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

(11) **EP 4 183 268 A1**

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

(43) Date of publication:
24.05.2023 Bulletin 2023/21

(21) Application number: **21846295.0**

(22) Date of filing: **22.06.2021**

(51) International Patent Classification (IPC):
A24B 3/14 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
A24B 3/14

(86) International application number:
PCT/JP2021/023577

(87) International publication number:
WO 2022/019029 (27.01.2022 Gazette 2022/04)

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

(30) Priority: **20.07.2020 JP 2020123444**

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

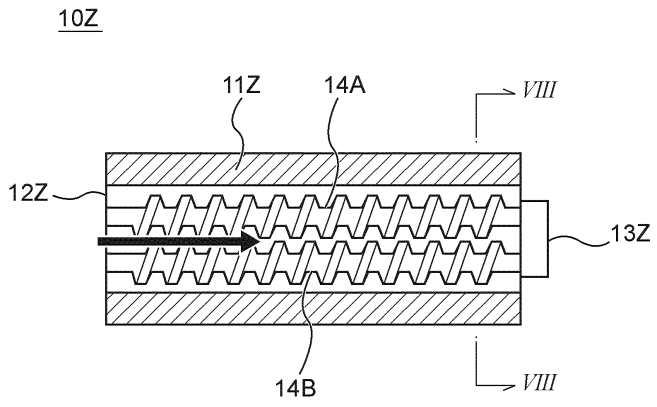
(72) Inventors:
- **SENDA, Kotaro**
  Tokyo 130-8603 (JP)
- **MITSUCHI, Kenta**
  Tokyo 130-8603 (JP)

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

(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 and an extruder that press-feeds the reconstituted tobacco raw material to the die by rotation of a screw that is rotatably disposed inside the extruder. 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.

Fig. 7



EP 4 183 268 A1

Description

TECHNICAL FIELD

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

BACKGROUND ART

[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.

[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.

[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).

[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

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

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[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.

SOLUTION TO PROBLEM

[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, and an extruder that press-feeds the reconstituted tobacco raw material to the die by rotation of a screw that is rotatably disposed inside the extruder. 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. 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.

[0009] In a second mode of the invention according to the first mode, the extruder is a two-axis extruder including a pair of screws disposed parallel with each other and configured to rotate in opposite directions to each other. This makes it possible to efficiently knead the reconstituted tobacco raw material having an extremely high viscosity and also makes it possible to enhance sheet formability during extrusion of the reconstituted tobacco raw material.

[0010] In a third mode of the invention according to the first or second mode, the manufacturing device for a reconstituted tobacco sheet further comprises a deaeration mechanism that deaerates the reconstituted tobacco raw material that is fed to the extruder. This makes it possible to obtain reconstituted tobacco sheets having high and uniform density and high strength.

[0011] A fourth mode of the invention provides a manufacturing method for a reconstituted tobacco sheet. The man-

ufacturing method for a reconstituted tobacco sheet comprises the steps of press-feeding reconstituted tobacco raw material to a feed port of a die by rotation of a screw provided in an extruder, and forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from a discharge port of the die. This makes it possible to obtain the reconstituted tobacco sheet having uniform thickness and being slitted through a simple manufacturing process, regardless of moisture content in the reconstituted tobacco raw material.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

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.

Fig. 7 is a cross-section of an extruder of a manufacturing device for a reconstituted tobacco sheet according to a second embodiment of the invention.

Fig. 8 is a cross-section as viewed from the arrow VIII - VIII shown in Fig. 7.

Fig. 9 is a plan view of a manufacturing device for a reconstituted tobacco sheet according to a third embodiment of the invention.

Fig. 10 is a plan view of a manufacturing device for a reconstituted tobacco sheet according to a fourth embodiment of the invention.

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

Fig. 12 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to a seventh embodiment of the invention as viewed from a discharge port side.

Fig. 13 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to an eighth embodiment of the invention as viewed from a discharge port side.

Fig. 14 is a side view of another die of a manufacturing device for a reconstituted tobacco sheet according to the eight embodiment of the invention as viewed from the discharge port side

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

Fig. 16 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 10th embodiment of the invention.

Fig. 17 is a side view of a manufacturing device for a reconstituted tobacco sheet according to an 11th 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.

Fig. 19 is a side view of the manufacturing device for a reconstituted tobacco sheet according to a 14th embodiment of the invention.

Fig. 20 is a block diagram showing opening width control in the manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention.

Fig. 21 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 15th embodiment of the invention.

Fig. 22 is a block diagram showing discharge velocity control in the manufacturing device for a reconstituted tobacco sheet according to the 15th embodiment of the invention.

Fig. 23 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 16th embodiment of the invention.

Fig. 24 is a block diagram showing hot air temperature control in the manufacturing device for a reconstituted tobacco sheet according to the 16th embodiment of the invention.

Fig. 25 is a side view of a manufacturing device for a reconstituted tobacco sheet according to a 17th embodiment of the invention.

Fig. 26 is a side view of a manufacturing device for a reconstituted tobacco sheet according to an 18th embodiment of the invention.

DESCRIPTION OF EMBODIMENTS

[0013] 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.

First Embodiment:

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] In short, the reconstituted tobacco sheet 1 is manufactured by the manufacturing method that includes the steps of press-feeding the reconstituted tobacco raw material to the feed port 24 of the die 20 by rotation of the screw 14 provided in the extruder 10, and 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.

[0026] 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:

[0027] Fig. 7 is a cross-section of an extruder of a manufacturing device for a reconstituted tobacco sheet according to the second embodiment of the invention. Fig. 8 is a cross-section as viewed from the arrow VIII - VIII shown in Fig. 7. The manufacturing device for a reconstituted tobacco sheet according to the second embodiment of the invention comprises an extruder 10Z illustrated in Figs. 7 and 8, instead of the extruder 10 illustrated in Fig. 1. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0028] In Figs. 7 and 8, the extruder 10Z is a two-axis extruder including a housing 11Z, a feed port 12Z formed at one end of the housing 11Z, an extrusion port 13Z formed at the other end of the housing 11Z, and a first screw 14A and a second screw 14B which are rotatably disposed inside the housing 11Z.

[0029] The first screw 14A and the second screw 14B are disposed parallel with each other and configured to rotate in opposite directions to each other. The reconstituted tobacco raw material that is fed from a tank or the like through the feed port 12Z to the extruder 10Z is kneaded and delivered to the extrusion port 13Z by rotation of the first screw 14A and the second screw 14B and press-fed from the extrusion port 13Z to the die 20.

[0030] The use of the first screw 14A and the second screw 14B rotating in the opposite directions to each other increases a force to take in the reconstituted tobacco raw material. This enables efficient kneading even if the reconstituted tobacco raw material has an extremely high viscosity. The use of the first screw 14A and the second screw 14B rotating in the opposite directions to each other further increases a shearing force to shear the reconstituted tobacco raw material,

which encourages moisture on the surface of the reconstituted tobacco raw material to bind together and improves a sheet formability during extrusion.

[0031] As discussed above, according to the second embodiment, the extruder is the two-axis extruder including the pair of screws disposed parallel with each other and configured to rotate in the opposite directions to each other. This enables efficient kneading even if the reconstituted tobacco raw material has an extremely high viscosity. It is also possible to improve the sheet formability during the extrusion of the reconstituted tobacco raw material.

Third Embodiment:

[0032] Fig. 9 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the third embodiment of the invention. Fig. 9 shows a manufacturing device 100L for a reconstituted tobacco sheet which is obtained by adding a deaeration mechanism 2 to the manufacturing device 100 for a reconstituted tobacco sheet illustrated in Fig. 1. The deaeration mechanism 2 deaerates the reconstituted tobacco raw material that is fed to the extruder 10. The deaeration mechanism 2 includes an extruder 2A and a deaeration chamber 2B. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0033] The extruder 2A has a similar configuration to the extruder 10 illustrated in Fig. 1. The extruder 2A press-feeds to the deaeration chamber 2B the reconstituted tobacco raw material that is fed from the tank or the like, not shown. The extruder 2A may have a similar configuration to the extruder 10Z illustrated in Figs. 7 and 8.

[0034] The deaeration chamber 2B uses a vacuum pump or the like, not shown, to deaerate the reconstituted tobacco raw material that is press-fed from the extruder 2A and feed the reconstituted tobacco raw material to the extruder 10. The degree of vacuum in the deaeration chamber 2B is adjusted by operating a valve that is provided in a deaeration path, not shown.

[0035] Since the deaeration of the reconstituted tobacco raw material restrains the creation of an air layer in the reconstituted tobacco raw material, that is, the generation of micro air bubbles, it is possible to obtain the reconstituted tobacco sheet 1 having high and uniform density and high strength.

[0036] As discussed above, according to the third embodiment, the manufacturing device for a reconstituted tobacco sheet further comprises the deaeration mechanism that deaerates the reconstituted tobacco raw material that is fed to the extruder. It is therefore possible to obtain the reconstituted tobacco sheet having high and uniform density and high strength. In this connection, the extruder 2A, the deaeration chamber 2B, and the extruder 10 may be integrally configured to function as an extruder having a deaerating function.

Fourth Embodiment:

[0037] Fig. 10 is a plan view of a manufacturing device for a reconstituted tobacco sheet according to the fourth embodiment of the invention. In Fig. 10, 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] As discussed above, according to the fourth 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.

Fifth Embodiment:

[0042] 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 fifth 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.

[0043] 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.

[0044] As discussed above, according to the fifth 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.

Sixth Embodiment:

[0045] Fig. 11 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the sixth embodiment of the invention. In Fig. 11, 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.

[0046] 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.

[0047] 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.

[0048] 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.

[0049] As discussed above, according to the sixth 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.

Seventh Embodiment:

[0050] Fig. 12 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to the seventh embodiment of the invention as viewed from a discharge port side. In Fig. 12, 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.

12. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0051] 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.

[0052] As discussed above, according to the seventh 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.

Eighth Embodiment:

[0053] Fig. 13 is a side view of a die of a manufacturing device for a reconstituted tobacco sheet according to the eighth embodiment of the invention as viewed from a discharge port side. In Fig. 13, 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. 13 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.

[0054] 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.

[0055] As discussed above, according to the eighth 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.

[0056] If the protruding portion 28 has the shape of the letter T as illustrated in Fig. 14, 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 eighth embodiment.

Ninth Embodiment:

[0057] Fig. 15 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the ninth embodiment of the invention. Fig. 15 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.

[0058] 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] As discussed above, according to the ninth 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 ninth 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.

10th Embodiment:

[0063] Fig. 16 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 10th embodiment of the invention. Fig. 16 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.

[0064] 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.

[0065] 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.

[0066] 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.

[0067] 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.

[0068] 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.

[0069] As discussed above, according to the 10th 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.

11th Embodiment:

[0070] Fig. 17 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 11th embodiment of the invention. Fig. 17 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. 16. The other configurations are similar to the 10th embodiment discussed above and

therefore will be omitted from discussion.

[0071] 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.

[0072] 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.

[0073] As discussed above, according to the 11th 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.

12th Embodiment:

[0074] In a manufacturing device for a reconstituted tobacco sheet according to the 12th 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.

[0075] 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

(continued)

Surface treatment		Representative characteristics		
		Decorativeness	Rust-proofness	Abrasion resistance
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	Hard chrome		Excellent	Good	*	Excellent	Good	Good	*
	Very hard chrome		Excellent	Good	*	Excellent	Good	Good	*
	Zinc	Trivalent chromate			*			Good	Good
		Trivalent black chromate			*			Good	Good
		Hexavalent chromate			*			Good	Good
	Nickel					Good			
	Nickel-Chrome (Decorative chrome)								
Non-electrolytic plating	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	Colorless	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)						

[0076] 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.

[0077] As discussed above, according to the 12th 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.

13th Embodiment:

[0078] Fig. 18 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 13th embodiment of the invention. Fig. 18 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.

[0079] 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.

[0080] 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.

[0081] As discussed above, according to the 13th 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 13th 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.

14th Embodiment:

[0082] Fig. 19 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention. Fig. 20 is a block diagram showing opening width control in the manufacturing device for a reconstituted tobacco sheet according to the 14th embodiment of the invention. Figs. 19 and 20 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 fifth embodiment. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0083] 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 a result as a measured thickness value to the PLC (programmable logic controller) 200.

[0084] 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.

[0085] 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.

[0086] As discussed above, according to the 14th 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.

15th Embodiment:

[0087] Fig. 21 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 15th embodiment of the invention. Fig. 22 is a block diagram showing discharge velocity control in the manufacturing device for a reconstituted tobacco sheet according to the 15th embodiment of the invention. Figs. 21 and 22 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.

[0088] 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 a result 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.

[0089] 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.

[0090] 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.

[0091] As discussed above, according to the 15th 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 flow rate or discharge pressure 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.

[0092] In the 15th 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.

16th Embodiment:

[0093] Fig. 23 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 16th embodiment of the invention. Fig. 24 is a block diagram showing hot air temperature control in the manufacturing device

for a reconstituted tobacco sheet according to the 16th embodiment of the invention. Figs. 23 and 24 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 13th embodiment as an actuator. The other configurations are similar to the first embodiment discussed above and therefore will be omitted from discussion.

[0094] 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 a result 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.

[0095] 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.

[0096] 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.

[0097] As discussed above, according to the 16th 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.

[0098] The manufacturing device 100G for a reconstituted tobacco sheet according to the 14th embodiment, the manufacturing device 100H for a reconstituted tobacco sheet according to the 15th embodiment, and the manufacturing device 100I for a reconstituted tobacco sheet according to the 16th embodiment may be combined together in any way.

17th Embodiment:

[0099] Fig. 25 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 17th embodiment of the invention. Fig. 25 shows a manufacturing device 100J for a reconstituted tobacco sheet which is obtained by adding an addition mechanism 95 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.

[0100] The addition mechanism 95 is provided near a discharge port 26 and adds powdered or liquid aroma chemical by discharge onto a reconstituted tobacco sheet 1 discharged from a die 20. The addition mechanism does not necessarily have to be installed near the discharge port 26 but may be provided on a drying path of a drum dryer 30.

[0101] The reconstituted tobacco sheet 1 manufactured by the invention is low in liquid permeability because of flat and smooth surfaces thereof which are resulted from pressure load applied to the reconstituted tobacco sheet 1 by the die 20 and shrinkage that occurs when the reconstituted tobacco sheet 1 is dried by the drum dryer 30. If the aroma chemical is added before or during the drying of the reconstituted tobacco sheet 1, an additive is improved in adherence. The installation of the addition mechanism 95 in the manufacturing device 100J for a reconstituted tobacco sheet eliminates the necessity of the step of adding aroma chemical in a downstream step.

[0102] As discussed above, according to the 17th embodiment, the addition mechanism that adds powdered or liquid aroma chemical is further provided on the downstream side of the die 20, which improves the adherence of additives.

18th Embodiment:

[0103] Fig. 26 is a side view of a manufacturing device for a reconstituted tobacco sheet according to the 18th embodiment of the invention. Fig. 26 shows a manufacturing device 100K for a reconstituted tobacco sheet which is obtained by adding a buffer mechanism 55 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.

[0104] The buffer mechanism 55 is provided between a discharge port 26 and a drum dryer 30. The buffer mechanism 55 reels a reconstituted tobacco sheet 1 discharged from a die 20 thereon and temporarily holds the reconstituted tobacco sheet 1. The buffer mechanism 55 is suitable for reconstituted tobacco raw material with a low moisture content. The reconstituted tobacco sheet 1, before being dried by the drum dryer 30, has low strength. With regard to a structure of the buffer mechanism 55, the buffer mechanism including, for example, fixed rollers 56 and movable rollers 57 that are movable according to tension of the reconstituted tobacco sheet 1 is suitable. The buffer mechanism 55 moves the movable rollers 57 so that the reconstituted tobacco sheet 1 has an even tension.

[0105] The installation of the buffer mechanism 55 makes it possible to deal with the situation where discharge velocity of the reconstituted tobacco sheet 1 discharged from the die 20 and rotational frequency of a drum body 32 are out of synchronization due to fluctuation in discharge rate from the die 20. To be more specific, the discharge velocity of the reconstituted tobacco sheet 1 and the rotational velocity of the drum body 32 can be synchronized with each other by reeling out the reconstituted tobacco sheet 1 held by the buffer mechanism 55 or temporarily holding the reconstituted tobacco sheet 1 at the buffer mechanism 55. Even if a device located upstream or downstream of the buffer mechanism 55 is suspended for a short period of time, the use of the buffer mechanism 55 restrains the suspension of the entire manufacturing device 100K for a reconstituted tobacco sheet.

[0106] As discussed above, according to the 18th embodiment, the buffer mechanism 55 that temporarily holds the reconstituted tobacco sheet 1 discharged from the die 20 is provided on the downstream side of the die 20. This makes it possible to deal with the situation where the discharge velocity of the reconstituted tobacco sheet 1 and the rotational frequency of the drum body 32 are out of synchronization.

[0107] 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

[0108]

1: Reconstituted tobacco sheet
2: Deaeration mechanism
2A: Extruder
2B: Deaeration chamber
10, 10A to 10X, 10Z: Extruder
11, 11Z: Housing
12, 12Z: Feed port
13, 13Z: Extrusion port
14: Screw
14A: First screw
14B: Second 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
53: Slitting drum
55: Buffer mechanism
56: Fixed roller
57: Movable 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
95: Addition mechanism
100, 100A to 100L: Manufacturing device for a reconstituted tobacco sheet

Claims

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

a die configured to discharge reconstituted tobacco raw material, and
an extruder configured to press-feed the reconstituted tobacco raw material to the die by rotation of a screw that is rotatably disposed inside the extruder,
the die including:

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.

2. The manufacturing device for a reconstituted tobacco sheet according to Claim 1,
wherein the extruder is a two-axis extruder including a pair of screws disposed parallel with each other and configured to rotate in opposite directions to each other.

3. The manufacturing device for a reconstituted tobacco sheet according to Claim 1 or 2, further comprising:
a deaeration mechanism configured to deaerate the reconstituted tobacco raw material that is fed to the extruder.

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

press-feeding reconstituted tobacco raw material to a feed port of a die by rotation of a screw provided in an extruder, and
forming the reconstituted tobacco raw material into a sheet and discharging the reconstituted tobacco raw material from a discharge port of the die.

Fig. 1

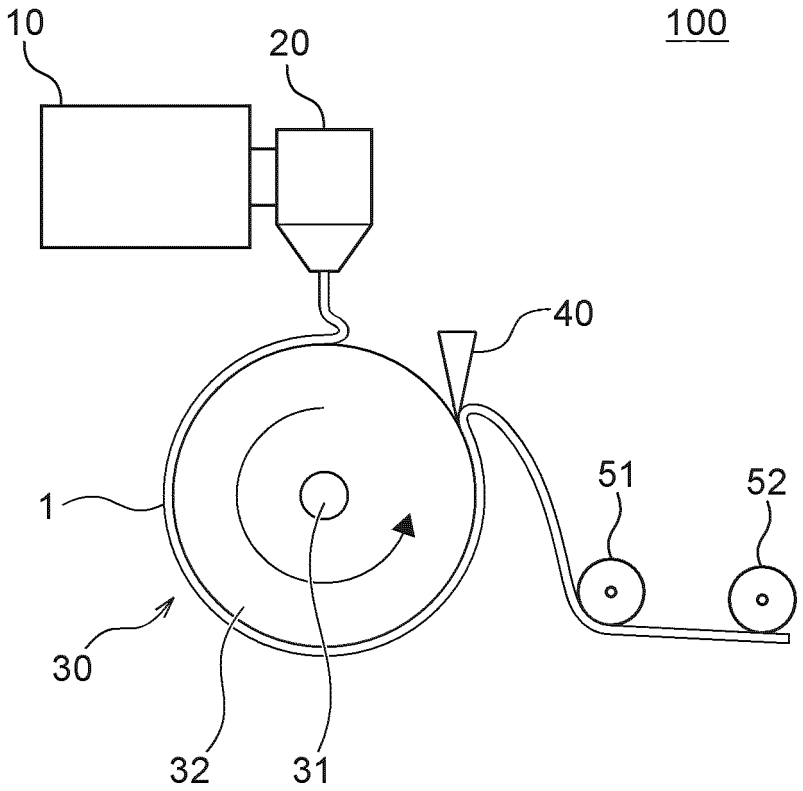


Fig. 2

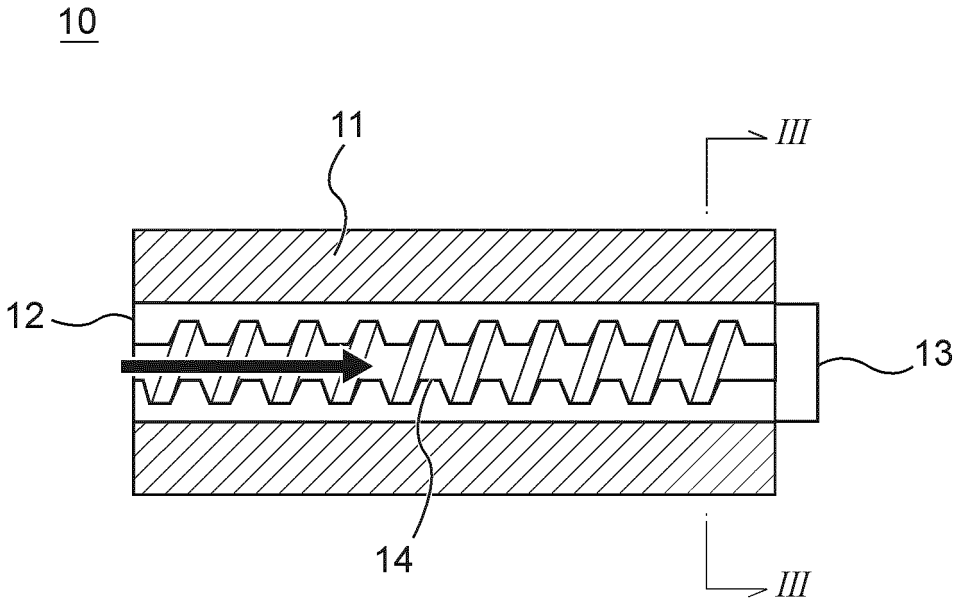


Fig. 3

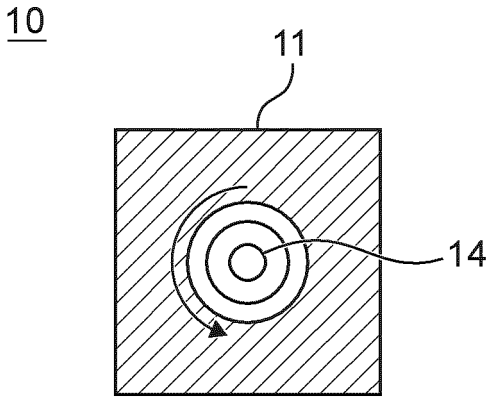


Fig. 4

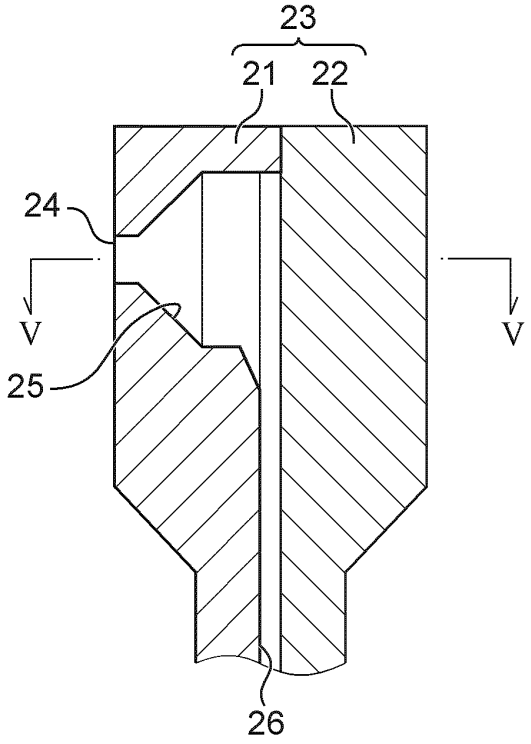


Fig. 5

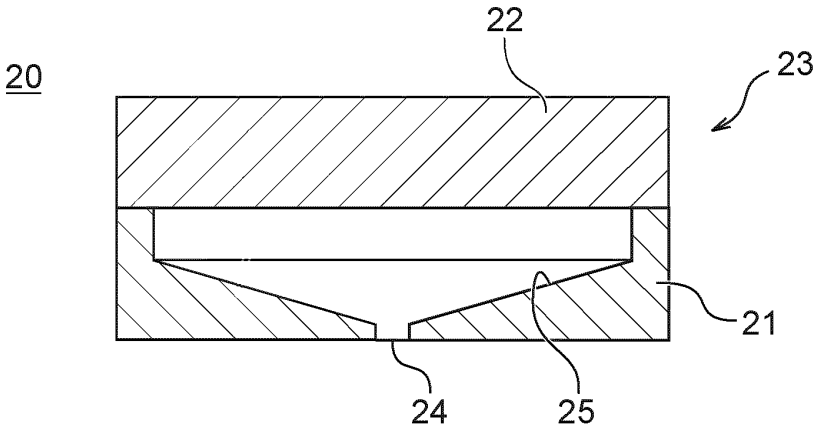


Fig. 6

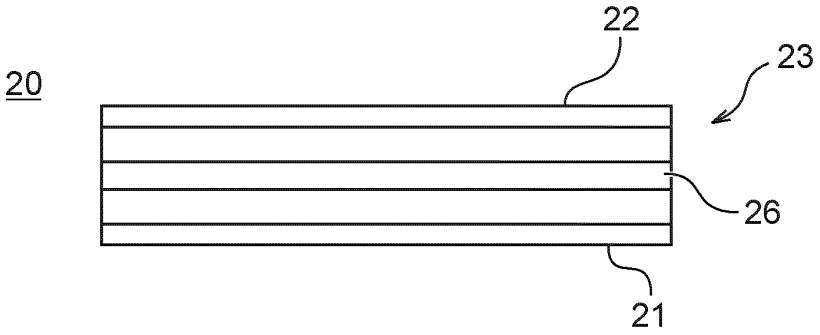


Fig. 7

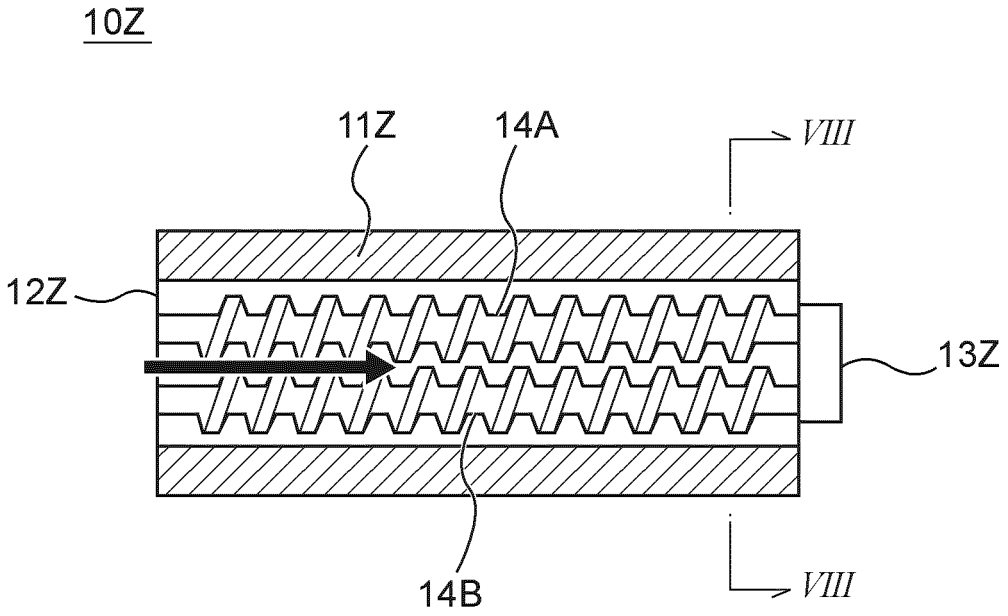


Fig. 8

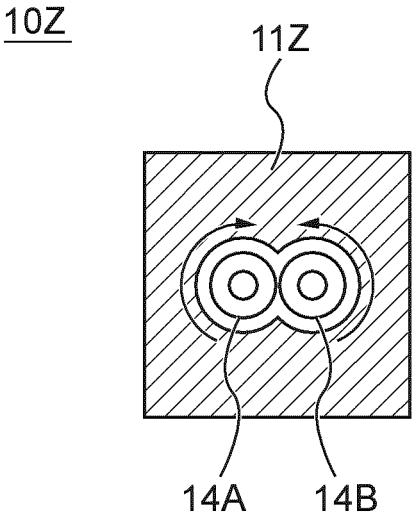


Fig. 9

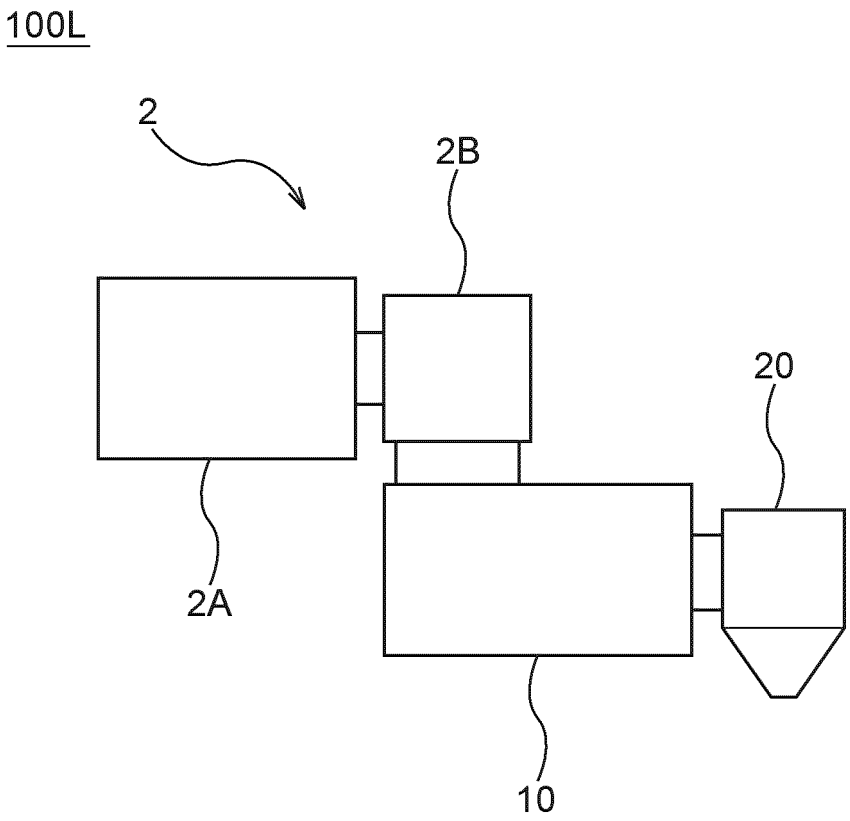


Fig. 10

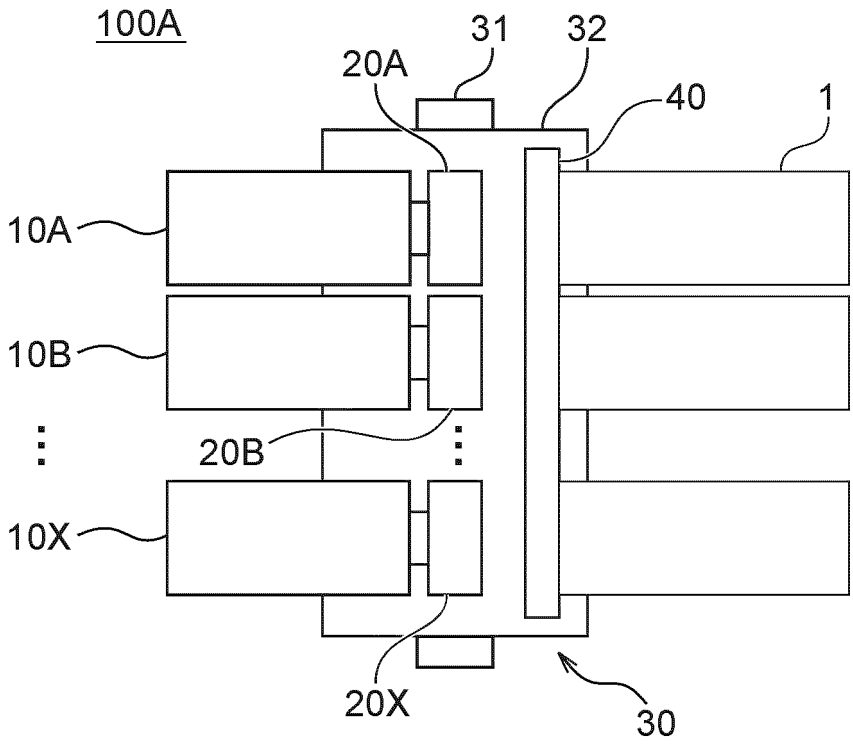


Fig. 11

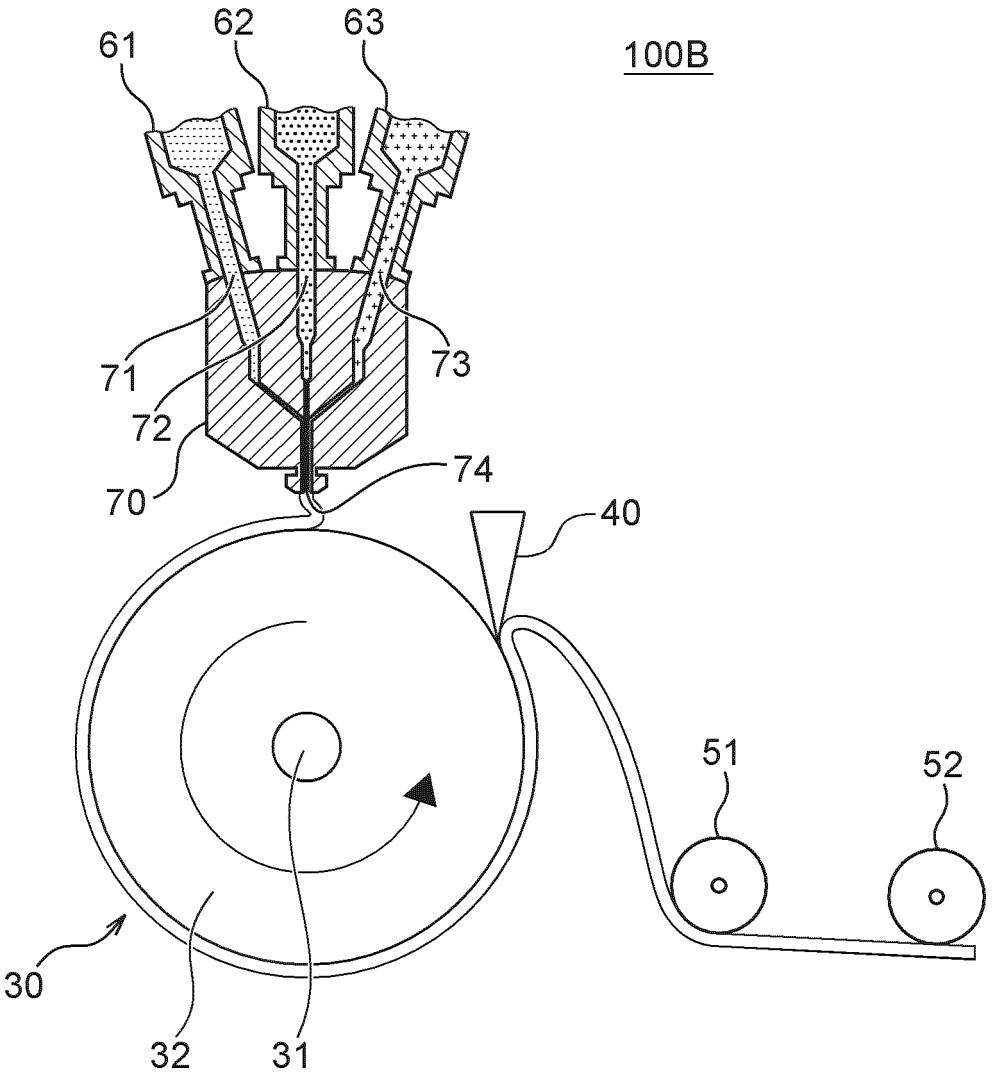


Fig. 12

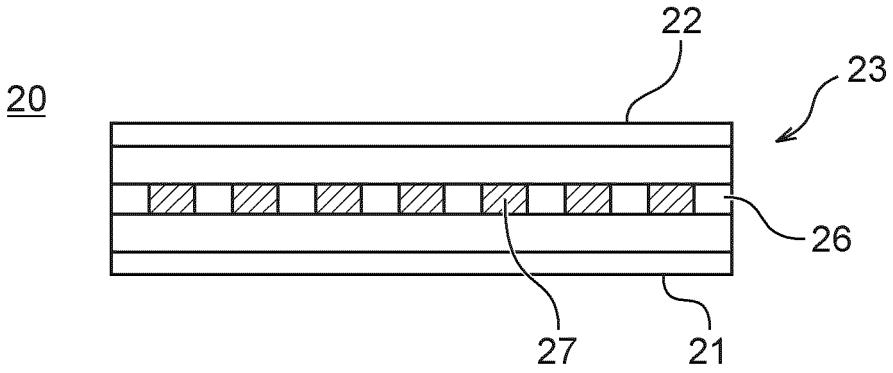


Fig. 13

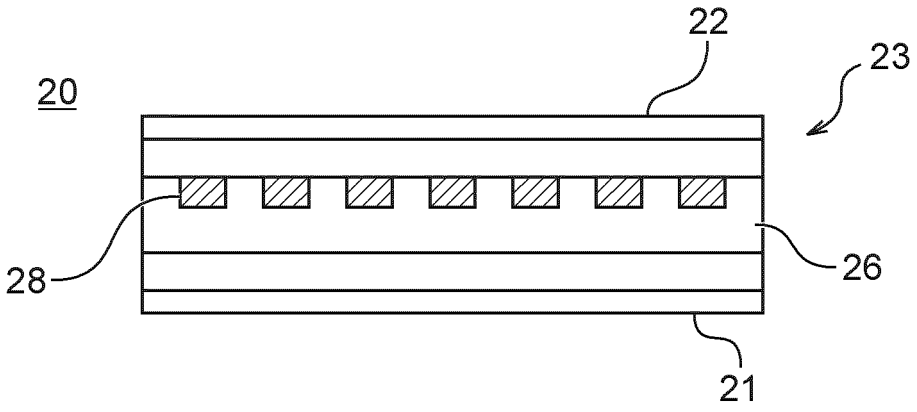


Fig. 14

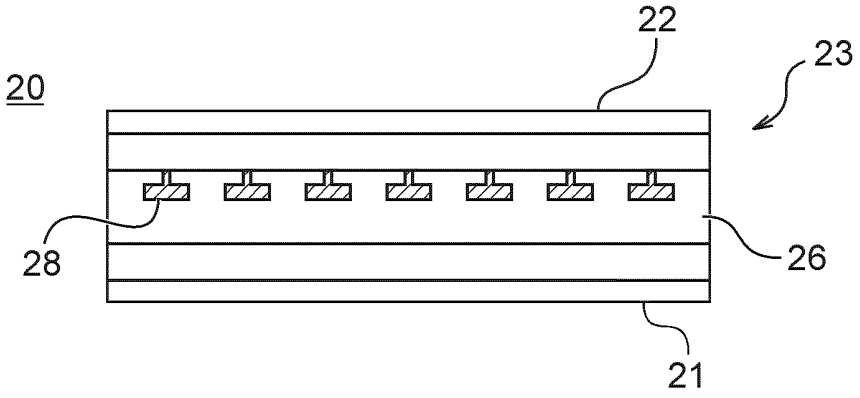


Fig. 15

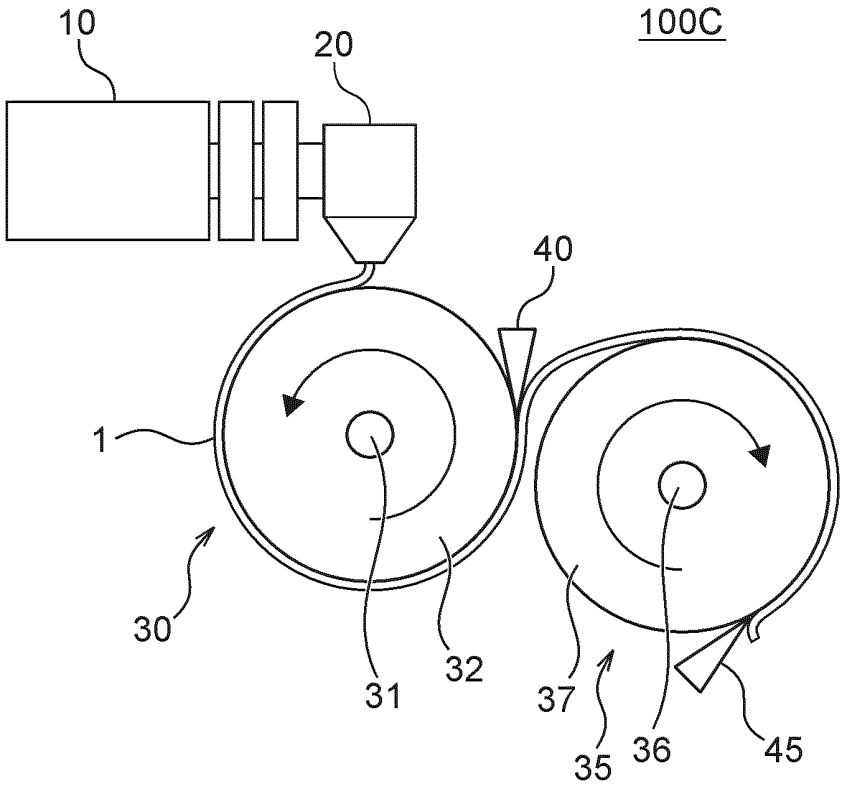


Fig. 16

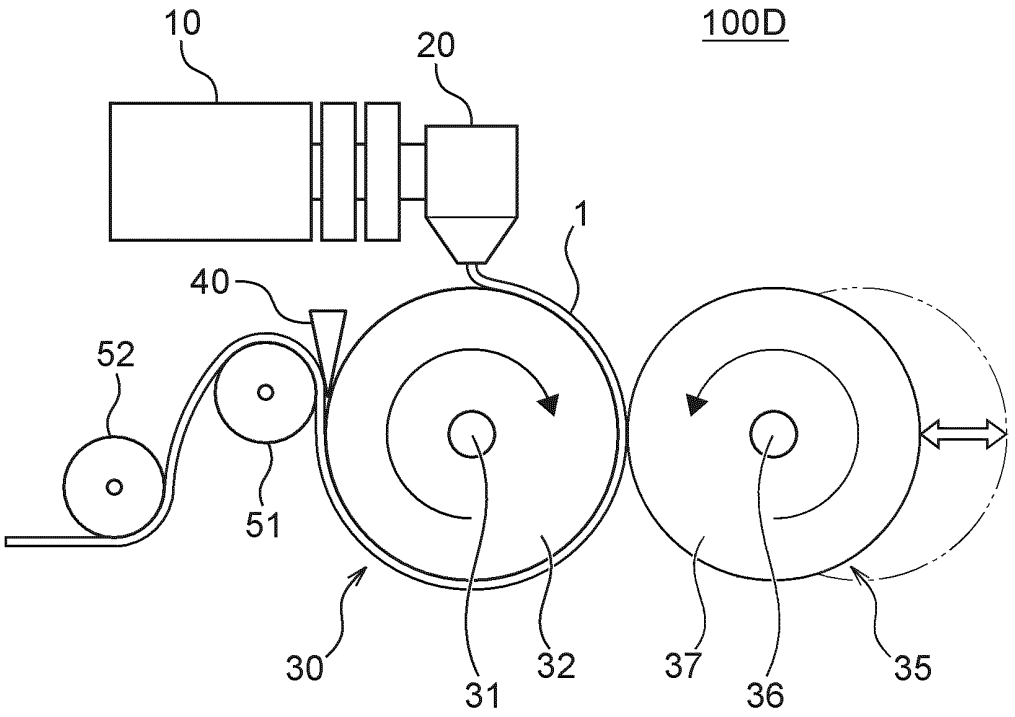

100D
10
20
1
40
52
51
30
31
32
37
36
35

Fig. 17

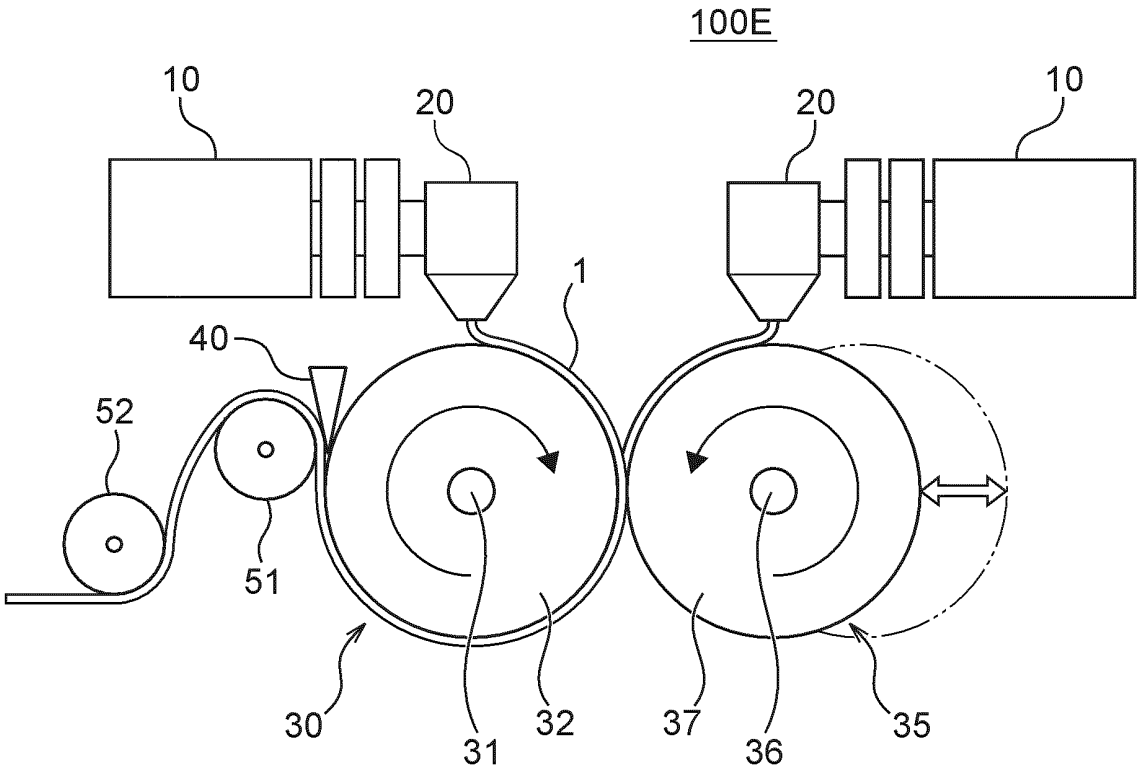

100E
10
20
20
10
1
40
52
51
30
31
32
37
36
35

Fig. 18

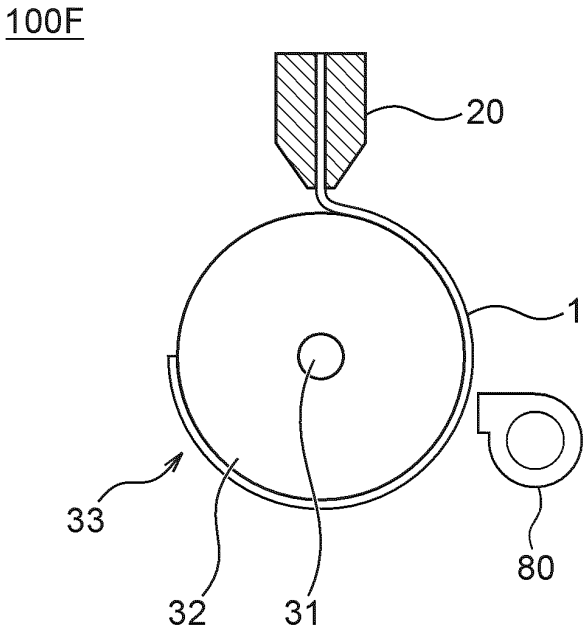


Fig. 19

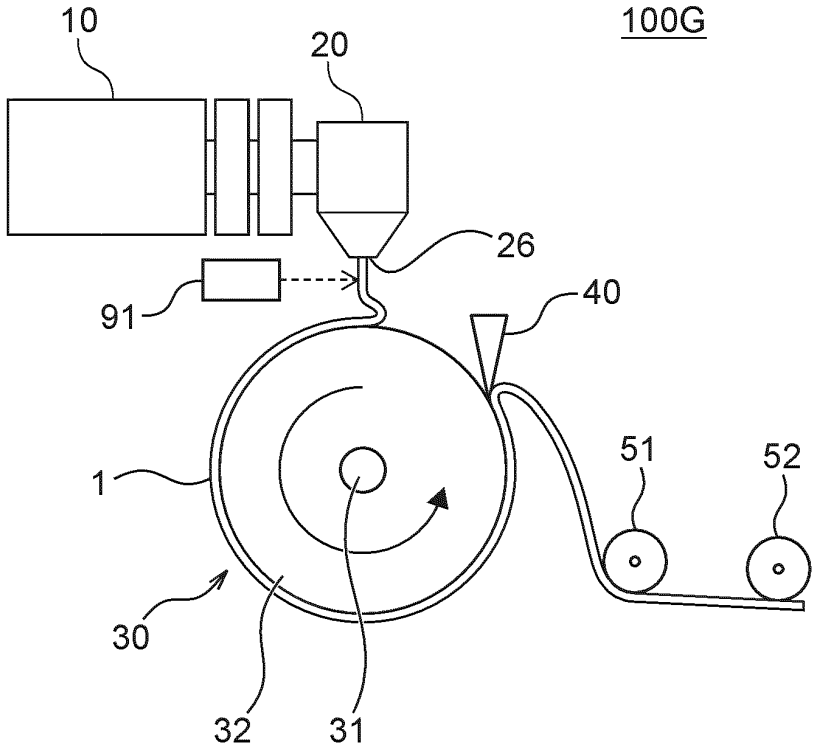


Fig. 20

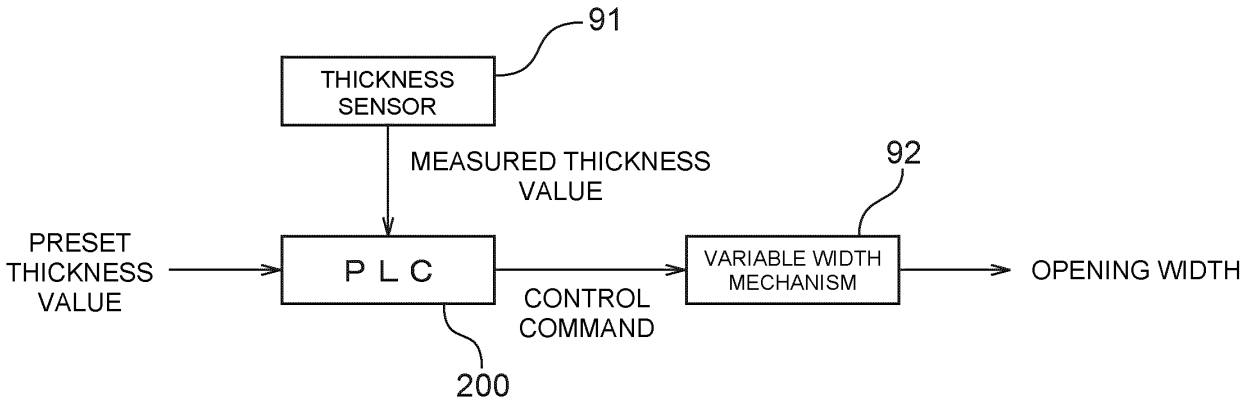

91
THICKNESS SENSOR
MEASURED THICKNESS VALUE
92
PRESET THICKNESS VALUE
P L C
VARIABLE WIDTH MECHANISM
OPENING WIDTH
CONTROL COMMAND
200

Fig. 21

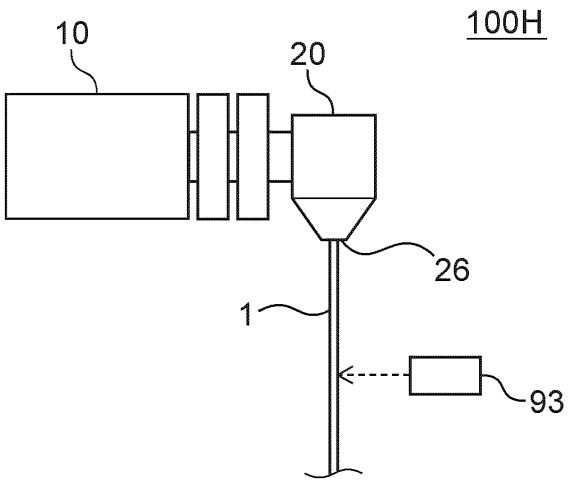

100H
10
20
26
1
93

Fig. 22

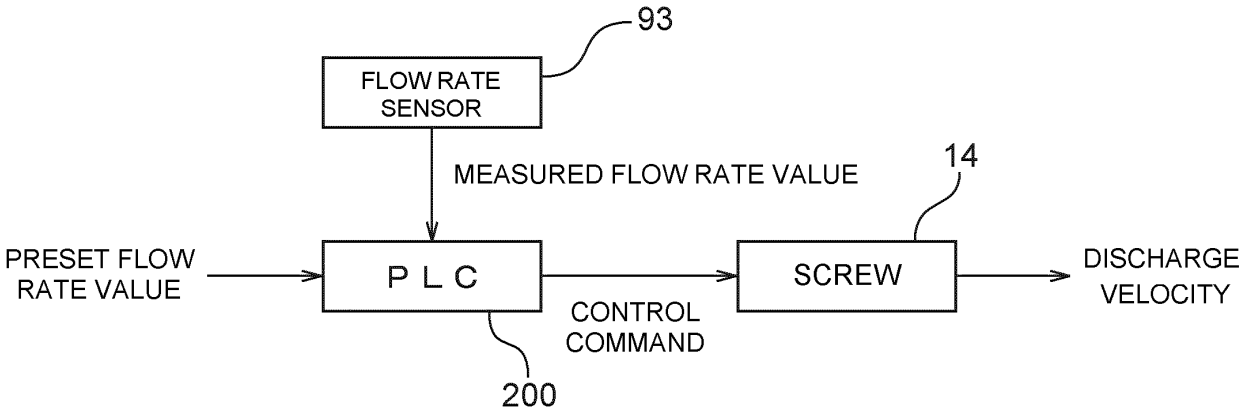

93
FLOW RATE SENSOR
MEASURED FLOW RATE VALUE
14
PRESET FLOW RATE VALUE
P L C
SCREW
DISCHARGE VELOCITY
CONTROL COMMAND
200

Fig. 23

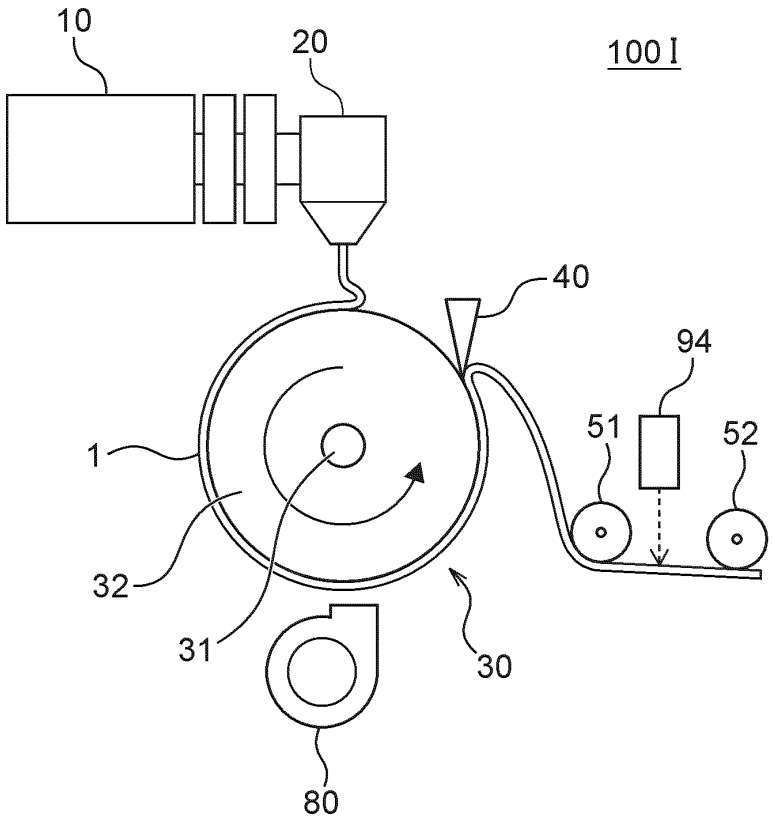

10
20
100 I
40
94
51
52
1
32
31
30
80

Fig. 24

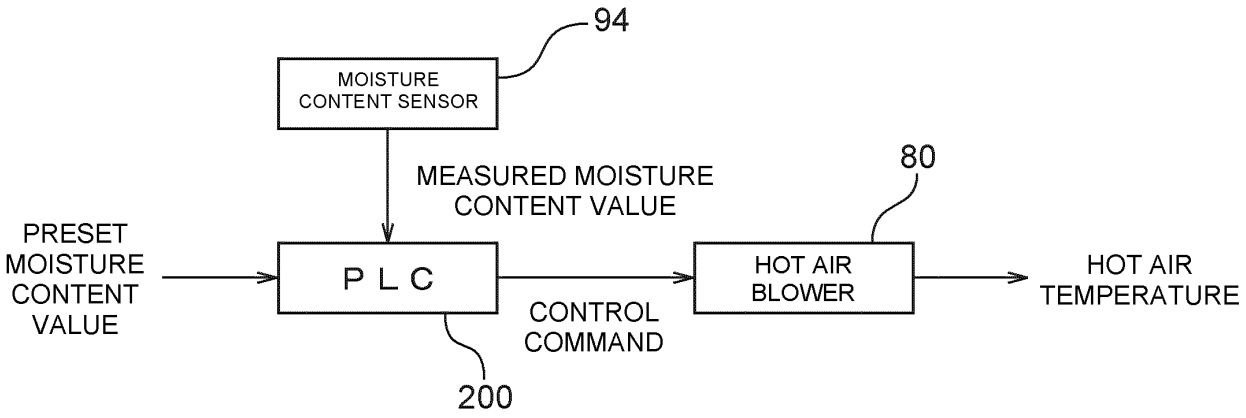

94
MOISTURE CONTENT SENSOR
MEASURED MOISTURE CONTENT VALUE
80
PRESET MOISTURE CONTENT VALUE
P L C
HOT AIR BLOWER
HOT AIR TEMPERATURE
CONTROL COMMAND
200

Fig. 25

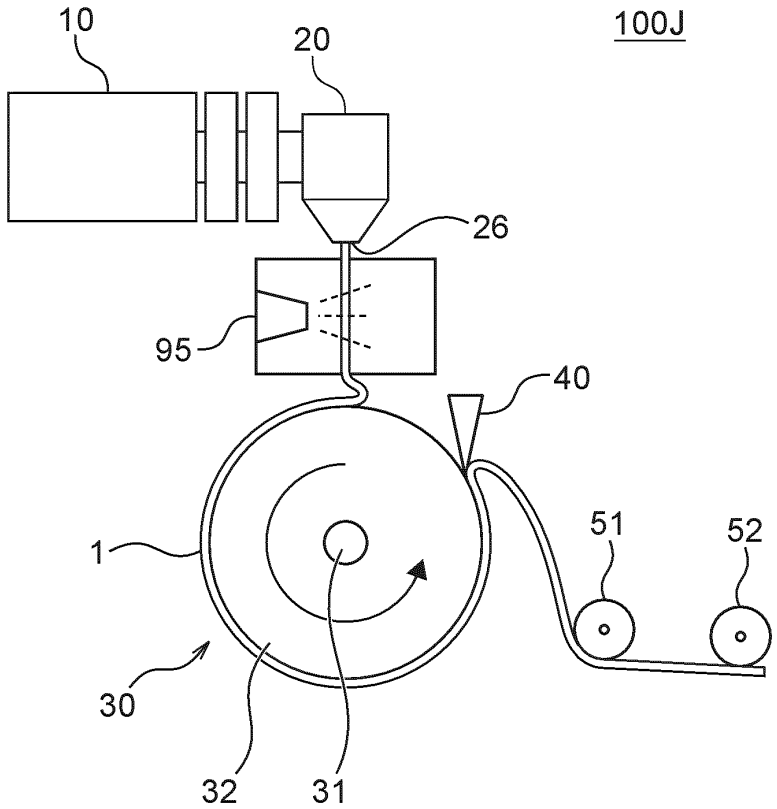
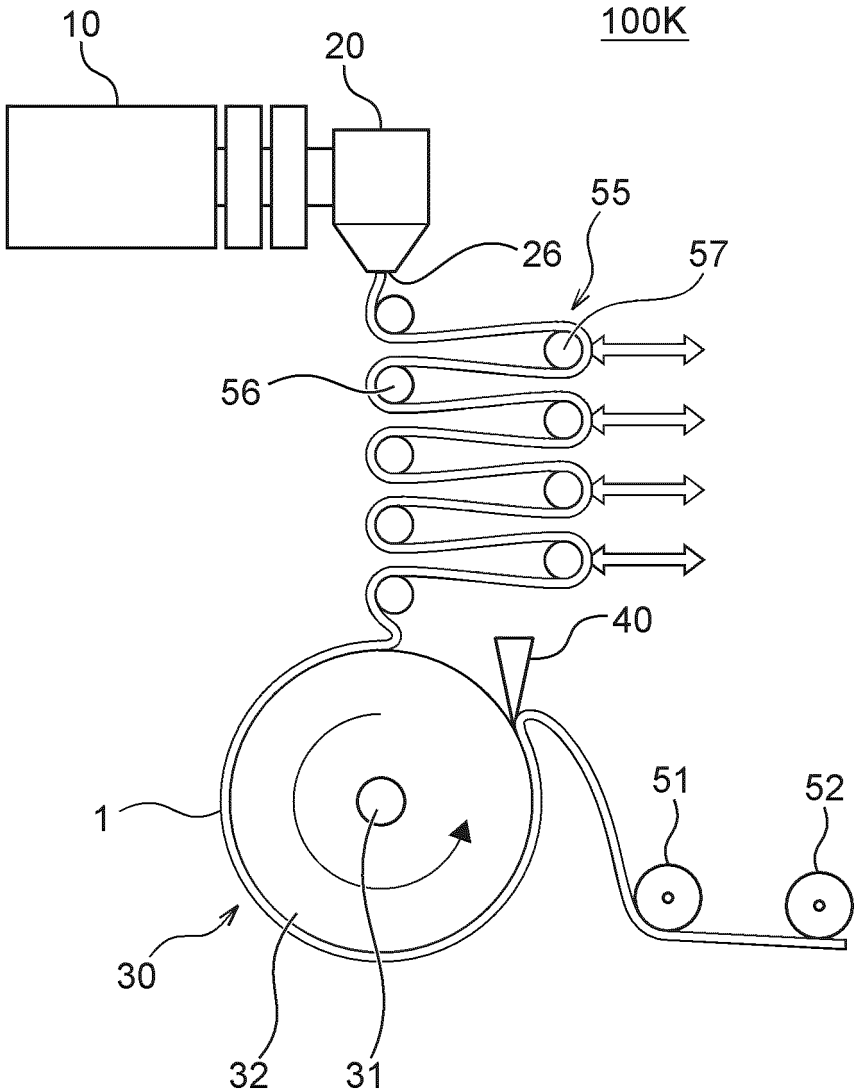

10
20
100J
26
95
40
1
51
52
30
32
31

Fig. 26



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023577

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. A24B3/14(2006.01)i
FI: A24B3/14

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)
Int. Cl. 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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2011-500021 A (PHILIP MORRIS PRODUCTS S.A.) 06 January 2011 (2011-01-06), paragraphs [0114], [0115], fig. 2, 3	1, 4 2-3
X Y	JP 07-265042 A (JAPAN TOBACCO INC.) 17 October 1995 (1995-10-17), paragraphs [0019]-[0021], fig. 1	1, 4 2-3
Y	JP 61-224941 A (THE NISSHIN OIL MILLS, LTD.) 06 October 1986 (1986-10-06), p. 2, lower right column, line 17 to p. 3, upper left column, line 4, all drawings	2-3
Y	JP 2009-542244 A (AYAM SARL) 03 December 2009 (2009-12-03), paragraph [0056]	2-3

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
12.08.2021	24.08.2021
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)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/023577

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 2020-0017762 A (KT & G CORPORATION) 19 February 2020 (2020-02-19), paragraphs [0037]-[0039], fig. 2	3

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/023577

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 2011-500021 A	06.01.2011	US 2009/0095313 A1 paragraphs [0112], [0113], fig. 1, 2 WO 2009/048522 A1 EP 2205227 A1 KR 10-2010-0067127 A CN 101877975 A	
JP 07-265042 A	17.10.1995	(Family: none)	
JP 61-224941 A	06.10.1986	(Family: none)	
JP 2009-542244 A	03.12.2009	US 2010/0021593 A1 paragraph [0101] WO 2008/003837 A1 EP 2051597 A1 CN 101505616 A	
KR 2020-0017762 A	19.02.2020	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2019520036 A **[0006]**