

(10) International Publication Number
WO 2006/003263 A1

- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(57) Abstract: The invention relates to a method for coating a fibrous web with one or more layers of coating. The method comprises applying at least one layer of a coating material to the surface on at least one side of a fibrous web (W) by means of a curtain coater (21), and that a still moist coating of the applied layers of coating material is subjected, essentially immediately after said application process, to a hot compression contact by means of a hot contact surface or contact surfaces, the coating bonding to the fibrous web's (W) surface, the coating drying and its surface becoming smooth and glazed. The invention relates also to an apparatus (2) for coating a fibrous web (W). The apparatus comprises at least one curtain coater (21) for applying at least one layer of coating material onto a surface of the fibrous web (W), as well as a treatment unit (22) substantially immediately downstream of said curtain coater in the fibrous web's (W) traveling direction for treating the fibrous web (W) in a hot compression contact.

Method for coating a fibrous web

The invention relates to a method for coating a fibrous web with one or more layers of coating material. The invention relates also to an apparatus for
5 performing the method.

According to the prior art, it is conventional to effect coating of a fibrous web by means of a so-called cast-coating technique. It involves applying a coating material first in one or more operations onto the surface of a fibrous web.

10 The application can be followed by performing an intermediate drying step or an intermediate moistening step or by performing a final drying process directly on the coating material, bonding it to the fibrous web, as well as glazing it in a compressive contact with a hot contact surface. This process is generally carried out by means of a Yankee cylinder. An essential feature in
15 the cast-coating process is to establish a direct contact between a still wet coating and a hot, typically polished metal surface. While in contact with a hot surface, the coating undergoes drying and its surface becomes glazed as it adheres to a surface of the fibrous web. The process enables providing a fibrous web surface with particularly good printing qualities. The surface has
20 a high-quality smoothness and the surface layers also absorb printing ink quickly and drying of printing ink occurs quickly as well.

A problem in this type of process has been caused e.g. by limitations on running speed. Higher running speeds have been denied both by application
25 methods and limited operating characteristics of a Yankee cylinder generally employed in the contact process. Consequently, it has been generally necessary to use an off-line machine for a cast-coating type of coating process. Another obvious problem has been caused by the adherence of a wet coating material to a hot metal surface. Attempts have been made to
30 alleviate the adherence problem by means of anti-adhesive agents. Such a release agent has been applied, for example, first directly to a hot contact

surface and then, during the actual compressive contact, between the contact surface and the coating.

On the other hand, prior technology comprises also a multiple coating process by means of a curtain coating technique. Without blending the layers, this technique enables the application at one or separate process stages of several layers of coating material or layers of some other functional material in precisely desired thicknesses onto the surface of a fibrous web. For example, the actual layers of coating material can be topped by applying other additional coats without affecting the underlying material layers in any way. The curtain coating technique also facilitates higher running speeds with respect to many other coating techniques.

Accordingly, one important objective of the present invention is to provide a method, which offers benefits equal to those of a cast-coating process in terms of the printability of a coated fibrous web and which at the same time enables avoiding the above type of problem involving the adherence of coating materials to contact surfaces and facilitates higher running speeds, the method thus becoming more applicable than before also in the context of on-line machines.

In order to accomplish these objectives, a method of the present invention is characterized by what is set forth in the characterizing clause of the independent claim 1. Preferred embodiments of the invention are disclosed in the dependent claims.

The inventive method offers numerous benefits with respect to prior art solutions. An essential advantage gained by the inventive method is that the use of a curtain coating process enables a controlled application of release agents to a coating, for example either to a top liner and on top of the top liner as a separate coat. This makes it easier to avoid the problems involved in a cast-coating process as the coating adheres to a hot contact surface.

Thus, the application of a release agent to the coating can be performed as early as concurrently with the actual application of the coating itself. This, when considered in combination with a higher running speed of application generally achieved in curtain coating technique, enables a higher running speed in terms of the entire coating process. At the same time, this enables the coating process to be implemented as an on-line machine.

The use of a curtain coating process, and especially a multiple curtain coating process, enables also the forming of several separate layers of coating material and thereby a desired type of lamellar structure for providing layer-specific coating characteristics. Various layers of the coating can be provided with qualities as desired. Until now, the capabilities of regulating the characteristics of a coating within various layers of the coating have been decidedly more limited.

When the curtain coating process, essentially immediately after the application of a coating as required by the invention, is adapted to include a compression contact with a hot contact surface, the coating surface of excellent smoothness will even be obtained. This has a major significance in terms of printability. After all, one adverse factor in coating methods based on contactless application of a coating has been the fact that the coating develops a rough surface matching the paper's original roughness. A method of the invention is capable of providing the end product with a smooth surface, which is usually not possible for a contactless coating method. In spray and curtain coating, for example, the surface is usually quite rough, matching the paper's original roughness. During a compression contact, the top liner surface of a coating becomes substantially smoother. Another notable advantage is that, as the question is about a contactless coating method, the stress applied thereby to a fibrous web, and thereby also the propensity to web breaks, will be substantially reduced with respect to other coating methods.

Substantial further advantage is gained if the compression contact is performed in a particularly preferred way by means of a metal belt calender, as proposed in one embodiment of the invention. The use of a metal belt calender makes it readily possible to provide adjustable, exactly appropriate values matching various running conditions, both in terms of the treatment time in compression contact, the pressure applied to a fibrous web and the temperature of contact surfaces. At the same time, an opportunity presents itself to relinquish a separate final calendering of the fibrous web downstream of the coating process. Another essential benefit in the use of a metal belt calender is that, unlike for example a Yankee cylinder, it does not impose any limitations on running speed with regard the coating process.

A still further significant benefit offered by the inventive solution is a possibility of designing particularly compact and hence low-cost machine configurations, regarding especially the implementation of a multiple coating process and compression contact stages preceding and following it. Several available calendering processes consist of a plurality of discrete sub-processes, such as e.g. a two-nip soft calender and a multi-nip calender with a number of identical nips in succession. The invention offers a possibility of exploiting a calender of several treatment stages in a fibrous web coating process, such that a coating method is provided, which enables the use of an apparatus as compact as possible. In a method according to this further embodiment of the invention, a fibrous web to be coated is conveyed, upstream of a coating operation of the fibrous web, into one nip or treatment zone of a calender, for example for pre-calendering. This is followed by executing a coating operation of the fibrous web, and after the coating operation the fibrous web is conveyed into a second nip or treatment zone of the same calender for final calendering. By providing two or more compression contact stages, especially for calendering to be executed in various treatment zones of one and the same apparatus, the resulting machine configurations will be substantially more compact and less expensive than before.

The invention will now be described in more detail with reference to the accompanying drawing. In the drawing

Fig. 1 shows a prior known cast-coating method for coating a fibrous web,

fig. 2 shows one apparatus applying a method of the invention for coating a fibrous web, the compression contact being effected by means of a metal belt calender.

10

Figs. 3-5 depict schematically a few metal belt calenders suitable for the execution of a method according to a further embodiment of the invention,

15 fig. 6 depicts schematically one two-nip soft calender suitable for the execution of a method according to a further embodiment of the invention, and

20 figs. 7-8 depict schematically a few multi-nip calenders suitable for the execution of a method according to a further embodiment of the invention.

The cast-coating type fibrous web coating process shown in fig. 1 is executed with an off-line machine, as typical for the method. A fibrous web W is delivered from an unwinder 10 and to its surface is applied a coating. The application can be performed by using a number of prior known techniques, such as for example an air brush coating process 11 shown in fig. 1. In the process of fig. 1, the application is followed by an intermediate drying 12 as well as a remoistening 13 prior to leading the fibrous web to a hot compression contact. It is also possible to employ a method in which the drying and remoistening process has been omitted, i.e. the treatment with a hot contact surface takes place substantially immediately after the application

of a coating and possible chemical additions. What is meant here is that, without separate actions performed on a fibrous web for speeding up the drying of a coating, there shall not be enough time for a meaningful drying of the coating before conveying it to a compression contact with contact
5 surfaces.

Thus, the drying of a coating is effected in a compressive contact with a hot, typically polished metal surface. The compression contact is in this case performed by means of a Yankee cylinder 20, the Yankee cylinder's surface
10 thereby functioning as a hot contact surface. Prior to the treatment, to the fibrous web's surface can be further applied an anti-adhesive agent, either as such or for example admixed with a coating material. In fig. 1, there is still provided the application of a further coating with a puddle coating method 14, as well as the addition of an anti-adhesive agent just before treatment in
15 the Yankee cylinder.

The treatment is followed by subjecting the dried and still warm coated fibrous web to a cooling step 16 and possibly also to a remoistening step, for example in a moistening/steaming cabinet 17, and once more to another
20 cooling step. Finally, this is followed by a possible calendering step 18 and other possible finishing procedures prior to winding for a roll 19.

The above type of cast-coating processes are hampered by many problems. Due to currently employed coating techniques, the only way of influencing
25 the structure and properties of a coating is by regulating the composition and thickness of the entire coating. The wet surface of a coating creates problems with its propensity to adhere to hot contact surfaces. The most significant singular solution for this problem has been to employ anti-adhesive agents between a coating and contact surfaces. Full-scale
30 application of such agents directly to the surface of a wet coating has proved difficult and the application is usually performed by way of a contact surface. Hence, the objective is to spread the agent for a consistent film on a hot

contact surface just before contact with a fibrous web. Problems have been encountered both in keeping the surfaces clean, uniform spreading of the agents, as well as in increasing the running speeds.

- 5 In addition, conventional coating techniques involve limitations with regard to running speed. The running speed is further restricted by a Yankee cylinder, which is typically used for compression contact. Due to limitations on running speed, the cast-coating type of coating processes must often be implemented as an off-line application. With regard to a Yankee cylinder, the
- 10 increase of running speed would actually require the use of a backing wire or other such arrangements. In addition, the already large size of a Yankee cylinder would have to be increased even further in order to provide a sufficiently long contact time.
- 15 Fig. 2 illustrates a coating process of the invention, in which a fibrous web W to be coated is conveyed to the treatment either straight from a paper/board machine or is unrolled from an unwinder (not shown). The application of a coating onto the fibrous web's surface is presently effected by means of a curtain coater 21. The curtain coater can be either a slot-fed or slide-fed
- 20 curtain coater. In the latter case, several layers of coating material can be preferably applied at the same time. Thus, the application of even a multiple coating can be performed in its entirety in a single process operation by means of a single apparatus. Naturally, it is also conceivable to employ a plurality of successive slot-fed curtain coaters for producing a multiple
- 25 coating.

By virtue of curtain coating technology, the coating can be formed of layers highly diverse both in terms of properties and thicknesses thereof. Each layer can be adjusted for its properties to comply precisely with those required.

- 30 The underlayer, including a bonding agent, can be formulated for a high adherence to the surface of a fibrous web, the middle layers can be formed of less expensive bulk layers. On the other hand, the upper layers can be

made while keeping in mind the requirements set by printability and, particularly in the case of a top liner, the problems regarding adherence to a hot contact surface. The layer can either be supplemented with or composed solely of an anti-adhesive agent. What is essential with regard to the adherence problem is now the fact that the properties of top layers can be regulated as desired without affecting adversely the other material layers of a coating.

After the application, the fibrous web is immediately ready for proceeding to a compression contact with a hot treatment surface. It is also plausible to effect a pre-drying 23 of the fibrous web W as well as to perform yet another moistening 24 prior to the treatment. There are a multitude of prior known devices for performing the actual treatment, such as a Condebelt type of apparatus, a Yankee cylinder, as well as a variety of calenders with at least one heated metal surface, such as a machine, soft or shoe calender. It is also conceivable that the treatment of a fibrous web against a hot contact surface be performed by means of drying cylinders. In a particularly preferred case, the compression contact applied to a fibrous web in an arrangement of the invention is effected by means of a metal belt calender.

What is essential in an arrangement of the invention, regarding the treatment of a fibrous web, is that the coating applied to the surface of a fibrous web continues to be substantially moist upon entering the treatment, the dry content being typically less than 90%. The treatment is adapted to take place substantially immediately after the application of a coating, such that, without specific drying processes applied to the fibrous web, there is not enough time for the coating to undergo significant drying before the treatment.

Especially the use of a metal belt calender in an arrangement of the invention provides an additional benefit of omitting a separate calendering process after the coating process. The fibrous web can be subjected both to

a treatment time sufficiently long in terms of drying the coating and also to an adequately high pressure effect for providing a desired action on the structure of both the coating and the fibrous web. If necessary, the pressure effect can be increased by means of a press nip N established with a
5 separate nip roll 26 in the metal belt calender's treatment zone. The coating can be provided with a surface of excellent smoothness and desired properties for printing. By applying appropriate process parameters, it is also possible to accomplish an extra benefit of being able to omit a separate final calendering process for finishing the coated fibrous web.

10

Other benefits offered by a metal belt calender in the treatment of a fibrous web include its adjustability and speed. The length of a treatment zone can be adjusted, nor is the running speed a limiting factor as compared for example to a curtain coating process. Moreover, in the metal belt calender, it
15 is simple to provide a hot contact surface on either side of a fibrous web. It is feasible to use, for example, two heated metal belts, the fibrous web being adapted to pass therethrough. On the other hand, the heating can also be provided on a metal belt calender's counter-element, which is usually a roll 25. In a method of the invention, the preferred temperature range for
20 contact surfaces is from about +50°C to +400°C.

In the above-described embodiment of the invention, the application of an entire coating is performed by means of curtain coating. It is naturally also conceivable that some of the coating be applied by other known methods.
25 What is essential in an arrangement of the invention is that at least the uppermost material layers of the coating, as well as an anti-adhesive agent or agents, possibly either blended therewith or applied entirely in its own layer, be applied to the fibrous web's surface by a curtain coating method. This enables performing the application without substantially affecting the
30 underlying layers of coating material.

According to one further aspect of the invention, the treatment in a compression contact can be preceded by applying to the coating surface an anti-adhesive agent for example by a spray method. The agent can be applied as such in an appropriately thin liquid or, for example, blended in
5 water or some other liquid.

According to another further aspect of the invention, the coating process can also be effected on both sides of a fibrous web. This can be implemented either by performing the application with curtain coating first for one side
10 and then for the other side or by performing the application on both sides of a fibrous web prior to treating the fibrous web in a hot compression contact.

Fig. 3 in turn illustrates one arrangement for executing a method according to a preferred further embodiment of the invention, which is based on a
15 metal belt calender. The arrangement comprises two separate metal belts 2a and 2b circling around guide rolls 3 for establishing, by means of a roll 5 present therebetween and functioning as a counter-element, two treatment zones N_1 and N_2 for a fibrous web W_1 , W_2 . At least some of the guide rolls 3 within the belt circles are made displaceable for adjusting tension of the belts
20 2a and 2b and the running thereof as desired. During its passage through each treatment zone, the fibrous web is subjected to a desired pressured impulse and heat effect as a function of time. Within the belt circle 2a can be provided a nip roll 6, as shown in dashed lines in fig. 1, for establishing an extra nip against the roll 5 to produce an enhanced pressure effect on the
25 fibrous web. The counter-roll 5, as well as the nip roll 6, may or may not be a deflection-compensated roll, and it is chosen from a group, including: a flexible-surface roll, such as a polymer-coated roll, a rubber-coated roll or an elastomer-surface roll, a shoe roll, a thermal roll and a filled roll.

30 When using an apparatus 30 of fig. 3, a fibrous web W_1 is first conveyed, prior to a coating stage, through a treatment zone N_1 for pre-calendering the fibrous web. This is followed by conveying the fibrous web to a coating

process 15 for coating the same with an appropriate coating method, especially a curtain coating method. In this instance, it is also conceivable that the coating method be selected from a group, including dry coating, cast coating, blade coating, spray coating, microjet coating or film coating. The coating process is followed by conveying the coated fibrous web, represented by reference numeral W_2 , through a second treatment zone N_2 of the same calender unit for bonding the coating and final calendering the fibrous web. In this context, the term calendering is used in reference to both calendering and also generally to compression contact or hot pressing contact applied to a fibrous web.

Fig. 4 illustrates a configuration 40, which also includes two belt circles 2a, 2b and therebetween a counter-roll 5 for establishing two treatment zones N_1 and N_2 as in fig. 1. The number of coating stages is optionally more than one, whereby e.g. a coating stage 15a can be used for coating one side of a web and a coating stage 15b for the other side of the web. Especially in a curtain coating process, however, a single coating stage is sufficient for implementing a concurrent application of several discrete layers of coating material. In order to effect a multiple coating process, it is possible, on the other hand, to design the coating stage 15b such that it is used for coating the same side as the coating stage 15a. A fibrous web W_1 is conveyed first to a pre-calendering process N_1 and then to the coating stage 15a, followed by leading it by way of a deflection roll 7 to an optional second coating stage 15 and thence to a bonding/final calendering stage N_2 .

A configuration 50 shown in fig. 5 comprises a first metal belt circle 2a and a first counter-roll 5a for establishing therebetween a first treatment zone N_1 , as well as a second metal belt circle 2b and a second counter-roll 5b for establishing therebetween a second treatment zone N_2 . The counter-rolls 5a, 5b are disposed for establishing with each other a bonding nip N, preferably a heated one, for the coating. This configuration enables subjecting a fibrous web to various types of treatments, e.g. such that the fibrous web W_1 is first

conveyed for pre-calendering through the treatment zone N_1 and then through a coating stage 15a and by way of a deflection roll 7 further through a second coating stage 15b, from which it is delivered to the bonding nip N for bonding the coating material to the fibrous web and for effecting final calendering. This process can be followed by conveying a coated web W_2 out of the apparatus to a further processing, such as e.g. to a winding process. The coating stages 15a and 15b can be optional to each other or both of those can be used either for coating one side of a web with several layers or for coating opposite sides of a web. Downstream of the bonding nip N, the web can optionally have a third coating stage 15c, from which the web can be delivered by way of a deflection roll 7a to the second treatment zone N_2 for a bonding/final calendering process. The apparatus may even have a fourth coating stage 15d, which can function e.g. as a pre-coating stage upstream of the actual coating stage 15a and/or 15b and/or 15c. The coating stages 15a-15d can be optionally active one or more than one at a time for treating one fibrous web so as to provide a single or multiple coating on one or each side of the fibrous web. In addition, the traveling direction of a fibrous web can be reverse relative to what is described above, whereby e.g. the treatment zone N_2 or the bonding nip N can function as a pre-calender and the treatment zone N_1 as a final calender.

In a configuration 60 shown in fig. 6, a coating station 15 is disposed between two nips N_1 and N_2 of a soft calender, whereby one compact apparatus is capable of performing pre-calendering prior to a coating process and final calendering after the coating process.

In a configuration 70 shown in fig. 7, a coating stage 15 is positioned at a location between two nips of a multi-nip calender, and in a configuration 60 of fig. 6, a coating stage 15 is disposed at a location between two arrays of rolls. In the embodiments of figs. 7 and 8, the fibrous web passes through a plurality of nips before and after a coating process for effective pre-calendering and final calendering. Especially in the case of fig. 8, it should be

noted that the question may also be about a supercalender. As shown in fig. 8, a supercalender can be divided for two or more sections, more specifically for two separate sets of rolls, between which is adapted to be performed an appropriate coating process.

5

The coating process 15, 15a, 15b shown in the configuration of figs. 3-8 includes the application of a coating material, i.e. its transfer onto the surface of a web. The coating process may further include drying, heating and bonding, as necessary. In addition, the proposed method is suitable for a

10 coating process effected with a coating material in dry form (dry coating).

Claims

1. A method for coating a fibrous web with one or more coating layers,
characterized in that the method comprises applying at least one layer of a
5 coating material to the surface on at least one side of a fibrous web (W) by
means of a curtain coater (21), and that a still moist coating of the applied
layers of coating material is subjected, essentially immediately after said
application process, to a hot compression contact by means of a hot contact
surface or contact surfaces, the coating bonding to the fibrous web's (W)
10 surface, the coating drying and its surface becoming smooth and glazed.
2. A method as set forth in claim 1, **characterized** in that said compression
contact is performed with a metal belt calender.
- 15 3. A method as set forth in claim 1, **characterized** in that said compression
contact is performed with a Condebelt apparatus.
4. A method as set forth in claim 1, **characterized** in that said compression
contact is performed with a Yankee cylinder.
20
5. A method as set forth in claim 1, **characterized** in that said compression
contact is performed with some other prior known calender, including at least
one heated metal surface, such as with a machine, soft or shoe calender.
- 25 6. A method as set forth in claim 1, **characterized** in that said compression
contact is performed with drying cylinders.
7. A method as set forth in any of claims 1-6, **characterized** in that
said application is effected as a multiple curtain coating process.

8. A method as set forth in any of claims 1-7, **characterized** in that the top liner or the surface of coating layers, concurrently with said curtain coating application, is supplemented with an anti-adhesive agent.

5 9. A method as set forth in any of claims 1-8, **characterized** in that between the application of coating layers and the hot contact process is performed pre-drying of the coating layers and/or moistening of the coating surface.

10 10. A method as set forth in any of claims 1-9, **characterized** in that at least the application of a top liner onto the surface of a fibrous web is performed by a curtain coating technique, and that, essentially after the application process, the fibrous web is subjected to a compression in hot contact by means of a metal belt calender.

15

11. A method as set forth in any of claims 1-10, **characterized** in that said application of at least one coating layer is preceded by pre-calendering of the fibrous web (W) performed in a second treatment zone or nip, which is established in the same apparatus that is used for said post-coating

20 compression contact.

12. A method as set forth in claim 11, **characterized** in that the calendering is performed with a soft calender having at least two nips or treatment zones, a machine calender, a supercalender, a multi-nip calender, a belt
25 calender or a metal belt calender.

13. A method as set forth in any of the preceding claims, **characterized** in that the calendering is performed with a multi-nip calender (80) having at least two sets of rolls.

30

14. A method as set forth in any of the preceding claims, **characterized** in that the pre-calendering, coating and final calendering operations in a fibrous

web coating treatment are performed as an on-line process on a fibrous web manufacturing line.

15. A method as set forth in any of claims 1-13, **characterized** in that the
5 pre-calendering, coating and final calendering operations in a fibrous web coating treatment are performed as an off-line process with respect to a fibrous web manufacturing line.

16. An apparatus (2) for coating a fibrous web (W), **characterized** in that
10 the apparatus comprises at least one curtain coater (21) for applying at least one layer of coating material onto a surface of the fibrous web (W), as well as a treatment unit (22) substantially immediately downstream of said curtain coater in the fibrous web's (W) traveling direction for treating the fibrous web (W) in a hot compression contact.

15

17. An apparatus (30, 40, 50, 60, 70, 80) as set forth in claim 16 for pre-calendering, coating and final calendering a fibrous web, **characterized** in that the apparatus comprises a calender, including a pre-calendering stage (N_1), a coating stage (15; 15a-15d) and a final calendering stage (N ; N_2),
20 said pre-calendering stage comprising at least one nip or treatment zone in a calender, the final calendering stage comprising at least one second nip or treatment zone in the same calender, and the coating stage being set in connection with the same calender at a location between the pre-calendering stage and the final calendering stage.

25

18. An apparatus as set forth in claim 17, **characterized** in that the calender comprises a soft calender, a machine calender, a supercalender, a multi-nip calender or a belt calender.

30 19. An apparatus as set forth in claim 18, **characterized** in that the calender comprises a metal belt calender.

20. An apparatus as set forth in claim 19, **characterized** in that the metal belt calender comprises two separate metal belt circles (2a, 2b), between which is disposed a counter-roll (5) for establishing two treatment zones (N_1 , N_2) for a fibrous web (W_1 , W_2), and that the coating stage (15) is set at a
- 5 location between the treatment zones (N_1 , N_2) for passing the fibrous web through the first treatment zone (N_1), which serves as a pre-calendering stage, to the coating stage (15) and thence to the second treatment zone (N_2), which serves as a final calendering stage.
- 10 21. An apparatus as set forth in claim 18, **characterized** in that the calender comprises a multi-nip calender (80), including at least two separate sets of rolls.

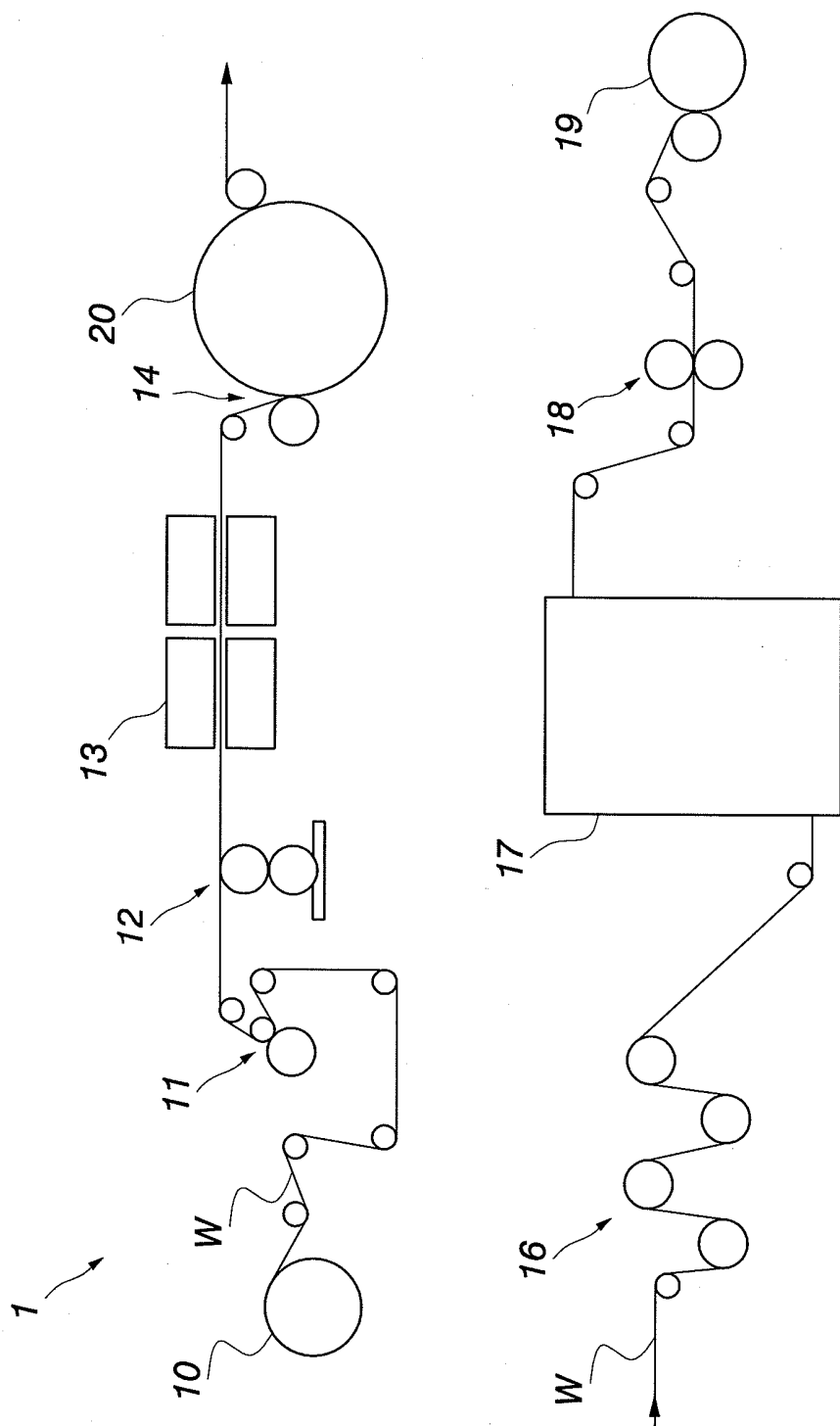


Fig. 1

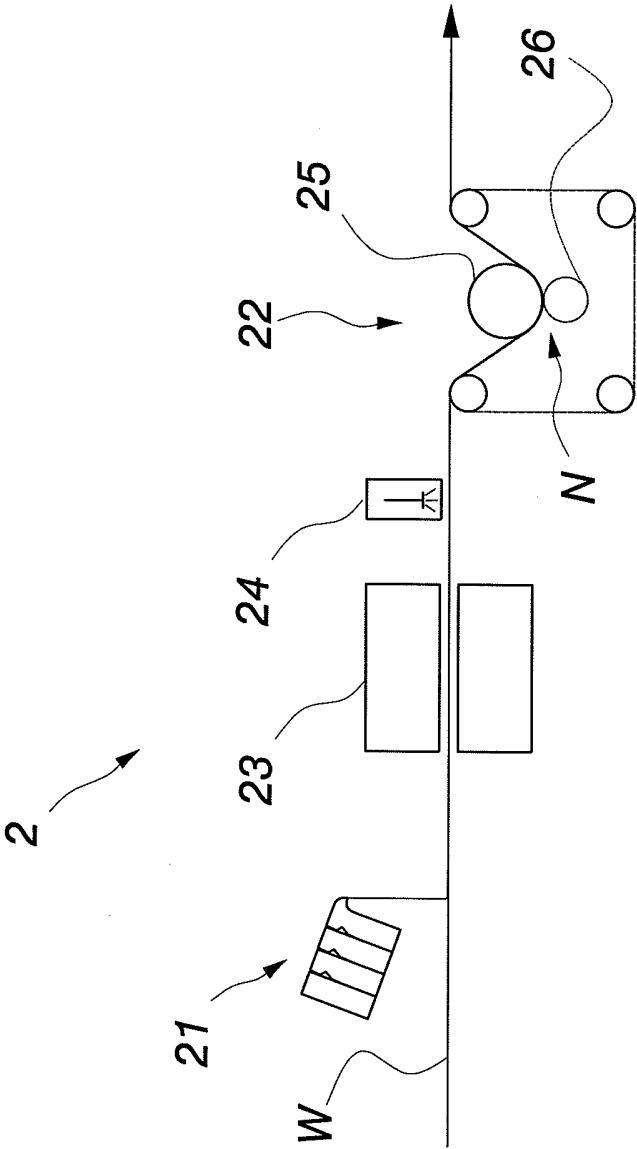


Fig. 2

3/5

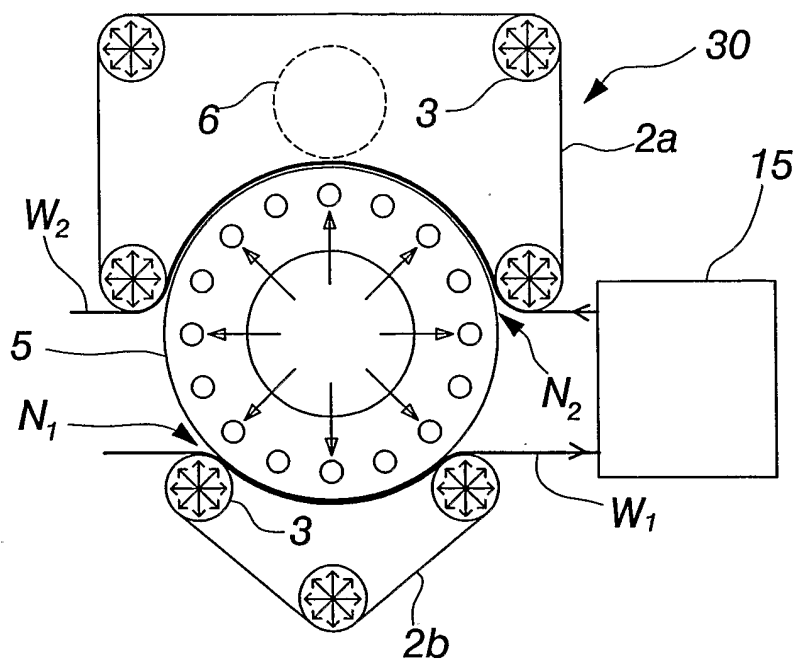


Fig. 3

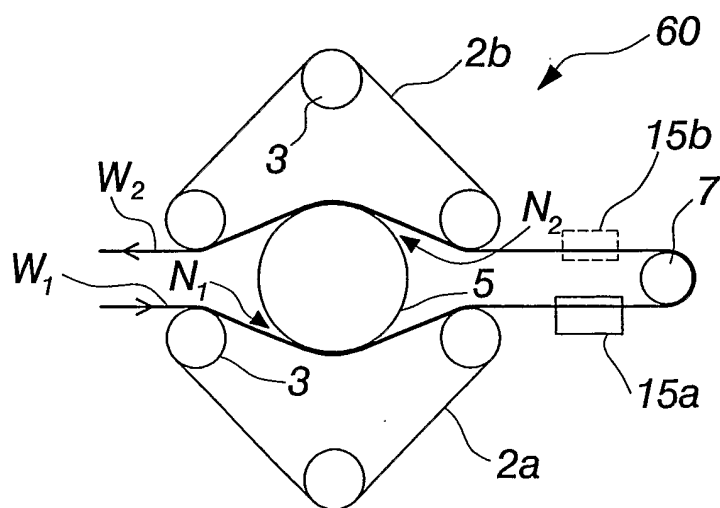


Fig. 4

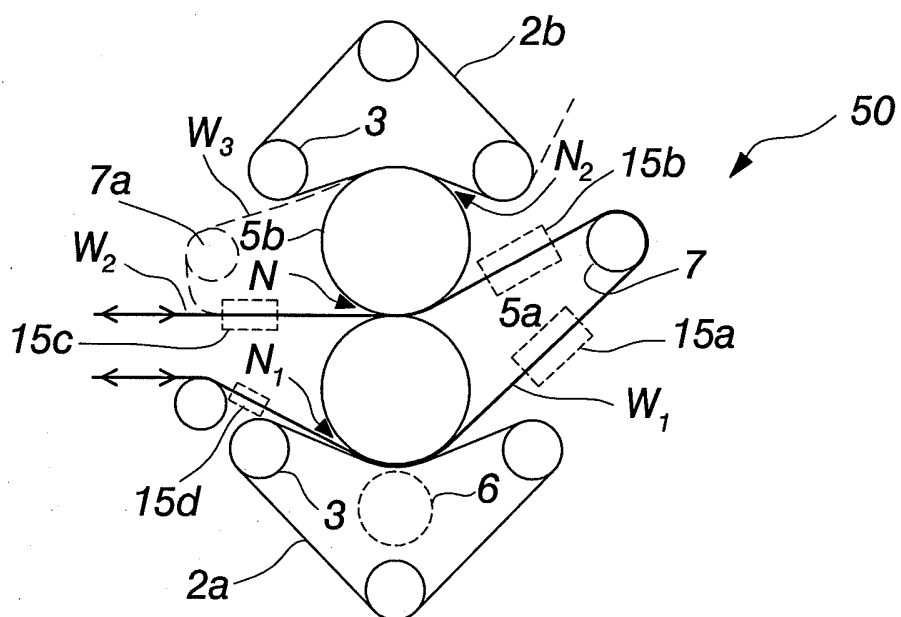


Fig. 5

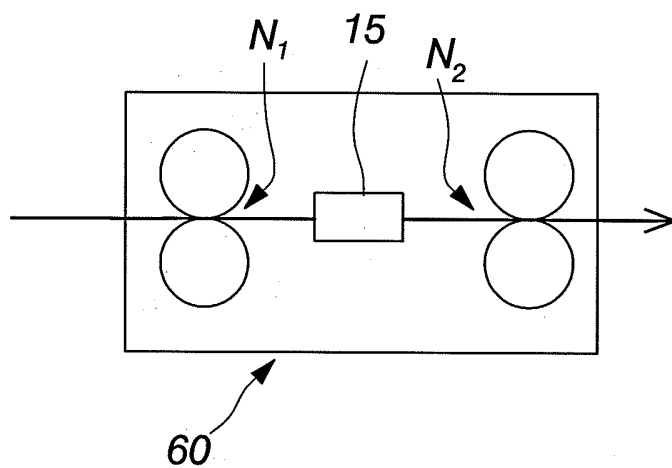
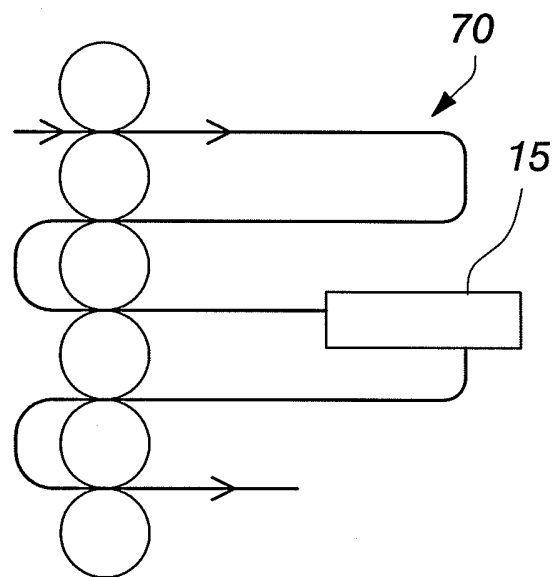
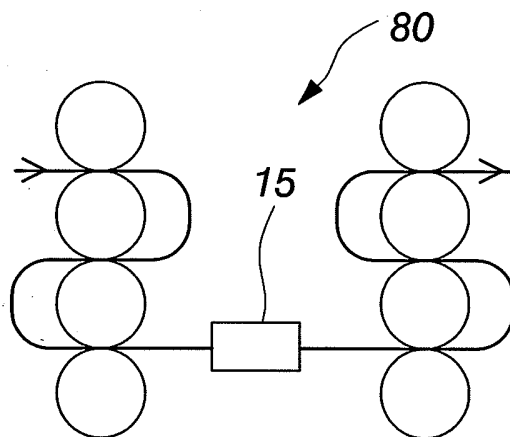


Fig. 6

*Fig. 7**Fig. 8*

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2005/050267

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21H 23/48, D21G 1/00

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)

IPC7: D21H, D21G

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

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02103109 A1 (METSO PAPER, INC), 27 December 2002 (27.12.2002), page 12, line 12 - line 15, figures 4,5	1-10,13-16
Y	--	11-12,17-21
P,X	WO 2005052252 A1 (VOITH PAPER PATENT GMBH), 9 June 2005 (09.06.2005), page 20, line 14 - page 21, line 5; page 25, line 1 - line 6, figure 1	1-10,13-16
P,Y	--	11-12,17-21

☒ Further documents are listed in the continuation of Box C.☒ 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

5 October 2005

Date of mailing of the international search report

06-10-2005

Name and mailing address of the ISA/

Swedish Patent Office

Box 5055, S-102 42 STOCKHOLM

Facsimile No. +46 8 666 02 86

Authorized officer

Tomas Lund/EK

Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 2005/050267

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,Y	WO 2005005724 A1 (METSO PAPER, INC), 20 January 2005 (20.01.2005), page 4, line 20 - line 24, figures 1,6 --	11-12,17-21
A	WO 03050352 A1 (METSO PAPER, INC), 19 June 2003 (19.06.2003), page 2, line 14 - line 29, figure 2 --	1-21
A	US 6589388 B1 (NISSINEN), 8 July 2003 (08.07.2003), column 5, line 8 - line 12, figure 1 -- -----	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

31/08/2005

International application No.

PCT/FI 2005/050267

WO	02103109	A1	27/12/2002	CA	2467100 A	27/12/2002
				FI	20011291 A	19/12/2002
				JP	2004530063 T	30/09/2004
				US	20050011624 A	20/01/2005

WO	2005052252	A1	09/06/2005	DE	10355686 A	23/06/2005
				DE	10358218 A	07/07/2005
				DE	10358833 A	21/07/2005
				WO	2005059245 A	30/06/2005
				WO	2005071158 A	04/08/2005

WO	2005005724	A1	20/01/2005	FI	114649 B	30/11/2004
				FI	20031056 D	00/00/0000

WO	03050352	A1	19/06/2003	AU	2002338999 A	00/00/0000
				CN	1602377 A	30/03/2005
				DE	10297514 T	18/11/2004
				FI	111281 B	00/00/0000
				FI	20012446 D	00/00/0000

US	6589388	B1	08/07/2003	AU	3294400 A	04/10/2000
				CA	2365991 A	21/09/2000
				DE	10084346 T	25/07/2002
				FI	111476 B	00/00/0000
				FI	990558 A	13/09/2000
				WO	0055424 A	21/09/2000
