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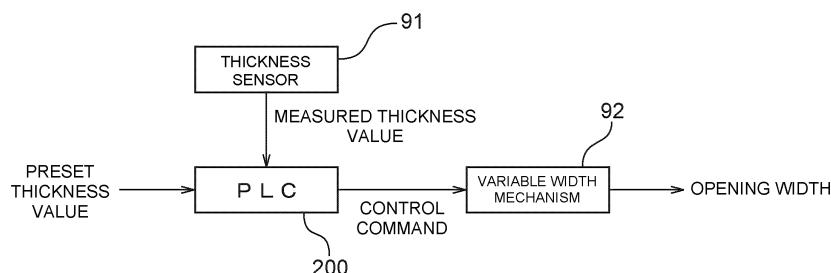
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(54) **DEVICE AND METHOD FOR MANUFACTURING RECONSTITUTED TOBACCO SHEET**

(57) The manufacturing device for a reconstituted tobacco sheet comprises a die that discharges reconstituted tobacco raw material. The die includes a housing, a feed port that is formed in the housing and to which the reconstituted tobacco raw material is fed, and a discharge port that is formed in one side face of the housing and from which the reconstituted tobacco raw material is discharged. The manufacturing device for a reconstituted tobacco sheet further comprises a condition detect-

ing portion that detects a condition of the reconstituted tobacco raw material in an interior portion of the die or a condition of the reconstituted tobacco raw material discharged from the die, and a control portion that controls behavior of the manufacturing device for a reconstituted tobacco sheet. The condition detecting portion outputs an electric signal according to a detection result of the condition of the reconstituted tobacco raw material to the control portion.

Fig. 17



Description

TECHNICAL FIELD

5 **[0001]** The invention relates to manufacturing devices and methods for reconstituted tobacco sheets.

BACKGROUND ART

10 **[0002]** Rolling, casting (slurry), and papermaking methods are conventionally known as manufacturing methods for reconstituted tobacco sheets. The choice of manufacturing methods depends on moisture content in reconstituted tobacco raw material. The manufacturing methods are carried out using their respective manufacturing devices for reconstituted tobacco sheets.

15 **[0003]** The rolling method is known to be suitable especially for reconstituted tobacco raw material containing 50 or less volume % water. In the rolling method, a kneaded mixture of the reconstituted tobacco raw material is roll-formed by a rotating roller, uniformed in thickness, and dried by a separately-provided dryer.

20 **[0004]** The casting (slurry) method is known to be suitable especially for reconstituted tobacco raw material containing 50 or more volume % water. In the casting (slurry) method, fluid comprising reconstituted tobacco raw material is continuously spread on a rotary drum or conveyor belt. After being uniformed into desired thickness by a member called a blade, the fluid is detached from the rotary drum or conveyor belt and dried by a separately-provided dryer (see, for example, Patent Literature 1).

25 **[0005]** The papermaking method is known to be suitable especially for reconstituted tobacco raw material containing 80 or more volume % water. In the papermaking method, fluid comprising reconstituted tobacco raw material is continuously spread on a liquid-permeable conveyor belt. After being subjected to water removal using a squeeze roller and uniformed into desired thickness, the fluid is dried by a separately-provided dryer.

CITATION LIST

PATENT LITERATURE

30 **[0006]** PTL 1: Japanese Unexamined Patent Application Publication (Kohyo) No. 2019-520036

SUMMARY OF INVENTION

TECHNICAL PROBLEM

35 **[0007]** An object of the invention is to provide a manufacturing device and method for reconstituted tobacco sheets which manufacture reconstituted tobacco sheets with uniform thickness through a simple manufacturing process, regardless of moisture content in reconstituted tobacco raw material.

40 SOLUTION TO PROBLEM

45 **[0008]** A first mode of the invention provides a manufacturing device for a reconstituted tobacco sheet. The manufacturing device for a reconstituted tobacco sheet comprises a die that discharges reconstituted tobacco raw material. The die includes a housing, a feed port that is formed in the housing and to which the reconstituted tobacco raw material is fed, and a discharge port that is formed in one side face of the housing and from which the reconstituted tobacco raw material is discharged. The manufacturing device for a reconstituted tobacco sheet further comprises a condition detecting portion that detects a condition of the reconstituted tobacco raw material in an interior portion of the die or a condition of the reconstituted tobacco raw material discharged from the die, and a control portion that controls behavior of the manufacturing device for a reconstituted tobacco sheet. The condition detecting portion outputs an electric signal according to a detection result of the condition of the reconstituted tobacco raw material to the control portion. This makes it possible to obtain a reconstituted tobacco sheet with uniform thickness through a simple manufacturing process, regardless of moisture content in the reconstituted tobacco raw material.

50 **[0009]** In a second mode of the invention according to the first mode, the manufacturing device for a reconstituted tobacco sheet further comprises an actuator that changes the condition of the reconstituted tobacco raw material. The control portion controls the actuator according to the electric signal outputted from the condition detecting portion. This makes it possible to change the condition of the reconstituted tobacco raw material.

55 **[0010]** In a third mode of the invention according to the second mode, the die includes a variable width mechanism as an actuator which is capable of changing length of the discharge port in a width direction. The condition detecting

portion detects thickness of the reconstituted tobacco raw material discharged from the die and outputs the electric signal according to the detection result to the control portion. The control portion controls the variable width mechanism according to the electric signal outputted from the condition detecting portion and changes length of the discharge port in a width direction. This makes it possible to adjust the thickness of the reconstituted tobacco sheet to desired thickness.

[0011] In a fourth mode of the invention according to the second or third mode, the manufacturing device for a reconstituted tobacco sheet further comprises an extruder that press-feeds the reconstituted tobacco raw material to the die. The condition detecting portion detects at least either one of discharge pressure of the reconstituted tobacco raw material in the interior portion of the die and a flow rate of the reconstituted tobacco raw material discharged from the die. The condition detecting portion then outputs the electric signal according to the detection result to the control portion. This makes it possible to change the condition of the reconstituted tobacco raw material according to either one of the discharge pressure of the reconstituted tobacco raw material in the interior portion of the die and the flow rate of the reconstituted tobacco raw material discharged from the die.

[0012] In a fifth mode of the invention according to the fourth mode, the extruder includes a screw as an actuator which is rotatably disposed within the housing, and the control portion controls rotation of the screw according to the electric signal outputted from the condition detecting portion and changes a discharge velocity of the reconstituted tobacco raw material discharged from the die. This makes it possible to maintain the discharge velocity of the reconstituted tobacco sheet discharged from the die at a constant value.

[0013] In a sixth mode of the invention according to any one of the second to fifth modes, the manufacturing device for a reconstituted tobacco sheet further comprises a drum that dries and transfers the reconstituted tobacco raw material discharged from the die, and includes a secondary drying device as an actuator which is disposed to face the drum and dries the reconstituted tobacco raw material discharged from the die. The condition detecting portion detects moisture content in the reconstituted tobacco raw material dried by the drum and the secondary drying device and outputs the electric signal according to the detection result to the control portion. This makes it possible to change the condition of the reconstituted tobacco raw material according to the moisture content in the reconstituted tobacco raw material that is dried by the drum and the secondary drying device.

[0014] In a seventh mode of the invention according to the sixth mode, the control portion controls the secondary drying device according to the electric signal outputted from the condition detecting portion and changes the moisture content in the reconstituted tobacco raw material that is dried by the drum and the secondary drying device. This makes it possible to maintain the moisture content in the reconstituted tobacco sheet that is dried by the drum and the secondary drying device within a certain definite range.

[0015] An eighth mode of the invention provides a manufacturing method for a reconstituted tobacco sheet. The manufacturing method for a reconstituted tobacco sheet comprises the steps of feeding reconstituted tobacco raw material to a feed port of a die; forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from a discharge port of the die; detecting a condition of the reconstituted tobacco raw material in an interior portion of the die or a condition of the reconstituted tobacco raw material discharged from the die; and outputting an electric signal according to the detected condition of the reconstituted tobacco raw material. This makes it possible to obtain the reconstituted tobacco sheet having uniform thickness through a simple manufacturing process, regardless of moisture content in the reconstituted tobacco raw material.

[0016] In a ninth mode of the invention according to the eighth mode, the manufacturing method for a reconstituted tobacco sheet further includes the step of controlling an actuator that changes a condition of the reconstituted tobacco raw material according to the outputted electric signal and thus changing the condition of the reconstituted tobacco raw material. This makes it possible to change the condition of the reconstituted tobacco raw material.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

Fig. 1 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a first embodiment of the invention.

Fig. 2 is a cross-sectional view of an extruder of the manufacturing device for a reconstituted tobacco sheet according to the first embodiment of the invention.

Fig. 3 is a cross-section as viewed from the arrow III - III shown in Fig. 2.

Fig. 4 is a cross-section of a die of the manufacturing device for a reconstituted tobacco sheet according to the first embodiment of the invention.

Fig. 5 is a cross-section as viewed from the arrow V - V shown in Fig. 4.

Fig. 6 is a side view of the die of Fig. 4 as viewed from a discharge port side.

5 Fig. 7 is a plan view of a manufacturing device for a reconstituted tobacco sheet according to a second embodiment of the invention.

Fig. 8 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a fourth embodiment of the invention.

10 Fig. 9 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to a fifth embodiment of the invention as viewed from a discharge port side.

Fig. 10 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to a sixth embodiment of the invention as viewed from a discharge port side.

Fig. 11 is a side view of another die of a manufacturing device for a reconstituted tobacco sheet according to the sixth embodiment of the invention as viewed from the discharge port side.

20 Fig. 12 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a seventh embodiment of the invention.

Fig. 13 is a side view of a manufacturing device for a reconstituted tobacco sheet according to an eighth embodiment of the invention.

25 Fig. 14 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a ninth embodiment of the invention.

Fig. 15 is a side view of a manufacturing device for a reconstituted tobacco sheet according to an 11th embodiment of the invention.

Fig. 16 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 12th embodiment of the invention.

35 Fig. 17 is a block diagram showing opening width control in the manufacturing device for a reconstituted tobacco sheet according to the 12th embodiment of the invention.

Fig. 18 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 13th embodiment of the invention.

40 Fig. 19 is a block diagram showing discharge velocity control in the manufacturing device for a reconstituted tobacco sheet according to the 13th embodiment of the invention.

Fig. 20 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 14th embodiment of the invention.

45 Fig. 21 is a block diagram showing hot air temperature control in the manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention.

50 DESCRIPTION OF EMBODIMENTS

[0018] A manufacturing device and method for a reconstituted tobacco sheet according to the invention will be discussed with reference to the drawings. The same or corresponding parts are provided with the same reference signs in the drawings.

55 First Embodiment:

[0019] Fig. 1 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a first embodiment

of the invention. In Fig. 1, a manufacturing device 100 for a reconstituted tobacco sheet comprises an extruder 10, a die 20, a drum dryer (main drum) 30, a scraper 40, and rollers 51, 52. The drum dryer 30 includes a shaft 31 and a drum body 32.

[0020] The extruder 10 press-feeds reconstituted tobacco raw material that is fed from a tank or the like, not shown, to the die 20. The die 20 discharges the reconstituted tobacco raw material that is fed from the extruder 10. The reconstituted tobacco raw material is thus formed into a reconstituted tobacco sheet 1 on the drum body 32 of the drum dryer 30. The drum dryer 30 dries and transfers the reconstituted tobacco sheet 1 that is formed on the drum body 32. The scraper 40 detaches from the drum body 32 the reconstituted tobacco sheet 1 dried by the drum dryer 30. The rollers 51, 52 guide the transfer of the reconstituted tobacco sheet 1 detached by the scraper 40.

[0021] The reconstituted tobacco raw material here is a kneaded mixture containing at least one substance that is selected from among polysaccharides (starch, dextrin, and the like), at least one substance that is selected from among water or alcohol (ethanol, propylene glycol or the like) as a freely-selected liquid medium, and shreds or fine particles of tobacco plants. The reconstituted tobacco raw material does not necessarily have to be the foregoing and may contain another substance.

[0022] Fig. 2 is a configuration view of the extruder of the manufacturing device for a reconstituted tobacco sheet according to the first embodiment of the invention. Fig. 3 is a cross-section as viewed from the arrow III - III shown in Fig. 2. In Figs. 2 and 3, the extruder 10 includes a housing 11, a feed port 12 formed at one end of the housing 11, an extrusion port 13 formed at the other end of the housing 11, and a screw 14 that is rotatably disposed inside the housing 11.

[0023] The reconstituted tobacco raw material that is fed from the tank or the like to the extruder 10 through the feed port 12 is delivered to the extrusion port 13 while being kneaded by rotation of the screw 14 and then press-fed from the extrusion port 13 to the die 20. Discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20 is determined by rotational frequency of the screw 14.

[0024] Fig. 4 is a cross-section of the die of the manufacturing device for a reconstituted tobacco sheet according to the first embodiment of the invention. Fig. 5 is a cross-section as viewed from the arrow V - V shown in Fig. 4. Fig. 6 is a side view of the die of Fig. 4 as viewed from the discharge port side. In Figs. 4 to 6, the die 20 includes a housing 23 comprising a first block 21 and a second block 22, a feed port 24 that is formed in the first block 21 and communicates with the extrusion port 13 of the extruder 10, a manifold 25 that is formed between the first block 21 and the second block 22 and stores the reconstituted tobacco raw material, and a discharge port 26 that communicates with the manifold 25.

[0025] The discharge port 26 is formed into a slit-like shape in one side face of the housing 23. A direction orthogonal to a longitudinal direction of the discharge port 26 is referred to as a width direction of the discharge port 26. Longitudinal length of the discharge port 26 is referred to as opening length, and length of the discharge port 26 in a width direction as opening width. The discharge port 26 may have a hole- or groove-like shape. The discharge port 26 having the slit-like shape allows the reconstituted tobacco raw material to be adjusted to have uniform thickness according to the opening width of the discharge port 26 and extruded into a sheet-like shape when the reconstituted tobacco raw material is discharged from the die 20, regardless of moisture content in the reconstituted tobacco raw material.

[0026] The reconstituted tobacco raw material that is fed from the extruder 10 to the die 20 through the feed port 24 is delivered through the manifold 25 to the discharge port 26 and discharged as the reconstituted tobacco sheet 1 from the discharge port 26 onto the drum body 32.

[0027] Referring back to Fig. 1, the drum dryer 30 includes the shaft 31 and the drum body 32 that rotates around the shaft 31. The drum body 32 dries the reconstituted tobacco sheet 1, for example, by steam that is sent into an interior portion of the drum body 32. The drum body 32 may be heated by a heater or the like.

[0028] The scraper 40 is disposed to face the drum body 32 along the entire length of the drum body 32 in a width direction, which is orthogonal to a rotating direction of the drum body 32. The scraper 40 is thus positioned so that a distal end portion thereof abuts or is close to the drum body 32. The scraper 40 is disposed near an end portion of the drum body 32 which is located on a downstream side in the rotating direction of the drum body 32 so that the reconstituted tobacco sheet 1 discharged on an upstream side of the drum body 32 in the rotating direction is sufficiently dried.

[0029] The reconstituted tobacco sheet 1 discharged from the discharge port 26 of the die 20 onto the drum body 32 is dried by the drum body 32 into which steam is sent. The reconstituted tobacco sheet 1, after being dried, is detached by the scraper 40 and moved to downstream steps. The downstream steps include, for example, slitting the reconstituted tobacco sheet 1 into desired width and reeling the slitted reconstituted tobacco sheet onto a bobbin.

[0030] As discussed above, according to the first embodiment, the manufacturing device for a reconstituted tobacco sheet comprises a die configured to discharge reconstituted tobacco raw material, and a main drum configured to dry and transfer the reconstituted tobacco raw material discharged from the die. The die includes the housing, the feed port that is formed in the housing and to which the reconstituted tobacco raw material is fed, and the discharge port that is formed in the one side face of the housing and from which the reconstituted tobacco raw material is discharged. This makes it possible to obtain the reconstituted tobacco sheet with uniform thickness through the simple manufacturing process, regardless of moisture content in the reconstituted tobacco raw material.

Second Embodiment:

[0031] Fig. 7 is a plan view of a manufacturing device for a reconstituted tobacco sheet according to a second embodiment of the invention. In Fig. 7, a manufacturing device 100A for a reconstituted tobacco sheet comprises X extruders 10A to 10X and X dies 20A to 20X, instead of the extruder 10 and the die 20 illustrated in Fig. 1. X may be 2 or more. The single extruder 10 may be connected with the X dies 20A to 20X. The rest of the configuration is similar to the first embodiment and will be omitted from discussion.

[0032] The extruders 10A to 10X are connected to the dies 20A to 20X, respectively. The dies 20A to 20X are disposed along a longitudinal direction of discharge ports 26. The extruders 10A to 10X press-feed to the respective dies 20A to 20X the reconstituted tobacco raw material that is fed from the tank or the like, not shown. The dies 20A to 20X discharge onto the drum body 32 the reconstituted tobacco raw material which is fed from the extruders 10A to 10X.

[0033] Opening length of each of the discharge ports 26 of the dies 20A to 20X is conformed to width of the bobbin onto which the reconstituted tobacco sheet 1 is reeled in the aforementioned downstream step. This eliminates the necessity of the aforementioned downstream step of slitting the reconstituted tobacco sheet 1 into the desired width. The dies 20A to 20X are designed to have different opening widths from one another, which makes it possible to manufacture reconstituted tobacco sheets 1 that are different in thickness by means of the single drum dryer 30.

[0034] Reconstituted tobacco raw materials that are fed to the respective extruders 10A to 10X are differentiated in composition, which makes it possible to manufacture different kinds of reconstituted tobacco sheets 1 by means of the single drum dryer 30. Furthermore, the manufacturability of the manufacturing device 100A for a reconstituted tobacco sheet can be adjusted without difficulty by activating pairs of the extruders 10A to 10X and the respective dies 20A to 20X in a selective manner.

[0035] As discussed above, according to the second embodiment, the plurality of dies is disposed along the longitudinal direction of the discharge ports. It is therefore possible to omit the step of slitting the obtained reconstituted tobacco sheet into the desired width.

Third Embodiment:

[0036] In the first embodiment, the discharge port 26 of the die 20 has a constant opening width. A die 20 in a manufacturing device for a reconstituted tobacco sheet according to the third embodiment of the invention includes a variable width mechanism, not shown, which is capable of varying the opening width of a discharge port 26. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0037] The variable width mechanism is, for example, a screw. The variable width mechanism varies the opening width of the discharge port 26 by adjusting a space between a first block 21 and a second block 22 which are illustrated in Fig. 6 according to a fastening amount of the screw. The variable width mechanism may be so configured that a plurality of screws is provided to differentiate the opening width at each longitudinal end portion of the discharge port 26 and the opening width of a longitudinal center of the discharge port 26. If the opening length of the discharge port 26 is larger than the opening width thereof, it makes a difference in discharging condition of the reconstituted tobacco raw material in the longitudinal direction of the discharge port 26. In order to uniform the discharging condition of the reconstituted tobacco sheet 1 in the width direction, it is preferable that a plurality of variable width mechanisms be arranged in the longitudinal direction of the discharge port 26 as mentioned above. The variable width mechanism may include an actuator, such as a motor, for driving the screw. The use of the variable width mechanism makes it possible to vary the thickness of the reconstituted tobacco sheet 1 without difficulty.

[0038] As discussed above, according to the third embodiment, the die includes the variable width mechanism that is capable of varying the length of the discharge port in the width direction. This makes it possible to obtain reconstituted tobacco sheets that are different in thickness without replacing the die. The opening width of the discharge port is varied so that the flow velocity of the reconstituted tobacco raw material at the discharge port of the die is constant in the longitudinal direction of the discharge port, which restrains wrinkling and forms the reconstituted tobacco sheet into a flat shape.

Fourth Embodiment:

[0039] Fig. 8 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the fourth embodiment of the invention. In Fig. 8, a manufacturing device 100B for a reconstituted tobacco sheet comprises three extruders 61 to 63 and a die 70, instead of the extruder 10 and the die 20 illustrated in Fig. 1. The number of the extruders is not limited to three as long as it is two or more. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0040] The extruders 61 to 63 are connected to the die 70. The extruders 61 to 63 are fed with respective raw materials from a tank or the like, not shown. At least one of the raw materials fed to the extruders 61 to 63 contains reconstituted

tobacco raw material. The raw materials fed to the extruders 61 to 63 may contain either different raw materials or the same raw material. The extruders 61 to 63 use screws or the like, not shown, to press-feed the raw materials which are fed thereto.

[0041] The die 70 includes a plurality of feed ports 71 to 73 to which different raw materials are fed from the extruders 61 to 63, and a discharge port 74 that is formed into a slit-like shape in one side face of the die 70. The die 70 spreads the raw materials, which are fed from the extruders 61 to 63 through the feed ports 71 to 73, in respective manifolds, not shown. The die 70 then converges the raw materials in the vicinity of the discharge port 74 and discharges reconstituted tobacco sheets 1 in layers onto a drum body 32. The die 70 may converge the different raw materials in the manifolds.

[0042] Since the different raw materials are discharged in layers from the discharge port 74 of the die 70, it is possible to multilayer the raw materials without sticking the sheets having different characteristics together. It is therefore possible to omit the step of sticking the sheets together and yet obtain the reconstituted tobacco sheets 1 multilayered with a simple configuration. The reconstituted tobacco sheets 1 are multilayered before being dried with the drum dryer 30, which reinforces adhesion between the layers. Furthermore, if sheets reduced in adhesion are put into the multilayered sheets, it facilitates the reeling of the reconstituted tobacco sheets 1 onto and from a bobbin without the necessity of preparation of dusting powder, separate films or the like.

[0043] As discussed above, according to the fourth embodiment, the die includes the plurality of feed ports to which the respective different raw materials are fed, and the different raw materials are discharged in layers from the discharge port. This omits the step of sticking the plurality of sheets together.

Fifth Embodiment:

[0044] Fig. 9 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to the fifth embodiment of the invention as viewed from a discharge port side. In Fig. 9, a die 20 further includes partitioning portions 27 dividing a discharge port 26 into a plurality of areas along a longitudinal direction of the discharge port 26. In other words, the discharge port 26 having the slit-like shape in Fig. 6 includes openings spaced at intervals in Fig. 9. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0045] Reconstituted tobacco raw material that is fed from an extruder 10 through a feed port 24 to the die 20 is delivered to the discharge port 26 through a manifold 25 and discharged as a reconstituted tobacco sheet 1 from the discharge port 26 onto a drum body 32. Since the discharge port 26 includes the openings spaced at intervals, the discharged reconstituted tobacco sheet 1 is already formed into strips. The reconstituted tobacco sheet 1 dried by a drum dryer 30 therefore can be retrieved as strands after the drying is finished.

[0046] As discussed above, according to the fifth embodiment, the die includes the partitioning portions dividing the discharge port into the plurality of areas along the longitudinal direction of the discharge port. This makes it possible to omit the step of stranding the sheet. According to the invention, the discharged reconstituted tobacco sheet has a stable form even before being dried. It is therefore effective to use the die 20 including the partitioning portions 27.

Sixth Embodiment:

[0047] Fig. 10 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to the sixth embodiment of the invention as viewed from a discharge port side. In Fig. 10, a die 20 further includes at least one protruding portion 28 extending in a width direction of a discharge port 26 along a longitudinal direction of the discharge port 26. The protruding portion 28 may have a cross-section in the shape of a triangle, rectangle, sine wave, the letter T or another shape. In other words, the slit-like discharge port 26 shown in Fig. 6 is altered in Fig. 10 to have two widths including the width measured from a top of the protruding portion 28 or an edge including the top of the protruding portion 28 and the width measured from a bottom edge of the protruding portion 28. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0048] The reconstituted tobacco raw material that is fed from an extruder 10 through a feed port 24 to the die 20 is delivered to the discharge port 26 through a manifold 25 and discharged as a reconstituted tobacco sheet 1 from the discharge port 26 onto a drum body 32. Since the discharge port 26 is provided with the protruding portion 28, grooves are already formed in the discharged reconstituted tobacco sheet 1. The grooves have a cross-sectional shape corresponding to the protruding portion 28. The reconstituted tobacco sheet 1 that is dried by the drum dryer 30 therefore can be retrieved as the reconstituted tobacco sheet 1 in which the grooves are formed after the drying is finished.

[0049] As discussed above, according to the sixth embodiment, the die includes at least one protruding portion extending in the width direction of the discharge port along the longitudinal direction of the discharge port. It is therefore possible to omit the step of passing the reconstituted tobacco sheet between a pair of rollers and pressing the reconstituted tobacco sheet to provide a zigzag or wave shape as carried out with conventional reconstituted tobacco sheets, and yet carry out surface fabrication (embossing, for example) for increasing surface area per weight in the reconstituted tobacco sheet. According to the invention, the discharged reconstituted tobacco sheet has a stable form even before being dried.

It is therefore effective to use the die 20 including the protruding portion 28.

[0050] If the protruding portion 28 has the shape of the letter T as illustrated in Fig. 11, the grooves formed in the reconstituted tobacco sheet 1 spread within the reconstituted tobacco sheet 1. Such a surface shape is obtained not by pressing the reconstituted tobacco sheet 1 with the rollers but only by using the die 20 described in the sixth embodiment.

Seventh Embodiment:

[0051] Fig. 12 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the seventh embodiment of the invention. Fig. 12 shows a manufacturing device 100C for a reconstituted tobacco sheet which is obtained by adding a drum dryer (secondary drum) 35 and a scraper 45 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0052] The drum dryer 35 is disposed downstream of the drum dryer 30 and used in combination with the drum dryer 30. The drum dryer 35 includes a shaft 36 and a drum body 37 that rotates around the shaft 36. The drum body 37 is heated, for example, by steam that is sent into an interior portion of the drum body 37. The drum body 37 may be heated by a heater or the like. The drum dryer 30 and the drum dryer 35 are adjustable in temperature independently from each other.

[0053] The drum dryer 35 receives a reconstituted tobacco sheet 1 that is dried by the drum dryer 30 and detached by the scraper 40. The drum dryer 35 transfers the reconstituted tobacco sheet 1 while further drying the reconstituted tobacco sheet 1. The scraper 45 detaches from the drum body 37 the reconstituted tobacco sheet 1 dried by the drum dryer 35.

[0054] The use of the drum dryer 30 and the drum dryer 35 increases a drying distance of the reconstituted tobacco sheet 1 and thus enhances a drying ability of the manufacturing device 100C for a reconstituted tobacco sheet. The manufacturing device 100C is therefore capable of handling reconstituted tobacco raw material with a high moisture content.

[0055] A comparison is made below between a case where two drum dryers having the same drum diameter are used and a case where a single drum dryer is used, on the condition that drying distances in both cases are equal. When the two drum dryers are used, the drum diameter of each drum may be designed to be a half of the drum diameter of one drum dryer. In other words, the total volume of the two drum dryers may be designed to be a half of the volume of one drum dryer. The use of the two drum dryers therefore reduces necessary thermal energy to half as compared to when the single drum dryer is used.

[0056] As discussed above, according to the seventh embodiment, there is further provided the secondary drum that is used in combination with the main drum. The secondary drum is disposed downstream of the main drum. The secondary drum receives from the main drum the reconstituted tobacco raw material transferred by the main drum. The secondary drum then transfers the reconstituted tobacco raw material. It is therefore possible to increase a transfer distance of the reconstituted tobacco raw material and apply further treatment to the reconstituted tobacco raw material that is dried and transferred by the main drum. In the seventh embodiment, the secondary drum is used as a drum dryer. However, the secondary drum is not limited to a drum dryer and may be a cooling drum that cools the reconstituted tobacco sheet 1 dried by the drum dryer 30.

Eighth Embodiment:

[0057] Fig. 13 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the eighth embodiment of the invention. Fig. 13 shows a manufacturing device 100D for a reconstituted tobacco sheet which is obtained by adding a drum dryer (secondary drum) 35 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0058] The drum dryer 35 is disposed to face a drum dryer 30 and used in combination with the drum dryer 30. The drum dryer 35 includes a shaft 36 and a drum body 37 that rotates around the shaft 36. The shaft 36 is configured to be capable of adjusting a clearance between the drum dryer 30 and the drum dryer 35, as necessary, using a drive mechanism, not shown.

[0059] The drum body 37 is heated, for example, by steam that is sent into an interior portion of the drum body 37. The drum body 37 may be heated by a heater or the like. The drum dryer 30 and the drum dryer 35 are adjustable in temperature independently from each other.

[0060] The drum dryer 35 dries and transfers a reconstituted tobacco sheet 1 formed on a drum body 32 in consort with the drum dryer 30. The reconstituted tobacco sheet 1 transferred by the drum dryer 30 and the drum dryer 35 is compressed while passing the clearance between the drum dryer 30 and the drum dryer 35.

[0061] As a result of the compression of the reconstituted tobacco sheet 1 using the drum dryer 30 and the drum dryer

35, the reconstituted tobacco sheet 1 becomes higher in density than when being discharged from the die 20 due to a consolidation effect that is produced by the drum dryer 30 and the drum dryer 35. The reconstituted tobacco sheet 1, after passing through the clearance between the drum dryer 30 and the drum dryer 35, can be regulated in thickness by adjusting the clearance between the drum dryer 30 and the drum dryer 35.

[0062] Since the reconstituted tobacco sheet 1 is made to pass through the clearance between the drum dryer 30 and the drum dryer 35, it is possible to solve a wrinkling problem or the like in the reconstituted tobacco sheet 1 depending on discharge velocity distribution when the reconstituted tobacco sheet 1 is discharged from the die 20 as a result of the consolidation effect produced by the drum dryer 30 and the drum dryer 35. If the drum body 37 is embossed on a surface thereof, embossing is applied to a surface of the reconstituted tobacco sheet 1 when the reconstituted tobacco sheet 1 passes through the clearance between the drum dryer 30 and the drum dryer 35. This increases specific surface area of the reconstituted tobacco sheet 1. The treatment applied to the surface of the drum body 37 is not limited to embossing and may be slitting for slitting the reconstituted tobacco sheet 1 or another like treatment.

[0063] As discussed above, according to the eighth embodiment, there is further provided the secondary drum that is used in combination with the main drum. The secondary drum is disposed to face the main drum. The secondary drum transfers the reconstituted tobacco raw material discharged from the die in consort with the main drum. The secondary drum, in consort with the main drum, thus applies additional treatment to the reconstituted tobacco raw material that is dried and transferred by the main drum.

Ninth Embodiment:

[0064] Fig. 14 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the ninth embodiment of the invention. Fig. 14 shows a manufacturing device 100E for a reconstituted tobacco sheet which is obtained by adding an extruder 10 and a die 20 provided in a drum dryer 35 to the manufacturing device 100D for a reconstituted tobacco sheet shown in Fig. 13. The other configurations are similar to the eighth embodiment discussed above and therefore will be omitted from discussion.

[0065] The extruder 10 provided in the drum dryer 35 is fed with raw material that is fed from a tank or the like, not shown. The raw material that is fed to the extruder 10 may contain reconstituted tobacco raw material but does not necessarily have to contain reconstituted tobacco raw material. The extruder 10 press-feeds the fed raw material to the die 20 with a screw or the like, not shown. The die 20 provided in the drum dryer 35 forms the raw material fed from the extruder 10 into a sheet and discharges the raw material onto a drum body 37. The sheets discharged from the die 20 provided in the drum dryer 30 and the die 20 provided in the drum dryer 35 are layered when passing through a clearance between the drum dryer 30 and the drum dryer 35.

[0066] The sheets discharged from the dies 20 provided in the drum dryer 30 and the drum dryer 35 are made to pass through the clearance between the drum dryer 30 and the drum dryer 35, so that the sheets having different characteristics are multilayered without being stuck together. It is therefore possible to omit the step of sticking the sheets together and yet obtain the reconstituted tobacco sheet 1 multilayered with a simple configuration. The sheets are multilayered before the reconstituted tobacco sheet 1 is dried by the drum dryer 30 and the drum dryer 35, which reinforces adhesion between the layers. Furthermore, the clearance between the drum dryer 30 and the drum dryer 35 is adjusted, so that the reconstituted tobacco sheet 1 that passes through the clearance between the drum dryer 30 and the drum dryer 35 can be regulated in thickness.

[0067] As discussed above, according to the ninth embodiment, the invention includes the secondary drum that is used in combination with the main drum and the die having a similar configuration to the die provided in the main drum and configured to discharge discharge material to the secondary drum. This makes it possible to omit the step of sticking a plurality of sheets together.

10th Embodiment:

[0068] In a manufacturing device for a reconstituted tobacco sheet according to the 10th embodiment of the invention, surface modification treatment is applied to a surface of the drum body 32 of the drum dryer 30 and a surface of the drum body 37 of the drum dryer 35, which are mentioned in the first embodiment, in the aim of improving characteristics.

[0069] The improvement of characteristics here is to improve abrasion resistance, corrosion resistance, detachability/mold releasability, and thermal conductivity. The surface modification treatments include chemical treatment, such as plating, and physical treatment, such as blasting. Tables 1 to 6 show specific characteristics and examples of surface modification treatment. The surface modification treatment improves the characteristics of the surfaces of the drum body 32 of the drum dryer 30 and the drum body 37 of the drum dryer 35 and enhances the device in usability and durability.

[Table 1]

Surface treatment			Representative characteristics		
			Decorativeness	Rust-proofness	Abrasion resistance
Electroplating	Hard chrome		Good	Good	Excellent
	Very hard chrome		Good	Excellent	Excellent
	Zinc	Trivalent chromate	Good	Excellent	
		Trivalent black chromate	Excellent	Excellent	
		Hexavalent chromate	Good	Excellent	
	Nickel		Good	Good	
	Nickel-Chrome (Decorative chrome)		Excellent	Good	Good
Non-electrolytic plating	Electroless nickel		Good	Excellent	Excellent
Anodization	Alumite	Colorless	Good	Good	Good
		Colored	Excellent	Good	Good
Chemical conversion treatment	Zinc phosphate film			Poor	
	Manganese phosphate			Poor	Good
	Black oxide finish		Good		
Passivation treatment	Stainless steel passivation film			Excellent	
Special plating	Composite plating (CBN abrasive eutectoid)			Good	Excellent

[Table 2]

	Surface treatment		Mechanical characteristics						
			Hardness	Lubricity	Dimension accuracy	Weld overlay property	Mold releasability	Low friction coefficient	Secondary workability
Electroplating	Zinc	Hard chrome	Excellent	Good	*	Excellent	Good	Good	*
		Very hard chrome	Excellent	Good	*	Excellent	Good	Good	*
		Zinc			*			Good	Good
		Hexavalent chromate			*			Good	Good
	Nickel					Good			
	Nickel-Chrome (Decorative chrome)								
	Electroless nickel		Good	*	Excellent		Good	Good	
Anodization	Alumite	Colorless	Poor	Good					
		Colored	Poor	Good					
Chemical conversion treatment	Zinc phosphate film			Good					Excellent
	Manganese phosphate			Good					Excellent
	Black oxide finish				Good				
Passivation treatment	Stainless steel passivation film				Excellent				
Special plating	Composite plating (CBN abrasive eutectoid)		Excellent	Good					

[Table 3]

Surface treatment		Electrical characteristics				
		Electric conductivity	Highfrequency property	Magnetic property	Low contact resistance	Resistive property
Electroplating	Hard chrome					
	Very hard chrome					
	Zinc	Trivalent chromate				
		Trivalent black chromate				
		Hexavalent chromate				
	Nickel		Good			*
	Nickel-Chrome (Decorative chrome)					
	Non-electrolytic plating	Electroless nickel	Good		*	Excellent
Anodization	Alumite	Insulative			Good	
	Colored	Insulative			Good	
Chemical conversion treatment	Zinc phosphate film					
	Manganese phosphate					
	Black oxide finish					
Passivation treatment	Stainless steel passivation film					
Special plating	Composite plating (CBN abrasive eutectoid)					

[Table 4]

Surface treatment			Optical characteristics			
			Antireflection property	Selective absorption property	Optical reflectivity	Weather resistance
Electroplating	Hard chrome					
	Very hard chrome					
	Zinc	Trivalent chromate	*		*	*
		Trivalent black chromate	*		*	*
		Hexavalent chromate	*		*	*
	Nickel			*	Good	Good
	Nickel-Chrome (Decorative chrome)				Excellent	Excellent
Non-electrolytic plating	Electroless nickel					
Anodization	Alumite	Colorless				
		Colored				
Chemical conversion treatment	Zinc phosphate film		Good			
	Manganese phosphate		Good			
	Black oxide finish					
Passivation treatment	Stainless steel passivation film					
Special plating	Composite plating (CBN abrasive eutectoid)					

[Table 5]

Surface treatment			Thermal characteristics			
			Heat resistance	Thermal absorptivity	Thermal conductivity	Thermal reflectivity
Electroplating	Hard chrome		Good			
	Very hard chrome		Good			
	Zinc	Trivalent chromate		*		
		Trivalent black chromate		*		
		Hexavalent chromate		*		
	Nickel					
	Nickel-Chrome (Decorative chrome)					Excellent

(continued)

Surface treatment			Thermal characteristics			
			Heat resistance	Thermal absorptivity	Thermal conductivity	Thermal reflectivity
Non-electrolytic plating	Electroless nickel		Excellent			
Anodization	Alumite	Colorless				
		Colored				
Chemical conversion treatment	Zinc phosphate film					
	Manganese phosphate					
	Black oxide finish					
Passivation treatment	Stainless steel passivation film					
Special plating	Composite plating (CBN abrasive eutectoid)					

[Table 6]

Surface treatment			Physical characteristics				
			Soldering property	Bonding property	Porosity	Non-viscosity	Adhesiveness
Electroplating	Hard chrome				Excellent	Good	
	Very hard chrome				Excellent	Good	
	Zinc	Trivalent chromate	*				Good
		Trivalent black chromate	*				Good
		Hexavalent chromate	*				Good
	Nickel		Good				
	Nickel-Chrome (Decorative chrome)						
Non-electrolytic plating	Electroless nickel		Good	Excellent			
Anodization	Alumite	Colorless			*		
		Colored			*		
Chemical conversion treatment	Zinc phosphate film						Good
	Manganese phosphate						Good
	Black oxide finish						
Passivation treatment	Stainless steel passivation film						
Special plating	Composite plating (CBN abrasive eutectoid)						

[0070] A person skilled in the art can select and apply a surface treatment suitable for accomplishing his/her objective among the surface modification treatments in Tables 1 to 6. In Tables 1 to 6, "Excellent" means that the surface treatment is applicable, regardless of conditions on an extruded material or an extruding device. In Tables 1 to 6, "Good" means that the surface treatment is applicable if either conditions on an extruded material or conditions on an extruding device are satisfied. In Tables 1 to 6, "Poor" means that the surface treatment is applicable if both conditions on an extruded material and conditions on an extruding device are satisfied. The asterisks in Tables 1 to 6 mean that the surface treatment is applicable if conditions (temperature and viscosity) on an extruded material and conditions (temperature and motion velocity of the drum surface) on an extruding device are satisfied. In Table 3, to be insulative means that galvanic corrosion is unlikely to occur on a surface due to insulation.

[0071] As discussed above, according to the 10th embodiment, the main drum is subjected to surface modification treatment. The surface of the main drum is therefore improved in characteristics. The surface modification treatment does not necessarily have to be applied to the main drum and may be applied to the secondary drum.

11th Embodiment:

[0072] Fig. 15 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 11th embodiment of the invention. Fig. 15 shows a manufacturing device 100F for a reconstituted tobacco sheet which is obtained by adding a hot air blower (secondary drying device) 80 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0073] The hot air blower 80 is disposed to face a drum body 32 of a drum dryer 30 on a drying path of the drum dryer 30. The hot air blower 80 sends hot air to dry the reconstituted tobacco sheet 1 from the surface side of the reconstituted tobacco sheet 1 which is discharged from a discharge port 26 of a die 20 onto the drum body 32. The surface of the reconstituted tobacco sheet 1 here is a surface of the reconstituted tobacco sheet 1 which is not in contact with the drum body 32. The hot air blower 80 is so configured to be adjustable in drying ability by using intrinsic parameters including air volume, output, and hot air temperature. The hot air temperature may be set at a temperature equal to or higher than room temperature.

[0074] The use of the hot air blower 80 enhances the drying ability of the manufacturing device 100F for a reconstituted tobacco sheet. The manufacturing device 100F for a reconstituted tobacco sheet is therefore capable of dealing with reconstituted tobacco raw material with a high moisture content with a simple configuration. The use of the hot air blower 80 also makes it possible to dry both sides of the reconstituted tobacco sheet 1 at the same time.

[0075] As discussed above, according to the 11th embodiment, there is further provided the secondary drying device that is disposed to face the main drum and configured to dry the reconstituted tobacco raw material discharged from the die. This enhances the drying ability of the manufacturing device for a reconstituted tobacco sheet. In the 11th embodiment, the secondary drying device is the hot air blower. However, the secondary drying device is not limited to the hot air blower and may be an IR heater. Instead of the secondary drying device, a cooling device may be provided, which sends cold air to the reconstituted tobacco sheet 1.

12th Embodiment:

[0076] Fig. 16 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 12th embodiment of the invention. Fig. 17 is a block diagram showing opening width control in the manufacturing device for a reconstituted tobacco sheet according to the 12th embodiment of the invention. Figs. 16 and 17 show a manufacturing device 100G for a reconstituted tobacco sheet which is obtained by adding a thickness detection sensor (condition detecting portion) 91 and a PLC (control portion) 200 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. A die 20 of the manufacturing device 100G for a reconstituted tobacco sheet includes a variable width mechanism 92 that is capable of varying opening width of a discharge port 26 using a motor as an actuator, which is mentioned in the third embodiment. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0077] The thickness detection sensor 91 is provided near the discharge port 26. The thickness detection sensor 91 uses an X-ray, a laser, ultrasonic waves or the like to detect the thickness of the reconstituted tobacco sheet 1 discharged from the die 20 in a non-contact manner and output an electric signal as a measured thickness value to the PLC (programmable logic controller) 200.

[0078] The PLC 200 may be either built into or provided away from the manufacturing device 100G for a reconstituted tobacco sheet. On the basis of a preset thickness value that is desired thickness for the reconstituted tobacco sheet 1 and the measured thickness value outputted from the thickness detection sensor 91, the PLC 200 outputs a control command to the variable width mechanism 92 to control the motor so that difference between the preset thickness value and the measured thickness value is zero. The opening width of the discharge port 26 is thus varied, and the thickness

of the reconstituted tobacco sheet 1 discharged from the die 20 is also changed.

[0079] When the reconstituted tobacco sheet 1 is discharged from the die 20, the sheet is expanded as a result of pressure release, so that, in some occasions, the thickness of the reconstituted tobacco sheet 1 is not equal to the opening width of the discharge port 26. The thickness of the reconstituted tobacco sheet 1 can be made equal to the desired thickness by feedback-controlling the opening width of the discharge port 26 as opposed to the pressure release that is an uncontrollable element.

[0080] In other words, the reconstituted tobacco sheet 1 is manufactured by the manufacturing method including the steps of feeding the reconstituted tobacco raw material to the feed port 24 of the die 20; forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from the discharge port 26 of the die 20; detecting the condition (thickness) of the reconstituted tobacco raw material discharged from the die 20; outputting the electric signal according to the detected condition of the reconstituted tobacco raw material; and controlling the variable width mechanism 92 that is the actuator configured to change the condition of the reconstituted tobacco raw material according to the outputted electric signal and thus changing the condition of the reconstituted tobacco raw material.

[0081] As discussed above, according to the 12th embodiment, the die includes the variable width mechanism as an actuator which is capable of varying length of the discharge port in a width direction. The condition detecting portion detects the thickness of the reconstituted tobacco raw material discharged from the die. The control portion controls the variable width mechanism on the basis of a detection result obtained by the condition detecting portion and changes the length of the discharge port in the width direction. The thickness of the reconstituted tobacco sheet therefore can be made equal to the desired thickness.

13th Embodiment:

[0082] Fig. 18 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 13th embodiment of the invention. Fig. 19 is a block diagram showing discharge velocity control in the manufacturing device for a reconstituted tobacco sheet according to the 13th embodiment of the invention. Figs. 18 and 19 show a manufacturing device 100H for a reconstituted tobacco sheet which is obtained by adding a flow rate sensor (condition detection portion) 93 and a PLC (control portion) 200 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. In the manufacturing device 100H for a reconstituted tobacco sheet, a screw 14 that is rotatably placed in the inside of a housing 11 of an extruder 10 functions as an actuator. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0083] The flow rate sensor 93 is provided near a discharge port 26. The flow rate sensor 93 uses a laser or the like to detect a flow rate of a reconstituted tobacco sheet 1 discharged from a die 20 in a non-contact manner and outputs an electric signal as a measured flow rate value to the PLC 200. The measured flow rate value is used as a value for estimating discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20.

[0084] The PLC 200 may be either built into or provided away from the manufacturing device 100H for a reconstituted tobacco sheet. On the basis of a preset flow rate value that is a desired flow rate for the reconstituted tobacco sheet 1 and the measured flow rate value outputted from the flow rate sensor 93, the PLC 200 outputs a control command to the screw 14 to control the rotation of the screw 14 so that difference between the preset flow rate value and the measured flow rate value is zero. The discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20 is thus changed.

[0085] There is a certain degree of fluctuation in discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20 due to waviness of the screw 14. The discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20 can be maintained within a certain definite range by feedback-controlling the discharge velocity of the reconstituted tobacco sheet 1. If the discharge velocity of the reconstituted tobacco sheet 1 is maintained at a constant value, it is possible to restrain the reconstituted tobacco sheet 1 from being sagged on a drum dryer 30 or torn due to a tension increase. To maintain the discharge velocity of the reconstituted tobacco sheet 1 at a constant value further restrains variation in thickness of the sheet which is caused by pressure release and thus stabilizes the quality of the reconstituted tobacco sheet 1.

[0086] In other words, the reconstituted tobacco sheet 1 is manufactured by the manufacturing method including the steps of feeding the reconstituted tobacco raw material to the feed port 24 of the die 20; forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from the discharge port 26 of the die 20; detecting the condition (flow rate) of the reconstituted tobacco raw material discharged from the die 20; outputting the electric signal according to the detected condition of the reconstituted tobacco raw material; and controlling the screw 14 that is the actuator configured to change the condition of the reconstituted tobacco raw material according to the outputted electric signal and thus changing the condition of the reconstituted tobacco raw material.

[0087] As discussed above, according to the 13th embodiment, the manufacturing device for a reconstituted tobacco sheet further comprises the extruder that press-feeds the reconstituted tobacco raw material to the die. The extruder

includes the screw as an actuator which is rotatably placed in the inside of the housing. The condition detecting portion detects at least either the discharge pressure of the reconstituted tobacco raw material in the interior portion of the die or the flow rate of the reconstituted tobacco raw material discharged from the die. The control portion controls the rotation of the screw and changes the discharge velocity of the reconstituted tobacco raw material discharged from the die on the basis of the detection result obtained by the condition detecting portion. The discharge velocity of the reconstituted tobacco sheet discharged from the die is therefore maintained at a constant value.

[0088] In the 13th embodiment, instead of or in addition to the flow rate sensor 93, a discharge pressure sensor may be provided near the discharge port 26 or inside the die 20. The discharge pressure sensor detects the discharge pressure of the reconstituted tobacco sheet 1 discharged from the die 20. In such a case, the discharge pressure detected by the discharge pressure sensor may be used as a value for estimating the discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20.

[0089] At this point of time, the reconstituted tobacco sheet 1 is manufactured by the manufacturing method including the steps of feeding the reconstituted tobacco raw material to the feed port 24 of the die 20; forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from the discharge port 26 of the die 20; detecting the condition (discharge pressure) of the reconstituted tobacco raw material in the interior portion of the die 20 or the condition (flow rate) of the reconstituted tobacco raw material discharged from the die 20; outputting the electric signal according to the detected condition of the reconstituted tobacco raw material; and controlling the screw 14 that is the actuator configured to change the condition of the reconstituted tobacco raw material and thus changing the condition of the reconstituted tobacco raw material according to the outputted electric signal.

14th Embodiment:

[0090] Fig. 20 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention. Fig. 21 is a block diagram showing hot air temperature control in the manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention. Figs. 20 and 21 show a manufacturing device 100I for a reconstituted tobacco sheet which is obtained by adding a moisture content sensor (condition detecting portion) 94 and a PLC (control portion) 200 to the manufacturing device 100 for a reconstituted tobacco sheet which is illustrated in Fig. 1. The manufacturing device 100I for a reconstituted tobacco sheet includes the hot air blower (secondary drying device) 80 mentioned in the 11th embodiment as an actuator. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0091] The moisture content sensor 94 is provided downstream of a scraper 40. The moisture content sensor 94 uses an infrared ray, microwaves or the like to detect moisture content of a reconstituted tobacco sheet 1 detached by the scraper 40 in a non-contact manner and outputs an electric signal as a measured moisture content value to the PLC 200. The hot air blower 80 is disposed on a drying path of a drum dryer 30 so as to face a drum body 32 of the drum dryer 30.

[0092] The PLC 200 may be either built into or provided away from the manufacturing device 100I for a reconstituted tobacco sheet. On the basis of a preset moisture content value that is desired moisture content for the reconstituted tobacco sheet 1 and a measured moisture content value outputted from the moisture content sensor 94, the PLC 200 outputs a control command to a hot air blower 80 and controls the temperature of hot air that is sent from the hot air blower 80 so that difference between the preset moisture content value and the measured moisture content value is zero. This changes the moisture content of the reconstituted tobacco sheet 1 that is dried by the drum dryer 30 and the hot air blower 80.

[0093] The moisture content of the reconstituted tobacco sheet 1 that is dried by the drum dryer 30 and the hot air blower 80 fluctuates according to environment, season, and other like factors. Feedback control on the moisture content of the reconstituted tobacco sheet 1 maintains the moisture content of the reconstituted tobacco sheet 1 that is dried by the drum dryer 30 and the hot air blower 80 within a certain definite range. The reconstituted tobacco sheet 1 is thus stabilized in quality. The hot air blower 80 is more responsive and easier to control as compared to the drum dryer 30, which makes it possible to finely control the moisture content of the reconstituted tobacco sheet 1. It is also possible to automatically control the moisture content of the reconstituted tobacco sheet 1, which eliminates the necessity of constant monitoring with an operator.

[0094] In other words, the reconstituted tobacco sheet 1 is manufactured by the manufacturing method including the steps of feeding the reconstituted tobacco raw material to the feed port 24 of the die 20; forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from the discharge port 26 of the die 20; detecting the condition (moisture content) of the reconstituted tobacco raw material discharged from the die 20; outputting the electric signal according to the detected condition of the reconstituted tobacco raw material; and controlling the hot air blower 80 that is the actuator configured to change the condition of the reconstituted tobacco raw material according to the outputted electric signal and thus changing the condition of the reconstituted tobacco raw material.

[0095] As discussed above, according to the 14th embodiment, the manufacturing device for a reconstituted tobacco sheet further comprises the drum that dries and transfers the reconstituted tobacco raw material discharged from the

die, and the secondary drying device that is disposed to face the drum and dries the reconstituted tobacco raw material discharged from the die. The condition detecting portion detects the moisture content of the reconstituted tobacco raw material that is dried by the drum and the secondary drying device. On the basis of a detection result obtained by the condition detecting portion, the control portion controls the secondary drying device and changes the moisture content of the reconstituted tobacco raw material that is dried by the drum and the secondary drying device. The moisture content of the reconstituted tobacco sheet that is dried by the drum and the secondary drying device is thus maintained within a certain definite range.

[0096] The manufacturing device 100G for a reconstituted tobacco sheet according to the 12th embodiment, the manufacturing device 100H for a reconstituted tobacco sheet according to the 13th embodiment, and the manufacturing device 100I for a reconstituted tobacco sheet according to the 14th embodiment may be combined together in any way.

[0097] Several embodiments of the invention have been discussed. The embodiments of the invention are intended not to limit the invention but to facilitate the understanding of the invention. The invention may be modified or improved without deviating from the gist thereof and includes equivalents thereof. Constituent elements mentioned in the claims and specification may be combined or omitted as long as the problem is at least partially solved or advantageous effects are at least partially provided.

REFERENCE SIGNS LIST

[0098]

1:	Reconstituted tobacco sheet
10, 10A to 10X:	Extruder
11:	Housing
12:	Feed port
13:	Extrusion port
14:	Screw
20, 20A to 20X:	Die
21:	First block
22:	Second block
23:	Housing
24:	Feed port
25:	Manifold
26:	Discharge port
27:	Partitioning portion
28:	Protruding portion
30:	Drum dryer
31:	Shaft
32:	Drum body
35:	Drum dryer
36:	Shaft
37:	Drum body
40:	Scraper
45:	Scraper
51:	Roller
52:	Roller
61 to 63:	Extruder
70:	Die
71 to 73:	Feed port
74:	Discharge port
80:	Hot air blower
91:	Detection sensor
92:	Variable width mechanism
93:	Flow rate sensor
94:	Moisture content sensor

(continued)

100, 100A to 100I: Manufacturing device for a reconstituted tobacco sheet

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Claims

1. A manufacturing device for a reconstituted tobacco sheet, comprising:

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a die configured to discharge reconstituted tobacco raw material,
the die including:

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a housing;
a feed port that is formed in the housing and to which the reconstituted tobacco raw material is fed; and
a discharge port that is formed in one side face of the housing and from which the reconstituted tobacco
raw material is discharged,
the manufacturing device for a reconstituted tobacco sheet, further comprising:

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a condition detecting portion configured to detect a condition of the reconstituted tobacco raw material in an
interior portion of the die or a condition of the reconstituted tobacco raw material discharged from the die, and
a control portion configured to control behavior of the manufacturing device for a reconstituted tobacco sheet,
the condition detecting portion being configured to output an electric signal according to a detection result of
the condition of the reconstituted tobacco raw material to the control portion.

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2. The manufacturing device for a reconstituted tobacco sheet according to Claim 1, further comprising:

an actuator configured to change the condition of the reconstituted tobacco raw material,
wherein the control portion controls the actuator according to the electric signal outputted from the condition
detecting portion.

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3. The manufacturing device for a reconstituted tobacco sheet according to Claim 2,

wherein the die includes a variable width mechanism as an actuator which is capable of changing length of the
discharge port in a width direction;
wherein the condition detecting portion detects thickness of the reconstituted tobacco raw material discharged
from the die and outputs the electric signal according to the detection result to the control portion; and
wherein the control portion controls the variable width mechanism according to the electric signal outputted
from the condition detecting portion and changes length of the discharge port in a width direction.

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4. The manufacturing device for a reconstituted tobacco sheet according to Claim 2 or 3, further comprising:

an extruder configured to press-feed the reconstituted tobacco raw material to the die,
wherein the condition detecting portion detects at least either one of discharge pressure of the reconstituted
tobacco raw material in the interior portion of the die and a flow rate of the reconstituted tobacco raw material
discharged from the die, and then outputs the electric signal according to the detection result to the control portion.

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5. The manufacturing device for a reconstituted tobacco sheet according to Claim 4,

wherein the extruder includes a screw as an actuator which is rotatably disposed within the housing, and
wherein the control portion controls rotation of the screw according to the electric signal outputted from the
condition detecting portion and changes a discharge velocity of the reconstituted tobacco raw material discharged
from the die.

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6. The manufacturing device for a reconstituted tobacco sheet according to any one of Claims 2 to 5, further comprising:

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a drum configured to dry and transfer the reconstituted tobacco raw material discharged from the die,
the manufacturing device for a reconstituted tobacco sheet, including a secondary drying device as an actuator
which is disposed to face the drum and configured to dry the reconstituted tobacco raw material discharged

from the die,

wherein the condition detecting portion detects moisture content in the reconstituted tobacco raw material that is dried by the drum and the secondary drying device and outputs the electric signal according to the detection result to the control portion.

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7. The manufacturing device for a reconstituted tobacco sheet according to Claim 6, wherein the control portion controls the secondary drying device according to the electric signal outputted from the condition detecting portion and changes the moisture content in the reconstituted tobacco raw material that is dried by the drum and the secondary drying device.

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8. A manufacturing method for a reconstituted tobacco sheet, comprising the steps of:

feeding reconstituted tobacco raw material to a feed port of a die;

forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from a discharge port of the die;

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detecting a condition of the reconstituted tobacco raw material in an interior portion of the die or a condition of the reconstituted tobacco raw material discharged from the die; and

outputting an electric signal according to the detected condition of the reconstituted tobacco raw material.

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9. The manufacturing method for a reconstituted tobacco sheet according to Claim 8, further comprising the step of controlling an actuator that changes a condition of the reconstituted tobacco raw material according to the outputted electric signal and thus changing the condition of the reconstituted tobacco raw material.

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Fig. 1

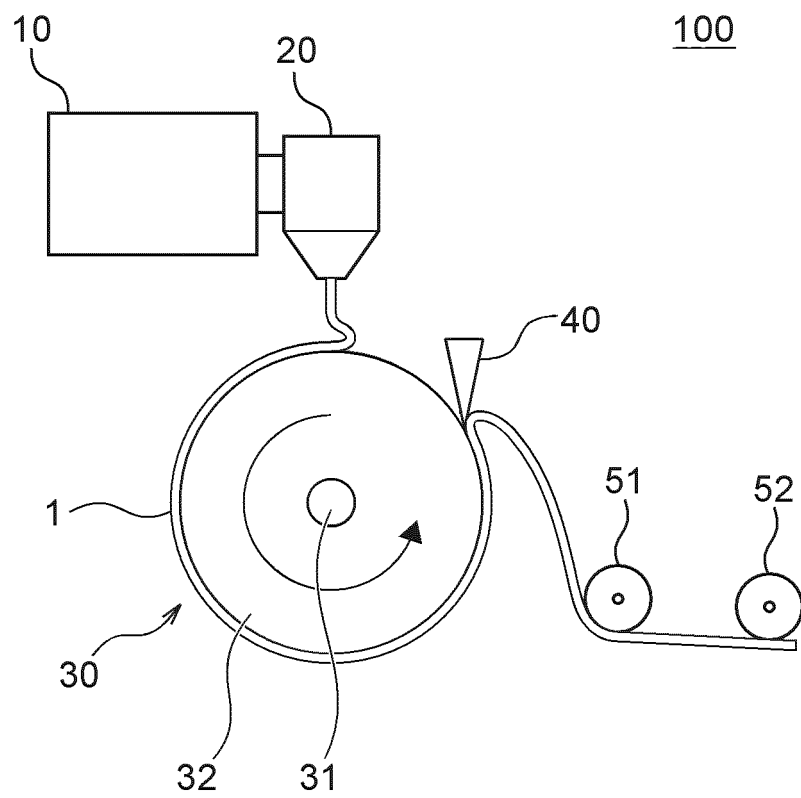


Fig. 2

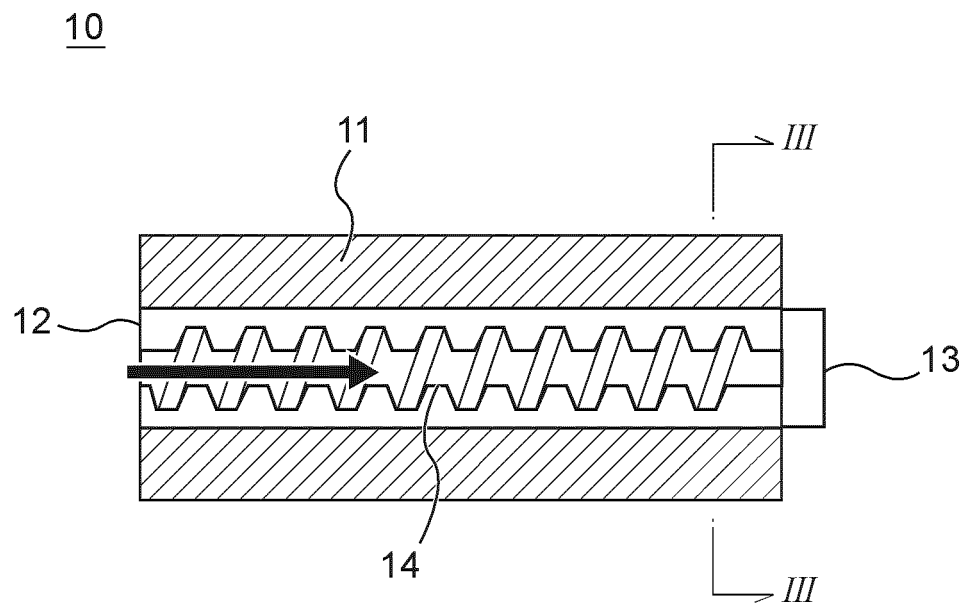


Fig. 3

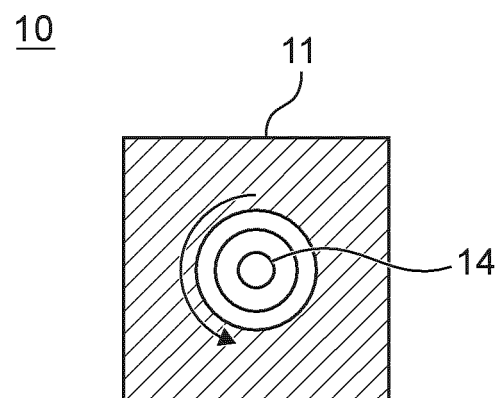


Fig. 4

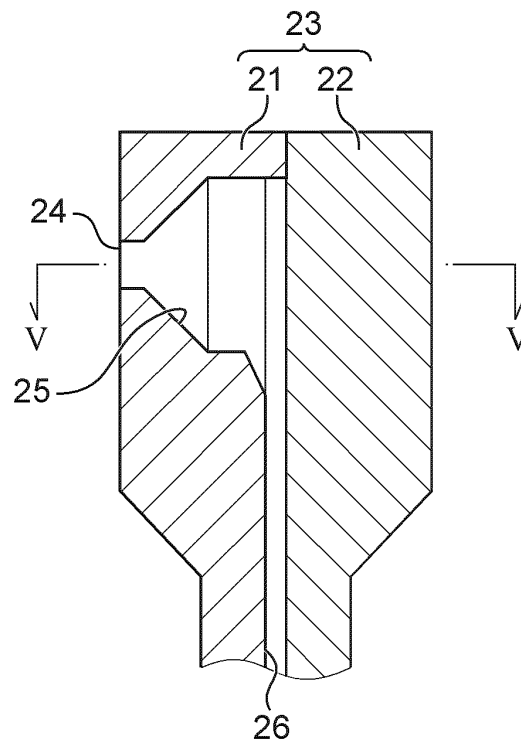


Fig. 5

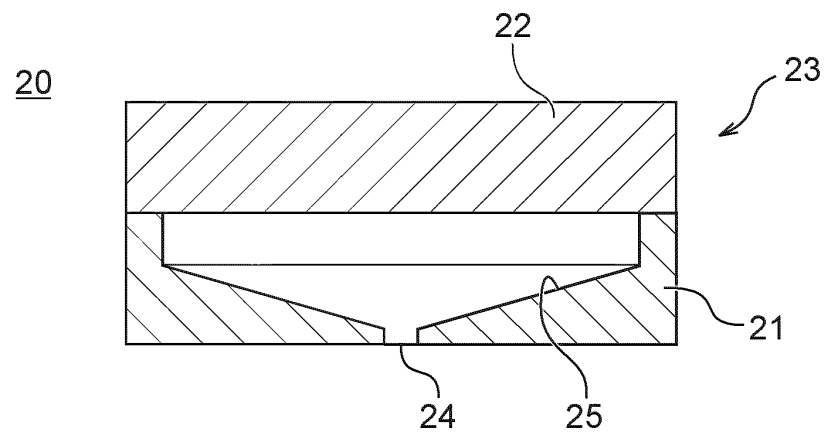


Fig. 6

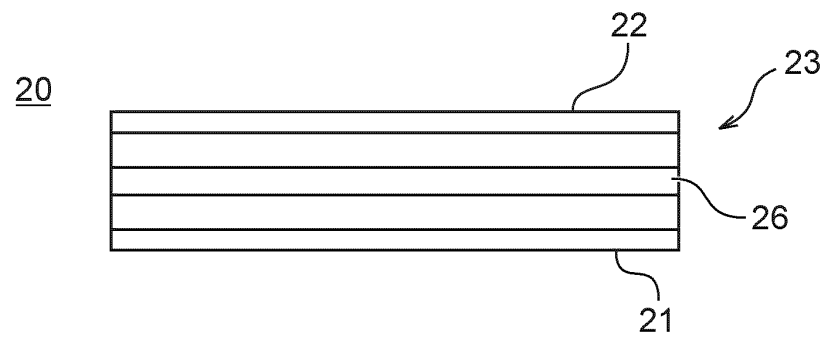


Fig. 7

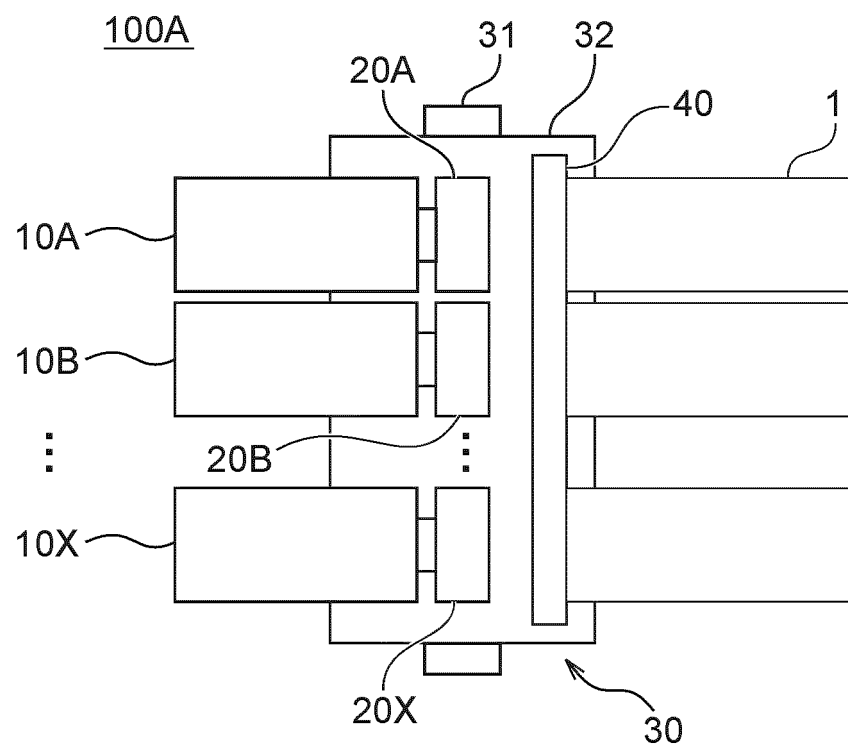


Fig. 8

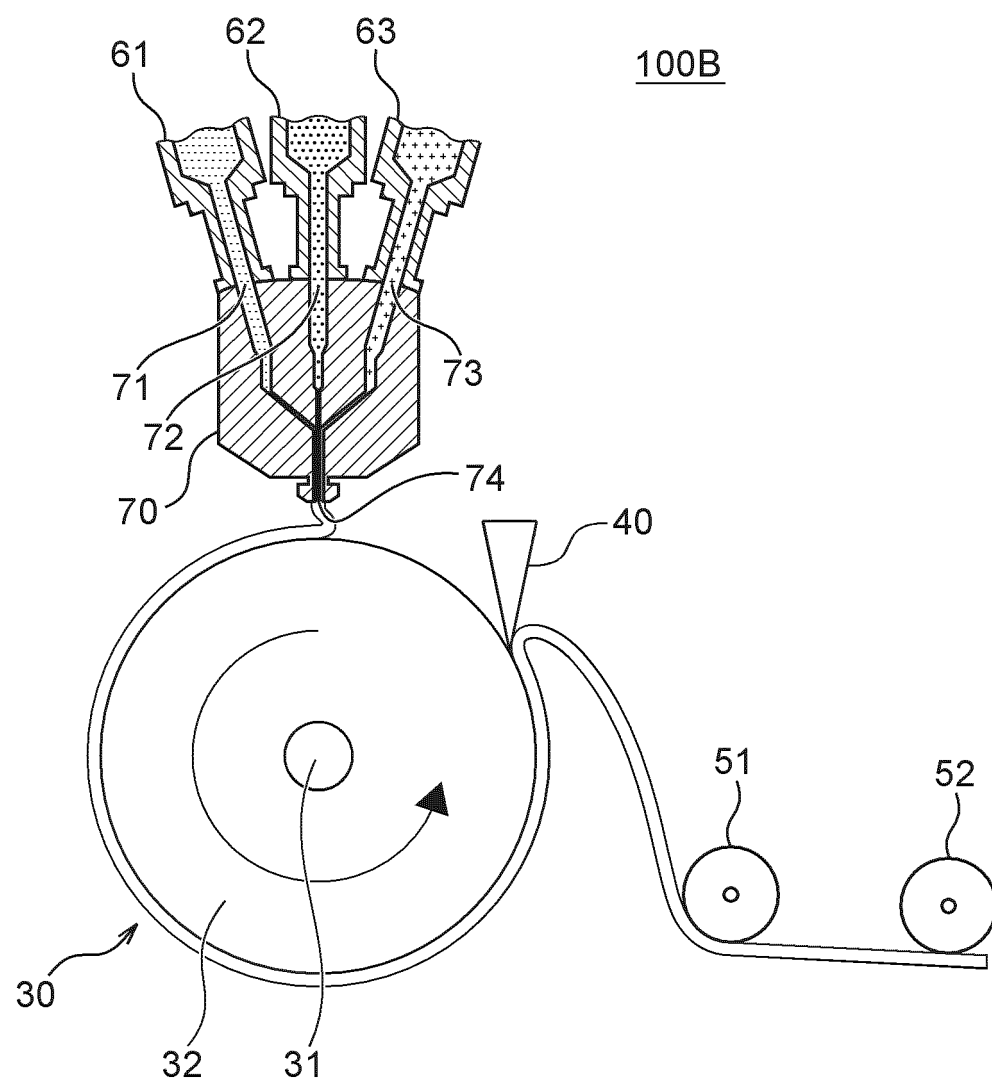


Fig. 9

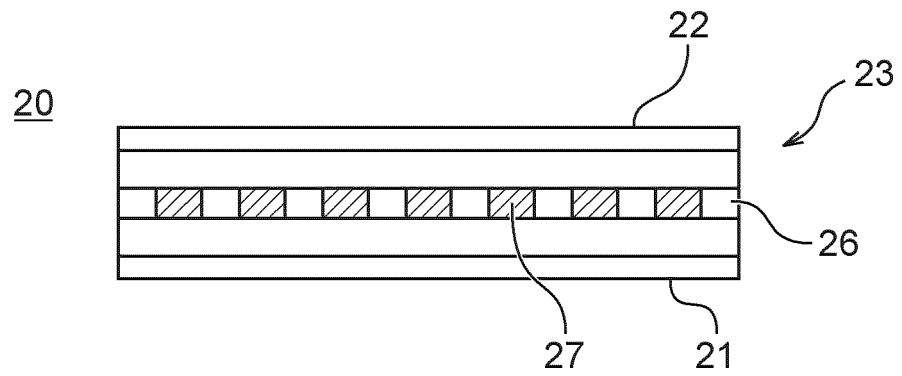


Fig. 10

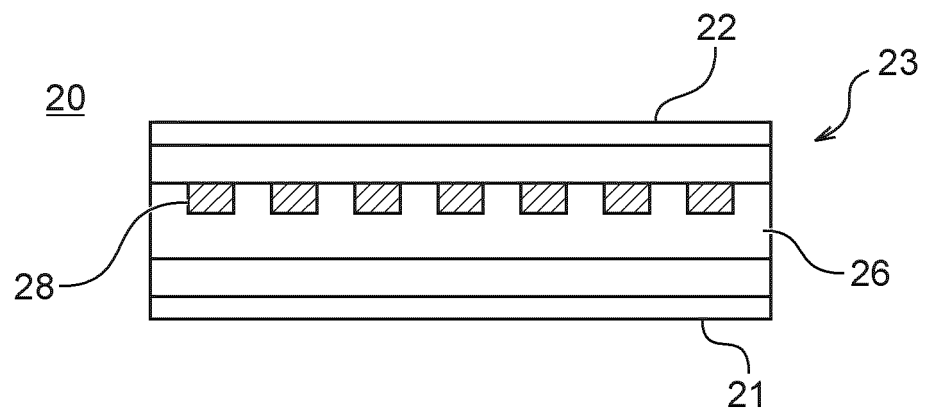


Fig. 11

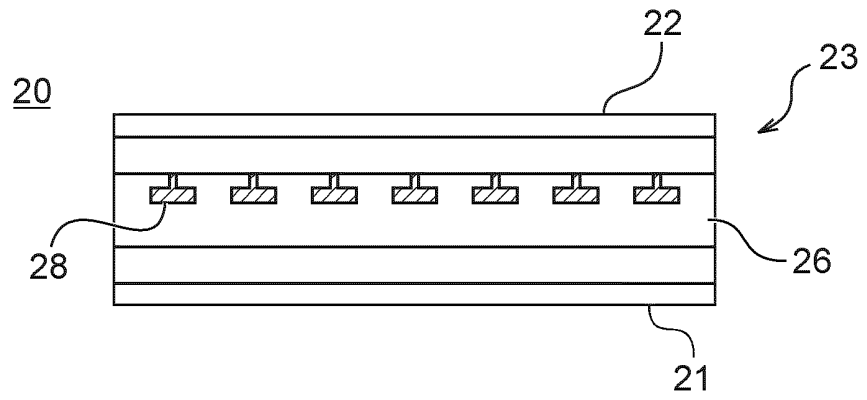


Fig. 12

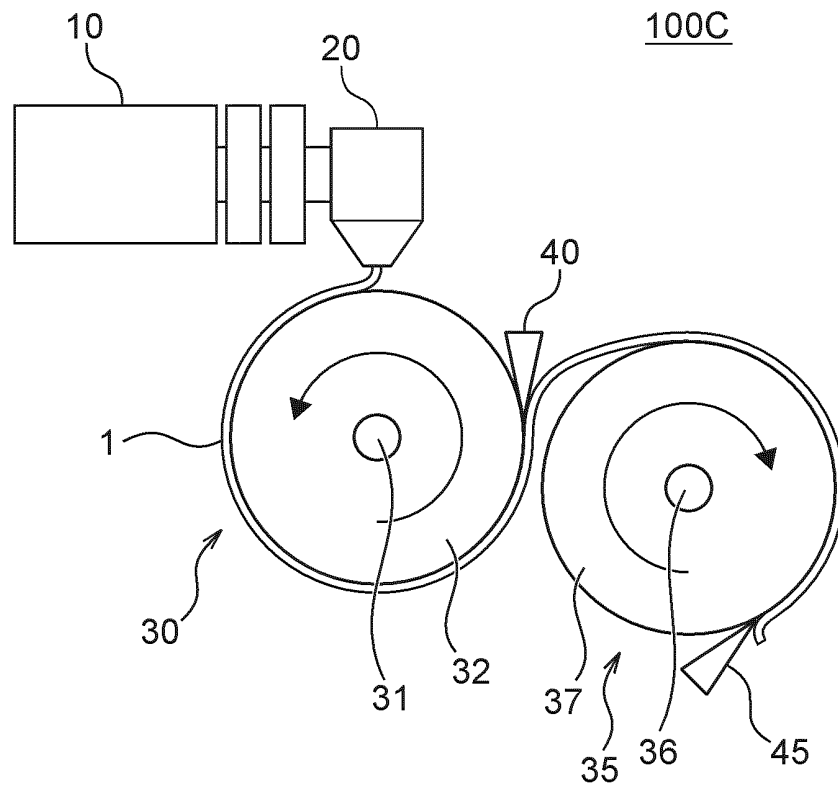


Fig. 13

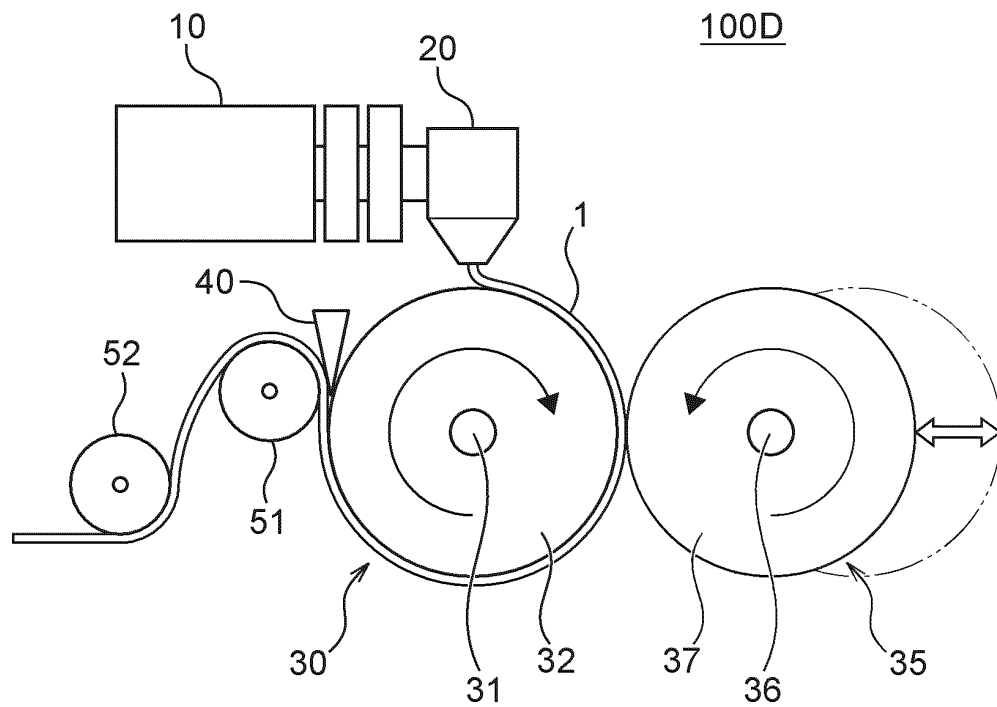


Fig. 14

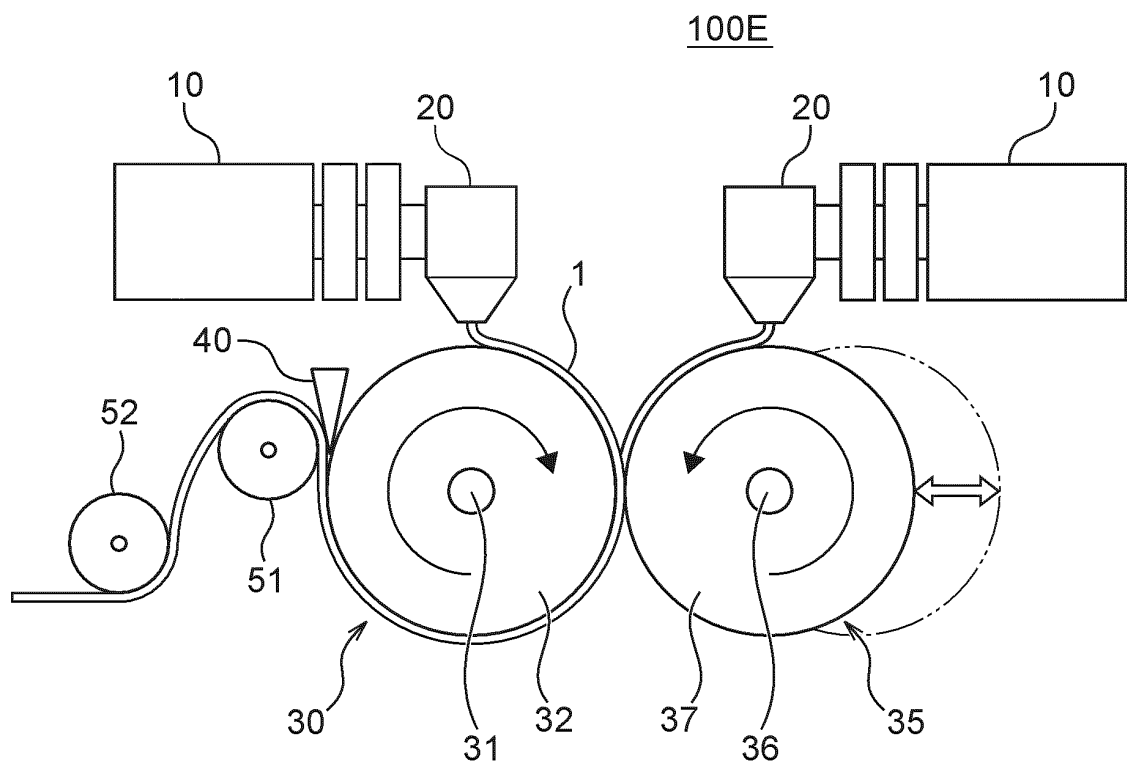


Fig. 15

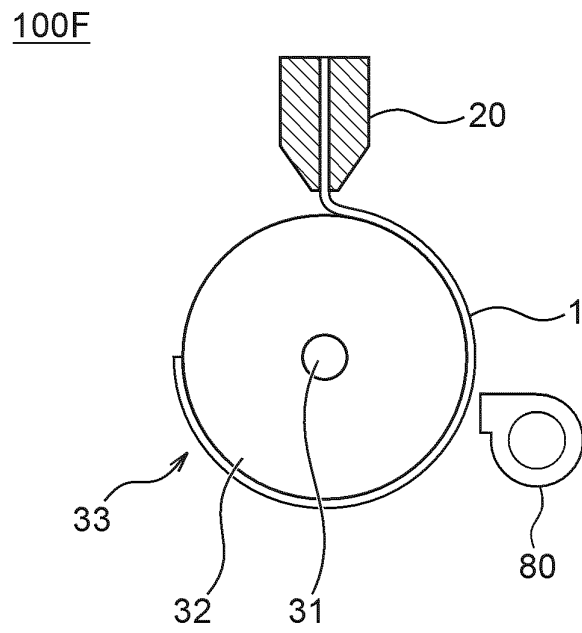


Fig. 16

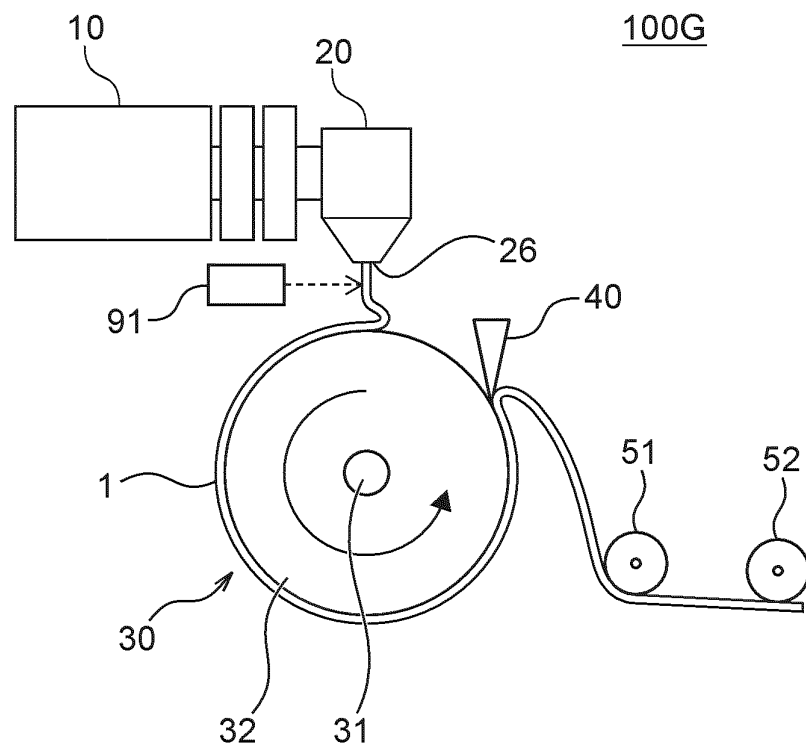


Fig. 17

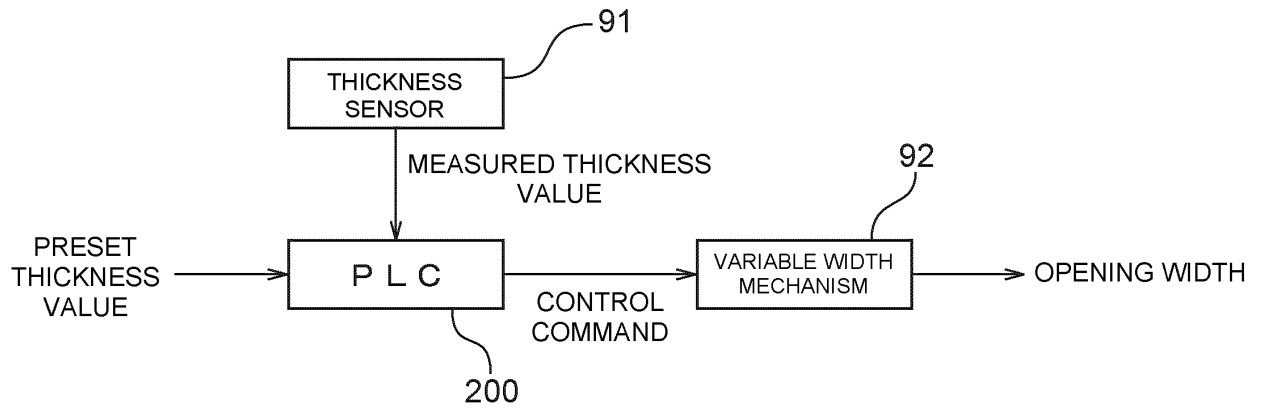


Fig. 18

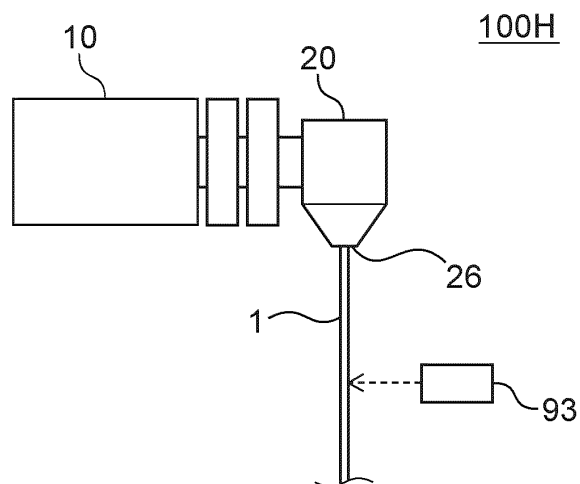


Fig. 19

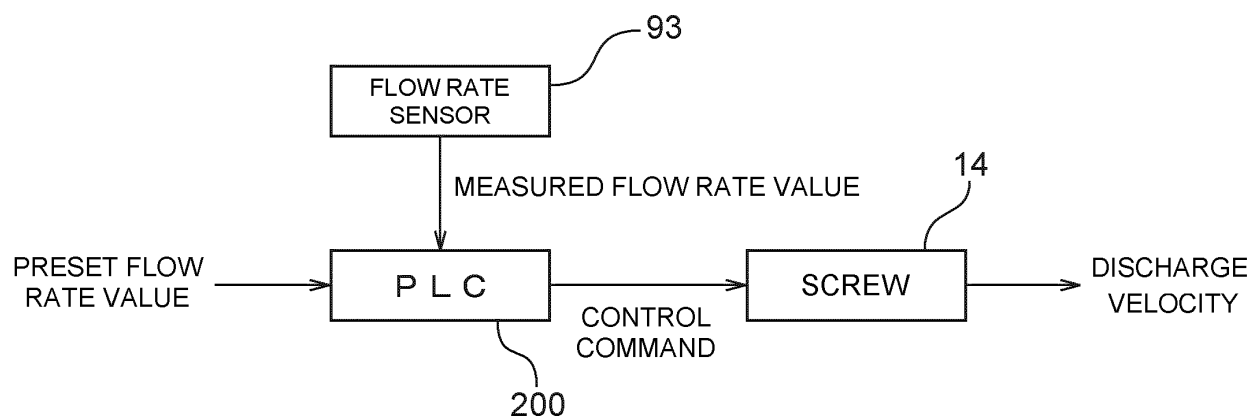


Fig. 20

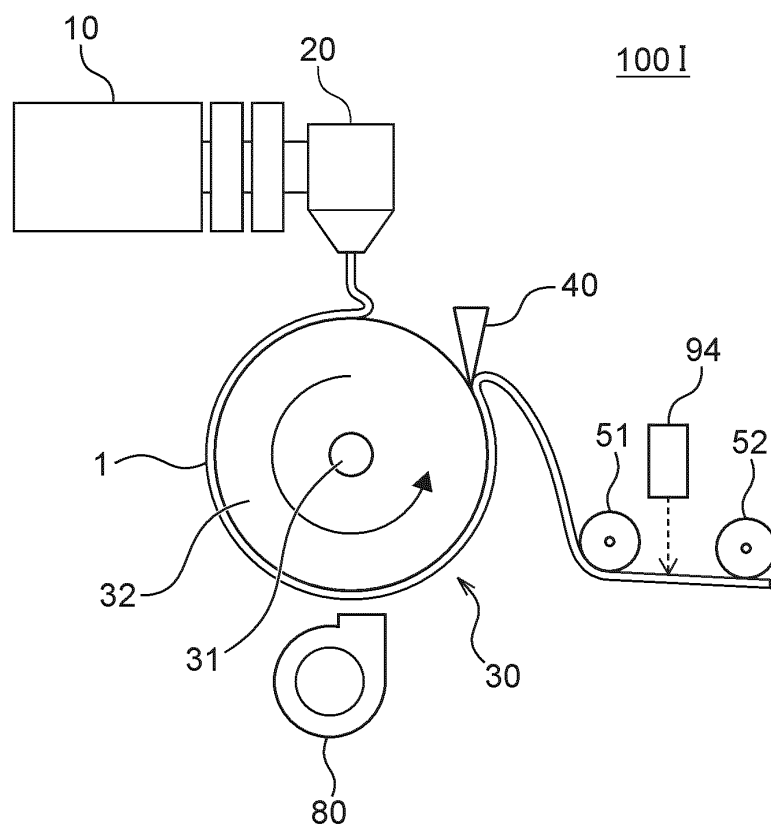
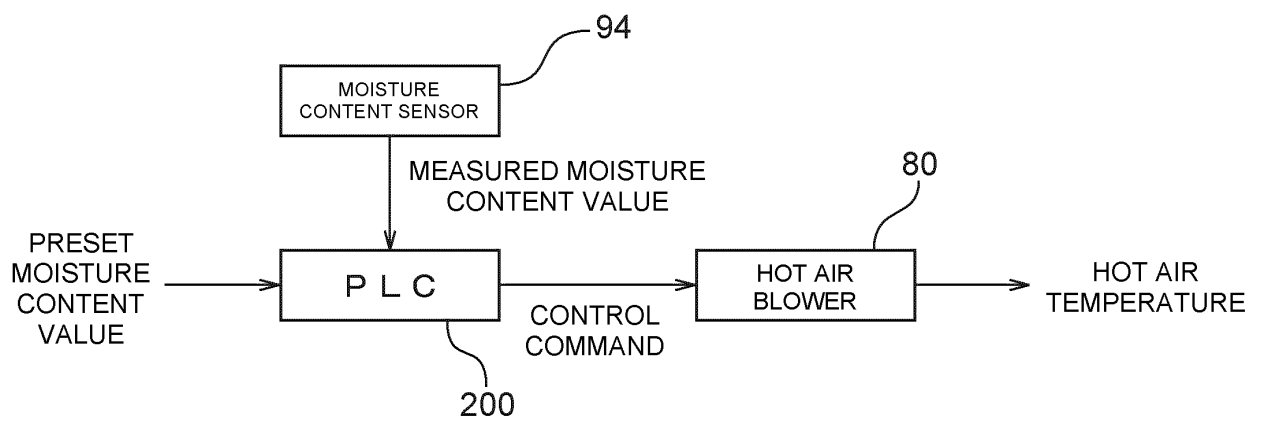


Fig. 21



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/023587

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A. CLASSIFICATION OF SUBJECT MATTER
 A24B 3/14 (2006.01) i
 FI: A24B3/14

According to International Patent Classification (IPC) or to both national classification and IPC

15

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 A24B3/14

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	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2019-520036 A (PHILIP MORRIS PRODUCTS S.A.) 18	1-4, 6-9
Y	July 2019 (2019-07-18) paragraphs [0001]-[0084], fig. 1-6	5-7
Y	JP 7-265042 A (JAPAN TOBACCO INC.) 17 October 1995 (1995-10-17) abstract, paragraph [0019], fig. 1	5-7
A	WO 2014/020699 A1 (JAPAN TOBACCO INC.) 06 February 2014 (2014-02-06) entire text, all drawings	1-9
A	JP 63-192369 A (R.J. REYNOLDS TOBACCO COMPANY) 09 August 1988 (1988-08-09) entire text, all drawings	1-9
A	JP 2012-2 A (JAPAN TOBACCO INC.) 05 January 2012 (2012-01-05) entire text, all drawings	1-9

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

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search
 30 August 2021 (30.08.2021)

Date of mailing of the international search report
 07 September 2021 (07.09.2021)

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Name and mailing address of the ISA/
 Japan Patent Office
 3-4-3, Kasumigaseki, Chiyoda-ku,
 Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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

5	INTERNATIONAL SEARCH REPORT Information on patent family members			International application No. PCT/JP2021/023587
	Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
10	JP 2019-520036 A	18 Jul. 2019	US 2019/0289897 A1 paragraphs [0001]- [0089], fig. 1-6 WO 2017/207161 A1 EP 3463789 A1 CN 109153158 A BR 112018071362 A2 KR 10-2019-0015192 A RU 2018138392 A PL 3463789 T3 (Family: none)	
15	JP 7-265042 A WO 2014/020699 A1	17 Oct. 1995 06 Feb. 2014	US 2015/0136161 A1 entire text, all drawings EP 2881000 A1 CN 104602551 A US 4768527 A entire text, all drawings EP 276172 A2 BR 8800204 A CA 1296965 C CN 88100385 A KR 10-1988-0008768 A WO 2010/041660 A1	
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25	JP 63-192369 A	09 Aug. 1988		
30	JP 2012-2 A	05 Jan. 2012		
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55	Form PCT/ISA/210 (patent family annex) (January 2015)			

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2019520036 A [0006]