(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 November 2018 (15.11.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/206490 A1

(51) International Patent Classification:
B29C 53/24 (2006.01) *A24B 3/14* (2006.01)
B29C 53/84 (2006.01) *A24D 3/02* (2006.01)

(21) International Application Number:
PCT/EP2018/061688

(22) International Filing Date:
07 May 2018 (07.05.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
17170940.5 12 May 2017 (12.05.2017) EP

(71) Applicant: **PHILIP MORRIS PRODUCTS S.A.** [CH/CH]; Quai Jeanrenaud 3, CH-2000 Neuchâtel (CH).

(72) Inventor: **POINDRON, Cyrille**; 2061 route de Beccon, 74350 Cruseilles (FR).

(74) Agent: **PORTA, CHECCACCI & ASSOCIATI S.P.A.**; Via Vittoria Colonna, 4, 20149 Milano (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: METHOD OF CRIMPING A SUBSTANTIALLY CONTINUOUS SHEET OF POLYMERIC MATERIAL

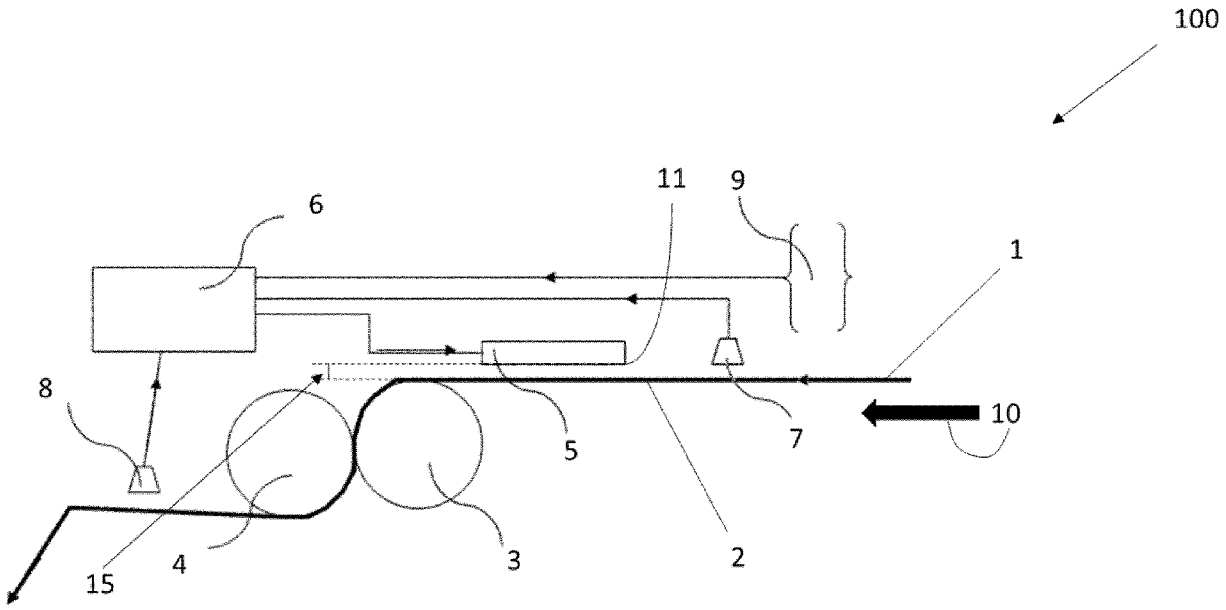

Fig 1

(57) Abstract: The present invention relates to a method of crimping a substantially continuous sheet of polymeric material (1), for a rod-shaped component of an aerosol-generating article, the method comprising the steps of: - bringing the temperature of the substantially continuous sheet of polymeric material (1) below its glass transition temperature; - feeding the substantially continuous sheet of polymeric material (1) to a first and second crimping rollers (3, 4) in a transport direction (10); and - crimping the substantially continuous sheet of polymeric material (1) to form a crimped sheet of polymeric material by feeding the substantially continuous sheet of polymeric material (1) between a first and a second crimping rollers (3, 4) so that the first and second crimping rollers (3, 4) apply crimp corrugations to the substantially continuous sheet of polymeric material, wherein bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature takes place upstream the first and second rollers (3, 4)

WO 2018/206490 A1

[Continued on next page]

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

Method of crimping a substantially continuous sheet of polymeric material

The present invention is related to a method for crimping a substantially continuous sheet of polymeric material, which is preferably used for producing an aerosol-generating article.

In the manufacture of aerosol-generating articles, such as for example cigarettes, often components which are in rod format are used.

These components may be made of polymeric materials that, typically, are made starting from materials that originally are in a sheet form and that, at a certain point of the processing line, go through a crimping process and then are compressed and formed into (usually) a tubular rod having a predetermined diameter.

A classic example of such components is the filter rod used in the manufacturing of smoking articles which, after the crimping process, is then wrapped into a paper and drag by a conveyor belt up to knifes wherein it is cut into parts, usually called "sticks", which are components of the aerosol -generating article.

A typical crimping process uses two rotating cylindrical rollers between which the sheet of material is pressed. These rollers have often matching textured ridges/grooves patterns on their outside surfaces that crimp the sheet. This crimping process creates various effects to the material, which is pressed between the crimping rollers, and helps its subsequent compressing/folding into a tubular rod.

In this regard, it is important to note that, once compressed, polymeric materials have a resistance to compression that works to expand the compressed foil, to make it push against the paper wrapping the rod and by doing so increases the frictions of the rod against the conveyor belt, which creates heat that could damage the rod.

Such damaged rods need to be intercepted and discarded from the processing line, thus contributing to render less productive the overall process for the production of the aerosol-generating article.

Furthermore, the damaged rods, once discarded from the processing line, need to be disposed or stored, recycled to the process and then reworked for producing new rods, in this way increasing the cost of the process.

Therefore, there is a need of a method for crimping a substantially continuous sheet of polymeric material that is capable of reducing the above mentioned disadvantages which may impair the overall productivity of the processing line and the competitiveness of the process for the production of the aerosol-generating article.

The invention may satisfy at least one of the above needs.

In an aspect, the invention relates to a method for crimping a substantially continuous sheet of polymeric material, for a rod-shaped component of an aerosol-generating article, the method comprising the steps of: bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature; feeding the substantially continuous sheet of polymeric material to a first and second crimping rollers in a transport direction; and crimping the substantially continuous sheet of polymeric material to form a crimped sheet of polymeric material by feeding the substantially continuous sheet of polymeric material between the first and the second rollers so that the first and second crimping rollers apply crimp corrugations to the substantially continuous sheet of polymeric material, wherein bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature takes place upstream the first and second rollers in the transport direction.

The first and second crimping rollers apply crimp corrugations to the substantially continuous sheet of polymeric material, which is brought below its glass transition temperature before being subjected to the crimping. In this way, in the method of the invention, the polymeric material of the substantially continuous sheet is in a brittle, fragile, or glassy, state when it undergoes the crimping step. In such a state, the elasticity of the continuous sheet of polymeric material is reduced and

this helps the crimping process to break the polymeric material fibers or parts of the sheet. In other words, the crimping process, with a material having its temperature below the glass trnsition temperature, results in a crimped foil having a lower ability or capacity to return into a flat state. Indeed, not broken parts or fibers could – without the invention - have afterwards, for example when the continuous sheet is formed into a rod, an elastic resistance to compression which could create frictions for example between the rod and the conveyor belt.

As used herein, the term "brittle state" or "glassy state" denotes a state of the polymeric material below its glass transition temperature.

As used herein, the term "sheet" denotes a laminar element having a length and length substantially greater than the thickness thereof. The width of a sheet is preferably greater than 10 millimeters, more preferably greater than about 20 millimeters or about 30 millimeters. Even more preferably, the width of the sheet is comprised between about 100 millimeters and about 300 millimeters.

As used herein, the term "rod" denotes a generally cylindrical element of substantially cylindrical, oval or elliptical cross-section, comprising two or more components of an aerosol-generating article.

Aerosol-generating articles according to the present invention may be in the form of filter cigarettes or other smoking articles in which tobacco material is combusted to form smoke. The present invention additionally encompasses articles in which tobacco material is heated to form an aerosol, rather than combusted, and articles in which a nicotine-containing aerosol is generated from a tobacco material, tobacco extract, or other nicotine source, without combustion or heating. These articles in which aerosol is formed without combustion or where smoke is produced by combustion are in general called "aerosol-generating articles". Aerosol-generating articles according to the invention may be whole, assembled aerosol forming articles or components of aerosol-generating articles that are combined with one or more other components in order

to provide an assembled article for producing an aerosol, such as for example, the consumable part of a heated smoking device.

As used herein, aerosol -generating article is any article that generates an inhalable aerosol when an aerosol forming substrate is heated. The term includes articles that comprise an aerosol forming substrate that is heated by and external heat source, such as an electric heating element. An aerosol -generating article may be a non-combustible aerosol -generating article, which is an article that releases volatile compounds without the combustion of the aerosol-generating substrate. An aerosol forming article may be a heated aerosol -generating article, which is an aerosol-generating article comprising an aerosol forming substrate that is intended to be heated rather than combusted in order to release volatile compounds that can form an aerosol. The term includes articles that comprise an aerosol forming substrate and an integral heat source, for example a combustible heat source.

An aerosol-generating article may be an article that generates an aerosol that is directly inhalable into a user's lungs through the user's mouth. An aerosol-generating article may resemble a conventional smoking article, such as a cigarette and may comprise tobacco. An aerosol-generating article may be disposable. An aerosol-generating article may alternatively be partially-reusable and comprise a replenisheable or replaceable aerosol forming substrate.

An aerosol-generating article may also include a combustible cigarette.

In preferred embodiments, the aerosol-generating article may be substantially cylindrical in shape. The aerosol-generating article may be substantially elongated. The aerosol-generating article may have a length and a circumference substantially perpendicular to the length. The aerosol-generating article may have a total length between approximately about 30 millimeters and approximately about 100 millimeters. The aerosol-generating article may have an external diameter between approximately about 5 millimeters and approximately

about 12 millimeters.

According to the invention, the crimping of the sheet of polymeric material is made between a first and a second roller. The rollers can be any, due to the fact that the invention is applicable to any crimping. Therefore, the first and the second roller may have any type of corrugations on their surface.

In order to produce a crimped sheet of polymeric material, the sheet of polymeric material is transported along a transport direction. The transport can be performed by any suitable means, for example by pulling via rollers, in particular by pulling using said first and second crimping roller. During the transport, the sheet of polymeric material passes through a so-called 'nip' that is formed between the first and the second roller.

At least one of the rollers, either the first or the second roller or both includes corrugations, preferably ridges, which come into contact with the sheet of material so that corresponding corrugations are formed on the sheet when it passes through the nip.

Both the first and the second crimping rollers may show a plurality of ridges or corrugations. In particular in this case, the rollers may be designed an arranged in a way that at least parts of them do substantially interleave.

Alternatively, only one of the first and second rollers may show corrugations, the other roller showing an essentially smooth cylindrical surface.

Alternatively, both the first and second rollers may both show corrugations, but in non-corresponding sections, that is for each portion of the sheet of material which comes into contact with the rollers, only one of the first and second roller forms crimp corrugations on that portion of the sheet of material.

According to the method of the invention, before crimping, the sheet of polymeric material is brought at a temperature below the glass transition

temperature. For example, the sheet of material can be cooled below such a temperature. The cooling can take place with any means.

In this way a better control of crimping is obtained, which is helpful in controlling the final product's characteristics, in particular if the crimped sheet is used as a component for an aerosol-generating article.

In the method of the invention the step of bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature takes place upstream the first and second crimping rollers in the transport direction. The wording "upstream" refers to the transport direction. In this way, during crimping between the two rollers, the sheet of polymeric material is in a glass state and the crimping is improved.

Preferably, the step of bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature comprises bringing temperature of the substantially continuous sheet of polymeric material at least about 10 degrees Celsius below its glass transition temperature, more preferably at least about 40 degrees Celsius below its glass transition temperature.

Preferably, the glass transition temperature of the polymeric material is at least about 25 degrees Celsius lower than the external temperature, more preferably at least about 45 degrees Celsius lower than the external temperature.

Preferably, the glass transition temperature of the polymeric material is between approximately about 20 degrees Celsius and about 80 degrees Celsius, more preferably between approximately about 50 degrees Celsius and approximately about 70 degrees Celsius. Although the glass transition tyemperature may be higher than the room temperature, there is still the need to cool the sheet to go below the glass transition temperature because the sheet may heat up significantly during the process.

Preferably, the substantially continuous sheet of polymeric material

includes one or more of: polypropylene (PP), polyvinylchloride (PVC), polyethylene terephthalate (PET), polylactic acid (PLA), cellulose acetate (CA), starch based copolyester. These materials are useful in forming components for an aerosol – generating article.

Preferably, the method of the invention includes the steps of sensing the temperature of the substantially continuous sheet of polymeric material upstream the first and second crimping rollers; varying a temperature of a thermo-regulating device adapted to lower or increase the temperature of the substantially continuous sheet of polymeric material depending on the sensed temperature of the substantially continuous sheet of polymeric material. Preferably, a continuous feedback is provided, so that the sheet of polymeric material remains below the glass transition temperature during the whole crimping process.

More preferably, the method includes the step of providing a first and a second temperature sensor to sense the temperature of the substantially continuous sheet of polymeric material, the first sensor being positioned upstream the first and second crimping rollers and upstream a region where the temperature of the sheet of polymeric material is lowered or increased and the second sensor being positioned downstream the first and second crimping rollers. In this way, the method of the invention provides for adapting and adjusting in real-time the power of the thermo-regulating device to enable accurate control of the temperature of the substantially continuous sheet of polymeric material when crimped.

Preferably, in the method of the invention the step of bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature includes providing a thermo-regulating device forming a surface facing the substantially continuous sheet of polymeric material. More preferably, the surface facing the substantially continuous sheet of polymeric material is positioned at a predetermined distance from the substantially continuous sheet of polymeric material. In this way, the process efficiency is improved in

terms of its reproducibility. Further, the heat exchange between the thermo-regulating device and the sheet of polymeric material can be easily adapted changing the surface area facing the sheet.

Preferably, the thermo-regulating device includes a thermoelectric element. Thermoelectric elements provides a very accurate and constant control of the temperature, thus allowing the method of the invention to control in an effective and consistent way the temperature of the substantially continuous sheet of polymeric material.

Preferably, the thermo-regulating device includes a thermo-regulating roller having a thermo-conductor surface facing the substantially continuous sheet of polymeric material. More preferably, the thermo-conductor surface of the thermo-regulating roller adheres to the substantially continuous sheet of polymeric material. The roller can therefore have a double function of changing the temperature of the sheet and at the same time of guiding the sheet itself.

Preferably, the method of the invention includes the step of changing a temperature or a power to lower or increase the temperature of the substantially continuous sheet of polymeric material depending on a speed of the substantially continuous sheet of polymeric material. In this way, the substantially continuous sheet of polymeric material may be crimped at a predetermined temperature even in case of variations of the speed of the substantially continuous sheet of polymeric material and this significantly improves process robustness and stability, product consistency, and therefore product quality. For instance, the temperature or power of the thermo-regulating device will be reduced if the speed of the substantially continuous sheet of polymeric material is reduced (for instance when changing the sheet input), so as not to overcool the continuous sheet of polymeric material.

Preferably, the method of the invention includes the steps of gathering the crimped sheet of polymeric material, and forming a continuous rod using the gathered crimped sheet of polymeric material. More preferably,

the method of the invention includes the step of wrapping the continuous rod. The resulting rod is preferably used as a component for an aerosol-generating article and therefore the crimped sheet is subjected to the method step for the production of such a component. The wrapping might be done by wrapping the crimped foil into a wrapper paper, which is glued. The efficient crimping done below the glass transiotion temperature lowers the stress applied to the glue, as the crimped foil will exert less stress to return into a flat state.

More preferably, the method of the invention includes the step of cutting the continuous rod into a plurality of rod-shaped components, each rod-shaped component having a gathered crimped sheet formed from a cut portion of the crimped sheet of polymeric material, the crimp corrugations of the crimped sheet defining a plurality of channels in the rod-shaped component. In this way, the method of the invention provides rod-shaped components that may be used for the production line of aerosol-generating articles. Preferably, the rod-shaped components are filter components and/or air cooling components for aerosol-generating articles.

Preferably, the step of bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature includes lowering the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature.

According to a second aspect, the invention relates to a method of crimping a substantially continuous sheet of polymeric material, for a rod-shaped component of an aerosol-generating article, the method comprising the steps of: cooling the substantially continuous sheet of polymeric material from its initial temperature to at least about 10 degrees Celsius below the initial temperature; feeding the substantially continuous sheet of polymeric material to a first and second crimping rollers in a transport direction; and crimping the substantially continuous

sheet of polymeric material to form a crimped sheet of polymeric material by feeding the substantially continuous sheet of polymeric material between a first and a second crimping rollers so that the first and second crimping rollers apply crimp corrugations to the substantially continuous sheet of polymeric material.

Preferably, cooling the substantially continuous sheet of polymeric material from its initial temperature to at least about 10 degrees Celsius below the initial temperature includes bringing the temperature of the sheet at least about 20 degrees Celsius lower than its initial temperature, preferably bringing the temperature of the sheet at least about 30 degrees Celsius lower than its initial temperature, preferably bringing the temperature of the sheet at least 40 degrees Celsius lower than its initial temperature.

The invention discloses also an apparatus for crimping a substantially continuous sheet of polymeric material, for a rod-shaped component of an aerosol-generating article, the apparatus including a thermo-regulating device adapted to bring the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature; a first and a second crimping rollers adapted to apply crimp corrugations to the substantially continuous sheet of polymeric material so as to crimp the substantially continuous sheet of polymeric material to form a crimped sheet of polymeric material; a feed path adapted to feed along a transport direction the substantially continuous sheet of polymeric material to the first and second crimping rollers.

The advantages of this apparatus have been already outlined with reference to the above method and are not repeated herewith.

Preferably, in the apparatus of the invention the thermo-regulating device is positioned at a position upstream the first and second crimping rollers in the transport direction.

Preferably, the thermo-regulating device includes a surface facing the substantially continuous sheet of polymeric material.

More preferably, the surface facing the substantially continuous sheet of polymeric material is positioned at a predetermined distance from the substantially continuous sheet of polymeric material.

Preferably, the thermo-regulating device includes a thermoelectric element.

Preferably, the thermo-regulating device includes a thermo-regulating roller having a thermo-conductor surface facing the substantially continuous sheet of polymeric material. More preferably, the thermo-conductor surface of the thermo-regulating roller adheres to the substantially continuous sheet of polymeric material.

Preferably, the apparatus includes a sensor device positioned upstream the first and second crimping rollers and adapted to sense the temperature of the substantially continuous sheet of polymeric material. More preferably, the sensor device includes a first and a second temperature sensor adapted to sense the temperature of the substantially continuous sheet of polymeric material, the first sensor being positioned upstream the first and second crimping rollers and upstream the thermo-regulating device and the second sensor being positioned downstream the first and second crimping rollers.

Alternatively or in addition, the crimping rollers themselves are cooled, to provide the cooling or extra cooling of the foil.

The sheet of polymeric material has an initial temperature before reaching the cooling device or element. This initial temperature is decreased by at least about 10 degrees Celsius in order to obtain a better crimping.

Specific embodiments of the invention will be further described, by way of example only, with reference to the accompanying drawings in which:

- Fig. 1 is a side view of a first variant of the apparatus for crimping a substantially continuous sheet of polymeric material according to the method of the invention; and
- Fig. 2 is a side view of a second variant of the apparatus for

crimping a substantially continuous sheet of polymeric material according to the method of the invention.

In Fig. 1 a side view of a first variant of the apparatus 100 for crimping a substantially continuous sheet of polymeric material 1 is shown.

In Fig. 1, apparatus 100 to crimp the substantially continuous sheet of polymeric material 1 includes a feed path 2, a first crimping roller 3, a second crimping roller 4, a thermo-regulating device 5, and a control unit 6.

Feed path 2 feeds along a transport direction indicated by arrow 10 the substantially continuous sheet of polymeric material 1 to the first crimping roller 3 and the second crimping roller 4.

At least one of the first or second crimping roller 3, 4 includes a plurality of surface corrugations (not depicted in the drawings) such as ridges, so as to create corrugations onto the sheet of polymeric material during crimping. Any type of corrugation can be used.

Substantially continuous sheet of polymeric material 1 passes between first crimping roller 3 and second crimping roller 4 so that first crimping roller 3 and second crimping roller 4 apply crimp corrugations to substantially continuous sheet of polymeric material 1.

Thermo-regulating device 5 is adapted to change the temperature of the substantially continuous sheet of polymeric material. It includes a surface 11 facing at a predetermined distance 15 the substantially continuous sheet of polymeric material 1 and is located at a position upstream the first crimping roller 3 and the second crimping roller 4 with reference to the transport direction 10.

The thermo-regulating device 5 is in the present embodiment a cooling device, for instance a planar array of thermoelectric elements.

The apparatus 100 further includes a first temperature sensor 7, a second temperature sensor 8 and an external input element 9.

First temperature sensor 7 is positioned upstream the first crimping roller 3 and the second crimping roller 4 in the transport direction 10 and

upstream the thermo-regulating device 5 with reference to the transport direction 10.

Second temperature sensor 8 is positioned downstream the first crimping roller 3 and the second crimping roller 4 with reference to the transport direction 10.

Control unit 6 is connected to thermo-regulating device 5, to first temperature sensor 7 and second temperature sensor 8 and to external input element 9 and it is adapted to send or receive signals from them.

Control unit 6 is adapted to determine variations of temperature of the substantially continuous sheet of polymeric material 1 on the basis of signals sent by first temperature sensor 7, or second temperature sensor 8, or a combination thereof. Further, the control unit 6 is adapted to receive signals from the external input element 9 and send signals to thermo-regulating device 5 to regulate the temperature of the substantially continuous sheet of polymeric material 1.

External input element 9 may be for example a sensor of the speed of the sheet of polymeric material 1 or of other inputs from the most relevant process parameters; it might store preset data, for instance characteristics of the sheet of polymeric material being processed regarding heat transfer, or others. These data sent from the external input element 9 to the control unit 6 allow to adjust the thermo-regulating power to properly regulate the cooling or heating of the sheet of material 1 by means of the thermo-regulating device 5, for example to regulate the heat absorbed by the thermo-regulating device 5 from the sheet 1 so that the sheet 1 is always crimped at the same temperature reported to the values of the other parameters (for instance speed), and therefore to significantly improve process robustness and stability, product consistency, and therefore product quality.

The temperature of the thermo-regulating device 5 therefore depends as in a feedback loop from the temperature of the sheet and other parameters of the crimping process as well.

The thermo-regulating device brings the temperature of the sheet 1 below the glass transition temperature. This temperature of glass transition depends on the material of the sheet 1.

For example: polylactic acid presents a glass transition temperature of about 60 degrees Celsius, cellulose acetate presents a glass transition temperature of about 50 degrees Celsius to 95 degrees Celsius, polyethylene terephthalate presents a glass transition temperature of about 70 degrees Celsius, polyvinylchloride presents a glass transition temperature of about 80 degrees Celsius, polyvinylchloride presents a glass transition temperature of about -10 degrees Celsius.

The temperature of the sheet 1 is continuously controlled by the temperature sensors 7, 8 and a feedback loop controls it, so that the temperature of the sheet 1 always remains below the glass transition temperature.

In Fig. 2, a second embodiment of an apparatus 200 to crimp sheet of polymeric material 1 is depicted. Apparatus 200, as the apparatus 100 of figure 1, includes a feed path 2, a first crimping roller 3, a second crimping roller 4, a thermo-regulating device 50, and a control unit 6.

Feed path 2 feeds along a transport direction indicated by arrow 10 the substantially continuous sheet of polymeric material 1 to the first crimping roller 3 and the second crimping roller 4.

Substantially continuous sheet of polymeric material 1 passes between first crimping roller 3 and second crimping roller 4 so that first crimping roller 3 and second crimping roller 4 apply crimp corrugations to substantially continuous sheet of polymeric material 1.

Thermo-regulating device 50 includes a thermo-conductor surface 11 adhering to the substantially continuous sheet of polymeric material 1 and is positioned at a position upstream the first crimping roller 3 and the second crimping roller 4 in the transport direction 10.

The thermo-regulating device 5 includes a thermo-regulating roller.

The functioning of the thermo-regulating device 50 and of the apparatus

200 is as described in the first embodiment of apparatus 100.

CLAIMS

1. Method of crimping a substantially continuous sheet of polymeric material, for a rod-shaped component of an aerosol-generating article, the method comprising the steps of:
   - bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature;
   - feeding the substantially continuous sheet of polymeric material to a first and second crimping rollers in a transport direction; and
   - crimping the substantially continuous sheet of polymeric material to form a crimped sheet of polymeric material by feeding the substantially continuous sheet of polymeric material between a first and a second crimping rollers so that the first and second crimping rollers apply crimp corrugations to the substantially continuous sheet of polymeric material,

   wherein bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature takes place upstream the first and second rollers in the transport direction.
2. Method according to claim 1, wherein the step of bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature comprises bringing temperature of the substantially continuous sheet of polymeric material at least about 10 degrees Celsius below its glass transition temperature.
3. Method according to any of the preceding claims, wherein the glass transition temperature of the polymeric material is at least about 25 degrees Celsius lower than the room temperature.
4. Method according to any of the preceding claims, wherein the glass transition temperature of the polymeric material is between approximately about 20 degrees Celsius and about 80 degrees

Celsius.

5. Method according to any of claims 1-4, wherein the substantially continuous sheet of polymeric material includes one or more of: polypropylene (PP), polyvinylchloride (PVC), polyethylene terephthalate (PET), polyactic acid (PLA), cellulose acetate (CA), starch based copolyester.

6. Method according to any of the preceding claims, including:
   - Sensing the temperature of the substantially continuous sheet of polymeric material upstream the first and second crimping rollers;
   - Varying a temperature of a thermo-regulating device adapted to lower or increase the temperature of the substantially continuous sheet of polymeric material depending on the sensed temperature of the substantially continuous sheet of polymeric material.

7. Method according to one claim 6, including providing a first and a second temperature sensor to sense the temperature of the substantially continuous sheet of polymeric material, the first sensor being positioned upstream the first and second crimping rollers and upstream a region where the temperature of the sheet of polymeric material is lowered or increased and the second sensor being positioned downstream the first and second crimping rollers.

8. Method according to any of the preceding claims, wherein bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature includes providing a thermo-regulating device forming a surface facing the substantially continuous sheet of polymeric material.

9. Method according to claim 8, wherein the thermo-regulating device includes a thermoelectric element.

10. Method according to any of the preceding claims, including the step of changing a temperature or a power to lower or increase the

temperature of the substantially continuous sheet of polymeric material depending on a speed of the substantially continuous sheet of polymeric material.

11. The method according to any of the preceding claims, including the steps of:
    - gathering the crimped sheet of polymeric material, and
    - forming a continuous rod using the gathered crimped sheet of polymeric material.
12. The method according to claim 11, including:
    - wrapping the continuous rod.
13. The method according to claim 11 or 12, comprising the step of:
    - cutting the continuous rod into a plurality of rod-shaped components, each rod-shaped component having a gathered crimped sheet formed from a cut portion of the crimped sheet of polymeric material, the crimp corrugations of the crimped sheet defining a plurality of channels in the rod-shaped component.
14. Method according to any of the preceding claims, wherein bringing the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature includes lowering the temperature of the substantially continuous sheet of polymeric material below its glass transition temperature.
15. Method of crimping a substantially continuous sheet of polymeric material, for a rod-shaped component of an aerosol-generating article, the method comprising the steps of:
    - Cooling the substantially continuous sheet of polymeric material from its initial temperature to at least about 10 degrees Celsius below the initial temperature;
    - feeding the substantially continuous sheet of polymeric material to a first and second crimping rollers in a transport direction; and

- crimping the substantially continuous sheet of polymeric material to form a crimped sheet of polymeric material by feeding the substantially continuous sheet of polymeric material between a first and a second crimping rollers so that the first and second crimping rollers apply crimp corrugations to the substantially continuous sheet of polymeric material.

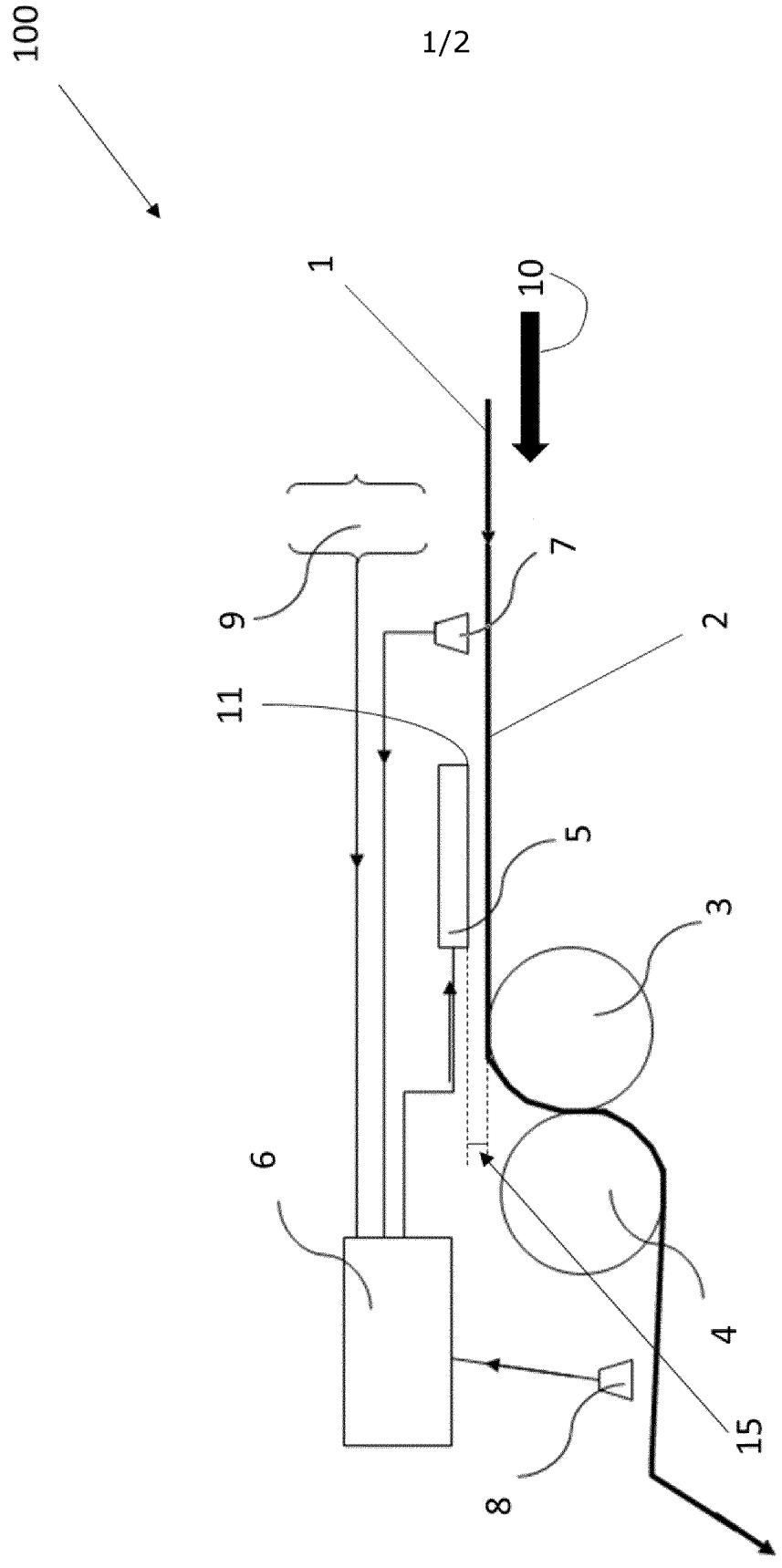

Fig 1

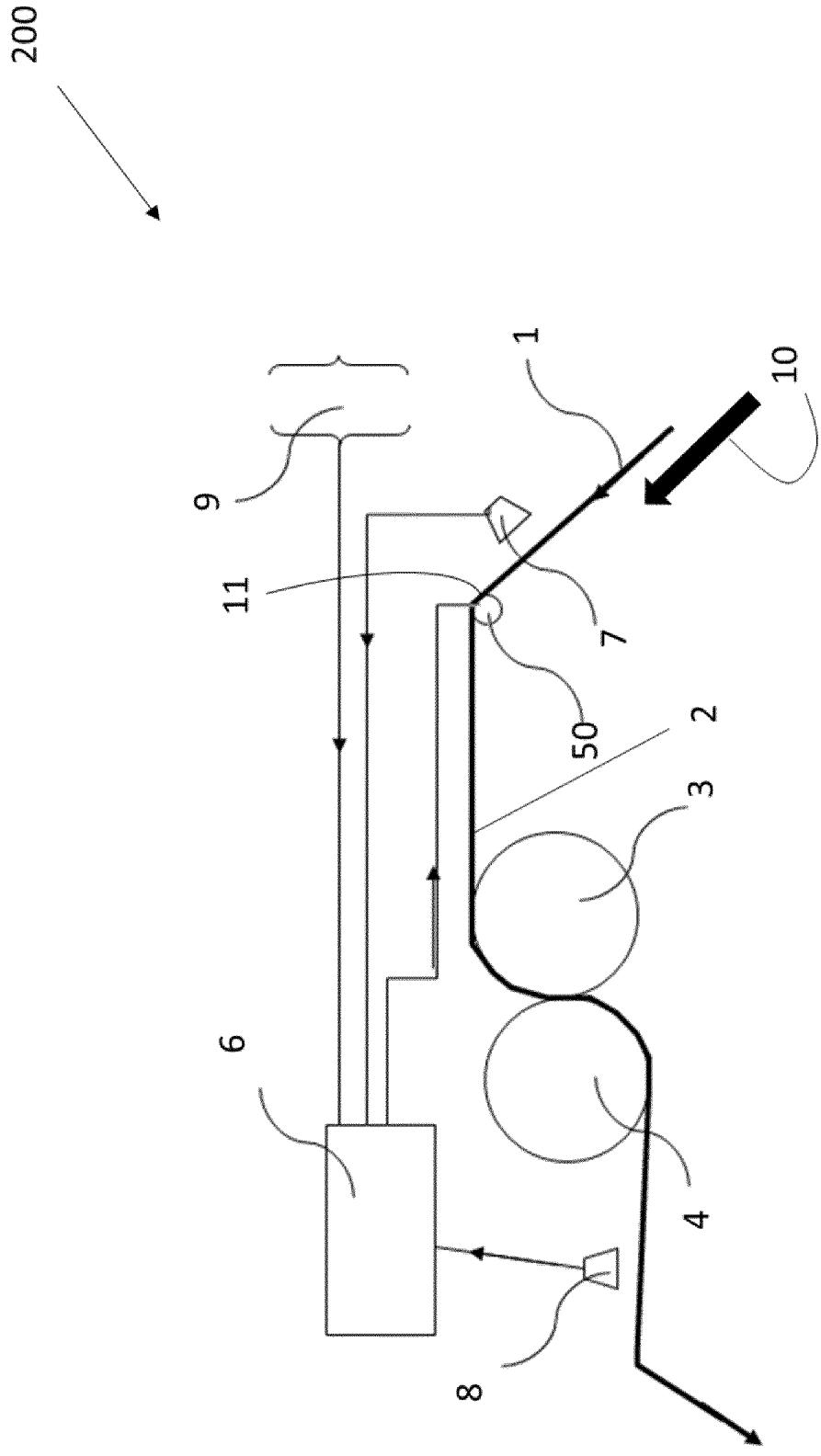

Fig 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/061688

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29C53/24 B29C53/84 A24B3/14 A24D3/02
ADD.

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)
B29C A24B A24D

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2016/097016 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 23 June 2016 (2016-06-23)	15
A	page 1, line 2 - line 5 page 2, line 17 - page 3, line 12 page 16, line 8 - line 30 page 17, line 15 - line 28 page 18, line 4 - line 13 page 19, line 26 - page 20, line 8 figure 1	1-14

A	US 2007/096366 A1 (SCHNEIDER JOSEF S [US]) 3 May 2007 (2007-05-03) paragraphs [0001], [0002], [0028], [0030], [0031], [0033], [0034], [0046], [0047] figures 2, 5, 10, 11	1-15

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] 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 June 2018	20/06/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Dias, Filipe

2

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 593 236 A1 (GEN ELECTRIC [US]) 20 April 1994 (1994-04-20) column 2, line 34 - line 44 column 3, line 54 - column 4, line 3 column 6, line 22 - line 29 column 7, line 1 - line 44 figures 1-4	1-15
A	WO 2016/023965 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 18 February 2016 (2016-02-18) abstract; figures 1-9	1-15
A	WO 2015/097127 A1 (PHILIP MORRIS PRODUCTS SA [CH]) 2 July 2015 (2015-07-02) abstract; figures 1-6	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2018/061688

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016097016 A1	23-06-2016	CN 107567286 A	09-01-2018
		EP 3232828 A1	25-10-2017
		JP 2018504100 A	15-02-2018
		KR 20170095203 A	22-08-2017
		US 2017332695 A1	23-11-2017
		WO 2016097016 A1	23-06-2016
US 2007096366 A1	03-05-2007	TW 200736430 A	01-10-2007
		US 2007096366 A1	03-05-2007
		WO 2007053830 A2	10-05-2007
EP 0593236 A1	20-04-1994	DE 69307252 D1	20-02-1997
		DE 69307252 T2	12-06-1997
		EP 0593236 A1	20-04-1994
		ES 2097459 T3	01-04-1997
		JP 2644673 B2	25-08-1997
		JP H06190914 A	12-07-1994
		US 5340518 A	23-08-1994
WO 2016023965 A1	18-02-2016	AR 101938 A1	25-01-2017
		AU 2015303169 A1	05-01-2017
		CA 2956345 A1	18-02-2016
		CN 106535668 A	22-03-2017
		DK 3136881 T3	02-01-2018
		EP 3136881 A1	08-03-2017
		EP 3281535 A1	14-02-2018
		ES 2650968 T3	23-01-2018
		HU E034709 T2	28-02-2018
		JP 6307661 B2	04-04-2018
		JP 2017524368 A	31-08-2017
		KR 20170018456 A	17-02-2017
		LT 3136881 T	10-01-2018
		PH 12016502452 A1	06-03-2017
		PL 3136881 T3	30-03-2018
		PT 3136881 T	04-01-2018
		RU 2639117 C1	19-12-2017
		SG 11201700963X A	30-03-2017
		SI 3136881 T1	31-01-2018
		TW 201607442 A	01-03-2016
		WO 2016023965 A1	18-02-2016
WO 2015097127 A1	02-07-2015	CN 105745069 A	06-07-2016
		EP 3086938 A1	02-11-2016
		JP 2017501686 A	19-01-2017
		KR 20160102391 A	30-08-2016
		RU 2016120862 A	30-01-2018
		US 2016288446 A1	06-10-2016
		WO 2015097127 A1	02-07-2015