



(11) **EP 1 759 601 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.03.2007 Bulletin 2007/10

(51) Int Cl.:
A24B 3/04 (2006.01) A24B 3/12 (2006.01)

(21) Application number: **06119168.0**

(22) Date of filing: **18.08.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventors:
• **Druzdzel, Arkadiusz**
26-600 Radom (PL)
• **Sieredzinski, Marek**
26-600 Radom (PL)

(30) Priority: **31.08.2005 PL 37684905**

(74) Representative: **Misztak, Irena**
Patpol
Nowoursynowska 162 J
02-776 Warszawa (PL)

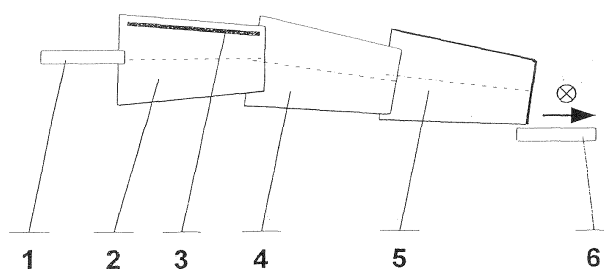
(71) Applicant: **International Tobacco Machinery**
Poland Ltd
26 600 Radom (PL)

(54) **Method and device for thermal processing of loose materials, particularly organic plant materials**

(57) The present invention relates to a method and a device for thermal processing of loose materials, particularly organic plant materials. In every step of the method according to the invention proper, preferable, local conditions for thermal processing of the material are established, by delivering a process gas, the temperature of which is adjusted independently for each of the steps of the method, the temperature of the hydrodynamic medium in a form of a process gas, preferably pure air and/or air saturated with another gas, ranging from 20° to 400°C. The gas is delivered via a set of one or several nozzles, positioned and controlled in each of the process sections independently, under an absolute pressure in the range from 0,2 hPa to 1 MPa, while the processed material is put into rotary motion, preferably in each of the steps, with a speed adjusted separately for each of the steps and a layer of the processed material is formed at the inner surface of the section, the rotary motion of the ma-

terial is generated around axes, inclination angle of which relative to the horizontal direction is adjusted separately for every section, depending on desired quality parameters of the final product, the process gas being fed concurrently and/or backwardly relative to the rotating processed material, at an angle of adjusted magnitude, and glued together fibers of the processed material are defibrated. In the device according to the invention, at least one additional nozzle (3) for the process gas is located in at least one of the process sections (2, 4, 5), the nozzle being directed at an angle relative to the direction of rotation of the process section (2, 4, 5) and situated at an adjusted angle δ relative to a tangent to the cross-section of the process section (2, 4, 5) and at an angle β relative to the horizontal axis, measured in the plane of this cross-section, and the distance R_n between the outlet of the nozzle (3) and the axis of rotation of process sections (2, 4, 5) is smaller than the radius R of the section's cross-section drawn in the plane of the location of the nozzle.

Fig. 1



Description

[0001] The invention relates to a method and a device for thermal processing of loose materials, particularly organic plant materials, for obtaining desired organoleptic properties of these materials, the desired final humidity and/or obtaining an increase of the specific volume. This invention is particularly useful for drying tobacco material, such as leaves, veins and/or cut tobacco.

[0002] In state of the art systems the batch material for thermal processing of organic plant materials, particularly tobacco, are leaves, particularly tobacco leaves, in any of various different forms, including whole leaves or parts thereof, veins of tobacco leaves, tobacco foils, fillings for cigars, cut filling for cigarettes, so called cut tobacco, wastes (shavings) and/or crumbs of tobacco, and also any combination of materials containing tobacco and/or any other organic plant material in any form and proportions.

[0003] It is recommended, before feeding the material to the thermal processing step, to carry out an initial processing step, the aim of which is to obtain a uniform humidity level throughout the fed material in the minimum range of 13-14 % by weight, suitably at least 16% by weight, preferably more than 19% by weight. Parameters of the above-mentioned processes for increasing the humidity level are known and commonly employed in the art. The wetted tobacco material is then subject to further processing steps, including, e.g., supplementation of taste modifiers, and next it is ground using any method, most frequently a conventional method known in the art. An exemplary process of processing tobacco material has been described in US 5722431. One of the most important steps of the material processing is the thermal processing step, which typically follows the above mentioned steps and which particularly relates to material which has been already ground before. In order to obtain thermal processing results, which are proper, preferable and desired for a specific type/sort of the tobacco blend, known methods and devices are used, which enable thermal processing. However, all these known methods are only a part of a more complex process. Because of the origin and nature of a processed material (natural plant materials, particularly tobacco materials) and its physical-chemical properties, as well as employed initial processing steps and additives improving mechanical and organoleptic properties of the product, and desired physical-chemical changes in the material and the additives due to the thermal processing, the process requires such a kind of thermal processing, which allows to obtain many required parameters simultaneously. It concerns the increase of the specific volume (m^3/g) of the processed material as well as obtaining the proper range of the output humidity of the processed material (at the outlet/output of the machine) and also obtaining the proper output temperature of the material. Furthermore, this being potentially the main and particularly desired goal of the processing, the problem may concern obtaining prop-

er, desired and preferable chemical reactions between compounds contained in the material and/or introduced thereinto as a result of previous processing steps, in order to produce desired chemical compounds, which determine organoleptic properties of the final product, i.e., after finishing the step of thermal processing.

The subject matter of the present invention is a method for thermal processing of loose materials, particularly organic plant materials, and still more particularly tobacco material, wherein loose material is exposed to a process gas in a continuous mode, the method being carried out in multiple steps.

In each of the steps independently proper, preferable, local conditions for thermal processing are established by feeding a process gas, for which a stream of transported energy, preferably including thermal energy, is adjusted independently for every step of the method. The temperature of the thermodynamic medium in a form of a process gas, preferably pure air and/or air saturated with another gas, is in the range of 20 - 400°C. The process gas is injected into a near-wall layer of the processed material via a set of one or several nozzles, positioned and controlled separately in each of process sections, under a pressure from 0,2 hPa to 1 MPa. The processed material is put into rotary motion, preferably in each of the steps, with a speed adjusted separately for each of the steps and a layer of the processed material is formed at the inner surface of the section. The rotary motion of the material is generated around axes, inclination angle of which relative to the horizontal direction is adjusted separately for every section, depending on desired quality parameters of the final product, the process gas being fed concurrently and/or backwardly relative to the rotating processed material, at an angle of adjusted magnitude, and glued together fibers of the processed material are defibrated.

[0004] Preferably, the process gas is saturated steam or dry overheated steam.

[0005] The temperature of the process gas reaches 400°C, while the gas is injected under a pressure in the range from 0,1 MPa to 0,7 MPa.

[0006] The invention also relates to a device for thermal processing of loose materials, particularly organic plant materials, comprising at least one process section, having a form of a body of revolution with a variable and/or constant cross-section. Each of multiple sections of the device is equipped with an inlet stub pipe and outlet stub pipe for a process gas.

[0007] According to the invention, at least one additional nozzle for the process gas is located in at least one of the process sections, the nozzle being directed at an angle relative to the direction of rotation of the process section and situated at an adjusted angle relative to a tangent to the cross-section of the process section and at a constant angle relative to the horizontal axis, measured in the plane of this cross-section. The distance between the nozzle outlet and the axis of rotation of process sections is smaller than the radius of the section's cross-

section drawn in the plane of the location of the nozzle.

[0008] In a preferred embodiment at least one process section is located partially in the inner space of the next section, maintaining the distance from the inner surface of the section body, the distance enabling a free flow of the processed material, the axes of rotation of the both sections mutually intersecting at an adjusted angle, while the angle between generators of conical bodies of the both sections is in the range of 0 - 30°.

[0009] According to the invention, bodies of the process sections are preferably frusto-conical, and the angles of inclination of the cone side surfaces in subsequent sections are diversified and are obtuse angles or acute angles.

[0010] The angles of inclination of axes of rotation relative to the horizontal direction are diversified for different sections and depend on proportions of their diameters, and the angle of inclination of cone generators relative to the horizontal direction is in the range of 0 - 30°.

[0011] The differences between the distance of the nozzle outlets from axes of rotation of the process sections and the radii of the process sections' cross-sections drawn in the planes of locations of the nozzles, are in the range from 1 mm to 150 mm.

[0012] The inclination angle of the additional nozzle for the process gas relative to the horizontal direction, measured in the plane of this cross-section, is between 40° and 140°, preferably 50° and 100°.

[0013] The invention enables thermal processing of loose materials, particularly organic plant materials, for example leaves and/or cut tobacco, which are fed to the device and processed in a continuous mode. The device may comprise several sections, in which, separately, basic parameters of the thermal process are controlled, such as temperature of the dryer jacket, temperature and mass flow rate of the process gas, residence time of the processed material in subsequent thermal zones, etc.

[0014] By individual adjustment of a proper combination of thermal processing parameters in each of the sections, one obtains desired sequences of the kinetics of the thermal processing, this allowing for obtaining preferred mechanical and physical-chemical properties of the final product.

[0015] Employing several subsequent process sections allows, first of all, for significant intensification of the thermal process, and also allows for carrying out more complex versions of thermal processing of a material in a single, compact and modular device. A particular advantage of this design is also a possibility of obtaining such results of thermal processing, which require employing several separate devices in the state of the art systems. Furthermore, the method and device according to the invention enable obtaining proper quality parameters of the final product.

[0016] The term "quality parameters" is understood as:

- Obtaining final humidity of the product, at the outlet from the device, in a strictly defined range, typically

of ± 1 %, preferably ± 0.5 %;

- Obtaining a desired level of swelling of the product (the specific volume), in order to increase its volume per unit mass;
- Obtaining desired organoleptic properties of the product, particularly its taste and aroma properties, and also the color of the processed material, by carrying out controlled chemical reactions within the processed material and its components in different thermal zones.

[0017] The advantage of the adjustment of the inclination angle of the axis of rotation for each section is obtaining a preferred inclination of the lower edge of a rotating section, such that the duration of passing of the material through the section is important for the quality parameters, and, as a result, inter alia, the time of contact between the material and the casing of the process section is within a desired range.

[0018] Moreover, the invention allows for optimization of the angle of injection of the process gas jet relative to the inner surface of the process section by adjustment of the angle between the nozzle axis and the tangent to the inner surface of the process section. This enables obtaining optimal and preferred kinetic energies necessary to tear out a layer/stream of material adhering to the inner surface of the process section. At the same time, it also enables a more intensive exchange of the thermal energy from the process gas injected via a nozzle to the material, by generating conditions of hydrodynamic turbulent flow in the zone of contact between both streams, the material stream and the process gas stream, and a particularly beneficial for the processed material local hydrodynamic turbulent flow, thereby obtaining preferred increase and, as a result, relative difference of local speeds of relative slip of the both streams, thus obtaining a preferred uniform zone of intensive heat exchange to the material.

[0019] It is to be noticed that the proposed design of the process sections according to the invention and the possibility of adjustment of their inclination angles advantageously affect proportions between different mechanisms of thermodynamic and chemical processes, particularly intensity of the heat energy transfer to the material, particularly between the convection-type heat transfer (from the hot process gas) and the conduction-type heat transfer (from inner surfaces of the process sections).

[0020] The invention is further discussed and illustrated in embodiments referring to a drawing in which:

Fig. 1 shows schematically an arrangement of process sections in longitudinal section,

Fig. 2 shows schematically an arrangement of process sections in longitudinal section in another em-

bodiment of the invention,

Fig.3 shows schematically an arrangement of process sections in longitudinal section in yet another embodiment of the invention,

Figs. 4 a-e show exemplary shapes of the process sections,

Fig. 5 shows schematically one of the process sections in longitudinal section with the properly angularly situated axis of rotation,

Fig. 6 shows a cross-section of a process section, and

Fig. 6a shows a detail from the cross-section of fig. 6, covering location of a gas nozzle.

[0021] As shown in figs. 1 and 2, a device for thermal processing of loose materials according to the invention comprises several rotating process sections 2, 4, 5 arranged in series, in which thermal processing of loose materials is carried out, the materials being fed to the first of the process sections by means of a feeding device 1. According to the invention a feeding device 1 may be for example a vibratory feeder or a belt feeder. Process sections 2, 4, 5 have bodies in form of cylinders or truncated cones, the longitudinal axes of which, as shown in figs. 1 and 2, are situated at different angles. The main stream of a process gas is delivered to each of these sections by means of devices, which are known in the art and are not shown in the illustration, the gas being sucked at the section's outlet. According to the invention an additional nozzle 3 is located in each of the process sections 2, 4, 5, delivering the process gas directly to a layer of the processed material adhering to walls of the process section, acting as a hydrodynamic scraper, for example a pneumatic scraper. The thermally processed material is received by a collecting device 6 mounted at the outlet from the last process section, for example in a form a vibratory feeder or a belt feeder.

[0022] Fig. 3 shows another example of an arrangement of process sections, in which a portion of one section is located within the next section. In the lower zone, between the bodies of the sections there is a free space allowing for free flow of the material. Mutual inclination of the axes of the both sections is adjusted, this facilitating free flow of the material. The angle γ_2 between the generators of the conical bodies of these sections is within the range of 0 - 30°. In a preferred embodiment according to the invention, in order to increase the heat exchange by conduction between the jackets of the both sections, the angle γ_2 may be in the range of 0 - 20°.

[0023] Each section 2, 4, 5 may have differently shaped inner surface. Particularly, the inner surface may be smooth and/or may have specially formed bulges/recesses and/or blades.

[0024] Figs. 4 a-e show possible exemplary geometrical configurations of the process sections 2, 4, 5. Depending on the conditions of the thermal processing, the geometrical configuration of the sections' bodies may be selected in an arbitrary sequence within a single device.

[0025] As shown in Fig. 5, the angle α of inclination of the rotation axis of every section relative to the horizontal direction is adjusted depending on the proportion $D1/D2$, i.e., the dimensions of the diameters of the material's inlet and outlet from the process section. The angle α is adjusted within such a range that the lower edge of the section's body is inclined relative to the horizontal direction at the angle γ_1 of 30°.

Figs. 6 and 6a show angular orientation of an additional gas nozzle 3. According to fig. 6, the gas nozzle 3, delivering the process gas, is situated for delivering a stream of the process gas concurrently or backwardly relative to a layer of rotating processed material, at an adjusted angle β relative to the horizontal direction, in a plane perpendicular to the axis of rotation. The angle β may range from 40 to 140°, preferably from 50 to 100°. Furthermore, the nozzle is inclined at an adjusted angle δ relative to the tangent to the surface of the section's cross-section, the angle δ being adjusted in the range 10 - 170° relative to that tangent. The outlet of the nozzle 3 is located at a distance R_n from the rotation axis of the section, the distance being smaller than radius R of the cross-section in the plane of the position of the nozzle. In a preferred embodiment $R - R_n = 1-150$ mm.

[0026] According to a method of the invention, process parameters for each of the process sections 2, 4 and/or 5 are adjusted and controlled individually, separately and in independent ranges.

[0027] The functionality of each of the sections depends on selected parameters of the thermal processing. For example, the first process section 2 may be treated as a section in which intensive transfer of thermal energy to the material proceeds, via conduction from walls of the rotary section as well as via convection from the process gas, for example air. In this section, inter alia, free, not bound chemically with the material, liquid substances contained within the cellular structure of the material, particularly free water and its solutions undergo the phase transition to steam. As a result of the phase transition from liquid to gas, evaporation pressure within the cellular structure of the material increases significantly, and as a consequence thereof increases the volume of particles of the processed material. This process is called swelling and/or expanding of the material.

[0028] The next, at least one process section 4 has, for example, a function of drying and/or so-called roasting of the material simultaneously. By employing several, independently located and controlled gas nozzles 3, several thermal zones are created within one process section 4, in which different process parameters are maintained, thus obtaining a desired level of drying, desired kinetics of heat energy transfer to the material (and as a result also drying), and also, by selection of the material's

transition time through the process sections, a proper kinetics of chemical reactions of the material and its components, all this resulting in obtaining desired organoleptic changes and avoiding changes which are not desired.

[0029] The rotational speed of each of the sections 2, 4, 5 is adjusted in another range, rotations of the section 2 being adjusted in the range of 0 - 300 rpm, while rotations of the section 4 being adjusted in the range of 0 - 100 rpm, preferably in the range of 0 - 50 rpm. High rotational speeds for the sections 2, 4 are advantageous since such speeds enable the centrifugal force to be in a range, which allows a layer of the material to be kept at the wall of the rotating section.

[0030] A process gas of high kinetic energy is delivered via the additional nozzle 3, and collision of two backward streams is caused, namely the stream of coming out gas and the stream of the material, which is kept within a near-wall zone by the centrifugal force of the rotating section 2. The impact of the gas stream with the material stream causes tearing out the material particles from the walls of the process section 2 and simultaneously causes particularly intensive transfer of the heat energy of the gas delivered via the nozzle 3 to the processed material adhering to the walls of the section 2. An additional, advantageous effect of such processing is separation of fibers (defibration) of the processed material, which has been intentionally ground as a result of previous steps of the process.

[0031] The process gas is delivered via nozzle 3 under a pressure in the range from 0,2 hPa to 1 MPa, preferably in the range from 0,1 MPa to 0,7 MPa, and in the range of temperature which depends on expected results of the thermal processing. The temperature of the process gas is from 20°C to 400°C, preferably from 80°C to 300°C. According to the invention, pure air and/or air saturated with another gas is employed as the process gas, and also saturated and/or dry steam, or overheated steam may be used.

Claims

1. A method for thermal processing of loose materials, particularly organic plant materials, according to which loose material is exposed to a process gas in a continuous mode, the method being carried out in multiple steps, **characterized in that** in each of the steps independently, proper, preferred, local conditions for thermal processing of the loose material are established by feeding a process gas, for which a stream of transported energy, preferably including thermal energy, is adjusted independently for every step of the method, the temperature of the thermodynamic medium in a form of a process gas, preferably pure air and/or air saturated with another gas, is in the range of 20 - 400°C, the process gas is injected into a near-wall layer of the processed material via a set of one or several nozzles, positioned

and controlled separately in each of the process sections, under a pressure from 0,2 hPa to 1 MPa, while the processed material is put into rotary motion, preferably in each of the steps, with a speed adjusted separately for each of the steps, and a layer of the processed material is formed at the inner surface of the section, while the rotary motion of the material is generated around axes, the inclination angle of which relative to the horizontal direction is adjusted separately for every section, depending on desired quality parameters of the final product, the process gas being fed concurrently and/or backwardly relative to the rotating processed material, at an angle of adjusted magnitude, and glued together fibers/particles of the processed material are defibrated.

2. A method according to claim 1, **characterized in that** the process gas is saturated steam.

3. A method according to claim 1, **characterized in that** the process gas is dry overheated steam.

4. A method according to claim 1, **characterized in that** the temperature of the process gas reaches 400°C.

5. A method according to claim 1, **characterized in that** the pressure of the process gas is in the range from 0,1 MPa to 0,7 MPa.

6. A device for thermal processing of loose materials, particularly organic plant materials, comprising at least one process section having a form of a body of revolution with a variable and/or constant cross-section, each of the multiple sections of the device being equipped with an inlet stub pipe and an outlet stub pipe for a process gas, **characterized in that** at least one additional nozzle (3) for the process gas is located in at least one of the process sections (2, 4, 5), directed at an angle relative to the direction of rotation of the process section (2, 4, 5) and situated at an adjusted angle δ relative to a tangent to the cross-section of the process section (2, 4, 5) and at a constant angle β relative to the horizontal axis measured in the plane of this cross-section, and the distance R_n between the outlet of the nozzle (3) and the axis of rotation of the process sections (2, 4, 5) is smaller than the radius R of the section's cross-section drawn in the plane of the location of the nozzle.

7. A device according to claim 6, **characterized in that** at least one process section (4) is located partially in the inner space of the next section (5), maintaining the distance from the inner surface of the section body (5), the distance enabling a free flow of the processed material, the axes of rotation of the both sections mutually intersecting at an adjusted angle,

while the angle (γ_2) between generators of conical bodies of the both sections (4, 5) is in the range of 0 - 30°.

8. A device according to claim 6, **characterized in that** bodies of the process sections (2, 4, 5) are preferably frusto-conical, and the angles of inclination of the cone side surfaces in subsequent sections are diversified and are obtuse angles or acute angles. 5
9. A device according to claim 6, **characterized in that** the angles α of inclination of the axes of rotation relative to the horizontal direction are diversified for different sections (2, 4, 5) and depend on proportions D1/D2 of their diameters, and the angle (γ_1) of inclination of cone generators relative to the horizontal direction is in the range of 0 - 30°. 10 15
10. A device according to claim 6, **characterized in that** the difference of dimensions: R - Rn is in the range from 1 to 150 mm. 20
11. A device according to claim 6, **characterized in that** the angle β is in the range between 40 and 140°. 25
12. A device according to claim 11, **characterized in that** the angle β is in the range between 50 and 100°. 30

30

35

40

45

50

55

Fig. 1

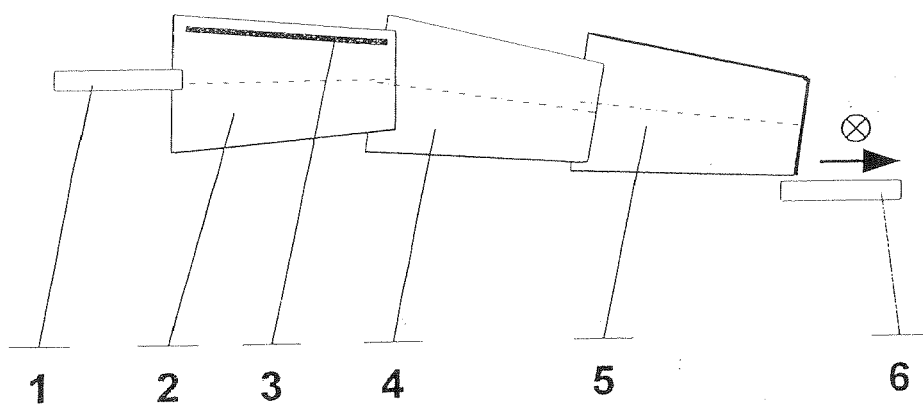


Fig. 2

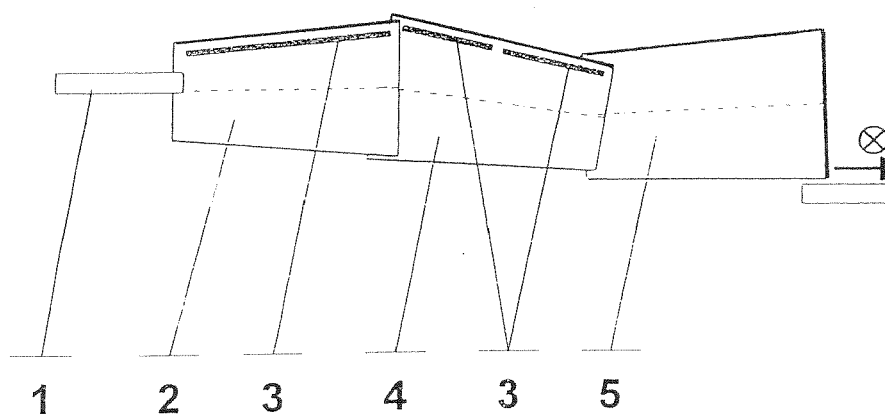


Fig. 3

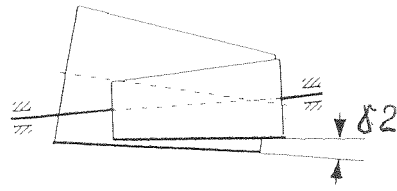


Fig. 4a

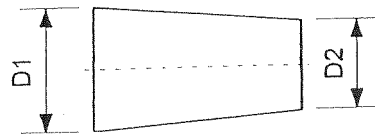


Fig. 4b

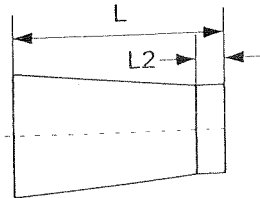


Fig. 4c

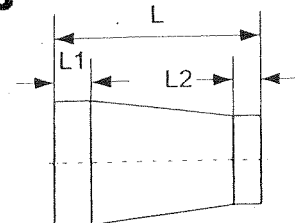


Fig. 4.e



Fig. 4d

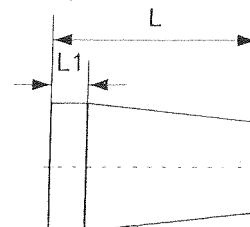


Fig. 5

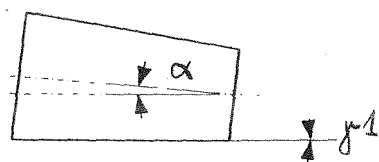


Fig. 6

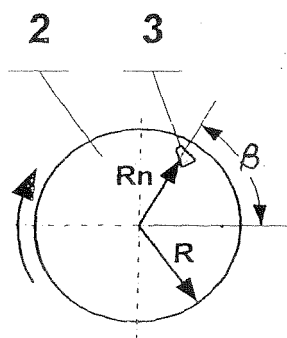
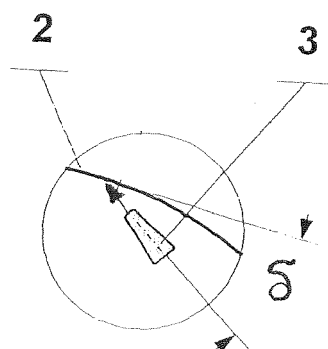


Fig. 6a





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 9168

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 273 596 A1 (REYNOLDS TOBACCO CO R [US]) 6 July 1988 (1988-07-06)	1	INV.
X	* column 8, line 34 - column 15, line 10; figures *	6	A24B3/04 A24B3/12
A	----- WO 97/27766 A (BROWN & WILLIAMSON TOBACCO [US]) 7 August 1997 (1997-08-07) * page 5, line 20 - page 8, line 21; figures *	1-5	
A	----- DE 199 45 892 A1 (BAT CIGARETTENFAB GMBH [DE]) 5 April 2001 (2001-04-05) * the whole document *	6	
A	----- EP 0 917 828 A2 (BAT CIGARETTENFAB GMBH [DE]) 26 May 1999 (1999-05-26) * abstract; figures *	1,6	
A	----- US 4 572 218 A (HINE EDWIN W [US] ET AL) 25 February 1986 (1986-02-25) * the whole document *	1,6	
			TECHNICAL FIELDS SEARCHED (IPC)
			A24B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		28 November 2006	MARZANO MONTEROSSO
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 11 9168

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

28-11-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0273596 A1	06-07-1988	BR 8706331 A CA 1276510 C DE 3776637 D1 US 4887619 A	05-07-1988 20-11-1990 19-03-1992 19-12-1989
WO 9727766 A	07-08-1997	AT 228781 T AU 704974 B2 AU 2245797 A BR 9707482 A CA 2246050 A1 CN 1210448 A DE 69717675 D1 DE 69717675 T2 EP 0959698 A1 ID 19597 A JP 3441079 B2 JP 2002502231 T JP 3807551 B2 JP 2003299473 A MA 26142 A1 TR 9801499 T2	15-12-2002 13-05-1999 22-08-1997 06-04-1999 07-08-1997 10-03-1999 16-01-2003 18-09-2003 01-12-1999 23-07-1998 25-08-2003 22-01-2002 09-08-2006 21-10-2003 01-07-2004 23-11-1998
DE 19945892 A1	05-04-2001	NONE	
EP 0917828 A2	26-05-1999	DE 19751525 A1 US 6155269 A	02-06-1999 05-12-2000
US 4572218 A	25-02-1986	NONE	

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

- US 5722431 A [0003]