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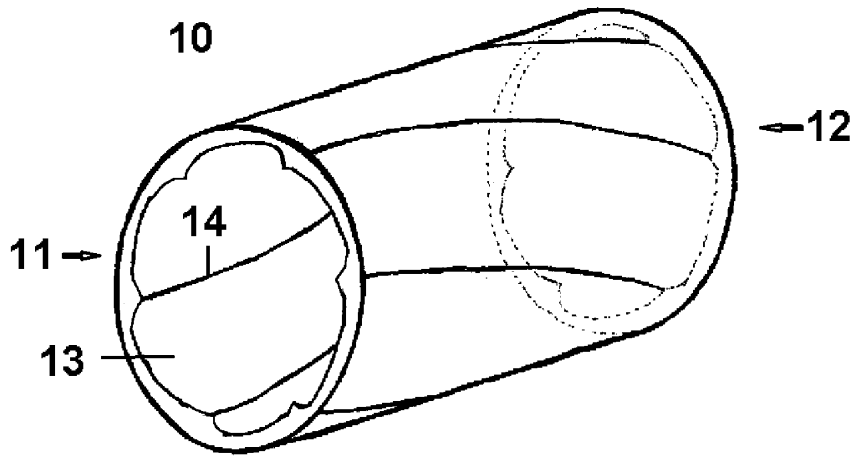
(54) **Transport jet adapter and method for forming rods**

(57) According to a first aspect of the invention there is provided a transport jet adapter. The transport jet adapter comprises a first open end defining an opening for receiving a strand-based continuous material and a second open end defining an outlet for supplying the strand-based continuous material to a rod making garniture. Between the first and the second opening, there is provided passageway for passing the strand-based continuous material through the transport jet adapter. The passageway is defined by the inner surface of the wall connecting the first and the second open end of the transport jet adapter. The inner surface of the transport jet adapter comprises a plurality of specifically designed rifled edges. The rifled edges are twisted about the longitudinal axis of the passageway at a predefined twist rate and are thus capable of twisting the strand-based continuous material about its longitudinal axis.

Figure 5



EP 3 047 739 A1

Description

[0001] The present invention relates to a transport jet adapter and a method for forming rods from continuous material using the adapter. The invention further relates to rods comprising continuous material being twisted about its longitudinal axis. In particular the invention relates to filter rods obtainable by use of the transport jet adapter and products made from the obtained rods, like filter tips and tobacco products comprising the filter tips.

[0002] Filter rods for use in the tobacco industry are made of filter material, typically cellulose acetate tow, provided in the form of a continuous strand of fibres of the filter material. The continuous strand of filter material is subjected to several process steps before being supplied to the garniture of a filter rod maker. Within the filter rod maker, the final product diameter is fixed. These process steps involve for example one or more of: opening of the strand (for example by blooming the cellulose acetate tow), crimping the strand or the application of particulate additives or liquid additives. Where particulate additives or liquid additives are applied, for example the strand of filter material is spread wide in relation to the direction of travel for processing. During subsequent collection or funnelling into the garniture the processed strand is transformed into a rod-shaped product.

[0003] This transformation causes the filter material to be unevenly distributed in the final filter rods. Typically, this leads to a non-homogeneously distribution of the hardness of the final filter rods about the circumference of the rods as depicted in Figure 1. This inhomogeneity may impair the stability of the rods. In turn, this may lead to difficulties in downstream processes like cigarette making and filter combining and may results in rejects. A similar effect may be observed with any material that is supplied in the form of a continuous material having an initially substantially "flat" cross-section for processing reasons when it is transformed into a product having a "round" cross-section, like a filter rod.

[0004] In conventional cigarette filter manufacturing processes, only the problem of the non-homogenous distribution of cigarette filter tow in length direction has been approached. This problem is basically attributed to the accumulation of filter tow during collection or funnelling, in particular when using a pneumatic device for increasing processing performance at high rates of production, known as transport jet in the art.

[0005] It is known from European patent application EP-A-0 269 915 A1 that the nonhomogeneous distribution of cigarette filter tow in length direction at higher processing speeds can be addressed by providing the garniture tongue with holes for the application and subsequent release of transport gas.

[0006] It is further known from European patent application EP-A-0 594 054 A2 that the nonhomogeneous distribution of cigarette filter tow in the transport direction at higher processing speeds can be addressed by use of a transport jet adapter which directly interconnects the tow opening device including a transport jet and the garniture tongue of a filter rod maker. The transport jet adapter avoids the garniture funnel and is provided with tapering walls having a multiplicity of apertures for dissipation of transport gas.

[0007] It would thus be desirable to have a device and a process for effecting a more even distribution of a continuous material before it is supplied to the garniture of a filter rod maker and thus mitigate or eliminate the circumferential variation in hardness of the rods. It would further be desirable to have rods made from continuous material being improved in circumferential hardness distribution, in particular filter rods for tobacco products, and tobacco products comprising filters obtained from these rods.

[0008] According to a first aspect of the present invention there is provided a transport jet adapter. The transport jet adapter comprises a first open end defining an opening for receiving a continuous material and a second open end defining an outlet for supplying the continuous material to a rod making garniture. Between the first and the second opening, there is provided passageway for passing the continuous material through the transport jet adapter. The passageway is defined by the inner surface of the wall connecting the first and the second open end of the transport jet adapter. The inner surface of the transport jet adapter comprises a plurality of rifled edges. The rifled edges are twisted about the longitudinal axis of the passageway at a predefined twist rate and are therefore capable of twisting the continuous material about its longitudinal axis.

[0009] Advantageously, the present invention improves rod making techniques in that a substantially flat continuous material is twisted about its longitudinal axis at a predefined twist rate in order to mitigate or eliminate the variation in circumferential hardness of the rods formed from the continuous material. With the present invention it is possible to improve the stability of the rods. The present invention is particularly useful in the manufacture of filter rods for tobacco products, since downstream processes like cigarette making and filter combining become more efficient, the final product quality improves and the number of rejects is lowered due to the improved stability of the rods.

[0010] In a preferred embodiment of the first aspect of the invention the twist rate of the rifled edges corresponds to a twist rate of 1 to 10 twists per meter, preferably 2 to 5 twists per meter and more preferably 3 to 4 twists per meter. Further preferably, the twist rate of the rifled edges corresponds to a twist of between about 90 degrees and about 180 degrees over a distance of 9.5 to 13 cm.

[0011] Preferably, the transport jet adapter typically has from 2 to 20, preferably from 3 to 16 and more preferably from 4 to 8 rifled edges.

[0012] Preferably, the peak-to-peak distance between the hills and the valleys defined by the rifled edges preferably between about 1 percent and about 30 percent and more preferably between about 2 percent and about

20 percent of the inner radius of the transport jet adapter. The inner radius is defined as the distance from the centre of a cross-section of the passageway of the transport jet adapter to the minimum of the valleys.

[0013] Preferably, the outer diameter of the transport jet adapter ranges between about 1 centimetre and about 10 centimetres, preferably between about 2 centimetres and about 6 centimetres and is more preferably about 3 centimetres. The length of rifled section of the transport jet adapter ranges between about 1 centimetre and about 20 centimetres, preferably between about 4 centimetres and about 12 centimetres and more preferably between about 5 centimetres and about 8 centimetres.

[0014] The transport jet adapter can be designed for convenient insertion into the transport jet or for connection in series to the transport jet. Like this transport jet adapters with different twist rates can be exchanged with ease in order to meet specific requirements of production. Accordingly the transport jet adapter can be provided with fastening means.

[0015] The transport jet adapter can be designed such that the risk of the material from being caught by the rifled edges when entering through the first open end is lowered. For example, the rifled edges can be formed such that the rifled edges and consequently the formed profile of peaks and valleys continuously develop from a non-profiled section of the inner wall at the first open end until reaching the desired peak-to-peak distance.

[0016] In alternative embodiments, the adapter may also be integrally formed in the transport jet by forming the desired profile directly on the inner surface of the transport jet. In such a case, the wall of the transport jet adapter constitutes the wall of the portion of a transport jet subsequent to the openings of the air nozzle.

[0017] The transport jet adapter can be formed from various materials. These materials typically include metals, metal alloys, plastics or combinations of metals and metal alloys with plastics like coated metals or metal alloys or metallized plastics. The materials should be formed in a manner that the inner surface of the wall is smooth without burrs in order to prevent the continuous material from being caught.

[0018] The transport jet adapter is particularly applicable in known commercially available transport jets for filter rod makers for the production of filter rods. Therefore, the present invention relates in accordance to a second aspect of the invention to a filter rod maker comprising the transport jet adapter of the first aspect of the present invention described above.

[0019] In a preferred embodiment of the second aspect of the present invention the filter rod maker is a filter rod maker for tobacco products.

[0020] According to a third aspect of the invention there is provided a method for the manufacture of rods. In a first step a material transport path is established for supplying a continuous material. It is known that materials typically used for forming filter rods in the tobacco industry, like cellulose acetate tow are provided as a bale of a continuous strand. Before being supplied to the transport jet of a filter rod maker, the material is typically subjected to several processing steps like opening, crimping and additive application. Therefore, if indicated by the nature of the material used for forming the rods, the method of the present invention may further include the step of opening the continuous material before it is supplied to the transport jet. Due to these steps, the material has a substantially flat shape before it is supplied to the transport jet.

[0021] However, it is to be understood that the continuous material for the purposes of the present invention is not restricted to conventional filter materials and that cellulose acetate tow exemplifies only one specific kind of continuous material suitable for the present invention.

[0022] Other materials useful in the present invention, like sheeted materials, also have a substantially flat shape before being supplied to the transport jet. Thus, the continuous material is typically provided in a substantially flat shape in the method of the present invention. The term "substantially flat" in this context means that the cross-section of the continuous strand of material in cross-machine direction has an aspect ratio of the longest diameter to the shortest diameter of 100:1 to 4:1, preferably from 20:1 to 4:1.

[0023] Subsequently, the optionally opened material is supplied to a transport jet comprising the transport jet adapter according to the first aspect of the invention for twisting the optionally opened material at a predefined twist rate. The method further encompasses further steps for finalizing the rods. Therein, the twisted material is first introduced to the entrance of a garniture of a filter rod maker in order to be then formed into rods in the final step.

[0024] In a preferred embodiment of the third aspect of the invention, the method relates to the manufacture of filter rods. With the method of the present invention it is possible to obtain rods, in particular filter rods, being improved in homogeneity of circumferential hardness over rods made by conventional non-twisting techniques.

[0025] According to a fourth aspect, the present invention is also directed to a rod, in particular a filter rod, made from a continuous material, wherein the material is twisted about the longitudinal axis of the rod at a predefined twist rate. In a preferred embodiment of the fourth aspect of the invention the twist rate of the material corresponds to a twist rate of 1 to 10 twists per meter, preferably 2 to 5 twists per meter and more preferably 3 to 4 twists per meter. Most preferably, the twist rate of the material corresponds to a twist of 90 to 180degrees over a length of 9.5 centimetres to 13 centimetres.

[0026] The rods obtainable by use of the transport jet adapter of the present invention show an improvement in material distribution over conventionally formed rods. The rods of the present invention have a lower variation in circumferential hardness expressed as H_{min}/H_{max} compared to conventionally formed rods. Thus, according to a fifth aspect of the present invention there is provided a rod, preferably a filter rod, with a variation in cir-

cumferential hardness H_{min}/H_{max} of more than 0.95, preferably more than 0.97 and more preferably more than 0.99.

[0027] H_{min} refers to the minimum hardness and H_{max} refers to the maximum hardness measured about the circumference of a filter rod. H_{min} and H_{max} may be obtained by using a Borgwaldt DD60A instrument which is known in the art for determining the hardness of cigarettes. The principle of the measurement is described below in reference to Figure 7.

[0028] In a preferred embodiment of the third, fourth and the fifth aspect of the invention the rod is a filter rod for tobacco products.

[0029] The material used for forming the rods can be any continuous material having sufficient filtration efficiency according to desired demands. Typically, the material is cellulose acetate tow. In another preferred embodiment of the third, fourth and the fifth aspect of the invention the material is selected or derived from the group consisting of cellulose acetate tow, polylactic acid, paper, metallized paper, metallized sheet material, metal sheet, tobacco leaf, reconstituted tobacco, filamentary material, non-woven material and combinations thereof.

[0030] For example, sheet materials can be supplied directly in the form of a sheet or foil. Alternatively, fibre-like structures can be formed from the sheet materials which fibres can then be formed into a continuous non-woven material derived from the sheet material.

[0031] The rods obtainable by use of the transport jet adapter of the present invention are useful for the production of filter tips. In a sixth aspect, the present invention is therefore directed to filter tips obtained from the rods of the fourth and fifth aspect of the present invention. Preferably, the filter tips are filter tips for tobacco products.

[0032] According to a seventh aspect of the invention there are provided tobacco products, in particular cigarettes, comprising the filter tip of the sixth aspect of the invention.

[0033] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 schematically shows a cross-section of a prior art filter rod.

Figure 2 shows a diagram of the variation in circumferential hardness of the prior art rod of Figure 1.

Figure 3 schematically shows a well-known, typical filter rod maker.

Figure 4 schematically shows a longitudinal section through a transport jet having inserted a transport jet adapter of the present invention.

Figure 5 schematically shows the transport jet adapter of the present invention.

Figure 6 shows a cross-sectional view of the transport jet adapter according to the present invention.

Figure 7 schematically depicts a filter rod subjected to hardness measurement using a Borgwaldt DD60A instrument.

[0034] Figure 1 shows in cross-section a prior art filter rod. The rod shows the typical hardness distribution pattern that is obtained when a substantially flat continuous strand of cellulose acetate tow is formed into a rod-shaped article with conventional non-twisting techniques.

[0035] As indicated by the shaded area, the material used for forming the filter rod is unevenly distributed within the rod. The distribution of material has its maximum at the diameter in direction parallel to the plane defined by the supplied material. This results in a corresponding density distribution. This is believed to cause variation in hardness about the circumference of the rod as shown qualitatively in the diagram of Fig. 2. The arrows in Figures 1 and 2 indicate different measurement points about the circumference of the rod.

[0036] Figure 3 shows a cigarette filter rod maker suitable for the practice of the present invention comprising a transport jet **1,** a garniture funnel **3,** a garniture tongue **4,** garniture belt **5** and plug wrap paper **6.** As can be seen from Figure 3, the transport jet **1** receives a continuous material **2** from guiding rolls **7** of a typical prior art opening device **8** for opening the continuous material **2,** like cellulose acetate filter tow.

[0037] Fig. 4 schematically shows a longitudinal section of transport jet **1.** The transport jet comprises the transport jet adapter **10** of the present invention. In order to maintain proper operation of the transport jet **1,** the transport jet adapter **10** is positioned downstream to the location where the air or gas (shown by arrows) used for transporting the continuous material **2** is supplied by the air/gas nozzle of the transport jet **1.** The air/gas stream forces the continuous material **2** through the transport jet adapter **10** of the present invention (twist not shown).

[0038] Figure 5 schematically shows the transport jet adapter **10** of the present invention. The transport jet adapter **10** comprises a first open end **11** defining an opening for receiving a continuous material **2** (material not shown), a second open end **12** defining an outlet for supplying the material **2** to a garniture of a filter rod maker, and a passageway for passing the material through the transport jet adapter, the passageway being defined by the inner surface of the wall **13** connecting the first open end **11** and the second open end **12** of the transport jet adapter **10.** The inner surface of the wall **13** comprises a plurality of rifled edges **14** which are twisted about the longitudinal axis of the passageway at a predefined twist rate for twisting the continuous material **2** at the corresponding rate.

[0039] The rifled edges **14** force the continuous material **2** to twist about its longitudinal axis as the continuous material **2** passes the transport jet adapter **10** from the transport jet **1** to the garniture of the filter rod maker. The twist of the continuous material **2** homogenizes the distribution of the material and thus homogenizes the circumferentially measured hardness.

[0040] Figure 6 schematically shows a cross-sectional view of the transport jet adapter **10** of the present invention. Point **20** indicates the maximum of the hills defined by the rifled edges **14** and point **22** indicates the minimum of the valley defined between two adjacent hills. Point **24** indicates the centre of concentric circles **26** and **28.** Circle **26** has a radius r_1 denoted with reference numeral **30** in Fig. 6 and defined by the distance between points **20** and **24** and circle **28** has a radius r_2 denoted with reference numeral **32** in Fig. 6 and defined by the distance between points **22** and **24.** r_2 is also referred to as the inner radius of the transport jet adapter **10.** The peak-to-peak distance between the hills and the valleys is defined as $r_2 - r_1$.

[0041] The outer surface **15** of the wall of the transport jet adapter is bounded by another concentric circle **34** having a radius r_3 also referred to as outer radius of the transport jet adapter **10.** Point **36** indicates the most remote point of the outer surface **15** of the wall of the transport jet adapter **10** from centre **24.**

[0042] Figure 7 schematically shows a filter rod subjected to a hardness measurement using a Borgwaldt DD60A instrument. The Borgwaldt DD60A instrument is fitted with a measuring head for cigarettes and with a cigarette receptacle (holder). Before testing, filter rod samples are conditioned in a cabinet between 21 degrees Celsius and 23 degrees Celsius and between 57 percent and 63 percent RH (relative humidity) for at least 24 hours. The test laboratory is conditioned between 20 and 24 degrees Celsius and between 55 percent and 65 percent RH (relative humidity).

[0043] The principle consists in measuring the average diameter of 10 filter rod samples before and after a load **40** of 2 kilograms (203.48 Newton) has been applied to the filter rod samples for 20 seconds. Reference numeral **42** represents the nominal rod diameter D_S before compression. Reference numeral **44** represents the depressed diameter D_D, that is, the diameter of the rod samples after the load has been applied for 20 seconds and reference numeral **46** represents the corresponding depression d of the rod samples.

[0044] The hardness is calculated as: $H = (D_D/D_S)*100$. This measurement is performed for at least six evenly distributed points around the circumference of the samples and the maximum hardness H_{max} and H_{min} are determined. The variation in circumferential hardness distribution is then calculated as H_{min}/H_{max}.

Claims

1. A transport jet adapter (10) comprising:

a) a first open end (11) defining an opening for receiving a continuous material (2),
b) a second open end (12) defining an outlet for supplying the continuous material (2) to a rod making garniture, and
c) a passageway for passing the continuous material (2) through the transport jet adapter (10), the passageway being defined by the inner surface of the wall (13) connecting the first (11) and the second open end (12) of the transport jet adapter (10), wherein the inner surface of the transport jet adapter (10) comprises a plurality of rifled edges (14) which are twisted about the longitudinal axis of the passageway at a predefined twist rate.

2. The transport jet adapter according to claim 1, wherein the twist rate of the rifled edges corresponds to a twist rate of 1 to 10 twists per meter, preferably 2 to 5 twists per meter and more preferably 3 to 4 twists per meter.

3. The transport jet adapter according to claim 1 or claim 2, having from 2 to 20, preferably from 3 to 16 and more preferably from 4 to 8 rifled edges.

4. The transport jet adapter according to any one of claims 1 to 3, wherein the peak-to-peak distance between the hills and the valleys defined by the rifled edges comprises 1 to 30 percent, preferably 2 to 20 percent of the inner radius of the transport jet adapter.

5. The transport jet adapter according to any one of claims 1 to 4 having an outer diameter between about 1 centimetre and about 10 centimetres, preferably about 2 centimetres and about 6 centimetres and more preferably about 3 centimetres and having a length between about 1 centimetre and about 20 centimetres, preferably between about 4 centimetres and about 12 centimetres and more preferably between about 5 centimetres and about 8 centimetres.

6. A filter rod maker comprising the transport jet adapter according to any one of claims 1 to 5.

7. A method for the manufacture of rods comprising the steps of:

- establishing a material transport path;
- supplying a strand-based continuous material (2) to a transport jet (1) comprising the transport jet adapter (10) according to any one of claims 1 to 5; and
- introducing the twisted material (2) to the entrance of a garniture of a filter rod maker; and
- forming filter rods from the twisted material.

8. The method of claim 7, further comprising the step of opening the material (2) before it is supplied to the transport jet (1).

9. A rod made from a continuous material, wherein the

material is twisted about the longitudinal axis of the rod at a predefined twist rate.

10. The rod according to claim 9, wherein the twist rate of the material corresponds to a twist rate of 1 to 10 twists per meter, preferably 2 to 5 twists per meter and more preferably 3 to 4 twists per meter.

11. A rod with a variation in circumferential hardness H_{min}/H_{max} of more than 0.95, preferably more than 0.97 and more preferably more than 0.99.

12. The rod according to any one of claims 9 to 11, wherein the material is selected or derived from the group consisting of cellulose acetate tow, polylactic acid, paper, metallized paper, metallized sheet material, metal sheet, tobacco leaf, reconstituted tobacco and mixtures thereof.

13. A filter tip for tobacco products obtained from a rod according to any one of claims 9 to 12.

14. A tobacco product, preferably a cigarette, comprising the filter tip according to claim 13.

Figure 1

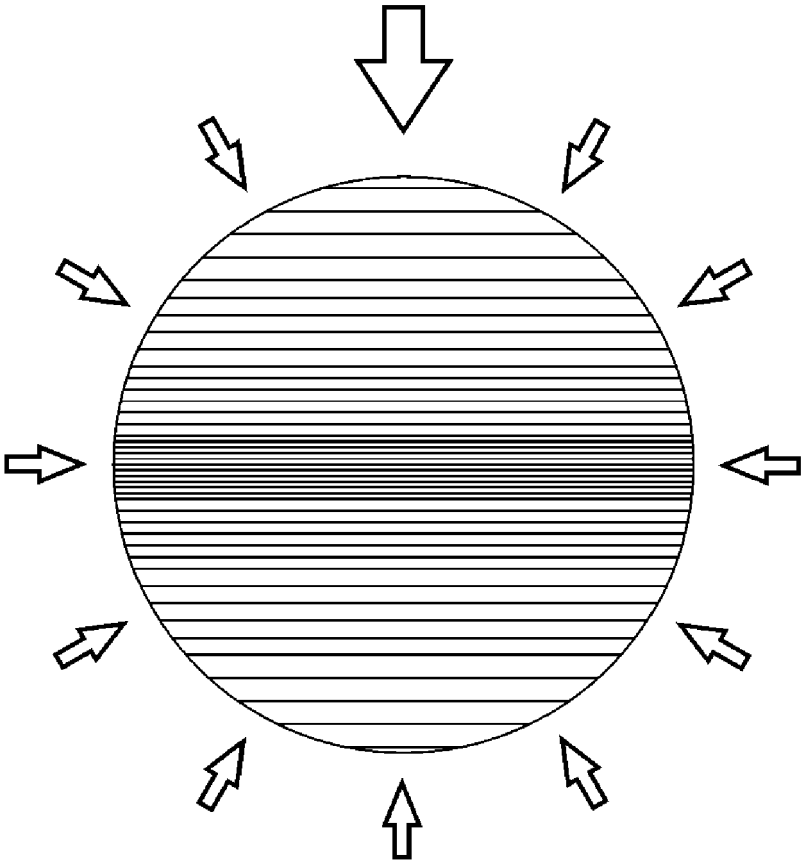


Figure 2

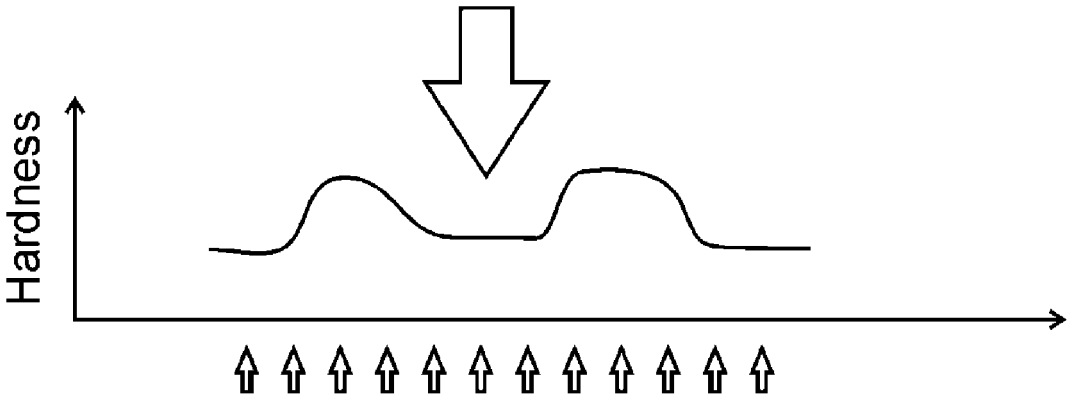


Figure 3

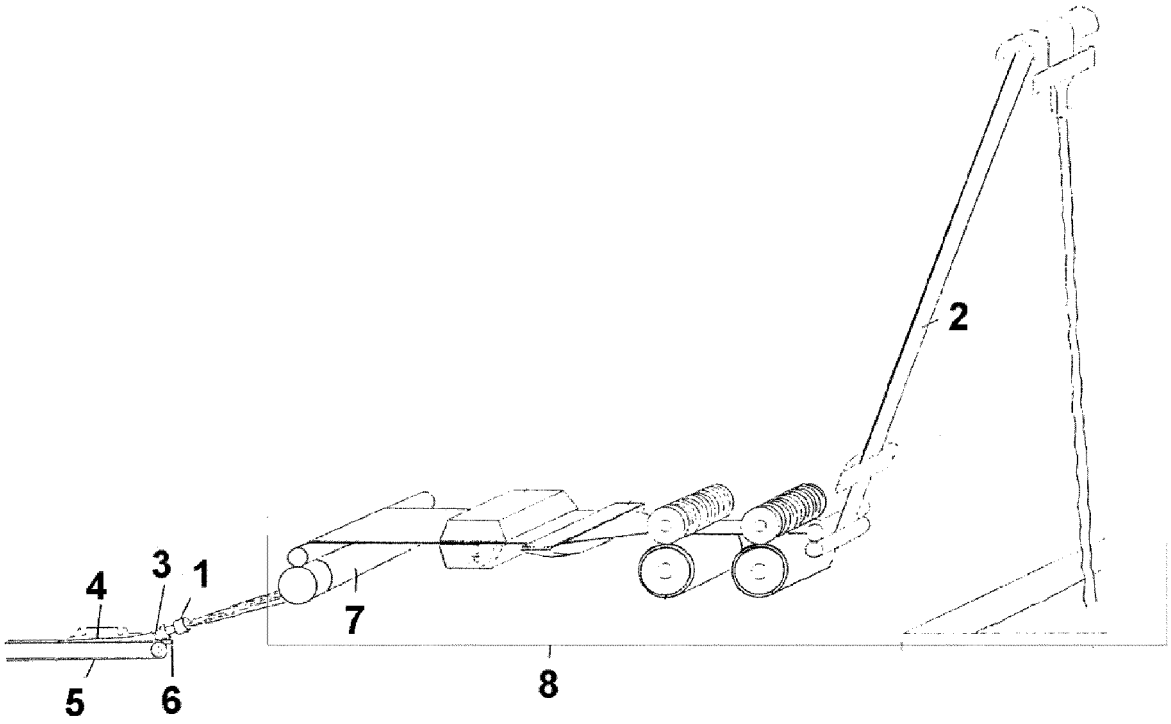


Figure 4

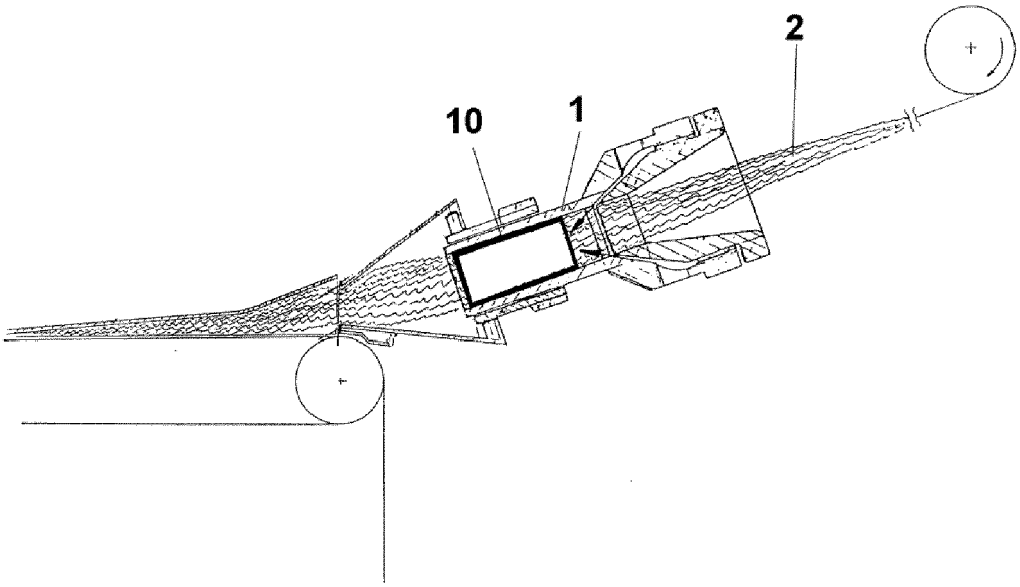


Figure 5

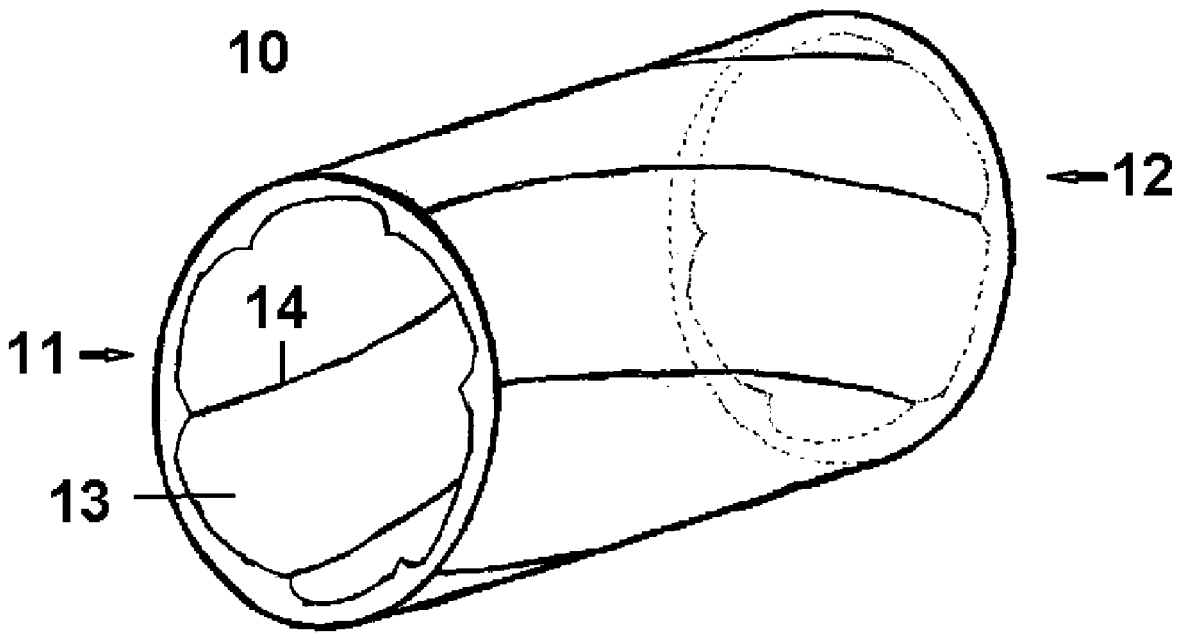


Figure 6

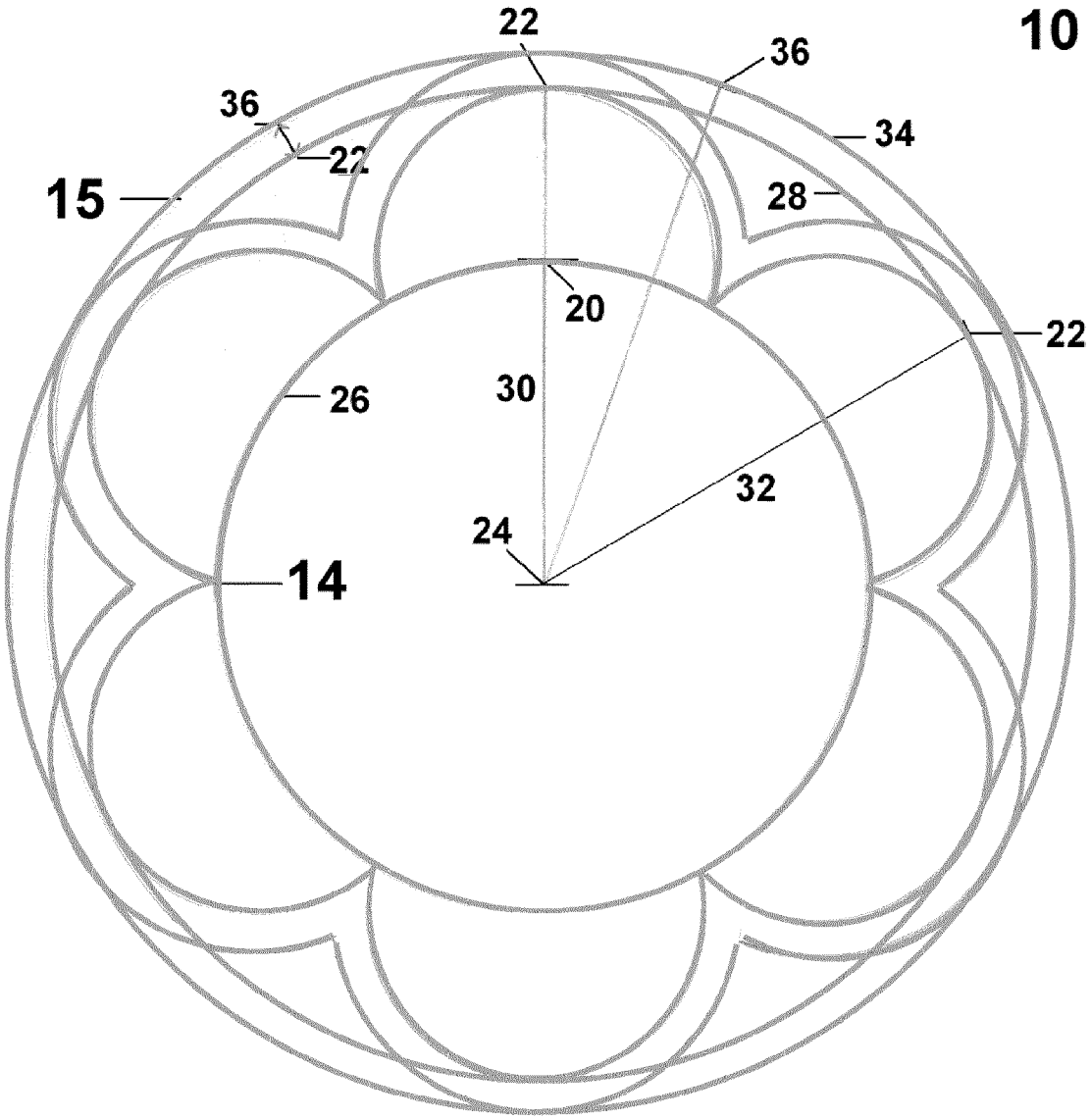
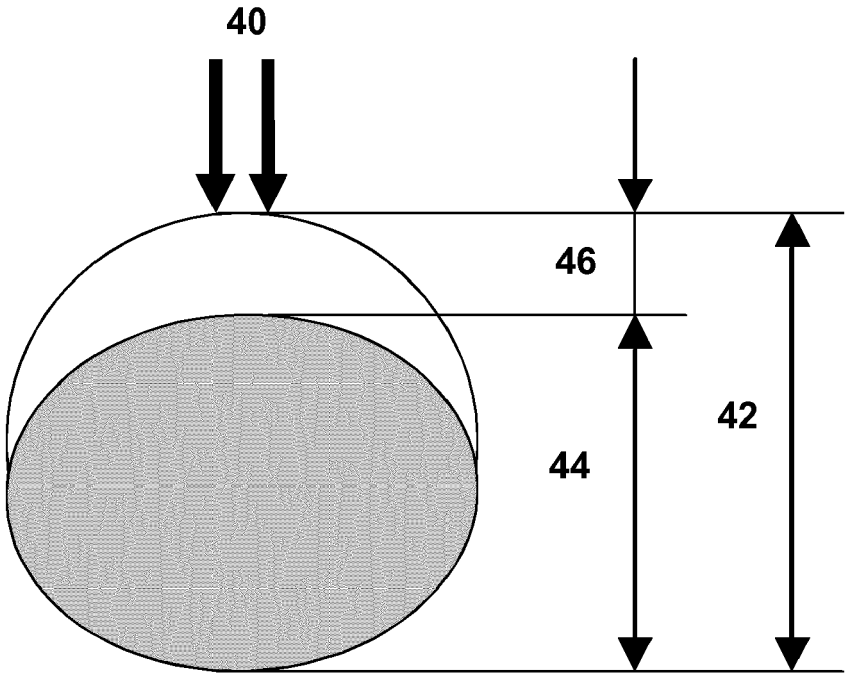


Figure 7



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EUROPEAN SEARCH REPORT

Application Number
EP 15 15 2109

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* the whole document *	1-8	

X	US 3 595 245 A (BUNTIN ROBERT R ET AL) 27 July 1971 (1971-07-27)	9-14	
A	* column 2, line 72 - column 4, line 6 * * column 5, lines 5-25 * * claims; figures *	1-8	

X	WO 84/02257 A1 (MOLINS PLC [GB]) 21 June 1984 (1984-06-21)	9-14	
A	* page 3, line 24 - page 4, line 11 * * page 7, line 7 - page 8, line 6 * * figure 4 *	1-8	

A	US 3 173 188 A (WEXLER VERNON K) 16 March 1965 (1965-03-16) * the whole document *	1-14	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 July 2015	Kock, Søren

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- EP 0594054 A2 **[0006]**