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

(11) **EP 2 692 247 A1**

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

(43) Date of publication:
05.02.2014 Bulletin 2014/06

(21) Application number: **11862760.3**

(22) Date of filing: **31.03.2011**

(51) Int Cl.:
A24B 3/04 *(2006.01)*

(86) International application number:
PCT/JP2011/058342

(87) International publication number:
WO 2012/132008 (04.10.2012 Gazette 2012/40)

(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

(71) Applicant: **Japan Tobacco, Inc.**
Tokyo 105-8422 (JP)

(72) Inventors:
- **TAGUCHI, Satoshi**
  Tokyo 130-8603 (JP)
- **UEMATSU, Hiromi**
  Tokyo 130-8603 (JP)
- **NISHIMURA, Manabu**
  Tokyo 130-8603 (JP)
- **SAKAMOTO, Koji**
  Tokyo 130-8603 (JP)
- **TSUCHIZAWA, Kazuyuki**
  Tokyo 130-8603 (JP)

(74) Representative: **Isarpatent**
Patent- und Rechtsanwälte
Friedrichstrasse 31
80801 München (DE)

(54) TOBACCO MATERIAL EXPANSION METHOD AND DEVICE

(57) A method of expanding tobacco material includes moistening and swelling tobacco material by swirling the tobacco material together with a steam flow at temperatures of 100-160°C in contact therewith, and drying the tobacco material after being moistened and swollen. According to the method, filling capacity of the tobacco material can be increased compared to conventional methods.

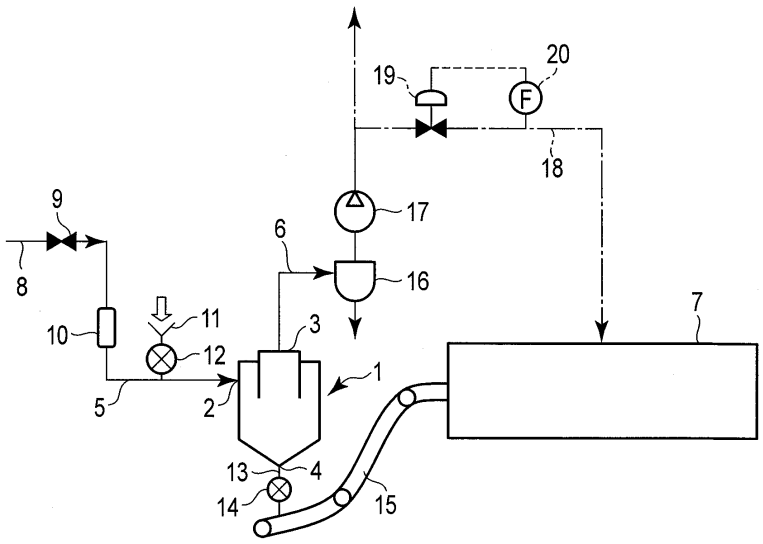

FIG. 1

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Description

Technical Field

[0001] The present invention relates to a method and an apparatus for expanding tobacco material.

Background Art

[0002] Tobacco material (such as stems), which is separated from tobacco leaves, constitutes 20-30% by weight of tobacco leaves. Shreds of stems (cut stems) are used as tobacco shreds together with cut laminas of tobacco leaves, from which the stems are removed, for the purpose of utilizing tobacco material. In general, cut stems are obtained by rolling and shredding stems. The cut stems are subjected to an expanding process including conditioning and drying, so as to increase filling capacity and combustibility and soften the smoking taste. Conventional processes of expanding cut stems and techniques related thereto will be described below.

[0003] Japanese Patent No. 4031115 discloses a method and an apparatus for applying a conditioning agent to tobacco material. This apparatus has a structure in which nozzles are provided in impeller-like projections such as carrying pins, including a rotary winnowing roll (hereinafter referred to as a winnower). According to this method, injection of a conditioning agent is performed prior to drying, by spraying steam from the nozzles to tobacco material falling freely, using the above-described apparatus, and then the tobacco material is conveyed to a drying process section.

[0004] The specification of U. S. Patent No. 4,766,912 discloses a method and an apparatus for expanding tobacco material. According to the U. S. patent, the apparatus comprises a steam spraying device including a vibratory conveyor for conveying tobacco material and conveys the tobacco material by spraying steam via holes in a lower surface of the vibratory conveyor to the material being conveyed while vibrating the material, and a fluidized bed dryer, in an attempt to improve filling capacity of the tobacco material. The specification of U. S. Patent No. 2,802,334 discloses an apparatus comprising a closed transport duct formed as a vibratory conveyor including an inlet and an outlet, a supply device for supplying steam or a heated gas to a bottom of the transport duct, and spraying holes, in relation to the above-mentioned U. S. Patent.

[0005] Jpn. Pat. Appln. KOKAI Publication No. 62-3778 discloses a method and an apparatus for drying tobacco in which two stages of pneumatic conveying flush drying process are continuously performed. More specifically, tobacco material is supplied into a high-temperature gas medium and is transported to a first separation device via a first duct, where the material and the gas medium are separated from each other. The high-temperature gas medium is supplied to a second duct, and the separated tobacco material is supplied to a downstream part of the first separation device. The tobacco material and the high-temperature gas medium are transported to the second separation device via the second duct, where the material and the gas medium are separated from each other. By thus letting the tobacco material pass through two drying sections, it is possible to (1) reduce the time during which the tobacco material is continuously exposed to the high-temperature gas medium, (2) solve the problem that overheating occurs in an excessively intensive manner, and (3) improve drying efficiency by difference in relative velocity as a result of the tobacco material being accelerated at two stages. The publication further discloses using a separation device for reducing the time during which the tobacco material and the high-temperature gas medium contact each other.

[0006] The above-mentioned conventional techniques, however, have problems as will be described below.

[0007] In the apparatus disclosed in Japanese Patent No. 4031115, the transit time of the tobacco material and the steam in the apparatus is short, judging from the descriptions on the velocity of free fall, the effective height of the apparatus, and the number of revolutions (200 rpm) of the winnower. Since the tobacco material contacts the steam for a short time, moistening and swelling is not sufficiently performed. Further, since the winnower includes a rotating part, deterioration of components is fast. Moreover, the tobacco material easily becomes tangled in the rotating part. The tangled tobacco material causes a significant effect on the smoking taste and physical properties.

[0008] U. S. Patent No. 4,766,912 discloses a structure of causing the steam spraying device to convey the material by vibration and spray steam from the holes in the bottom surface of the vibratory conveyor. Since deterioration of driving components caused by the vibration is fast, this structure is inferior in terms of durability. Spraying of steam from the bottom surface of the vibratory conveyor uses perforations with diameters of as small as 0.8 mm, for example. Accordingly, the perforations are clogged with scale (inorganic substances such as calcium carbonate) contained in the steam and fine powder of tobacco material. Clogging of the perforations causes fluctuation in the amount of steam and makes the quality of processed tobacco material unstable.

[0009] In the technique disclosed in Jpn. Pat. Appln. KOKAI Publication No. 62-3778, since two stages of pneumatic conveying flush drying process are performed using two separation devices connected in series, drying of tobacco material advances in each stage. Due to the characteristics of the apparatus, however, the time during which the tobacco material and high-temperature wet air or a superheated steam flow contact becomes very short. As a result, it is difficult to sufficiently moisten or swell the tobacco material. Further, the tobacco material is deposited on a mesh screen of the

separation devices, and thereby an exhaust system is blocked. This obstructs continuous operation of the separation devices.

Disclosure of Invention

[0010] The present invention provides a method for expanding tobacco material capable of increasing filling capacity of the tobacco material compared to conventional techniques.

[0011] The present invention provides an apparatus for expanding tobacco material with a simple structure capable of increasing filling capacity of the tobacco material compared to conventional techniques and achieving continuous processing and high durability.

[0012] According to a first aspect of the present invention, there is provided a method for expanding tobacco material, comprising: moistening and swelling tobacco material by swirling tobacco material together with a steam flow at temperatures of 100-160°C in contact therewith; and drying the tobacco material after being moistened and swollen.

[0013] According to a second aspect of the present invention, there is provided an apparatus for expanding tobacco material, comprising: a cyclone including an inlet, a vent, and an outlet; a supply duct connected to the inlet of the cyclone; an exhaust duct connected to the vent of the cyclone; a steam supply section connected to the supply duct; a tobacco material supply section connected to the supply duct in a position between a connection part of the steam supply section and the inlet of the cyclone; and a dryer to which tobacco material discharged from the outlet of the cyclone is conveyed and configured to dry the tobacco material.

Brief Description of Drawings

[0014]

FIG. 1 is a schematic diagram illustrating an apparatus for expanding tobacco material according to an embodiment.

Best Mode for Carrying Out the Invention

[0015] A method for expanding tobacco material according to an embodiment of the present invention will now be described.

(First Step)

[0016] Tobacco material is moistened and swollen by swirling the tobacco material with a steam flow at temperatures of 100-160°C in contact therewith.

[0017] Cut stems, for example, can be used as the tobacco material. Cut stems are obtained by separating rod-like stems from tobacco leaves and rolling and shredding the rod-like stem material according to a fixed method. More specifically, rod-like stem material is conditioned to a moisture content of 15-50% by weight, preferably 20-40% by weight, for example. The conditioned rod-like stem material is rolled by a rolling mill with 0.5 to 1.2 mm roll pitches, for example, and is shredded into 0.1-0.3 mm widths, and thereby cut stems are produced.

[0018] Steam at temperatures of 100-160°C can moisten and swell the tobacco material without drying the tobacco material. Preferably, the temperature of the steam should be in the range of 110-150°C.

[0019] Swirling of tobacco material together with a steam flow can be performed by introducing the tobacco material into a cyclone, for example, together with the steam flow. The residence time by the swirling should preferably be 0.5-5 seconds.

[0020] By letting the tobacco material contact the steam flow at the above-mentioned temperature in the above-mentioned residence time, condensation heat transfer of the steam to the tobacco material occurs. The condensation heat transfer causes increase in moisture and temperature (goods temperature) of the tobacco material, which makes tobacco tissues flexible and causes moistening and swelling. When the tobacco material contacts the steam flow at the above-described temperature in the above-described residence time, the moistened and swollen tobacco material does not dry and increases in moisture content to a level equal to a level before contacting the steam flow, or by 5% by weight or less.

(Second Step)

[0021] The moistened and swollen tobacco material is dried, and thereby expanded.

[0022] Drying can be performed by letting the tobacco material contact a superheated steam flow or a heated air flow.

[0023] The superheated steam flow should preferably have a temperature higher than the temperature of the steam

of the first step. By thus letting the superheated steam flow have a temperature higher than the temperature of the steam of the first step, the moistened and swollen tobacco material can be efficiently dried. The superheated steam flow should preferably have a temperature higher than the temperature of the steam of the first step, within the range of temperatures of 160-300°C. When the temperature of the superheated steam is 160°C, for example, the temperature of the steam of the first step is set to a temperature less than 160°C, and the temperature of the superheated steam is set to be higher than the temperature of the steam. Preferably, the temperature of the superheated steam should be within the range of 180-280°C.

[0024] A variety of existing approaches can be adopted in order to let the moistened and swollen tobacco material contact the superheated steam flow. In particular, the tobacco material should preferably be swirled together with the superheated steam flow. Swirling can be performed using a cyclone, for example. The residence time by the swirling should preferably be 2-15 seconds.

[0025] After the drying process, the moisture content of the tobacco material can be reduced to 3-15% by weight, for example.

[0026] According to the above-described method for expanding tobacco material of the present embodiment, by swirling tobacco material together with a steam flow at temperatures of 100-160°C in contact therewith, the tobacco material (such as cut stems) can be made into contact with the steam in a dispersed state without being damaged. As a result, the tobacco material can be moistened and swollen efficiently. After that, the moistened and swollen tobacco material is dried. Thereby, expanded tobacco material (such as expanded cut stems) with high filling capacity, compared to the conventional one obtained by directly drying conditioned tobacco material, can be obtained. By letting the moistened and swollen tobacco material contact heated air, preferably a superheated steam flow (in particular, at a temperature higher than the temperature of the steam of the preceding step, preferably a superheated steam flow within the range of temperatures of 160-300°C) during drying of the tobacco material, the filling capacity of the tobacco material can be further increased. By reducing the moisture content of the dried tobacco material to a level lower than 12% by weight, expanded tobacco material with remarkably increased filling capacity can be obtained.

[0027] When the tobacco material swirls together with the steam flow in contact therewith in the moistening and swelling step, the time required for moistening and swelling can be arbitrarily controlled by adjusting the amount of steam and the amount of air discharge. As a result, the filling capacity of the cut stems can be freely controlled by the drying process.

[0028] An apparatus for expanding tobacco material according to an embodiment will now be described with reference to FIG. 1.

[0029] A cyclone 1 includes an inlet 2 on a sidewall, a vent 3 at an upper part, and an outlet 4 at a bottom part. One end of a supply duct 5 is connected to the inlet 2 of the cyclone 1. One end of an exhaust duct 6 is connected to the vent 3 of the cyclone 1. A dryer 7 is arranged adjacent to the cyclone 1.

[0030] A steam supply tube 8 is connected to the other end of the supply duct 5. The steam supply tube 8 includes an on-off valve 9 which adjusts the amount of supply of steam. A heater 10 is arranged in the supply duct 5 in a position between a connection part of the steam supply tube 8 and the inlet 2 of the cyclone 1.

[0031] A tobacco material supply section 11 is connected to the supply duct 5 in a position between the heater 10 and the inlet 2 of the cyclone 1 via a first air locker 12.

[0032] The outlet 4 of the cyclone 1 is connected to a discharge duct 13, and a second air locker 14 is interposed in the discharge duct 13. One end of a transportation member, such as a vibratory conveyor 15, is positioned on the side of the discharge duct 13 of the cyclone 1, and the other end is positioned on the side of the dryer 7. The vibratory conveyor 15 conveys tobacco material discharged from the cyclone 1 to the dryer 7. A belt conveyor may be used instead of the vibratory conveyor as the transportation member. When the dryer is a pneumatic conveying dryer including a duct in which superheated steam circulates, the discharge duct 13 of the cyclone 1 may be directly connected to the duct of the dryer.

[0033] A drain separator 16 and an exhaust fan 17 are connected in this order to the exhaust duct 6 from the vent 3 of the cyclone 1. The other end of the exhaust duct 6 is made open so as to discharge steam circulating therein to the outside, or connected to the dryer 7 via a branch duct 18 so as to be reused as a drying source of the dryer 7.

[0034] A diaphragm valve 19 is arranged in the branch duct 18. A pressure gauge 20 is connected to the branch duct 18 in a position on the side of the dryer 7 from the diaphragm valve 19. An aperture of the diaphragm valve 19 is controlled on the basis of pressure detection data (pressure detection signal) from the pressure gauge 20.

[0035] A method for expanding tobacco material using the apparatus for expanding tobacco material shown in FIG. 1 will now be described.

[0036] Tobacco material (such as cut stems) is prepared. The cut stems are obtained by conditioning rod-like stem material to a moisture content of 20-40% by weight (wet basis), rolling the conditioned stem material using a rolling mill with 0.5-1.2 mm roll pitches, and then shredding the rolled stem material into 0.1-0.3 mm widths.

[0037] Dry saturated steam at a gauge pressure of 1-7 bars is sprayed into the supply duct 5 from the steam supply tube 8. The steam flow is heated by the heater 10 of the supply duct 5 as necessary. After that, the cut stem s are continuously supplied to the supply duct 5 from the tobacco material supply section 11 via the first air locker 12. By

driving the discharge fan 17 in advance, the cut stems flow into the cyclone 1 from the supply duct 5 together with the steam flow at temperatures of 100-160°C, and swirl together with the steam flow. In this case, the cut stems increase in moisture content to a level equal to a moisture level before the steam is supplied, or by 5% by weight, and is sufficiently moistened and swollen. Preferably, the circulation time in the supply duct 5 and the swirling time in the cyclone 1 should be 0.5-5 seconds, for example.

[0038] After the swirling, the cut stems are separated from the steam flow. The separated cut stems are discharged to the vibratory conveyor 15 via the second air locker 14 from the discharge duct 13 connected to the outlet 4 of the cyclone 1. When the exhaust fan 17 is driven, the steam flow is discharged to the exhaust duct 6 from the outlet 3 of the cyclone 1, from which the steam flow is discharged to the outside. While the steam flow circulates in the exhaust duct 6, water condensed in the steam flow is discharged from the drain separator 16.

[0039] The moistened cut stems are conveyed to the dryer (pneumatic conveying dryer, for example) 7 via the vibratory conveyor 15. The moistened cut stems are dried in the pneumatic conveying dryer 7, and thereby expanded. Drying in the pneumatic conveying dryer 7 can be performed using a superheated steam flow or a heated air flow. The superheated steam flow should preferably have a temperature higher than that of the steam supplied to the cyclone 1, within the range of temperatures of 160-280°C.

[0040] When the steam exhausted from the cyclone 1 is used as a part of the superheated steam of the pneumatic conveying dryer 7, an aperture of the diaphragm valve 19 arranged in the branch duct 18 is controlled on the basis of pressure detection data (pressure detection signal) from the pressure gauge 20, and a desired amount of steam flow circulating in the branch duct 18 is introduced into the pneumatic conveying dryer 7.

[0041] The obtained expanded cut stems have a moisture content of 3-15% by weight. The expanded cut stems have filling capacity of 580-750 cc per 100 g, and can improve the filling ability by approximately 30-70% compared to the filling capacity (450 cc per 100 g) of undried cut stems immediately after shredding.

[0042] In a step of drying cut stems in a system of a second cyclone 21 and a second circulation duct 25, when the moisture content has dropped to 10% or less by weight, for example, it is permitted to condition the cut stems by a known method, for example, by spraying water.

[0043] As described above, according to the apparatus for expanding tobacco material of the present embodiment, by performing moistening of the tobacco material (such as cut stems) using the cyclone 1 and the supply duct 5 connected to the cyclone 1, the cut stems can be efficiently contacted with a steam flow in a dispersed state, without being damaged. Generation of a swirling flow by the cut stems and the steam flow in the cyclone 1 makes it possible to increase the residence time of the cut stems in the steam flow even if the apparatus is reduced in size. As a result, the cut stems can be efficiently moistened and swollen, and by causing the pneumatic conveying dryer 7 to dry the cut stems thereafter, expanded cut stems with increased filling capacity can be obtained.

[0044] Since the cyclone 1 and the supply duct 5 installed in the expanding apparatus have an extremely simplified structure which does not require a rotary component or a mesh screen as in conventional apparatuses, the apparatus is excellent in durability and is capable of performing the steps of moistening and drying of the cut stems continuously.

[0045] Further, by letting the branch duct 18 divided from the exhaust duct 6 connected to the vent 3 of the cyclone 1 and connecting the branch duct 18 to the pneumatic conveying dryer 7 (such as a pneumatic conveying dryer which uses a superheated steam flow), steam circulating in the branch duct 18 from the cyclone 1 via the exhaust duct 6 can be efficiently used as a part of superheated steam of the dryer 7, thereby achieving energy-saving operation.

[0046] The example of the present invention will now be described in detail with reference to the apparatus for expanding tobacco material shown in FIG. 1.

(Example 1; Comparative Example)

[0047] In Example 1, a drying step was performed using the pneumatic conveying dryer 7 of FIG. 1.

[0048] Rod-like stem material of flue-cured tobacco of 100% by weight, for example, was conditioned by a method known to a person skilled in the art, e.g. by spraying water or steam, to a moisture content of 37% by weight, for example. Cut stems as tobacco material was prepared by causing a pair of rollers arranged at an interval of 0.8 mm to roll the rod-like stems, and then shredding the stems into 0.2 mm widths.

[0049] The cut stems were continuously introduced into the pneumatic conveying dryer 7 at a flow quantity of 25 kg/time by wet weight basis. The pneumatic conveying dryer is formed of a duct measuring approximately 100 mm in diameter and approximately 22 m in length, and a cyclone measuring approximately 460 mm in diameter and including a separator with an effective height of approximately 1.4 m. The dried medium circulating in the duct at a slot of the cut stems is adjusted by supplying 40 kg/time of saturated steam at a gauge pressure of 2 bars (0.2 MPa), such that the steam ratio becomes 90% by volume (which can be regarded as being approximately equal to a superheated steam flow) and the rate of flow becomes 25 m/s. That is, the cut stems circulated in the duct together with the superheated steam flow at 280°C, swirled and dried in the cyclone together with the superheated steam flow, and were thereby expanded. The residence time by the swirling was 5 seconds.

(Examples 2 and 3; Comparative Example)

[0050] Cut stems were dried and expanded in a manner similar to that of Example 1, except that the temperatures of the superheated steam flow circulating together with the cut stems were set to 260 and 210°C, respectively, in the duct of the pneumatic conveying dryer 7.

(Example 4; Embodiment)

[0051] In Example 4, the apparatus for expanding tobacco material shown in FIG. 1 was used.

[0052] Cut stems (37% by weight in moisture content and 0.2 mm in width) subjected to a process similar to that of Example 1 was prepared.

[0053] Saturated steam at a gauge pressure of 5 bars (0.5 MPa) was injected into the supply duct 5 (approximately 50 mm in diameter and approximately 0.6 m in length) arranged in a horizontal state from a nozzle part (3 mm in diameter) of the steam supply tube 8 at a flow quantity of approximately 40 kg/time. The cut stems were continuously introduced into the supply duct 5 via the first air locker 12 from the tobacco material supply section 11 at a flow quantity of 36 kg/time by wet weight basis. In this case, the steam flow circulating in the supply duct 5 was saturated steam at a temperature of 150°C. By driving the exhaust fan 17 in advance, the cut stems were introduced into the cyclone 1 (approximately 250 mm in diameter and including a separator with an effective height of approximately 0.75 m) together with the steam flow from the supply duct 5, and swirled together with the steam flow, and were thereby moistened and swollen. The transit time in the supply duct 5 and the cyclone 1 (residence time was 1.5 seconds) was approximately 1.8 seconds. The moisture content of the moistened cut stems was 39% by weight, which had increased by 2% by weight from the moisture content (37% by weight) at the time of conditioning.

[0054] After that, the moistened cut stems discharged from the cyclone 1 were continuously introduced into the pneumatic conveying dryer 7 via the vibratory conveyor 15, and the moistened cut stems were dried by a superheated steam flow under conditions similar to those of Example 1, and thereby expanded. The temperature of the superheated steam was set to 280°C.

(Example 5; Embodiment)

[0055] Moistened cut stems were dried and expanded in a manner similar to that of Example 4, except that the temperature of the superheated steam flow circulating together with the cut stems was set to 215°C, in the duct of the pneumatic conveying dryer 7.

[0056] The expanded cut stems obtained in Examples 1-5 were stored (conditioned) for 1 week in a constant temperature and humidity room at a temperature of 22.0°C and a relative humidity of 60%. After the equilibrium moisture content was obtained, the filling capacity was measured.

[0057] The filling capacity indicates the filling ability when the tobacco shreds are filled in rolling paper so as to be smoked. The measurement was performed using D51 from Borgwaldt, Germany. The examination was performed by measuring the filling capacity of the expanded cut stems 5 times repeatedly and calculating an average value.

[0058] The moisture content of the expanded cut stems was obtained as an average value of 5 points calculated from difference in weight before and after drying, after putting approximately 2 g of expanded cut stems into a weighing bottle and letting the expanded cut stems dry for 1 hour in a natural convection oven at a temperature of 100°C.

[0059] The filling capacity and the moisture content of the expanded cut stems of Examples 1-5 are shown in Table 1.

Table 1

	Whether moistening was performed and steam temperature thereof	Superheated steam temperature (°C) during drying	Moisture content (% by weight) of cut stems		Filling capacity (cc/100g)
			During conditioning	After drying	
Example 1	No	280	37.0	5.0	565
Example 2	No	260	37.0	6.0	560
Example 3	No	210	37.0	13.0	535

(continued)

			During moistening	After drying	
Example 4	Yes (150°C)	280	39.0	7.0	620
Example 5	Yes (150°C)	215	39.0	12.0	610

[0060] As clear from Table 1, in Examples 4 and 5, in which the conditioned cut stems were moistened by steam at a temperature of 150°C before being dried by a superheated steam flow, the filling capacity increases (improves) by 50 cc per 100 g or greater, compared to Examples 1-3, in which the cut stems were not moistened by a steam flow before being dried by a superheated steam flow, at every moisture level.

[0061] Improvement in filling capacity by 50 cc per 100 g or greater corresponds to approximately 10% in percentage. Since the filling capacity of unprocessed cut stems before being dried (after being conditioned and shredded) is 410 cc per 100 g, the expansion coefficient had increased to 51% in Example 4, for example, which demonstrates that the present method is an excellent expanding method.

(Example 6; Comparative Example)

[0062] Rod-like stem material obtained by mixing 70% by weight of flue-cured tobacco and 30% by weight of barley tobacco was conditioned to a moisture content of 37% by weight, by a method known to a person skilled in the art, e.g. by spraying water or steam. Cut stems as tobacco material were prepared by causing a pair of rollers arranged at an interval of 0.8 mm to roll the rod-like stems, and then shredding the rolled stems into 0.2 mm widths.

[0063] A moistening device including a tunnel-type vibratory conveyor and including a plurality of holes, from which steam was sprayed, in a lower surface of the conveyor was prepared. External dimensions of this device were 3800 mm in length, 400 mm in width, and 1500 mm in height, and a steam spray section was 2400 mm in length.

[0064] After that, the cut stems were supplied onto the tunnel-type vibratory conveyor of the moistening device at 320 kg/time by wet weight basis. While the cut stems are conveyed via the tunnel-type vibratory conveyor, saturated steam at a gauge pressure of 5 bars (0.5 MPa) at a temperature of 150°C is sprayed toward the cut stems from a plurality of holes in the lower surface of the conveyor at 130 kg/time (total amount of steam sprayed in the steam spray section), and thereby the cut stems were moistened and swollen. The water content in the moistened cut stems was 39.0% by weight, which had increased by 2% by weight from the water content (37.0% by weight) at the time of conditioning.

[0065] The conditioned and swollen cut stems were continuously supplied to the pneumatic conveying dryer with a structure similar to that of Example 1 at the flow quantity of 25 kg/time by wet weight basis, and were dried and swollen by a superheated steam flow (at a temperature of 220°C) under conditions similar to those of Example 1.

(Example 7; Embodiment)

[0066] Saturated steam at a gauge pressure of 5 bars (0.5 MPa) was injected into the supply duct 5 (approximately 50 mm in diameter and approximately 0.6 m in length) arranged in a horizontal state from a nozzle part (3 mm in diameter) of the steam supply tube 8 at the flow quantity of approximately 40 kg/time. Cut stems (with a moisture content of 37% by weight) subject to a process similar to that of Example 6 were continuously introduced from the tobacco material supply section 11 to the supply duct 5 via the first air locker 12 at the flow quantity of 36 kg/time by wet weight basis. In this case, the steam flow circulating in the supply duct 5 was saturated steam at the temperature of 150°C. By driving the exhaust fan 17 in advance, the cut stems were introduced from the supply duct 5 into the cyclone 1 (approximately 250 mm in diameter and including a separator with an effective height of approximately 0.75 m) together with the steam flow, swirled together with the steam flow, and were thereby moistened and swollen. The transit time in the supply duct 5 and the cyclone 1 (residence time was 1.5 seconds) was approximately 1.8 seconds. The moisture content of the moistened cut stems was 39% by weight, which had increased by 2% by weight from the moisture content (37% by weight) at the time of conditioning.

[0067] After that, the moistened cut stems discharged from the cyclone 1 was continuously introduced into the pneumatic conveying dryer 7 via the vibratory conveyor 15, and the moistened cut stems were dried and swollen by a superheated steam flow under conditions similar to those of Example 1. The temperature of the superheated steam was set to 220°C.

[0068] The expanded cut stems obtained in Examples 6 and 7 were stored (conditioned) in a constant temperature and humidity room at a temperature of 22.0°C and a relative humidity of 60% for 1 week. After the equilibrium moisture content was obtained, filling capacity was measured in a manner similar to those of Examples 1-5.

[0069] The moisture content of the expanded cut stems were obtained in a manner similar to those of Examples 1-5.
[0070] The obtained results are shown in Table 2.

Table 2

	Steam temperature (°C) during moistening	Superheated steam temperature (°C) during drying	Moisture content (% by weight) of cut stems		Filling capacity (cc/100g)
			During moistening	After drying	
Example 6	150	220	39.0	10.5	610
Example 7	150	220	39.0	11.0	635

[0071] As clear from Table 2, in Example 7, in which cut stems were moistened and swollen in a cyclone and dried by a superheated steam flow, the filling capacity can be increased compared to Example 6, in which cut stems were moistened and swollen by a tunnel-type vibratory conveyor including a plurality of holes from which steam was sprayed, and were dried using a superheated steam flow.

Claims

1. A method of expanding tobacco material, comprising:

moistening and swelling tobacco material by swirling tobacco material together with a steam flow at temperatures of 100-160°C in contact therewith; and
drying the tobacco material after being moistened and swollen.

2. The method of claim 1, wherein tobacco material before contacting the steam flow is conditioned to 15-50% by weight.

3. The method of claim 1, wherein the moistened and swollen tobacco material has a moisture content equal to that of the tobacco material before contacting the steam flow, or a moisture content which has increased by 5% by weight or less.

4. The method of claim 1, wherein the residence time by the swirling is 0.5-5 seconds.

5. The method of claim 1, wherein drying of the tobacco material is performed by letting the tobacco material contact a superheated steam flow or heated air.

6. The method of claim 5, wherein the superheated steam flow has a temperature higher than the temperature of the steam.

7. The method of any one of claims 1 to 6, wherein the tobacco material is cut stems.

8. An apparatus for expanding tobacco material, comprising:

a cyclone including an inlet, a vent, and an outlet;
a supply duct connected to the inlet of the cyclone;
an exhaust duct connected to the vent of the cyclone;
a steam supply section connected to the supply duct;
a tobacco material supply section connected to the supply duct in a position between a connection part of the steam supply section and the inlet of the cyclone; and
a dryer to which tobacco material discharged from the outlet of the cyclone is conveyed and configured to dry the tobacco material.

9. The apparatus of claim 8, wherein the discharge duct is divided into a branch duct, which is connected to the dryer.

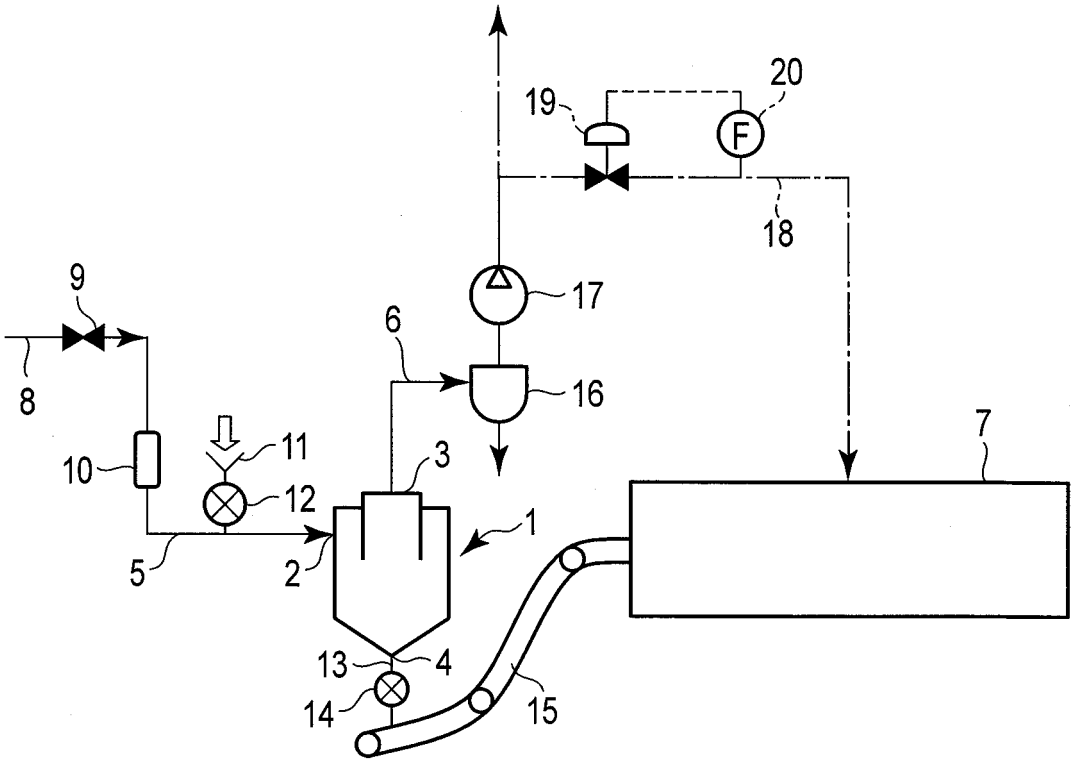

FIG. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/058342

A. CLASSIFICATION OF SUBJECT MATTER
A24B3/04(2006.01)i

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)
A24B3/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 60-70058 A (Nippon Senbai Kosha), 20 April 1985 (20.04.1985), page 2, lower left column, line 10 to upper right column, line 9 (Family: none)	1-9
Y	JP 2006-520599 A (R.J. Reynolds Tobacco Co.), 14 September 2006 (14.09.2006), paragraph [0021]; fig. 1 & US 2004/0182404 A1 & EP 1603412 B1 & WO 2004/084657 A2 & DE 602004006096 T2 & CA 2519153 A1 & CN 1774183 A & ES 2282853 T3	1-9

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

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"&" document member of the same patent family

Date of the actual completion of the international search 25 April, 2011 (25.04.11)	Date of mailing of the international search report 10 May, 2011 (10.05.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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- JP 62003778 A **[0005] [0009]**