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(54) **APPARATUS FOR LOOSENING THE FIBRES OF A RAW TISSUE WEB AND CORRESPONDING METHOD**

VORRICHTUNG ZUR LOCKERUNG DER FASERN EINER ROHEN TISSUE-PAPIER-BAHN UND
ENTSPRECHENDES VERFAHREN

APPAREIL POUR DELIER LES FIBRES D'UNE BANDE D'OUATE DE CELLULOSE BRUTE ET
PROCEDE CORRESPONDANT

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**EP-A- 1 232 854 US-A- 4 236 963
US-A- 5 743 999**

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Description

Field of the invention

[0001] The present invention relates to an apparatus for loosening the fibres of a raw tissue web before converting to the tissue product and to a corresponding method.

[0002] A raw tissue web is a continuous tissue paper and tissue paper is defined as a soft absorbent paper having a low basis weight. One generally selects a basis weight of 8 to 30 g/m², especially 10 to 25 g/m² per ply. The total basis weight of multiple-ply tissue products is preferably equal to a maximum of 65 g/m², more preferably to a maximum of 50 g/m². Its density is typically below 0.6 g/cm³, preferably below 0.30 g/cm³ and more preferably between 0.08 and 0.20 g/cm³.

[0003] The production of tissue is distinguished from paper production by the its extremely low basis weight and its much higher tensile energy absorption index (see DIN EN 12625-4 and DIN EN 12625-5). Paper and tissue paper also differ in general with regard to the modulus of elasticity that characterizes the stress-strain properties of these planar products as a material parameter.

[0004] A tissue's high tensile energy absorption index results from the outer or inner creping. The former is produced by compression of the paper web adhering to a dry cylinder as a result of the action of a crepe doctor or in the latter instance as a result of a difference in speed between two wires ("fabrics"). This causes the still moist, plastically deformable paper web to be internally broken up by compression and shearing, thereby rendering it more stretchable under load than an uncreped paper.

[0005] Moist tissue paper webs are usually dried by the so-called Yankee drying, the through air drying (TAD) or the impulse drying method.

[0006] The fibers contained in the tissue paper are mainly cellulosic fibres, such as pulp fibers from chemical pulp (e.g. Kraft sulfite and sulfate pulps), mechanical pulp (e.g. ground wood), thermo mechanical pulp, chemo-mechanical pulp and/or chemo-thermo mechanical pulp (CTMP). Pulps derived from both deciduous (hardwood) and coniferous (softwood) can be used. The fibers may also be or include recycled fibers, which may contain any or all of the above categories. The fibers can be treated with additives - such as fillers, softeners, such as quaternary ammonium compounds and binders, such as conventional dry-strength agents or wet-strength agents used to facilitate the original paper making or to adjust the properties thereof. The tissue paper may also contain other types of fibers, e.g. regenerated cellulosic fibres or synthetic fibers enhancing, for instance, strength, absorption, smoothness or softness of the paper.

[0007] Tissue paper may be converted to the final tissue product in many ways, for example, by embossing or laminating it into a multi-ply product, rolled or folded.

[0008] As raw tissue web in sense of the present invention it is meant the web discharged from the paper

making machine before it is converted to the tissue product as before-mentioned.

Background of the invention

[0009] In the paper-making machine, the fibres are arranged in a substantially oriented manner and the dried fibres form a fibre composite, namely the raw tissue web. In the conventional art, the fibres in the raw tissue web leaving the paper-making machine are as previously mentioned substantially oriented in the machine direction of the paper-making machine, as it is also depicted in Fig. 5A, which schematically shows a raw tissue web after leaving the papermaking machine and before being treated by method of the present invention.

[0010] Such a raw tissue web or tissue paper, respectively is depending on its basis weight relatively stiff and inflexible.

[0011] US-A-4,236,963 discloses an apparatus having the features defined in the preamble of claim 1. Further, a method for making a tissue paper product from a tissue paper web is known from EP-A-1 232 854, wherein the web is first subjected to stretch embossing and then to calendering. However, the calendering step is carried out to reduce the caliper of the web that is increased during the stretch embossing step. Finally, US-A-5,743,999 discloses a method for making soft tissue also lacking a calendering step.

Summary of the invention

[0012] Consequently, it is the technical problem underlying the present invention to provide an apparatus and a method which are capable to increase the flexibility and decrease the stiffness of a raw tissue web before converting to the final tissue product

[0013] This technical problem is solved by an apparatus having the features of claim 1 and a method having the features of claim 7.

[0014] The basic idea of the present invention is to loosen at least the fibres of the raw tissue web located in the surface region/-s of the tissue web so as to increase the softness on the surface of the raw tissue web and to break up the inflexible fibre composite of the raw tissue web, which is both achieved in that the raw tissue web is flexed in the machine direction and/or cross to the machine direction (cross-machine direction). The flexing for example could be compared (merely for the sake of explanation of the invention) with pulling the raw tissue web over an edge under tension, whereby the fibres on the surface of the tissue web opposite to the surface facing the edge are raised.

[0015] This basic idea of the present invention is achieved according to the present invention by an apparatus for loosening the fibres of a raw tissue web before converting to the tissue product, wherein the apparatus comprises a first pair of rollers and/or a second pair of rollers. The first pair of rollers defines a first nip for intro-

ducing the tissue web, the first nip being at least as large as the thickness of the tissue web. In the apparatus according to the present invention, the tissue web is introduced into the first nip in a machine direction preferably under tension. As the nip is at least as large as the thickness of the tissue web, the tissue web is not compressed or calendered in the nip. Preferably, the first nip equals the thickness of the tissue web or is slightly larger. In any case, the dimensions of the nip have to be determined so that the tissue web is still flexed as described in the following while not being compressed. One roller of the first pair of rollers has protuberances extending about the entire circumference of the roller and separated from each other in the longitudinal direction of the roller. The longitudinal direction of the roller is meant to be the direction parallel to the center axis of the roller. The other roller of the first pair of rollers is formed complementary to the one roller thereof. In other words, also the other roller has protuberances extending about the entire circumference of the roller and being separated from each other in the longitudinal direction of the roller. However, the rollers are arranged so that the protuberances of the one roller engage with regions separating adjacent protuberances of the other roller, etc. (i.e. both rollers mesh). This arrangement enables that the tissue web transported through the nip of the first pair of rollers being dimensioned as aforesaid is flexed in the machine direction. That is, the tissue web introduced in the nip is flexed about an axis or a plurality of axis in parallel with the machine direction. Furthermore, the apparatus of the present invention may alternatively or additionally comprise a second pair of rollers defining a second nip for introducing the tissue web, the second nip being at least as large as the thickness of the tissue web. In particular, the second nip is defined and configured similar or equal to the first nip. Furthermore, one roller of the second pair of rollers has protuberances being at least separated in a direction of the circumference of the roller. In other words, protuberances in the form of columns or knobs having e.g. a rounded head are distributed about the circumference of the roller and separated from each other. The other roller of the second pair of rollers is also complementary to the one roller thereof. That is, the other roller is also configured to have protuberances being at least separated from each other in a direction of the circumference of the roller and both rollers are arranged so that the protuberances engage portions between two protuberances of the other roller adjacent in a direction of the circumference of the roller. By this arrangement, the web introduced into the nip dimensioned as aforesaid in context with the first pair of rollers is flexed in the cross-machine direction. In other words, the web is flexed about an axis or a plurality of axis perpendicular to the machine direction or in parallel with the cross-machine direction.

[0016] The arrangement of the apparatus according to the present invention enables to loosen the fibres at least on one surface of a tissue web so as to increase the softness of the surface/-s of the tissue web as well as

the flexibility.

[0017] There is arranged downstream the first and/or the second pair of rollers, a pair of calender rollers for calendering the tissue web after flexing and to improve its visual appearance.

[0018] Preferably, the protuberances of the one roller of the first pair of rollers are separated by means of grooves extending about the entire circumference of the one roller and being complementary to the protuberances. This arrangement leads to an improved intermeshing between the two rollers and therefore, a more uniform flexing of the tissue web. This in turn leads to a more uniform flexibility and softness of the tissue web.

[0019] Similar, the protuberances of the one roller of the second pair of rollers can be separated by means of grooves at least between the protuberances, the grooves extending in the longitudinal direction of the one roller and being complementary to the protuberances. The grooves are at least complementary to the two protuberances separated by the groove. Thereby, a similar effect can be achieved as it has been pointed out above.

[0020] Preferably; the protuberances of the one roller of the second pair of rollers are separated in the longitudinal direction, so that the roller somewhat looks like an alternate arrangement of gear wheels and spacers on a common axis.

[0021] According to another embodiment of the present invention the protuberances on the one roller of the first pair of rollers are helically formed, being divided in the center of the roller as 'seen in the width direction of the center axis of the roller, the two parts running away from each other to the left side of the roller and to the right side of the roller, respectively, in the longitudinal direction of the roller. In other words, the roller is composed of two helically formed protuberances divided in the middle of the longitudinal direction of the roller. Thus, the web is pulled by one helical portion to the one side and by the other helical portion to the opposite side, so that the web does not move perpendicular to the machine direction but is somewhat extended in the cross-machine direction.

[0022] Preferably, and to increase the aforementioned effect of the present invention at least one of the rollers of the first and/or second pair of roller is heated.

[0023] Furthermore, in order not to damage the tissue web and in order not to leave some kind of embossing on the tissue web after being discharged from the apparatus of the present invention, the protuberances and/or grooves of the one roller of the first and/or second pair of rollers and preferably also of the other roller are rounded.

[0024] For this reason, it is also preferable that the protuberances have the dimensions of for example a micro-embossing used in converting. Preferably, the protuberances of the one roller of the first and/or second pair of rollers have a width parallel to the width of the roller of approximately 0.2 to 1.0 mm and a height perpendicular to the width of approximately 0.2 to 1.0 mm. Preferably,

the dimensions of the first pair of rollers and second pair of rollers is the same. Furthermore, it is also preferred that the width of the protuberances equals the height of the protuberances.

[0025] In addition, the present invention also provides a method for loosing the fibres of a raw tissue web, the method comprising the steps of introducing the tissue web into a first nip as described above and flexing the tissue web in the machine direction in the first nip. Furthermore, the method may alternatively or additionally comprise the step of introducing the tissue web into a second nip similar to the one described above and flexing the tissue web in the cross-machine direction in the second nip.

[0026] The method of the present invention also comprises the step of calendering the tissue web subsequent the step of flexing the tissue web in the first nip and/or the step of flexing the tissue web in the second nip.

Brief description of the drawings

[0027] In the following, the present invention is described in more detail referring to a preferred exemplary embodiment of the present invention and the accompanying drawings, in which:

Fig. 1 shows schematically the apparatus according to one embodiment of the present invention;

Fig. 2 shows the section A of Fig. 1 in an enlarged scale, wherein the two rollers of the second pair of rollers is depicted;

Fig. 3 shows a side view of the first pair of rollers shown in Fig. 1 in an enlarged scale;

Fig. 4 shows a cross section of the first pair of rollers perpendicular to the longitudinal direction of the one roller and the other roller;

Fig. 5A and Fig. 5B show the raw tissue web being discharged from the paper making machine before the process of the present invention (Fig. 5A) and after the process of the present invention (Fig. 5B).

Description of the preferred embodiment of the invention

[0028] Referring to Fig. 1, an apparatus according to one exemplary embodiment of the present invention is shown comprising a first pair of rollers and a second pair of rollers. In the shown embodiment the first pair of rollers is located downstream the second pair of rollers in the machine direction MD. However, alternatively also the second pair of rollers can be located downstream the first pair of rollers in the machine direction. The first pair of rollers has a first roller 3 and a second roller 4. Similar, the second pair of rollers has a first roller 5 and second roller 6. All rollers 3 to 6 are disposed with their axis of

rotation or-center axis, respectively in parallel with a raw tissue web 7 and transverse to the machine direction (in cross-machine direction). The tissue web is transported preferably under tension in the machine direction. The first pair of rollers defines between the first roller 3 and the second roller 4 a first nip 8. Similar, the first roller 5 and the second roller 6 of the second pair of rollers 2, define a second nip 9. As shown in Fig. 1, the raw tissue web 7 (hereinafter tissue web 7) is transported in the machine direction.

[0029] In Fig. 2 the section A in Fig. 1 is depicted in an enlarged scale. Thus, Fig. 2 shows the second pair of rollers including the first roller 5 and the second roller 6. The tissue web 7 is introduced into the second nip 9 and being transported in the machine direction MD. The first roller 5 of the second pair of rollers comprises protuberances 10 extending in the longitudinal direction of the roller 5, i.e. in parallel to the center axis. The protuberances 10 on the roller 5 are separated to each other by a groove 11 also extending in the longitudinal direction of the roller 5. In an alternative embodiment the protuberances 10 could additionally be separated from each other in the longitudinal direction so that the roller would look similar to an alternate arrangement of gear wheels and spacers on a common axis.

[0030] The second roller 6 of the second pair of rollers is configured complementary to the roller 5 as it is depicted in Fig. 2. In other words, the protuberances 10 of the roller 5 engage with grooves 11 of the roller 6 and vice versa. Consequently, if the tissue web 7 is passed through the second nip 9 in the machine direction, the tissue web is flexed about an axis in the cross machine direction, i.e. perpendicular to the machine direction.

[0031] The first pair of rollers 1 is depicted by a side view in enlarged scale in Fig. 3 and in a cross section perpendicular to the longitudinal direction (longitudinal cross section) of the two rollers in Fig. 4. The first roller 3 of the first pair of rollers 1 has protuberances 12 extending about the entire circumference of the roller 3 and grooves 13 separating the protuberances 12 from each other in the longitudinal direction of the roller 3, the grooves 13 also extending about the entire circumference of the roller 3. As best viewed in Fig. 4, the second roller 4 of the first pair of rollers 1 is configured complementary to the first roller 3. That is, the second roller 4 also has protuberances 12 and grooves 13, wherein the protuberances 12 of the second roller 4 mesh with grooves 13 of the first roller 3 and vice versa. Consequently, and as depicted in Fig. 4 the tissue web 7 is flexed about an axis in parallel with the machine direction, which in Fig. 4 runs perpendicular to the drawing sheet. Please note that in Fig. 4 only half of the first roller 3 and the second roller 4 is depicted and the axes 14 and 15 represent the symmetry axis of the respective rollers.

[0032] The protuberances 10 and 12 of the first and second pair of rollers preferably have a width W of between app. 0,2 and 1,0 mm and a height H of between app. 0,2 and 1,0 mm. More preferred the height H equals

the width and the protuberances of the first pair of rollers have substantially the same dimensions as of the second pair of rollers.

[0033] Furthermore, the first nip 8 and the second nip 9 are configured as schematically depicted in the figures so as to be not smaller than the thickness of the tissue web 7. Preferably, the dimension of the nips 8 and 9 is configured to be equal to the thickness of the tissue web 7 or slightly larger. This leads to the fact that the raw tissue web 7 introduced in the first and second nip 8, 9 is not damaged, no pattern is formed on the tissue web and the visual appearance is not inferred. To say it in other words, the tissue web is not calendered or compressed in the nips 8 and 9. Common thicknesses of raw tissue are approximately 150 to 400 μm , preferably 200 to 350 μm for TAD-Tissues, and approximately 80 to 200 μm , preferably 100 to 150 μm for tissues of the conventional drying method (Yankee-drying). These data always refer to the thickness of one ply.

[0034] By flexing the tissue web 7 in the first nip 8 and the second nip 9 in the machine direction and the cross machine direction the softness and flexibility of the tissue web 7 is increased compared to a tissue web from a conventional paper making machine.

[0035] The effect achieved by the apparatus and the method of the present invention will be explained in the following with reference to Figs. 5A and 5B. A tissue web is comprised of a plurality of fibres upon being discharged from the paper making machine. The plurality of fibres are all oriented substantially in the machine direction MD as shown in Fig. 5A. After the web is flexed in the second nip 9, the fibres 16 at least in the outer surface regions are raised so as to stand up and being not oriented in the machine direction MD anymore. Furthermore, by flexing the tissue web 7 in the first nip 8 the fibres 16 are also raised on the outer surfaces and are not oriented in the machine direction anymore, but parallel or angular to the cross machine direction. Consequently, by means of the apparatus of the present invention and the method of the present invention the softness and the flexibility of the tissue web is increased. However, it is to be expected that the rigidity of the tissue web 7 is reduced compared to the tissue web shown in Fig. 5A being discharged from the conventional paper making machine. In contrast, it is to be expected that the absorbency is increased. Consequently, it will be preferable for a tissue product (final tissue product) to be comprised of one ply manufactured by the apparatus or the method of the present invention and another ply being manufactured in a conventional manner, so that the conventional ply increases the rigidity of the overall product, whereas the new and inventive ply according to the present invention increases softness and flexibility of the overall product.

[0036] Furthermore, it is to be noted that the tissue web 7 produced by the present invention can be converted in any manner as it is known to the skilled person.

[0037] It is to be understood that the present invention has been explained by means of the embodiment shown

in the figures for the purpose of explaining the principles of the invention only and the detailed description is not to be considered as limiting the scope of the invention to this embodiment, but the scope of the invention is defined by the appended claims. In fact, various modifications and variations will be apparent to the skilled person.

Claims

1. Apparatus for loosening the fibers (16) of a raw tissue web (7) before conversion to a tissue product, the apparatus comprising:

a first pair (1) of rollers defining a first nip (8) for introducing the tissue web (7), the first nip being at least as large as the thickness of the tissue web, each roller (3, 4) of the first pair of rollers having protuberances (12) extending about the entire circumference of the roller and being separated from each other in the longitudinal direction of the roller, wherein the rollers (3, 4) of the first pair (1) of rollers are arranged so that protuberances (12) of one roller engage with regions separating the protuberances of the other roller, so that the tissue web is flexed about one or more axes parallel to the machine direction (MD); and/or

a second pair (2) of rollers defining a second nip (9) for introducing the tissue web (7), the second nip being at least as large as the thickness of the tissue web, each roller (5, 6) of the second pair of rollers having protuberances (10) being at least separated in a direction of the circumference of the roller, wherein the rollers (5, 6) of the second pair (2) of rollers are arranged so that protuberances (10) of one roller engage with regions separating protuberances of the other roller, so that the tissue web is flexed about one or more axes parallel to the cross-machine direction (CD), **characterized in that** a pair of calender rollers is arranged downstream of the first (1) and/or the second (2) pair of rollers.

2. Apparatus according to claim 1, wherein the protuberances (12) of the rollers (3, 4) of the first pair of rollers (1) are separated by means of grooves (13) extending about the entire circumference of the rollers.

3. Apparatus according to claim 1 or 2, wherein the protuberances (10) of the rollers (5, 6) of the second pair of rollers (2) are separated by means of grooves (11) extending in the longitudinal direction of the rollers.

4. Apparatus according to any one of the preceding claims, wherein the protuberances (10) of the rollers

(5, 6) of the second pair of rollers (2) are separated in the longitudinal direction.

5. Apparatus according to any one of the preceding claims, wherein at least one of the rollers (3, 4, 5, 6) of the first (1) and/or second (2) pair of rollers is heated. 5
6. Apparatus according to any one of the preceding claims, wherein the protuberances (10, 12) and/or grooves (11, 13) of the rollers (3, 4, 5, 6) of the first (1) and/or second (2) pair of rollers are rounded. 10
7. Method for loosening the fibers (16) of a raw tissue web (7), the method comprising the steps of: 15

introducing the tissue web (7) into a first nip (8) formed by a first pair (1) of rollers without compressing the tissue web between the rollers, each roller (3,4) of the first pair of rollers having protuberances (12) extending about the entire circumference of the roller and being separated in the longitudinal direction of the roller, wherein the rollers(3,4) of the first pair(1) of rollers are arranged so that protuberances (12) of one roller engage with regions separating the protuberances of the other roller; 20

flexing the tissue web about one or more axes parallel to the machine direction (MD) in the first nip (8); and/or 25

introducing the tissue web (7) into a second nip (9) formed by a second pair (2) of rollers without compressing the tissue web between the rollers, each roller (5, 6) of the second pair of rollers having each protuberances (10) being separated in the direction of the circumference of the roller, wherein the rollers (5,6) of the second pair (2) of rollers are arranged so that protuberances (10) of one roller engage with regions separating protuberances of the other roller; 30

flexing the tissue web (7) about one or more axes parallel to the cross-machine (CD) direction in the second nip (9); 35

characterized by calendaring the tissue web (7) subsequent the step of flexing the tissue web (7) in the first nip (8) and/or the step of flexing the tissue web (7) in the second nip (9). 40

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Patentansprüche

1. Vorrichtung zum Auflockern der Fasern (16) einer unbearbeiteten Stofffaserbahn (7) vor einer Umwandlung in ein Stoffprodukt, wobei die Vorrichtung umfasst: 50

ein erstes Walzenpaar (1), das einen ersten Walzenspalt (8) zum Einführen der Stofffaser-

bahn (7) definiert, wobei der erste Walzenspalt zumindest so breit wie die Dicke der Stofffaserbahn ist, wobei jede Walze (3, 4) des ersten Walzenpaars Protuberanzen (12) aufweist, die sich über den gesamten Umfang der Walze erstrecken und voneinander in der Längsrichtung der Walze getrennt sind, wobei die Walzen (3, 4) des ersten Walzenpaars (1) so angeordnet sind, dass Protuberanzen (12) einer Walze in Bereiche, welche die Protuberanzen der anderen Walze trennen, eingreifen, so dass die Stofffaserbahn um eine oder mehrere parallel zur Laufrichtung (MD) verlaufende Achsen gebogen wird, und/oder ein zweites Walzenpaar (2), das einen zweiten Walzenspalt (9) zum Einführen der Stofffaserbahn (7) definiert, wobei der zweite Walzenspalt zumindest so breit wie die Dicke der Stofffaserbahn ist, wobei jede Walze (5, 6) des zweiten Walzenpaars Protuberanzen (10) aufweist, die zumindest in einer Umfangsrichtung der Walze getrennt sind, wobei die Walzen (5, 6) des zweiten Walzenpaars (2) so angeordnet sind, dass Protuberanzen (10) einer Walze in Bereiche, welche die Protuberanzen der anderen Walze trennen, eingreifen, so dass die Stofffaserbahn um eine oder mehrere parallel zu der Querlaufrichtung (CD) verlaufende Achsen gebogen wird, **dadurch gekennzeichnet, dass** ein Kalandervalzenpaar auslaufseitig von dem ersten (1) und/oder dem zweiten (2) Walzenpaar angeordnet ist.

2. Vorrichtung nach Anspruch 1, wobei die Protuberanzen (12) der Walzen (3, 4) des ersten Walzenpaars (1) durch Fugen (13) getrennt sind, die sich über den gesamten Umfang der Walzen erstrecken.
3. Vorrichtung nach Anspruch 1 oder 2, wobei die Protuberanzen (10) der Walzen (5, 6) des zweiten Walzenpaars (2) durch Fugen (11) getrennt sind, die sich in der Längsrichtung der Walzen erstrecken.
4. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Protuberanzen (10) der Walzen (5, 6) des zweiten Walzenpaars (2) in der Längsrichtung getrennt sind.
5. Vorrichtung nach einem der vorstehenden Ansprüche, wobei zumindest eine der Walzen (3, 4, 5, 6) des ersten (1) und/oder zweiten (2) Walzenpaars beheizt ist.
6. Vorrichtung nach einem der vorstehenden Ansprüche, wobei die Protuberanzen (10, 12) und/oder Fugen (11, 13) der Walzen (3, 4, 5, 6) des ersten (1) und/oder zweiten (2) Walzenpaars abgerundet sind. 55

7. Verfahren zum Auflockern der Fasern (16) einer unbearbeiteten Stofffaserbahn (7), wobei das Verfahren die folgenden Schritte umfasst:

Einführen der Stofffaserbahn (7) in einen ersten Walzenspalt (8), der durch ein erstes Walzenpaar (1) gebildet wird, ohne Zusammendrücken der Stofffaserbahn zwischen den Walzen, wobei jede Walze (3, 4) des ersten Walzenpaars Protuberanzen (12) aufweist, die sich über den gesamten Umfang der Walze erstrecken und in der Längsrichtung der Walze getrennt sind, wobei die Walzen (3, 4) des ersten Walzenpaars (1) so angeordnet sind, dass Protuberanzen (12) einer Walze in Bereiche, welche die Protuberanzen der anderen Walze trennen, eingreifen, Biegen der Stofffaserbahn um eine oder mehrere parallel zu der Laufrichtung (MD) verlaufende Achsen in dem ersten Walzenspalt (8) und/oder

Einführen der Stofffaserbahn (7) in einen zweiten Walzenspalt (9), der durch ein zweites Walzenpaar (2) gebildet wird, ohne Zusammendrücken der Stofffaserbahn zwischen den Walzen, wobei jede Walze (5, 6) des zweiten Walzenpaars Protuberanzen (10) aufweist, die in der Umfangsrichtung der Walze getrennt sind, wobei die Walzen (5, 6) des zweiten Walzenpaars (2) so angeordnet sind, dass Protuberanzen (10) einer Walze in Bereiche, welche die Protuberanzen der anderen Walze trennen, eingreifen,

Biegen der Stofffaserbahn (7) um eine oder mehrere parallel zu der Querlaufrichtung (CD) verlaufende Achsen im zweiten Walzenspalt (9), **gekennzeichnet durch**

Kalandrieren der Stofffaserbahn (7) nach dem Schritt des Biegens der Stofffaserbahn (7) in dem ersten Walzenspalt (8) und/oder dem Schritt des Biegens der Stofffaserbahn (7) in dem zweiten Walzenspalt (9).

Revendications

1. Dispositif destiné à délier les fibres (16) d'une bande (7) de ouate de cellulose brute avant sa conversion en un produit du type ouate de cellulose, ce dispositif comprenant :

une première paire (1) de rouleaux qui définissent un premier intervalle (8) destiné à l'introduction de la bande (7) de ouate de cellulose, le premier intervalle étant au moins aussi important que l'épaisseur de la bande de ouate de cellulose, chaque rouleau (3, 4) de la première paire de rouleaux comportant des protubérances (12) qui s'étendent sur toute la circonférence

du rouleau et qui sont séparées les unes des autres dans la direction longitudinale du rouleau, les rouleaux (3, 4) de la première paire (1) de rouleaux étant disposés de telle manière que les protubérances (12) de l'un des rouleaux se mettent en prise avec des zones séparant les protubérances de l'autre rouleau, si bien que la bande de ouate de cellulose se trouve courbée sur un ou plusieurs axes parallèlement à la direction de la machine (MD) ; et/ou une deuxième paire (2) de rouleaux qui définissent un deuxième intervalle (9) destiné à l'introduction de la bande (7) de ouate de cellulose, le deuxième intervalle étant au moins aussi important que l'épaisseur de la bande de ouate de cellulose, chaque rouleau (5, 6) de la deuxième paire de rouleaux comportant des protubérances (10) qui sont au moins séparées dans la direction de la circonférence (2) du rouleau, les rouleaux (5, 6) de la deuxième paire de rouleaux étant disposés de telle manière que les protubérances (10) de l'un des rouleaux se mettent en prise avec des zones séparant les protubérances de l'autre rouleau, si bien que la bande de ouate de cellulose se trouve courbée sur un ou plusieurs axes parallèlement à la direction transversale (CD) de la machine, **caractérisé en ce qu'une** paire de rouleaux de calandrage est disposée en aval de la première paire (1) de rouleaux et/ou de la deuxième paire (2) de rouleaux.

2. Dispositif selon la revendication 1, dans lequel les protubérances (12) des rouleaux (3, 4) de la première paire de rouleaux (1) sont séparées par des rainures (13) s'étendant sur toute la circonférence des rouleaux.
3. Dispositif selon la revendication 1 ou 2, dans lequel les protubérances (10) des rouleaux (5, 6) de la deuxième paire de rouleaux (2) sont séparées par des rainures (11) s'étendant dans la direction longitudinale des rouleaux.
4. Dispositif selon l'une quelconque des revendications qui précèdent, dans lequel les protubérances (10) des rouleaux (5, 6) de la deuxième paire de rouleaux (2) sont séparées dans la direction longitudinale.
5. Dispositif selon l'une quelconque des revendications qui précèdent, dans lequel au moins un des rouleaux (3, 4, 5, 6) de la première paire (1) de rouleaux et/ou de la deuxième paire (2) de rouleaux est chauffé.
6. Dispositif selon l'une quelconque des revendications qui précèdent, dans lequel les protubérances (10, 12) et/ou les rainures (11, 13) des rouleaux (3, 4, 5, 6) de la première paire (1) de rouleaux et/ou de la

deuxième paire (2) de rouleaux sont arrondies.

7. Procédé de déliage des fibres (16) d'une bande (7) de ouate de cellulose brute, le procédé comprenant les étapes consistant à :

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introduire la bande (7) de ouate de cellulose dans un premier intervalle (8) formé par une première paire (1) de rouleaux sans comprimer la bande de ouate de cellulose entre les rouleaux, chaque rouleau (3, 4) de la première paire de rouleaux comportant des protubérances (12) qui s'étendent sur toute la circonférence du rouleau et qui sont séparées dans la direction longitudinale du rouleau, les rouleaux (3, 4) de la première paire (1) de rouleaux étant disposés de telle manière que les protubérances (12) de l'un des rouleaux se mettent en prise avec des zones séparant les protubérances de l'autre rouleau, faire se courber la bande de ouate de cellulose sur un ou plusieurs axes parallèlement à la direction de la machine (MD) dans le premier intervalle (8) ; et/ou

introduire la bande de ouate de cellulose (7) dans un deuxième intervalle (9) formé par une deuxième paire (2) de rouleaux sans comprimer la bande de ouate de cellulose entre les rouleaux, chaque rouleau (5, 6) de la deuxième paire de rouleaux comportant des protubérances (10) séparées dans la direction de la circonférence du rouleau, les rouleaux (5, 6) et la deuxième paire (2) de rouleaux étant disposés de telle manière que les protubérances (10) de l'un des rouleaux se mettent en prise avec des zones séparant les protubérances de l'autre rouleau ; faire se courber la bande (7) de ouate de cellulose sur un ou plusieurs axes parallèlement à la direction transversale (CD) de la machine dans le deuxième intervalle (9) ;

caractérisé par le calandrage de la bande (7) de ouate de cellulose, à la suite de l'opération consistant à faire se courber la bande (7) de ouate de cellulose dans le premier intervalle (8) et/ou l'opération consistant à faire se courber la bande (7) de ouate de cellulose dans le deuxième intervalle (9).

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Fig. 1

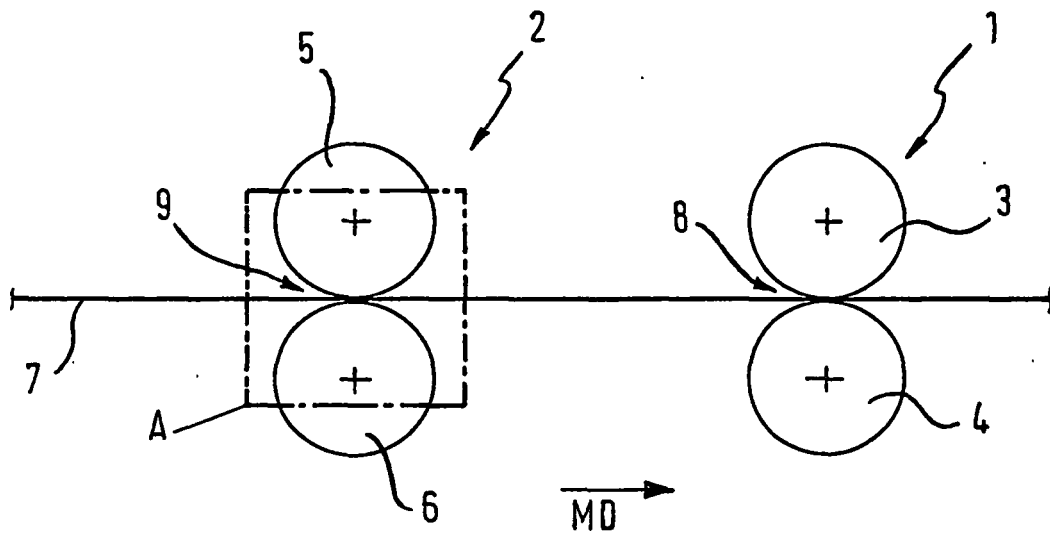


Fig. 2

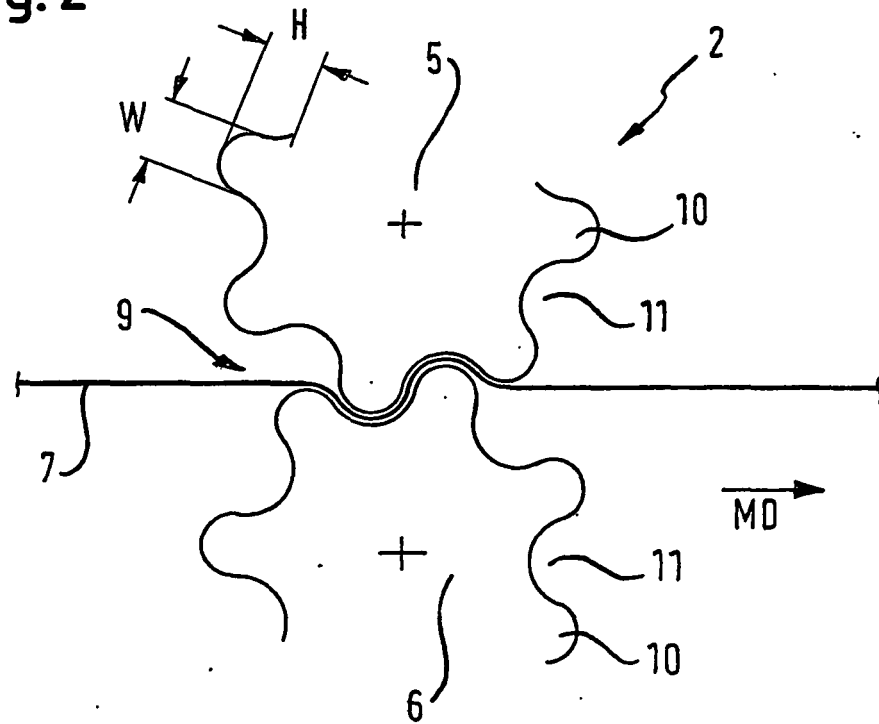


Fig. 3

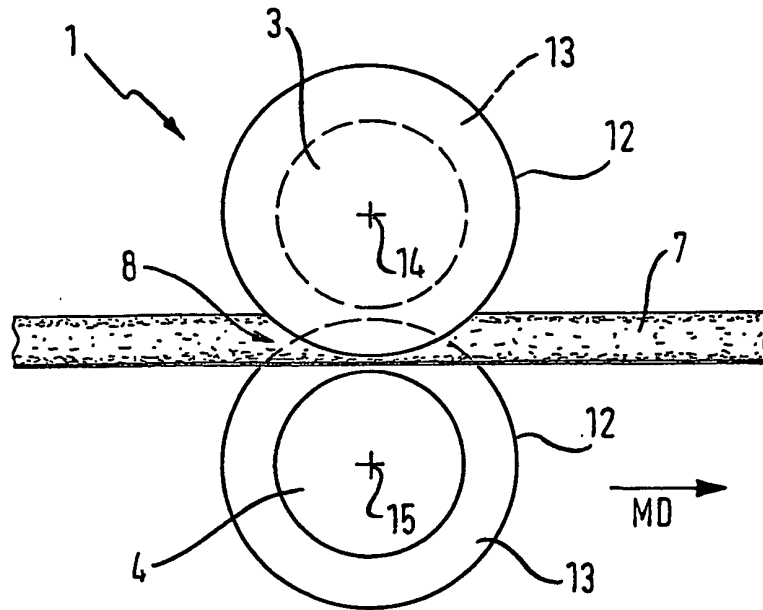


Fig. 4

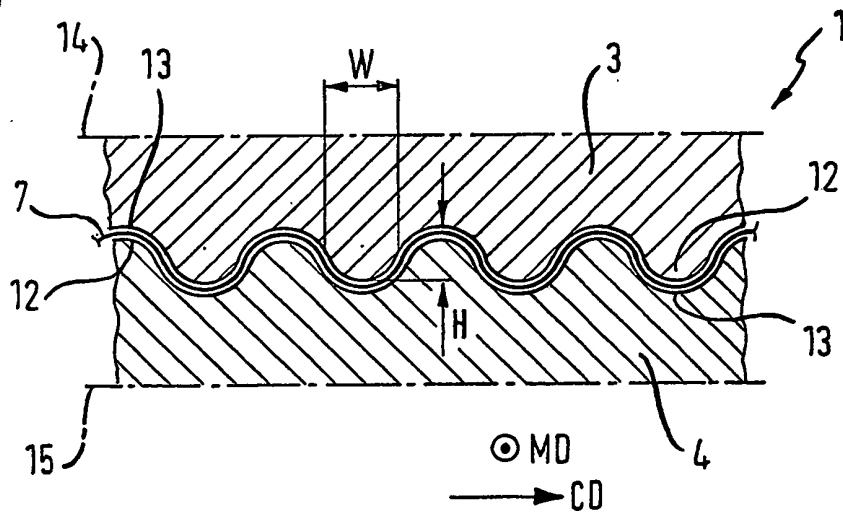


Fig. 5A

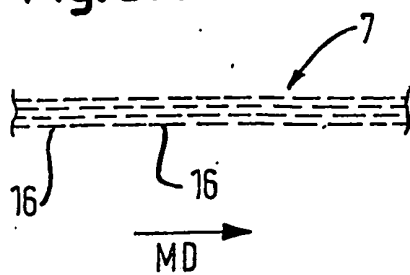
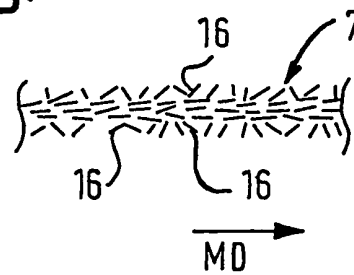


Fig. 5B



REFERENCES CITED IN THE DESCRIPTION

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