the range of 0 mm to 0.5 mm in each sheet 34.

[0048] As a result, it was found that, as the sheet width Ws of the sheet 34 increased when the diameter D of the filler rod 94 was constant, the sheet packing fraction of the filler rod 94 increased, and the air-flow resistance PD also increased. It was also found that, when the sheet 34 was subjected to crimping, the air-flow resistance PD reduced as compared to the case where crimping was not performed. Furthermore, it was found that, when the crimped depth d was increased, the air-flow resistance PD also increased.

[0049] Fig. 17 shows changes in the coefficient of variation CV of air-flow resistance PD shown in Fig. 16. A plurality of filler rods 94 manufactured by using each sheet 34 with a different sheet width Ws was prepared, and the air-flow resistances PD of the various filler rods 94 were measured. A standard deviation and average value of the obtained air-flow resistances PD were cal-

culated, and, by extension, the coefficient of variation CV was calculated. As a result, it was found that, regardless of the size of the sheet width Ws, when the crimped depth d was increased, the coefficient of variation CV of the air-flow resistance PD reduced. In other words, it was found that, when the crimped depth d was increased, variations in the air-flow resistance PD among the filler rods 94 reduced.

[0050] Fig. 18 shows the sheet packing fractions of filling elements 6 respectively manufactured from the sheets 34 with different specifications. For each of the sheets 34, fibers of SBSK were bonded with EVA/PVAc and dried to have a basis weight of 53 g/m^2 and a thickness t of 1.3 mm. Filling elements 6 each having a constant diameter D were manufactured from the sheets 34 of Samples A to D of which the sheet widths Ws were 100 mm, 110 mm, 120 mm, and 128 mm and the crimped depth d was 0 mm or 0.5 mm. A filling element 6 that uses acetate tow as a filling material was prepared as sample E.

[0051] Images of the end faces of the filling elements 6 (or the cross sections of the filler rods 94) that were the samples were captured with a camera, and the sheet packing fractions were calculated through image analysis by binarizing the captured images. As a result, it was found that, when the crimped depth d was increased, the sheet packing fraction approached 100%, occurrence of gaps and voids in the filling element 6 could be effectively suppressed, and furthermore the appearance of the end face of the filling element 6 could be improved.

[0052] Fig. 19 shows a captured image of the end face of the filling element 6 of Sample A. Fig. 20 shows an image obtained by binarizing the captured image of Fig. 19. Since Sample A uses the sheet 34 of which the sheet width Ws is relatively small 100 mm and the crimped depth d is 0 mm, a large number of gaps 96 occur in the filling element 6 as is apparent from Fig. 20. On the other hand, Fig. 21 shows a captured image of the end face of the filling element 6 of Sample E. Fig. 22 shows an image obtained by binarizing the captured image of Fig. 20.

[0053] Since Sample E uses acetate tow as a filling material, the sheet packing fraction is almost 100% as is apparent from Fig. 22. In contrast, Fig. 23 shows a captured image of the end face of the filling element 6 of Sample C. Fig. 24 shows an image obtained by binarizing the captured image of Fig. 23. Since Sample C uses the sheet 34 of which the sheet width Ws is relatively large 120 mm and the crimped depth d is 0.5 mm, gaps 96 do not occur so much in the filling element 6 as is apparent from Fig. 23.

[0054] In other words, it was found that, even when the sheet 34 was made from a filling material by setting the sheet width Ws to a predetermined size and additionally forming the crimped parts 40 with a predetermined crimped depth d in the sheet 34, a sheet packing fraction close to that of the filling element 6 using acetate tow as a filling material could be implemented. As shown in Fig. 18, Sample D has a lower sheet packing fraction than Sample C.

[0055] This is presumably because, at the time of manufacturing the filling element 6 having a constant diameter D, if the sheet width Ws is too large, gaps 96 easily occur even when the sheet 34 is subjected to crimping. Therefore, it was found that there were an optimal sheet width Ws and an optimal crimped depth d according to the diameter D of the filling element 6.

[0056] As described above, the filling element 6 according to the embodiment includes the sheet filled part 36 reduced in diameter by randomly gathering a sheet 34 in the width direction Z and the wrapping paper 18 wrapping the sheet filled part 36, and the sheet 34 is a dry nonwoven fabric obtained by bonding plant-derived fibers, such as wood pulp, to each other with a binder and drying the plant-derived fibers. The sheet 34 made of nonwoven fabric of wood pulp fibers is formed into the gathering rod 84 in the gathering step S3 via the sheet processing step S2 and is then formed into the filling element 6 not using a plastic material sequentially via the wrapping step S4 and the cutting step S5.

[0057] Thus, a goal 14th "Life Below Water" in SDGs can be achieved, and it is possible to contribute to stopping marine pollution due to plastic materials. The sheet filled parts 36, by extension, the filling elements 6, having multiple types of packing densities, can be formed by using one type and single sheet 34. Therefore, it is possible to easily and highly accurately control and optimize the packing density of the filling element 6.

[0058] It is possible to suppress occurrence of gaps and voids in the filling element 6 and optimize the air-flow resistance PD of the filling element 6 by optimizing the packing density of the filling element 6, so it is possible to improve the smoke taste of the article 1. It is also possible to improve the appearance of the end face of the filling element 6. Therefore, it is possible to ensure the quality of the article 1.

[0059] More specifically, the filling element 6 has a diameter D of 5.2 mm to 8.2 mm, and the sheet 34 has a basis weight of 30 g/m^2 to 100 g/m^2, a thickness t of 0.7 mm to 2.0 mm, and a sheet width Ws of 40 mm to 350 mm. From the measurement results shown in Figs. 15 to 18, when the sheet 34 and the filling element 6 have the above-described specifications, occurrence of gaps and voids in the filling element 6 can be effectively suppressed. It is also possible to further improve the appearance of the end face of the filling element 6.

[0060] The sheet 34 has the recessed crimped parts 40 arranged in the width direction Z and extending in the longitudinal direction X. The crimped parts 40 are formed in the crimping process P2 of the sheet processing step S2 in the course of conveying the sheet 34. Thus, it is possible to increase the surface area of the sheet 34, and intertangling of fibers of the sheet 34 when the sheet filled part 36 is formed is facilitated. Therefore, it is possible to further effectively suppress occurrence of gaps and voids in the filling element 6 and further improve the appearance of the end face of the filling element 6.

[0061] A crimped depth d of each crimped part 40 is less than or equal to 1.2 mm. Particularly, from the measurement results shown in Figs. 16 and 18, when the sheet 34 and the filling element 6 have the above-described specifications, the air-flow resistance PD of the filling element 6 can be further optimized, and variations in the air-flow resistance PD can be suppressed. Therefore, the quality of the article 1 further improves.

[0062] In the sheet feeding step S1, the S-feed process P1 in which the sheet 34 unreeled from the bobbin 64 is spanned in an S-shape between the pair of rollers 66a, 66b spaced apart up and down and fed along the conveying path 62 is performed. Thus, the sheet 34 can be conveyed to the sheet processing section 54 in a state where the thickness t of the sheet 34 is maintained without flattening fibers including the raised parts 38 of the sheet 34. Therefore, at the time of adjusting the crimped depth d of the crimped parts 40, it is not necessary to strictly manage factors other than the crimped depth d, that is, a degree of pressing and degree of extension of the sheet 34. Therefore, it is possible to further easily and highly accurately control the packing density of the filling element 6.

[0063] The description of the embodiment has been described above; however, the above-described embodiment is not restrictive and may be modified into various forms without departing from the purport. For example, the meshing part 80 of the roller set 68 can be formed by meshing of projected portions and recessed portions of shapes, other than the projections 76 or the recesses 78. Thus, the formation region and crimping pattern of the crimped parts 40 and the shape of the crimped parts 40, formed in the sheet 34, are not limited to the above-described embodiment and allow various changes. Thus, since the flexibility of crimping of the sheet 34 increases, it is possible to further easily and highly accurately control the packing density of the filling element 6.

[0064] Depending on the specifications of the sheet 34, there can be a case where the sheet 34 is not subjected to crimping (crimped depth d = 0 mm). The configuration of the article 1, the position of the filling element 6 and the number of the filling elements 6 in the article 1 are not limited to the above-described embodiment. Since the filling element 6 according to the embodiment can be used as various elements for the article 1, wide variations of the article 1 can be implemented.

Reference Signs List

[0065]

1 flavor inhaling article
6 filling element
18 wrapping paper
34 sheet (nonwoven fabric)
36 sheet filled part
40 crimped part
64 bobbin
66a, 66b pair of rollers
X longitudinal direction
Z width direction
d crimped depth

Claims

1. A filling element used for a flavor inhaling article, the filling element comprising:

   a sheet filled part reduced in diameter by randomly gathering a sheet in a width direction intersecting with a longitudinal direction of the sheet; and
   a wrapping paper wrapping the sheet filled part, wherein
   the sheet is a dry nonwoven fabric obtained by bonding plant-derived fibers to each other with a binder and drying the plant-derived fibers.

2. The filling element according to claim 1, wherein

   the filling element has a diameter of 5.2 mm to 8.2 mm, and
   the sheet has a basis weight of 30 g/m^2 to 100 g/m^2, a thickness of 0.7 mm to 2.0 mm, and a sheet width in the width direction of 40 mm to 350 mm.

3. The filling element according to claim 1 or 2, wherein the sheet has crimped parts arranged in the width direction and extending in the longitudinal direction.

4. The filling element according to claim 3, wherein a crimped depth of each crimped part is less than or equal to 1.2 mm.

5. A manufacturing method for a filling element used for a flavor inhaling article, the manufacturing method comprising:

   a sheet processing step of processing a serial sheet made of a dry nonwoven fabric obtained by bonding plant-derived fibers to each other with a binder and drying the plant-derived fibers, while conveying the serial sheet;
   a gathering step of forming a gathering rod reduced in diameter by gathering the sheet, processed in the sheet processing step, in a width direction intersecting with a longitudinal direction of the sheet in a course of conveying the sheet;
   a wrapping step of wrapping the gathering rod, formed in the gathering step, with a wrapping paper to form a filler rod; and
   a cutting step of cutting the filler rod, formed in

the wrapping step, into the filling element.

6. The manufacturing method for a filling element according to claim 5, wherein, in the sheet processing step, a crimping process of forming crimped parts, arranged in the width direction and extending in the longitudinal direction, in the sheet is performed in a course of conveying the sheet.

7. The manufacturing method for a filling element according to claim 6, further comprising

a sheet feeding step of, before the sheet processing step, feeding the serial sheet to a conveying path, wherein
in the sheet feeding step, an S-feed process of spanning the sheet unreeled from a bobbin in an S-shape between a pair of rollers spaced apart up and down and feeding the sheet to the conveying path is performed.

FIG. 1

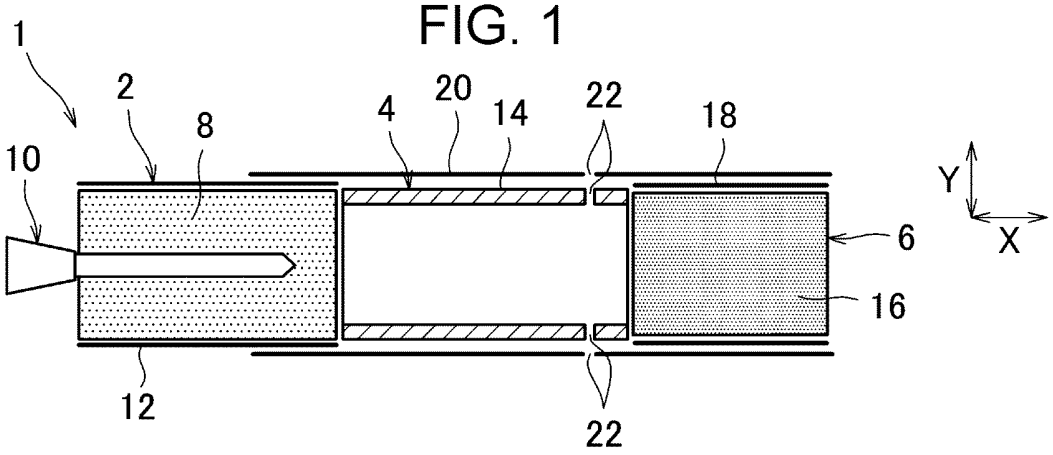


FIG. 2

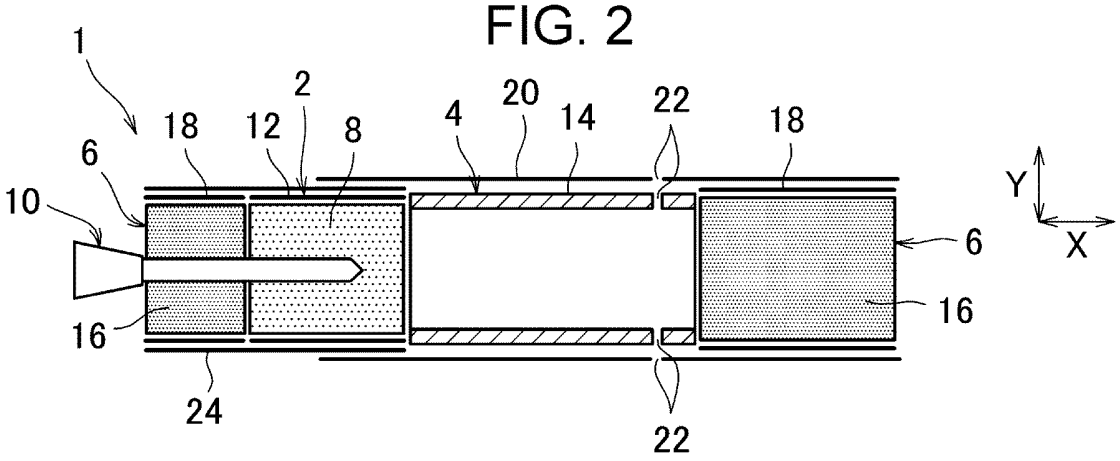


FIG. 3

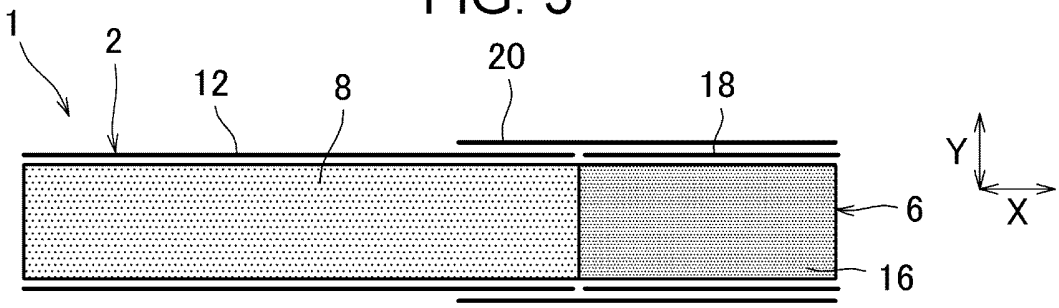


FIG. 4

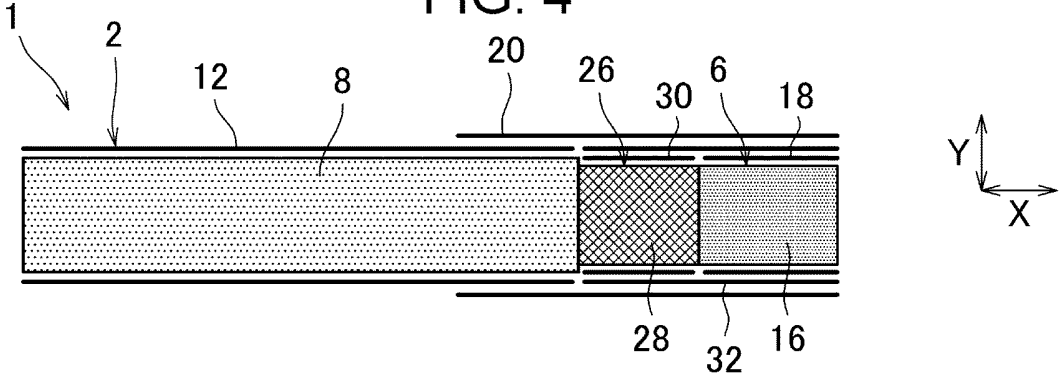


FIG. 5

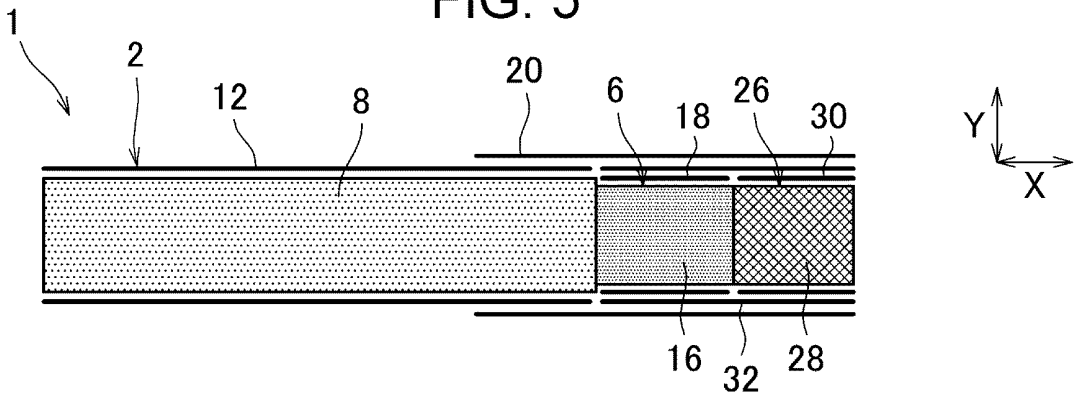


FIG. 6

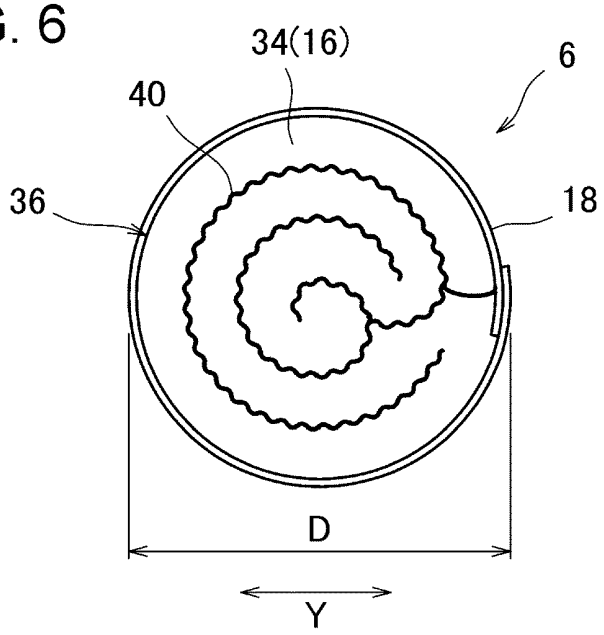


FIG. 7

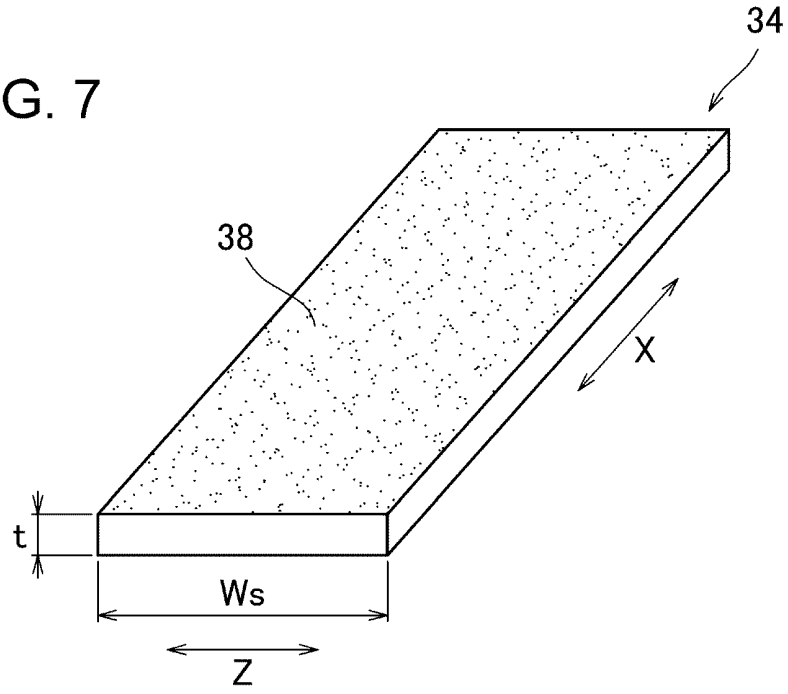


FIG. 8

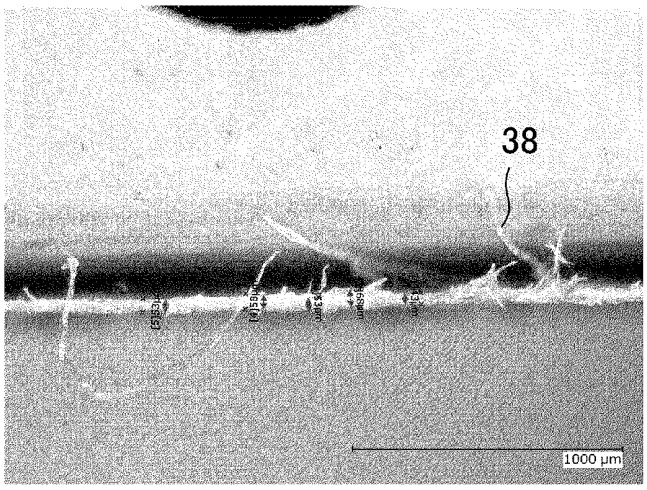


FIG. 9

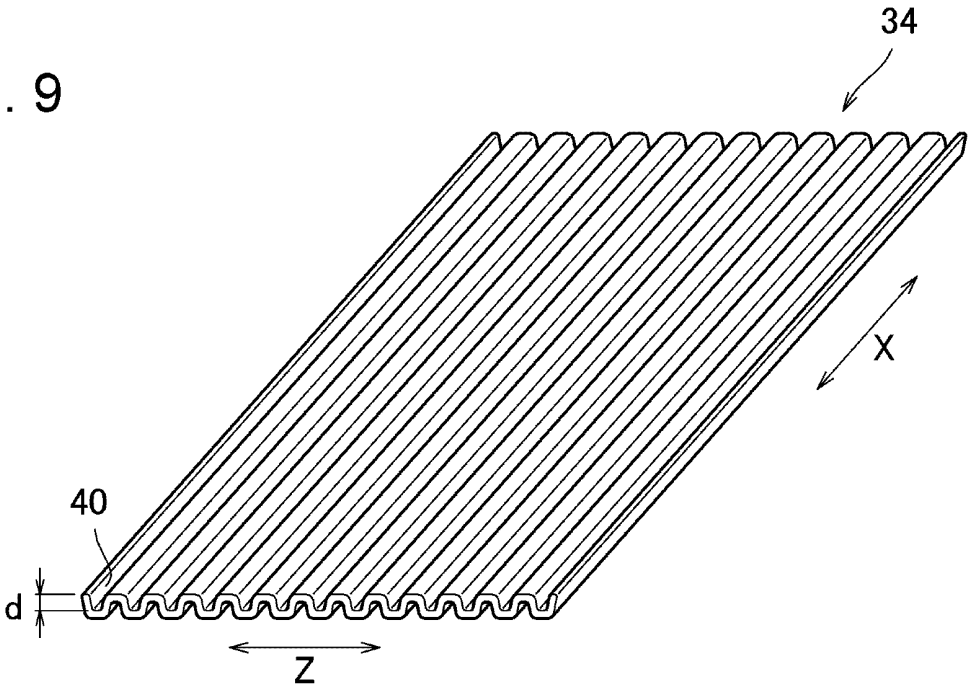


FIG. 10

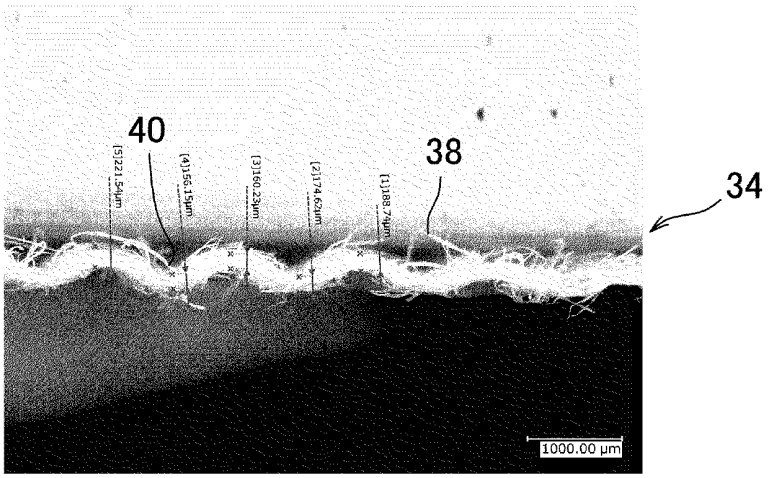


FIG. 11

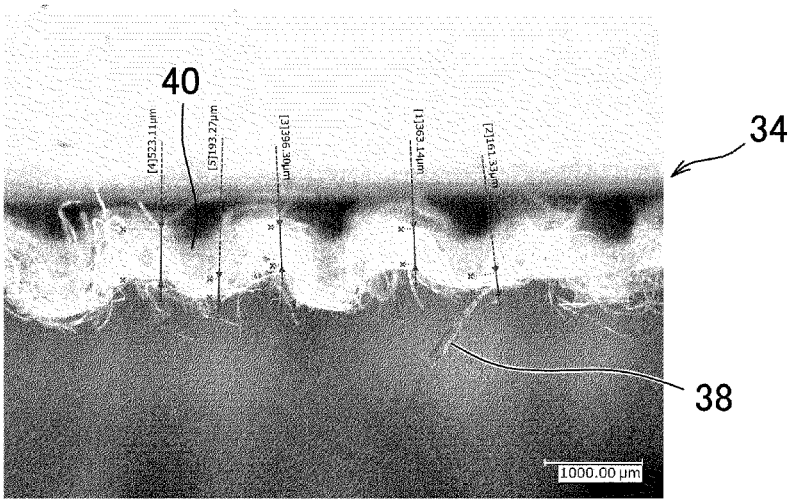
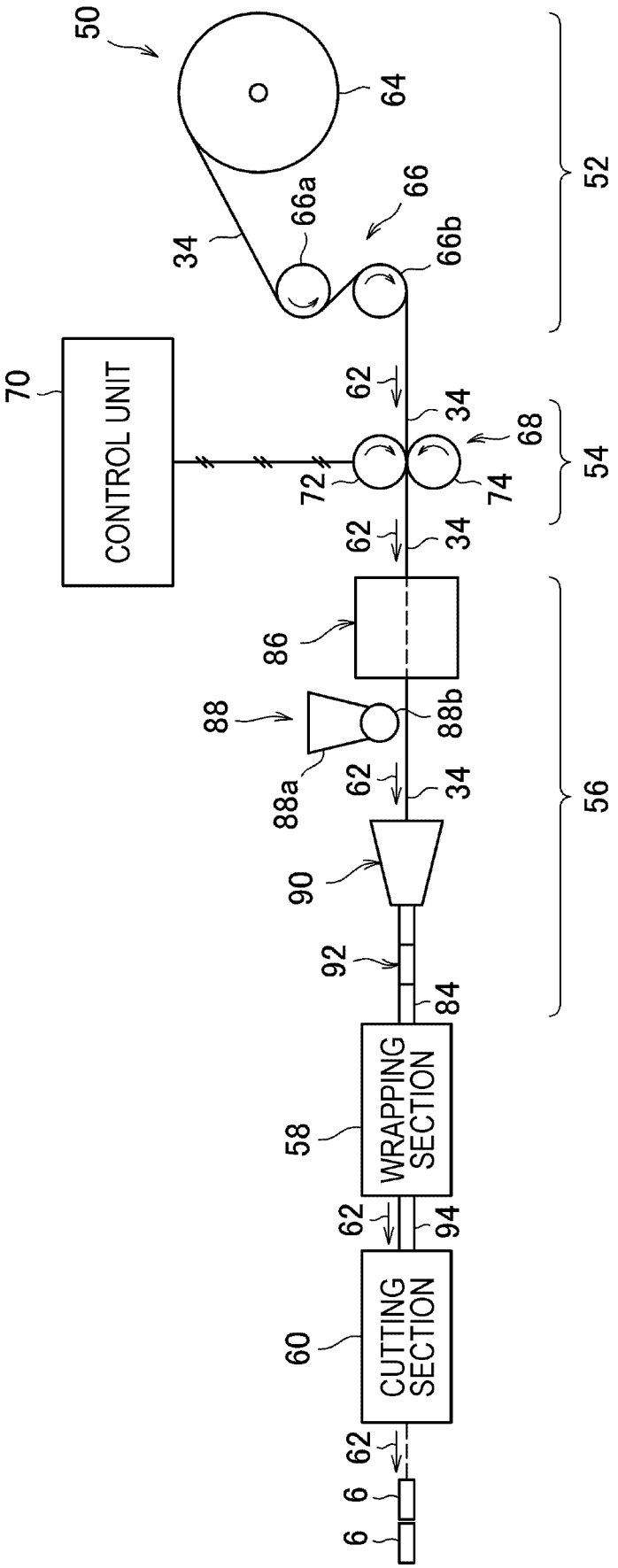


FIG. 12


50
64
52
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66a
66
66b
70
CONTROL UNIT
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34
68
54
72
74
62
34
86
88
88b
88a
62
34
56
90
92
84
58
WRAPPING SECTION
62
94
60
CUTTING SECTION
62
6
6

FIG. 13

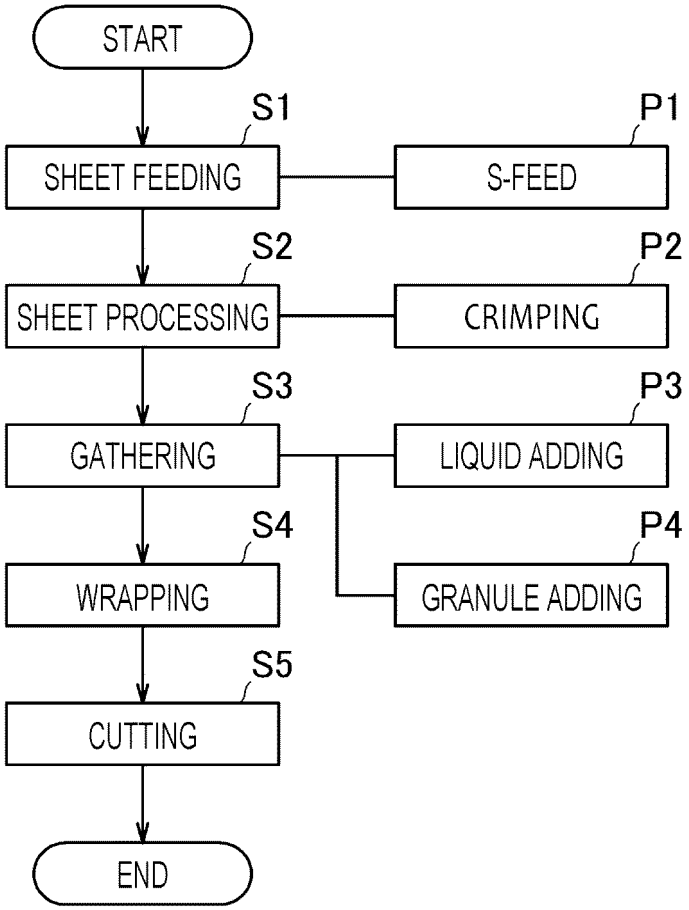

START
S1
SHEET FEEDING
P1
S-FEED
S2
SHEET PROCESSING
P2
CRIMPING
S3
GATHERING
P3
LIQUID ADDING
S4
WRAPPING
P4
GRANULE ADDING
S5
CUTTING
END

FIG. 14

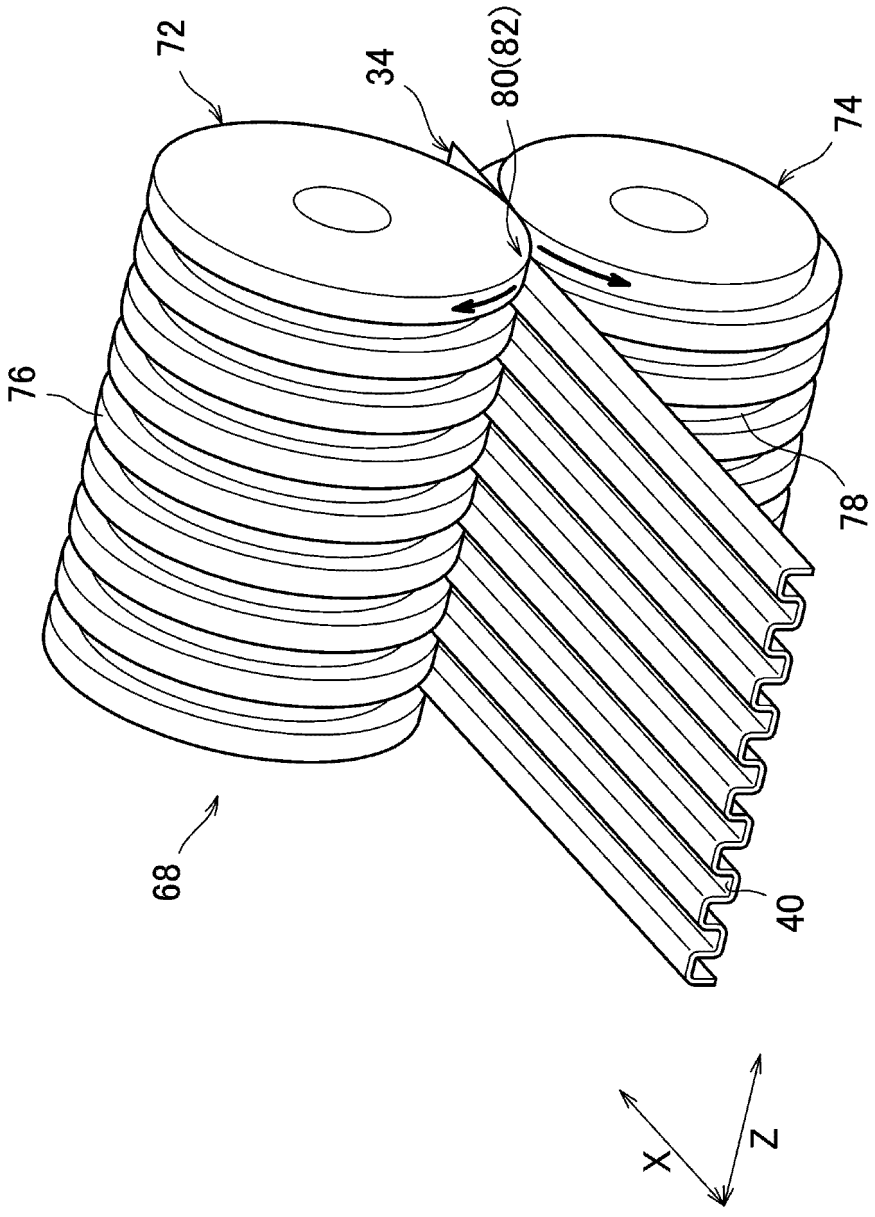


FIG. 15

		SAMPLE			
		No.1	No.2	No.3	No.4
SHEET	WOOD PULP	SBSK	NBSK	SBSK	NBSK
	BINDER	A	A	B	B
	WEIGHT RATIO BETWEEN WOOD PULP AND BINDER	4.3 : 1.0	4.4 : 1.0	3.5 : 1.0	4.6 : 1.0
	BASIS WEIGHT [g/m^2]	43.8	50.6	45.5	51.5
	LENGTH × WIDTH [mm]	108 × 128	108 × 128	108 × 128	108 × 128
	THICKNESS [mm]	0.93	1.18	0.98	1.08
	DENSITY [g/cm^3]	0.047	0.043	0.046	0.048
	AIR PERMEABILITY [l/m^2/s] (ISO9073-15 METHOD OF MEASURING NONWOVEN FABRIC)	4135	2657	4149	2203
FILLER ROD	LENGTH [mm]	108	108	108	108
	WEIGHT [g]	0.71	0.85	0.79	0.84
	CIRCUMFERENCE [mm]	24.3	24.3	24.1	24.1
	PACKING DENSITY [g/cm^3]	0.124	0.144	0.131	0.149
	DEGREE OF COMPLETE ROUND [%]	95	94	93	95
	PD (AIRFLOW RESISTANCE) [mmAq]	237	627	267	560
	COEFFICIENT OF VARIATION CV OF PD [%]	16	14	19	16
	HARDNESS [%]	87	90	90	92

FIG. 16

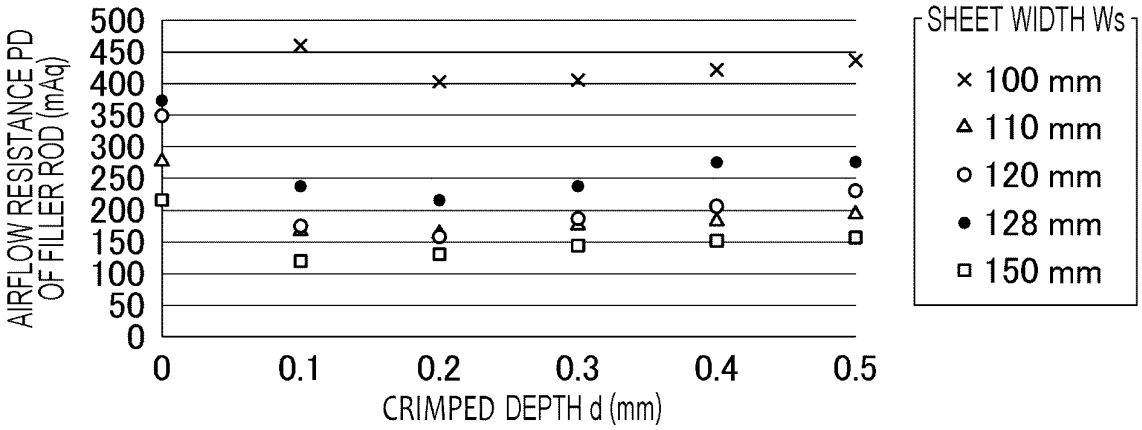


FIG. 17

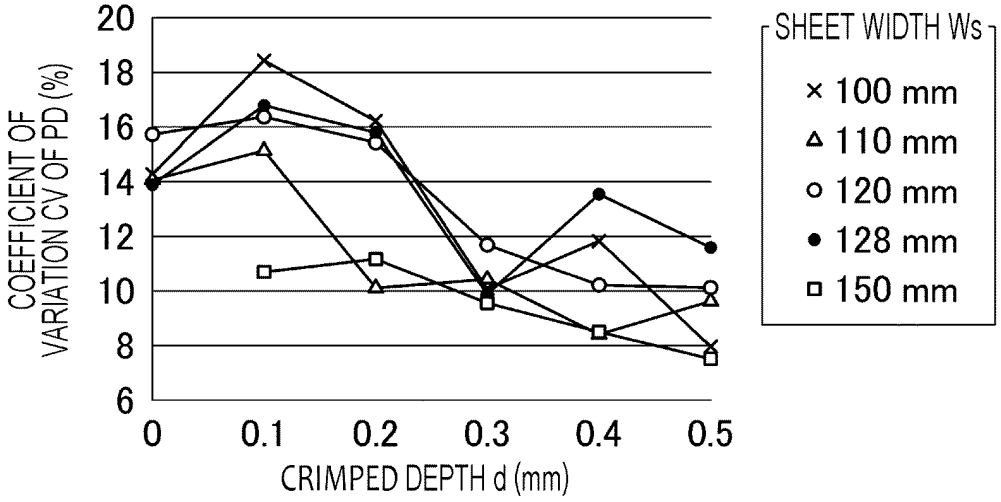


FIG. 18

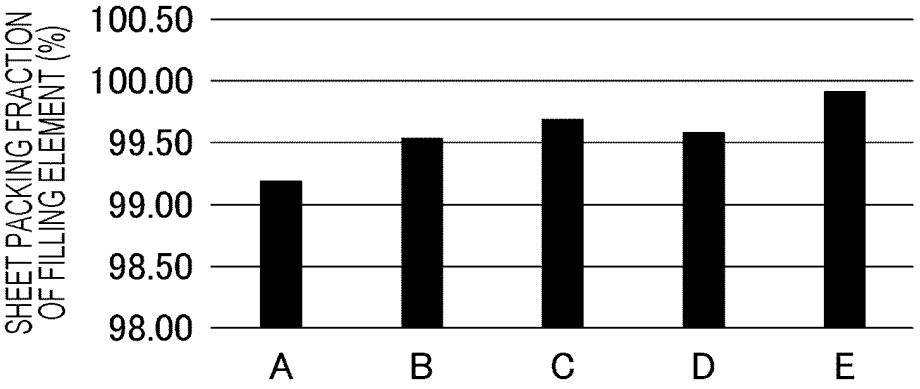


FIG. 19

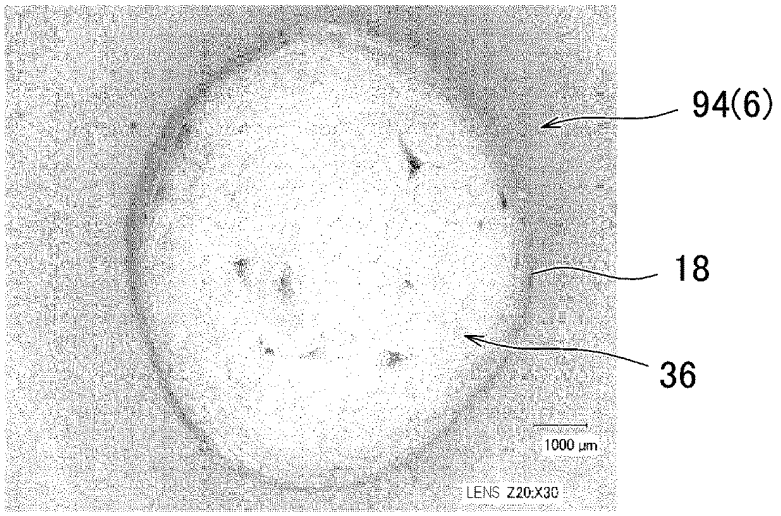


FIG. 20

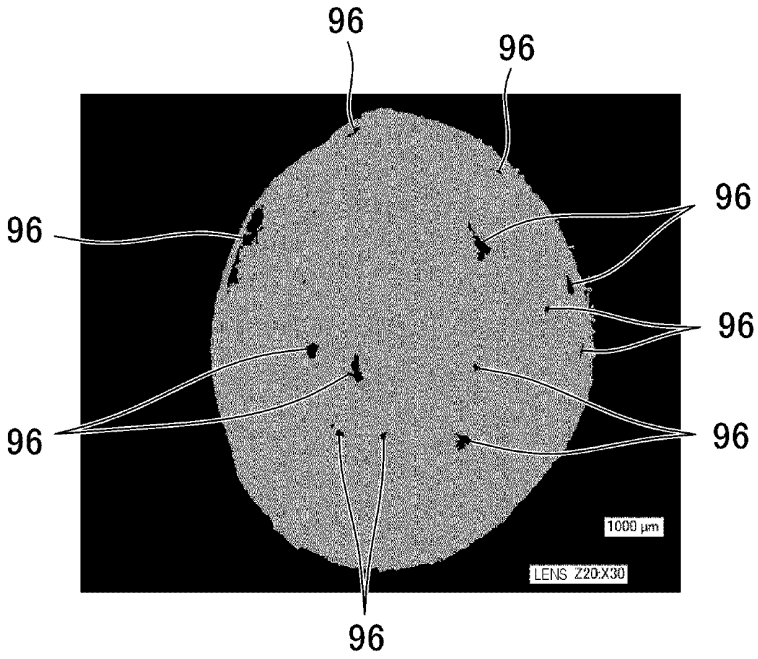


FIG. 21

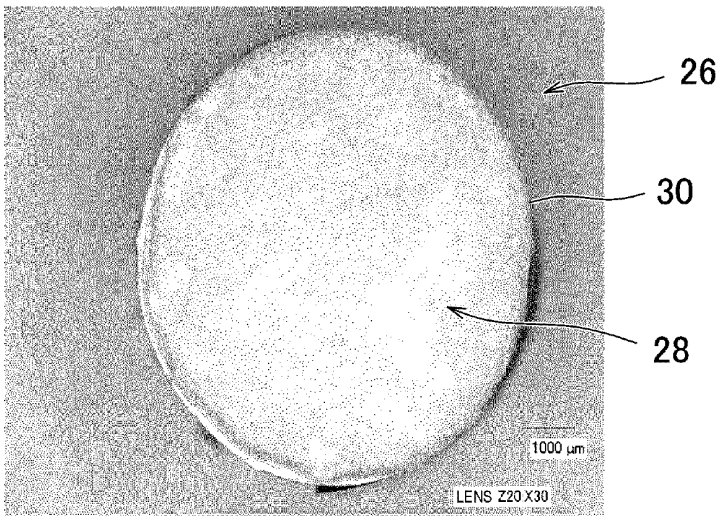


FIG. 22

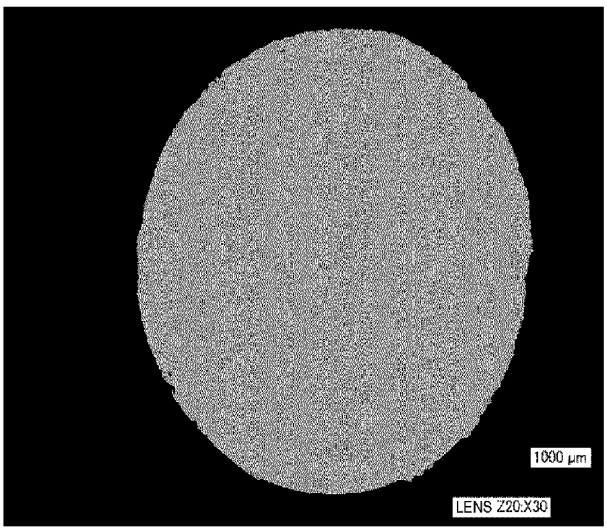


FIG. 23

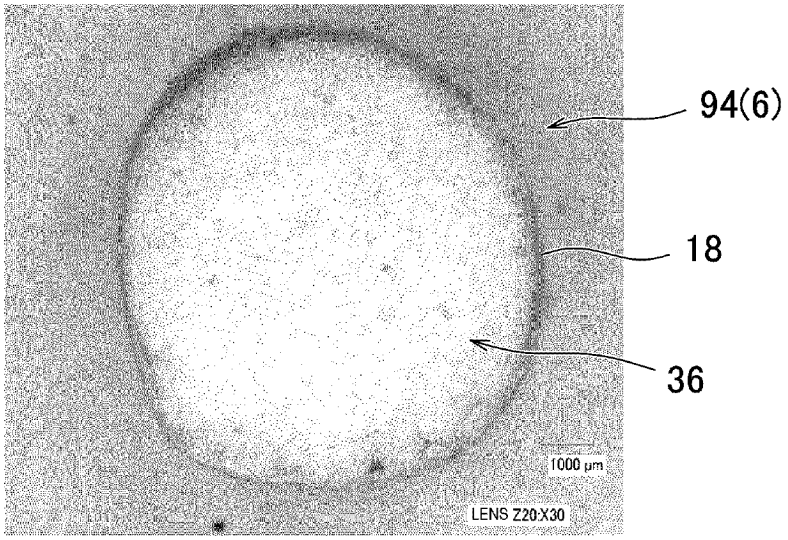
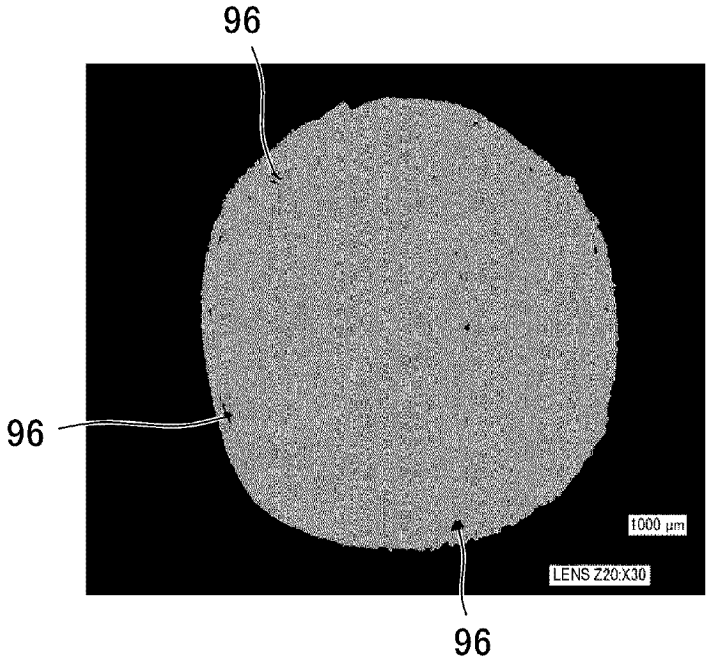


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/046519

A. CLASSIFICATION OF SUBJECT MATTER

A24D 3/00(2020.01)i
FI: A24D3/00

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)

A24D3/00

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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2001-506121 A (SCHWEITZER-MAUDUIT INTERNATIONAL, INC) 15 May 2001 (2001-05-15) p. 7, lines 9-24, p. 15, lines 14-19, p. 16, lines 16-17, p. 19, line 28 to p. 20, line 20, fig. 5-6	1-6
Y		7
Y	JP 2017-524368 A (PHILIP MORRIS PRODUCTS S.A) 31 August 2017 (2017-08-31) fig. 1	7

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

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 February 2022	**22 February 2022**
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.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/046519

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2001-506121 A	15 May 2001	US 5732718 A column 1, line 66 to column 2, line 9, column 4, lines 5-7, column 7, lines 1-11, column 7, lines 40-44, column 9, line 65 to column 10, line 27, fig. 5-6 WO 1996/005744 A1 EP 782400 A1 DE 782400 T1 AU 3204495 A AT 187041 T CA 2144999 A1	
JP 2017-524368 A	31 August 2017	US 2018/0177228 A1 fig. 1 WO 2016/023965 A1 EP 3136881 A1 TW 201607442 A AU 2015303169 A1 CA 2956345 A1 KR 10-2017-0018456 A CN 106535668 A AR 101938 A1 MX 2017001944 A RU 2639117 C1 DK 3136881 T3 LT 3136881 T ES 2650968 T3 SI 3136881 T1 PT 3136881 T HU E034709 T2 PL 3136881 T3 RS 56649 B1 BR 112017001233 A2 SG 11201700963X A AU 2019200902 A1 NO 3136881 T3 TW 201943346 A HK 1246099 A1	

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Patent documents cited in the description

- JP 44003727 B **[0003]**