

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
27 October 2005 (27.10.2005)

PCT

(10) International Publication Number
WO 2005/100218 A1

(51) International Patent Classification⁷: **B65H 18/22**,
23/02

(21) International Application Number:
PCT/FI2005/050115

(22) International Filing Date: 8 April 2005 (08.04.2005)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
20045133 14 April 2004 (14.04.2004) FI

(71) Applicant (for all designated States except US): **METSO
PAPER, INC** [FI/FI]; Fabianinkatu 9 A, FI-00130 Helsinki
(FI).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **NAATTI, Ilkka**
[FI/FI]; Norppatie 27 A, FI-01480 VANTAA (FI). **KOJO,**
Teppo [FI/FI]; Alhontie 10, FI-04600 Mäntsälä (FI).

MÄKINEN, Risto [FI/FI]; Koivikonkaari 24, FI-04600
Mäntsälä (FI). **RIIHELÄ, Vesa** [FI/FI]; Ritarintie 31,
FI-07190 Halkia (FI). **KEMPPAINEN, Matti** [FI/FI];
Temmonkaari 2, FI-05400 Jokela (FI). **TYNKKYEN,**
Topi [FI/FI]; Oolannintie 2 D 5, FI-01520 Vantaa (FI).

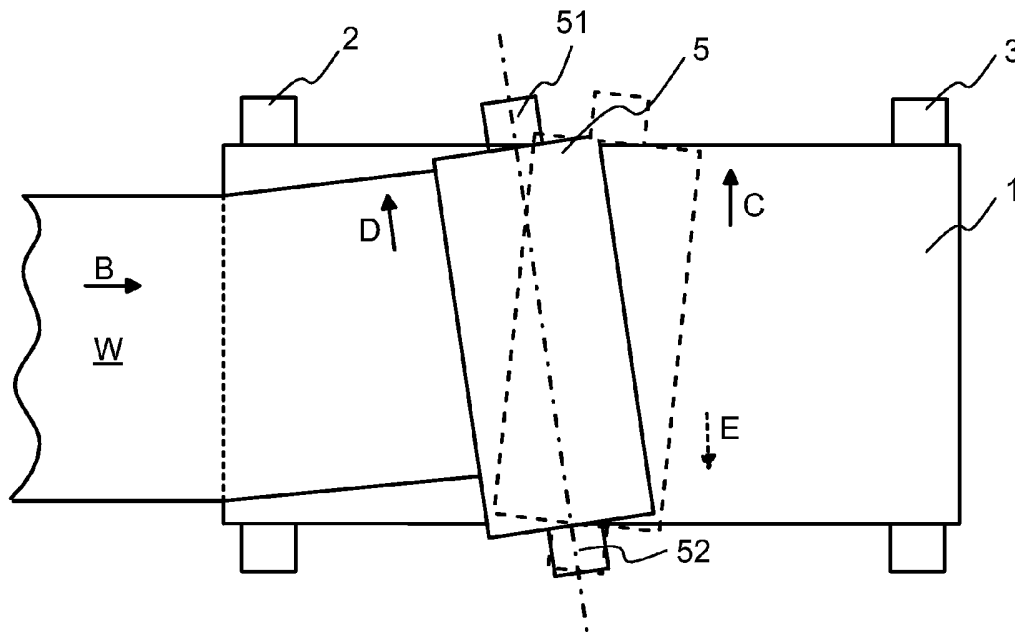
(74) Agent: **TAMPEREEN PATENTTITOIMISTO OY**;
Hermiankatu 12 B, FI-33720 TAMPERE (FI).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,
MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM,
PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY,
TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU,
ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,

[Continued on next page]

(54) Title: A METHOD AND AN APPARATUS FOR CONTROLLING A REEL-UP



(57) Abstract: Method and apparatus for controlling a reel-up, in which reel-up the paper web or the like (W) is reeled around a reel spool (5) via a reeling nip (N) to form a reel (R). The reeling nip (N) is formed by means of the loop of an endless supporting member (1) passed via two guiding rolls (2, 3) and a reel spool (5) and a reel (R) formed thereon. The web (W) reeled on the reel spool (5) and on the reel (R) formed thereon is guided in the axial direction of the reel spool (5) by turning the reel spool (5) or at least one of the guiding rolls (2, 3).



ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO,
SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN,
GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments*

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

A method and an apparatus for controlling a reel-up

Field of the invention

- 5 The invention relates to a method according to the preamble of the appended claim 1 for controlling a reel-up. The invention also relates to an apparatus for implementing the aforementioned method in accordance with the preamble of the appended claim 17.

10 Background of the invention

In the final end of a paper or paperboard machine or in a finishing apparatus for paper or paperboard, such as a coating machine, a continuous fiber web coming from the preceding process stages is reeled
15 around a rotating reeling shaft, i.e. a reel spool to form a reel, a so-called machine reel. There are many known reeling concepts. It is possible to perform the reeling by means of a so-called pope-reeler, in which the web is passed on the reel by means of a reeling cylinder that rotates at web speed and is in contact with the reel that is being
20 formed. Between the reeling cylinder and the reel loading is maintained, which produces certain linear load in the reeling nip which is located in the contact point of the reel and the reeling cylinder and extends approximately in parallel with the reeling shaft. It is possible to rotate the reel spool and the reel formed thereon for example by means
25 of surface draw, wherein the reel spool rotates freely in the supporting structures of the reel-up, and the force necessary for the rotation is transmitted from the reeling cylinder via the reeling nip to the reel, said reel-up type being disclosed for example in the US patent 4,634,068, or by means of a center drive, wherein in addition to the reeling cylinder
30 the reel spool also comprises a drive. A center-drive assisted reel-up is disclosed for example in the US patent 5,251,835.

The cross-directional profiles of the web are formed in the paper machine and finishing machine before the reeling up process, and it is no
35 longer possible to influence them by means of the reel-up. The variation in the thickness of the web in the cross-direction is one example of

such a cross-directional profile. The profiles varying in the cross-direction of the web affect the quality of the reel that is being formed. It has been observed that a "smiling" or "cup-like" cross-directional profile of thickness is especially problematic, in which cross-directional profile the edges of the web are thicker than its central part, which, on the basis of calculations, is known to result in that the inner radial pressure distribution of the reel also has a shape that rises from the edges. According to one theory a web having edges thicker than the central part produces forces inside the machine reel which may cause internal movements. As a result of the movements, the bottom of the machine reel may bulge outward, which produces bottom or edge cracks.

Because it is no longer possible to affect the quality of the web itself and its cross-directional profile by means of the reel-up, attempts have been made to improve the structure of the reel in conventional reel-ups by means of oscillation in the width direction of the web, i.e. by guiding the web in the axial direction of the reel spool to different points of the machine reel that is being formed. Thus, variations in the cross-directional profile of the web do not occur in the same point in the axial direction of the reel, and a more uniform structure of the reel is attained. The oscillation can be performed either by using a separate guiding device before the reel-up, by means of which the web is deflected in the axial direction of the reel spool or by moving the reel spool itself in the lateral direction with respect to the reeling cylinder, when the roll is located in the reeling station in the reel-up, as disclosed in the US patent 6,354,531 and WO publication 00/26131.

In the EP publication 959 032 the oscillation of the web is performed by moving the reeling cylinder and the machine reel formed on the reel spool together, so that the reeling nip between them remains closed. According to the publication, the reeling cylinder and the reel spool in nip contact with it is deflected in cycles in the travel direction of the web to be reeled so that a cyclic lateral deflection is produced in the reel that is being formed.

It is a problem of the above-mentioned solutions that the present attempt to increase the operating capacity of the reel-up in a paper or finishing machine, not only by increasing the running speed but also the size of the reels that are being formed, results in that the stoppage times of machine reels become longer, and the diameter of the reel reeled in the primary reel-up increases. The increasing sizes of the reels both in the primary and secondary reel-up require stronger transverse guides and oscillation means in the primary and secondary reeling devices, which are difficult to implement. Furthermore, the massive structures required by the aforementioned solutions occupy a great deal of space. Furthermore, for example in the solution shown in WO 00/26131 it is difficult to adapt the coupling of the center drive shaft and the reel spool.

It is also possible to implement the reeling by means of a reeling nip formed by means of the loop of an endless supporting member. Thus, the web is guided via a supporting member, such as a wire or a belt passed via guiding rolls to a reel formed around the reel spool. Thereby the reeling nip is formed by means of the supporting member and the reel that is being formed. Thus, the reeling nip becomes long, and the nip pressures in the reeling nip become smaller than in conventional reel-ups, which improves the controllability of the reeling nip. Such a reeling method is disclosed e.g. in the EP publication 860391.

Brief description of the invention

It is an aim of the present invention to attain a method that enables the oscillation of the web in a reel-up comprising a reeling nip formed by means of the loop of an endless supporting member. Another aim is to bring about a method to centralize the web or to adjust it to have the desired location in the axial direction of the reel spool. The method avoids the problems occurring in other reeling methods in the oscillation of the web and enables the implementation of the oscillation and the centralization of the web in a reel-up utilizing an endless supporting member loop in a simple manner and without separate oscillation devices to be placed before the reel-up. Furthermore, it is an

aim of the invention to provide an apparatus implementing the aforementioned method.

5 To attain these purposes, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the main independent claim 1.

10 The apparatus according to the invention, in turn, is primarily characterized in what will be presented in the characterizing part of the independent claim 17.

The other, dependent claims present some preferred embodiments of the invention.

15 The invention is based on the idea that in a reel-up comprising a reeling nip formed by means of the loop of an endless supporting member the web to be reeled is guided in the axial direction of the reel spool by moving either the reel spool or the guiding rolls guiding the loop of the supporting member. Thus, the position of the reel spool or
20 at least one of the guiding rolls is arranged movable. In continuous oscillation of the web, the web is guided back and forth in cycles on the reel spool in the axial direction of the reel spool. When the web is centralized in the axial direction of the reel spool, the guiding of the web takes place on the basis of measuring the position of the edges of the
25 web performed before the supporting member.

It is an advantage of the invention that by means of the invention it is possible to guide the web in the axial direction of the reel spool to different points of the reel spool during the entire reeling process. In the
30 reeling, actuators already existing in the reel-up will be used. Thus, separate actuators located before the reel-up are not required. Furthermore, by using guiding rolls guiding the loop of the supporting member to produce oscillation, separate oscillation means are not required in the secondary reeling device to move the reel spool in the transverse
35 direction of the reel-up. The implementation of the oscillation does not

require additional space, because the invention utilizes actuators already existing in the reel-up.

5 The reel spool is moved by turning it and the machine reel formed thereon diagonally with respect to the incoming direction of the paper web. The turning takes place by moving one or both ends of the reel spool substantially on the horizontal plane in such a manner that the web is guided in the axial direction to different points of the reel that is being formed. In other words the ends of the reel spool are moved
10 linearly in the machine direction. If the aim is to oscillate the web, i.e. to guide it continuously in the axial direction of the reel spool to different points of the reel spool, the reel spool is moved back and forth in cycles. It is possible to move the reel spool both when it is in the primary reeling device and when it has been transferred to the secondary
15 reeling device.

The wire guiding rolls guiding the loop of the supporting member are moved by turning them into an inclined position in the travel direction of the paper web either vertically or in the machine direction, either one or
20 both rolls. The turning takes place by moving an end of the wire guiding roll, which produces the tightening of the supporting member carried by the wire guiding rolls on that side from which the wire guiding roll was moved. This causes the travel of the web to a different location in the axial direction of the reel spool. The oscillation of the web, i.e. the
25 movement of the web back and forth in the transverse direction is attained by moving one or both ends of the wire guiding roll in cycles in such a manner that the web travels in the axial direction of the reel spool to different points of the reel that is being formed. The turning motion back and forth, i.e. the amplitude of the oscillation is so small
30 that the web remains on top of the supporting member during the entire reeling process. In other words, the formation of the reel, i.e. the inner tightness and other properties of the reel remain good also when the web is oscillated in accordance with the invention.

Brief description of the drawings

In the following, the invention will be described in more detail with reference to the appended drawings, in which

5

Fig. 1 illustrates the main principle of a belt reeler in a schematical side-view,

10

Fig. 2a shows a schematical side-view of the process of guiding the web by moving the reel spool, when the reel spool is positioned in the primary reeling device,

15

Fig. 2b shows a schematical side-view of the process of guiding the web by moving the reel spool, when the reel spool is positioned in the secondary reeling device,

20

Fig. 2c shows a schematical top-view of the process of guiding the web in the axial direction of the reel spool by moving the reel spool,

25

Fig. 3a shows a schematical side-view of the process of guiding the web by moving the guiding roll/rolls of the supporting member when the reel spool is positioned in the primary reeling device,

30

Fig. 3b shows a schematical side-view of the process of guiding the web by moving the guiding roll/rolls of the supporting member when the reel spool is positioned in the secondary reeling device,

35

Fig. 3c shows a schematical top-view of the process of guiding the web in the axial direction of the reel spool by moving at least one guiding roll, when friction force prevails between the web and the supporting member,

Fig. 3d shows a schematical top-view of the process of guiding the web in the axial direction of the reel spool by moving at least one guiding roll, when no friction force prevails between the web and the supporting member, and

Fig. 4 shows schematically the adjustment and control arrangement for guiding the web, as well as the principle of centralizing the web.

5 Detailed description of the invention

10 In the following, the invention will be described by means of the above-presented figures. It should be noted that in Figs 2c, 3c and 3d the turned position of the rolls needed for guiding the web is shown in a highly exaggerated manner to facilitate the understanding of the matter. During actual use the turning movement of the rolls is considerably smaller.

15 Fig. 1 illustrates a continuously operating reel-up, where a paper web W, which is normally several meters wide and comes from a preceding section of a paper machine or a finishing apparatus for paper, travels via a reeling nip N1 to a reel R. Said reel-up is a so-called belt reel-up in which the reeling nip is formed by means of a flexible supporting member 1 in the form of an endless loop, such as a belt or a wire. The
20 supporting member 1 is guided via two guiding rolls 2 and 3, at the location of each of which the run of the member 1 turns to the opposite direction. In the travel direction of the web the first guiding roll 2 can form a "hard nip" with the reel being started at the initial stage of the reeling in such a manner that the supporting member 1 is in contact
25 with the reel at a point where the member travels supported by the guiding roll 2 on the surface of the roll. The second guiding roll 3 can be a driven roll, i.e. a traction roll, or separate drives can be arranged for both rolls. The web travels guided by the supporting member 1 onto the machine reel R, which is formed around a reel spool 5 rotatable
30 with a center drive of its own. When the diameter of the machine reel R grows, it is transferred to the secondary reeling device 6. The reel R is in constant contact with the supporting member during the entire reeling process. It is possible for the reel spool 5 to move in the machine direction with respect to the loop of the supporting member 1,
35 and this is arranged in such a manner that the bearing housings at the ends of the reel spool that enable the rotation of the reel spool 2 are at

both ends of the reel spool supported on carriages, i.e. transfer devices 6 that move on supporting structures 7. The transfer devices 6 also function as a secondary reeling device. In connection with the reel-up, there is also a storage of empty reel spools 5 (not shown), from which the rolls are brought to the change station at the location of the first guiding roll 2 in order to change the web going to the machine reel R that is becoming full. The reel change takes place at production speed i.e. the paper web passed at high speed to the full reel is changed to travel onto a new, empty reel spool brought to the change station.

Figs 2a and 2b show a side-view of an embodiment of the invention to guide the web in the axial direction of the reel spool. The figures illustrate the control of the web by moving the reel spool 5, in which the web W is guided in the axial direction of the reel spool by turning one or both ends of the reel spool 5 in the machine direction either in or against the machine direction, which movement is shown by means of an arrow A. It is also possible to guide the web W when the reel spool 5 and the machine reel R formed thereon are still in the primary reeling device 8, which has been schematically described in Fig. 2a and/or when the reel spool 5 and the machine reel R formed thereon have been transferred to the secondary reeling device 6. This direction of motion of the reel spool 5 and the machine reel formed thereon have been presented schematically in Fig. 2b also by means of an arrow A.

Fig. 2c shows in a top view a situation in the guidance of the web in which one end 51 of the reel spool has been turned against the machine direction, i.e. towards the guiding roll 2. The supporting member 1 travels via the guiding rolls 2 and 3 and the web W enters the supporting member perpendicularly in the direction of the arrow B (machine direction). During the reeling process the reel spool 5 and the supporting member 1 are in constant nip contact at least for the part of the reel spool 5 extending across the width of the web. Consequently, when the reel spool 5 is turned the supporting member 1 tends to follow the movement of the reel spool 5 and seeks its way slowly to a new position, wherein the web travels on a reel spool 5 in a different location in its axial direction when compared to a situation where the reel

spool 5 is positioned perpendicularly against the direction of movement of the supporting member. In Fig. 2c, in which the end 51 of the reel spool 5 has been turned towards the guiding roll 2, the supporting member tends to move towards the arrow C, which guides the web W in the same direction (arrow D). If the end 51 of the reel spool is next transferred towards the guiding roll 3, which position of the reel spool is shown in Fig. 2c by means of broken lines, the supporting member 1 tends to move in the direction of the arrow E (the end of the reel spool 52 closer to the incoming web W and the guiding roll 2) and the web W travels towards the end 52 of the reel spool. The moving of the reel spool can be attained by means of suitable actuators, for example by means of transfer devices 6.

According to another embodiment of the invention the guidance of the web in the axial direction of the reel spool is attained by turning the guiding rolls guiding the loop of the supporting member to a diagonal position in the travel direction of the paper web, i.e. either in the vertical direction or in the machine direction. As above, one or both ends of said guiding roll is/are thus turned. In Figs 3a and 3b arrows F and G schematically illustrate possible movement directions of the guiding rolls 2 and 3 when seen from the side of the reel-up when the reel spool is in the primary reeling device (Fig. 3a) and in the secondary reeling device (Fig. 3b). If both guiding rolls 2 and 3 are turned to attain the guidance, it is essential to turn both wire guiding rolls on the same plane of movement.

Fig. 3c shows in a top view a situation in which, by turning the guiding roll 2, the web W has been guided to a different location in the axial direction of the reel spool 5. The reel spool 5 is substantially perpendicular to the travel direction of the web W prevailing before the supporting member 1. The end 21 of the guiding roll 2 has been turned into a diagonal position against the machine direction, i.e. towards the incoming direction of the web W (arrow B), wherein the edge of the supporting member 1 on the side of the other end 22 of said guiding roll is closer to the end 52 of the reel spool 5. This results in that the supporting member 1 is tightened from one edge, i.e. at the edge on the

side of the end 21 of the guiding roll 2, and slackened from the other, i.e. the edge on the side of the end 22 of the guiding roll 2. Thus, also the web W is slackened in the vicinity of the end 52 of the reel spool, which causes the guiding of the web in the direction of the arrow H, i.e. in the axial direction of the reel spool 5 towards the end 52 of the reel spool.

The effect of the turning of the guiding roll 2 on the supporting member 1 must be compensated by turning the second guiding roll 3 of the supporting member 1 into a diagonal position in the opposite direction, i.e. machine direction in such a manner that the end of the guiding roll 3 is turned away from the end 21 of the first guiding roll 2. Thus, the second guiding roll acts as a compensation roll that prevents the supporting member from being guided off the guiding rolls.

In a corresponding manner, when the aim is to guide the web 1 to the other edge in the axial direction of the reel spool 5, the end 22 of the guiding roll 2 is transferred against the machine direction and the movement is compensated by moving the end 31 of the roll 3 towards the reel spool 5, which position of the guiding rolls is shown by means of broken lines in Fig. 3c.

The guiding of the rolls takes place as presented above when the web to be reeled is for example uncoated, wherein friction force prevails between the web W and the supporting member 1, said friction force holding the web against the supporting member 1. Thus, the holding and control produced by the supporting member on the web also guide the web.

If the web to be reeled is coated at least from one side and the reeling takes place in such a manner that the coated side of the web is positioned against the surface of the supporting member 1, i.e. there is not at least any significant friction force between the supporting member and the web W. Thus, a spreading roll 10 is advantageously used before the reel-up, said spreading roll guiding the web W and causing it enter the supporting member 1 perpendicularly. This guidance situation

is shown in a schematical top-view in Fig. 3d. The use of the spreading roll affects the non-wrinkleness of the web and its guidance before the nip, and especially the positions of the guiding rolls 2 and 3, when the web is guided to a different location in the axial direction of the reel spool, because components of the spreading forces in the lateral direction of the spreading roll 10 affect especially the tighter edge of the supporting member 1, thus making the web W move towards the tighter edge. The effect of the spreading roll to the behaviour of the web must thus be taken into account when turning the guiding roll/rolls.

In Fig. 3d the guiding rolls 2 and 3 have been turned in the machine direction in such a manner that the end 22 of the guiding roll 2 has been turned against the machine direction and this movement of the guiding roll has been compensated by moving the end 32 of the guiding roll 3 to the opposite direction, i.e. machine direction (arrow B). Thus, the edge of the supporting member 1 on the side of these ends is thus tighter and the web moves towards the same. When the aim is to guide the web to another direction on the reel spool 5, the end 21 of the guiding roll 2 is turned against the machine direction and the end 31 of the guiding roll 3 is turned in the machine direction. The edge of the supporting member on the side of these roll ends is tighter and the web is guided to this end of the reel spool 5.

The above-described alternatives for guiding the web on the reel spool are also suitable for oscillation of the web, i.e. for guiding the web continuously to different points in the axial direction of the reel spool. Thus, the turning motion of the reel spool or the guiding roll/rolls is attained by turning one or both ends of said roll back and forth in cycles. If the guiding is performed by means of the reel spool, one or both of its ends are turned in the machine direction. If the guiding is performed by means of one or both guiding rolls guiding the supporting member, one or both of their ends is/are turned either in the machine direction or vertically.

The control arrangement of the control and oscillation of the web is shown schematically in Fig. 4. The oscillation of the web by means of

turning the reel spool 5 or the guiding rolls 2 and/or 3 is controlled with control means 9, which get the profile information of the web from sensors that are attached to the measurement beam 11 and measure the web continuously across its entire width. The measurement beam is located before the reel-up in the travel direction of the web. By means of the profile measurement information the control unit 9 calculates the control information necessary for changing the position of the roll to be turned, i.e. the reel spool, or one or both guiding rolls, and sends it to the roll in question.

When the oscillation of the web is performed by turning the guiding rolls, the control unit also controls the position of the other roll, i.e. the compensation roll either in accordance with a predetermined oscillation sequence, or the control unit can utilize the position information attained from the position of the roll to be turned. The position of the roll to be turned is measured for example by means of LVDT sensors 14, which can be attached to a suitable location, for example to the ends of the rolls 2 and 3, and said position information is transmitted to the control unit 9. The control unit 9 sends a control message further to another turnable roll i.e. the compensation roll. For example the position information of the roll 2 i.e. the roll to be turned is transmitted to the control unit, on the basis of which it transmits a control message to the compensation roll 3. It is possible to transmit the measurement and control messages by means of any known signal transmission method, either by means of guides, a field bus, or wirelessly. When wireless signal transmission is used, it is necessary to install transmitter-receiver pairs at the ends of the rolls and in the control unit.

The oscillation has certain maximum amplitude which is dependent on the oscillation mechanism or otherwise restricted. The maximum value of the amplitude can be dependent for example on the maximum cylinder stroke of the actuators effecting the oscillation. The oscillation speed, i.e. frequency, in turn, can be made dependent on the running speed of the machine. It can be directly proportional thereto. Each running speed of the machine may have a particular frequency, as presented hereinbelow.

The frequency (amplitude) of the reel spool in the axial direction is typically 100 at the most, advantageously between 2 and 50 mm, when expressed as the distance between the extreme positions of the edges of the web in the axial direction of the reel spool. To maintain a good structure in the reel, the oscillation must not be too rapidly deflecting. The maximum oscillation frequency is advantageously such that during one cycle at least 100 m, advantageously at least 200 m of web is reeled on the reel. For example at running speeds of 25 m/s, the distance of 100 m represents the frequency of 0.25 Hz (1 cycle/4 seconds). The minimum frequencies and the optimum frequencies may be determined in meters in a corresponding manner.

It is possible that because of the measurement information the profile is at a certain moment such that the oscillation takes place at maximum amplitude (for example within the limits of the maximum cylinder stroke of the actuators). When the situation is improved, a shorter oscillation, i.e. oscillation of smaller amplitude begins. Similarly, it is possible to transfer the effective area of the amplitude of oscillation, i.e. when oscillating at an amplitude smaller than the maximum amplitude, it is possible to change the location of the extreme points of the oscillation in the lateral direction. Thus, a transfer in a way "aside" from the preceding point takes place, wherein the amplitude of the oscillation can also remain the same.

By means of oscillation it is possible to avoid the disadvantages of all kinds of profiles that rise towards the edges from the middle. According to corresponding principles, the oscillation can be started and its amplitude can be increased also in cases of other kinds of profiles, also for profiles rising towards the middle from the edges or for such profiles in which the deflections are more irregular and the profile is more like wavy or irregular, comprising randomly occurring peaks. There are, of course, several mathematical methods and algorithms that can be used for estimating the quality of the profile and the extent of the variations, which can be programmed beforehand in the control unit 9 to

start the oscillation and to adjust it on the basis of the calculation results.

5 When the measurement result of the web no longer fulfils the oscillation conditions, i.e. the measurement result or calculation result of the web is within acceptable limits again, the oscillation is finished by the command of the adjustment and control unit 9.

10 It is also possible to utilize the invention when the aim is to control the web W as close as possible to the center of the reel spool with respect to its axial length. Thus, the location of the edges of the web (W) is measured before the web enters the supporting member 1 and on the basis of the measurement a correcting movement is performed either by means of the reel spool 5 or the guiding rolls 2 and/or 3 in the
15 above-described manner, which makes it possible to centralize the web (W). Figure 4 shows this embodiment schematically.

The web W enters the supporting member 1 of the reel-up in the direction of the arrow B. Measurement means 12 and 13 are placed
20 before the supporting member, on both sides of the width of the web W, and substantially at the same point of the web, said measurement means measuring the position of the edges of the web.

The measurement means 12 and 13 can be for example optical
25 measurement devices based on reflectance or transmittance of light, or measurement devices based on camera technology. Depending on the measurement principle, the exact location of the measurement means and the way of conveying the web before the supporting member, the measurement means are positioned either only above or below the
30 web, or on both sides of the web. Possible measurement configuration can be for example a CCD line camera that measures the edge area of the web with the reflectance principle. Thus, it is possible that the apparatus comprises a light source integrated in the same housing with the camera unit. The camera and the light source are installed on the
35 edge of the web, perpendicularly to the travel direction of the web in such a manner that part of the illumination and the measurement area

of the camera is positioned outside the edge of the web. The camera separates the web and the areas remaining outside its edges on the basis of their different reflection intensity, of which a measurement message is transmitted to the control unit 9. The location of the measurement means in the axial direction of the reel spool 5 has been determined beforehand, and thus the control unit is capable of determining the location of the web W on the reel spool on the basis of the measurement message. If desired, the measurement means 12 and 13 can also be attached to the measurement beam 11.

10 The control unit transmits a control message to a desired member correcting the position of the web on the reel spool, which can be the above-presented reel spool 5 or guiding roll or rolls 2 and/or 3. It is also possible to monitor and adjust the position of the reel spool and the guiding roll 2 and/or 3 as presented above.

In a corresponding manner, by means of the invention it is possible to guide the supporting member 1 in the axial direction of the guiding rolls 2 and/or 3 on the basis of the measurement of the position of the edges of the supporting member 1. Thus, the measurement means 12 and 13 are positioned on both sides of the width of the supporting member 1, substantially at the same point with respect to the length of the supporting member, in the machine direction either at the location of the guiding roll 2 or after the same. In Fig. 4 these measurement means 12 and 13 measuring the edges of the supporting member are shown in broken lines. Such a measurement can be installed to replace conventional edge controllers, for example mechanical spoon solutions used for supporting members, such as wires. By means of the measurement it is possible to monitor the position of the supporting member in the axial direction of the guiding rolls 2 or 3, and when it deflects from the desired one, to control the supporting member, i.e. to correct its position on the basis of a control message of the position change given from the control unit 9.

35 The invention is not intended to be limited to the embodiments presented as examples above, but the invention is intended to be applied

widely within the scope of the inventive idea as defined in the appended claims. Thus, the invention can be applied not only in connection with papermaking, but also in reeling of paperboard or tissue paper and in finishing machines relating thereto. The invention can also be
5 applied in so-called re-reelers.

Claims

1. A method for controlling a reel-up, in which reel-up a paper web or the like (W) is reeled around a rotating reel spool (5) via a reeling nip (N) to form a reel (R), said reeling nip (N) being formed by means of the reel spool (5) and the reel (R) formed thereon and the loop of an endless supporting member (1), **characterized** in that the web reeled on the reel spool (5) and on the reel (R) formed thereon is guided in the axial direction of the reel spool (5).
2. The method according to claim 1, **characterized** in that in the reel-up the paper web or the like (W) is continuously reeled around a rotating reel spool (5).
3. The method according to claim 1 or 2, **characterized** in that the web (W) reeled on the reel spool (5) and the reel (R) formed thereon is guided in the axial direction of the reel spool (5) to different points of the reel (R) that is being formed.
4. The method according to any of the preceding claims 1 to 3, **characterized** in that the web (W) is guided in the axial direction of the reel spool by turning the reel spool (5) in the machine direction.
5. The method according to claim 4, **characterized** in that the reel spool (5) is turned by turning one or both ends (51, 52) of the reel spool (5) in the machine direction.
6. The method according to claim 4 or 5, **characterized** in that the web (W) is guided in the axial direction of the reel spool (5) by turning one or both ends (51, 52) of the reel spool (5) back and forth in cycles in the machine direction.
7. The method according to any of the preceding claims 1 to 3, **characterized** in that the endless supporting member (1) travels via two guiding rolls (2, 3) and that the web (W) is guided in the axial direction of the reel spool (5) by turning at least one of the guiding rolls (2, 3).

8. The method according to claim 7, **characterized** in that at least one guiding roll (2, 3) is turned in the machine direction or in the vertical direction.

5

9. The method according to claim 7 or 8, **characterized** in that at least one guiding roll (2, 3) is turned by turning one or both ends (21, 22, 31, 32) of at least one guiding roll (2, 3) in the machine direction or in the vertical direction.

10

10. The method according to claim 7 to 9, **characterized** in that the web (W) is guided in the axial direction of the reel spool (5) by turning one or both ends (21, 22, 31, 32) of at least one guiding roll (2, 3) back and forth in cycles in the machine direction or in the vertical direction.

15

11. The method according to any of the preceding claims 7 to 10, **characterized** in that the effect of turning the first guiding roll (2, 3) on the supporting member (1) is compensated by turning the second guiding roll (2, 3) to the opposite direction in the same plane of movement with the first guiding roll (2, 3).

20

12. The method according to any of the preceding claims 7 to 11, **characterized** in that the web (W) is guided by means of a spreading roll (10) before it enters the supporting member (1).

25

13. The method according to any of the preceding claims 5 to 6 or 9 to 10, **characterized** in that the turning of the ends (51, 52, 21, 22, 31, 32) of the reel spool (5) or of the guiding rolls (2, 3) is controlled by means of profile measurement (11) of the web.

30

14. The method according to claim 11, **characterized** in that the turning of the second guiding roll (2, 3) is controlled by means of a pre-determined control sequence or by position measurement (14) of the first guiding roll (2, 3)

35

15. The method according to any of the preceding claims, **characterized** in that the web (W) is guided in the axial direction of the reel spool (5) on the basis of position measurement of the edges of the web (W).

5

16. The method according to any of the preceding claims, **characterized** in that the supporting member (1) is guided in the axial direction of the guiding rolls (2) and/or (3) on the basis of position measurement of the edges of the supporting member (1).

10

17. An apparatus for controlling a reel-up, which comprises a reel-up in which there is a reeling nip (N) formed by means of a loop of an endless supporting member (1) passed via two guiding rolls (2, 3) and a reel spool (5) and a reel (R) formed thereon, via which reeling nip (N) a paper web or the like (W) is reeled, and which reel-up is arranged to reel a paper web or the like (W) around a rotating reel spool (5) to form a reel (R), **characterized** in that the position of the reel spool (5) and at least one guiding roll (2, 3) is arranged to be changed to guide the web (W) to be reeled on the reel spool (5) and on the reel (R) formed thereon in the axial direction of the reel spool (5).

15

20

18. The method according to claim 17, **characterized** in that in the reel-up is arranged to continuously reel the paper web or the like (W) around the rotating reel spool (5).

25

19. The apparatus according to claim 17 or 18, **characterized** in that the position of the reel spool (5) or at least one of the guiding rolls (2, 3) is arranged to be changed to guide the web (W) in the axial direction of the reel spool (5) to different points of the reel (R) that is being formed.

30

20. The apparatus according to any of the preceding claims 17 to 19, **characterized** in that the reel spool (5) is arranged turnable in the machine direction.

35

21. The apparatus according to claim 20, **characterized** in that one or both ends (51, 52) of the reel spool (5) is/are arranged turnable in the machine direction.
- 5 22. The apparatus according to claim 20 or 21, **characterized** in that one or both ends (51, 52) of the reel spool (5) is/are arranged turnable back and forth in cycles in the machine direction.
- 10 23. The apparatus according to any of the preceding claims 17 to 19, **characterized** in that at least one guiding roll (2, 3) is arranged turnable.
- 15 24. The apparatus according to claim 23, **characterized** in that at least one guiding roll (2, 3) is arranged turnable in the machine direction or in the vertical direction.
- 20 25. The apparatus according to claim 23 or 24, **characterized** in that one or both ends (21, 22, 31, 32) of at least one guiding roll (2, 3) is/are arranged turnable in the machine direction or in the vertical direction.
- 25 26. The apparatus according to claim 23 to 25, **characterized** in that one or both ends (21, 22, 31, 32) of at least one guiding roll (2, 3) is/are arranged turnable in the machine direction or in the vertical direction.
- 30 27. The apparatus according to any of the preceding claims 23 to 26, **characterized** in that the effect of turning the first guiding roll (2, 3) on the supporting member (1) is arranged to be compensated by means of the second guiding roll (2, 3) by turning it to the opposite direction in the same plane of movement with the first guiding roll (2, 3).
- 35 28. The apparatus according to any of the preceding claims 23 to 27, **characterized** in that to guide the web (W), there is a spreading roll (10) positioned before the supporting member (1) in the travel direction of the web.

29. The apparatus according to any of the preceding claims 21 to 22 or 25 to 26, **characterized** in that the apparatus comprises control means (9) and measuring means (11, 12, 13) and that the profile measurement of the web (W) attained by the measuring means (11) is
5 utilized to control the turning of the ends (51, 52, 21, 22, 31, 32) of the reel spool (5) or of the guiding rolls (2, 3).

30. The method according to claim 27, **characterized** in that the apparatus comprises means (14) for measuring the position of the guiding
10 rolls (2, 3) and that the turning of the second guiding roll (2, 3) is arranged to be controlled by means of a predetermined control sequence or by position measurement of the first guiding roll (2, 3).

31. The method according to any of the preceding claims, **characterized**
15 **terized** in that position of the web (W) in the axial direction of the reel spool (5) is arranged to be controlled on the basis of position measurement (12, 13) of the edges of the web (W).

32. The method according to any of the preceding claims, **characterized**
20 **terized** in that the position of the supporting member (1) in the axial direction of the guiding rolls (2) and/or (3) is arranged to be controlled on the basis of position measurement (12,13) of the edges of the supporting member (1).

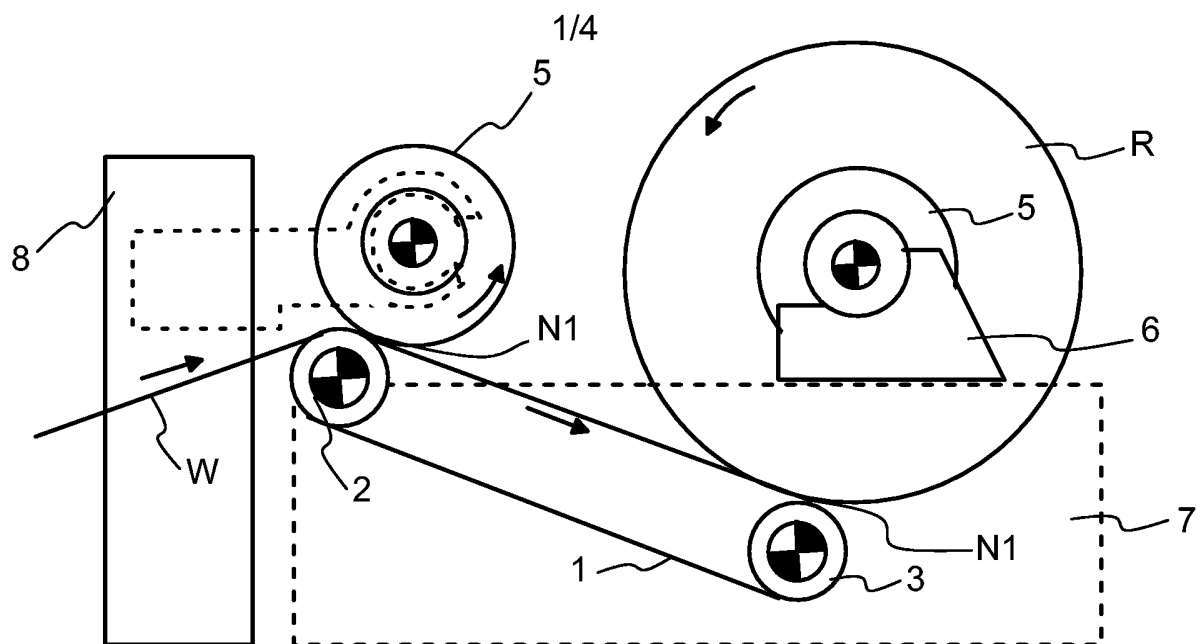


Fig.1

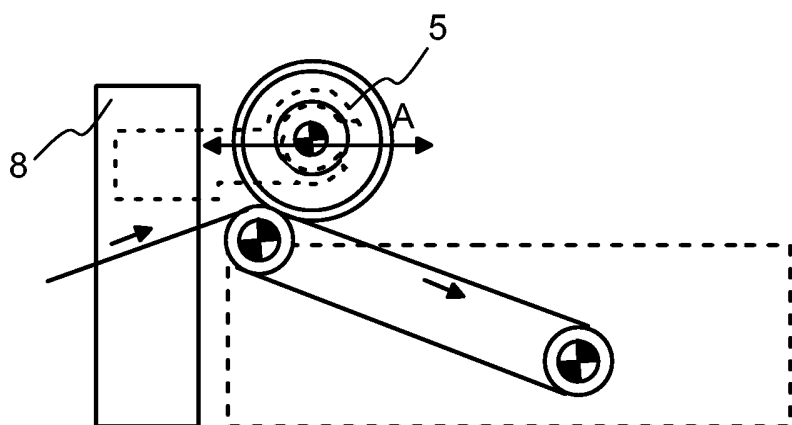


Fig. 2a

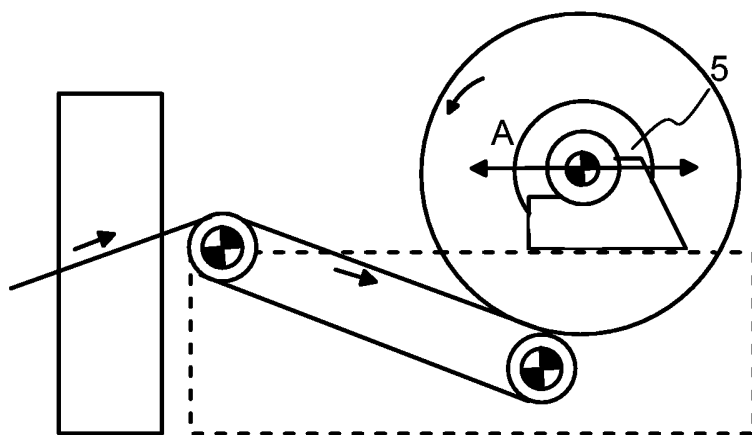
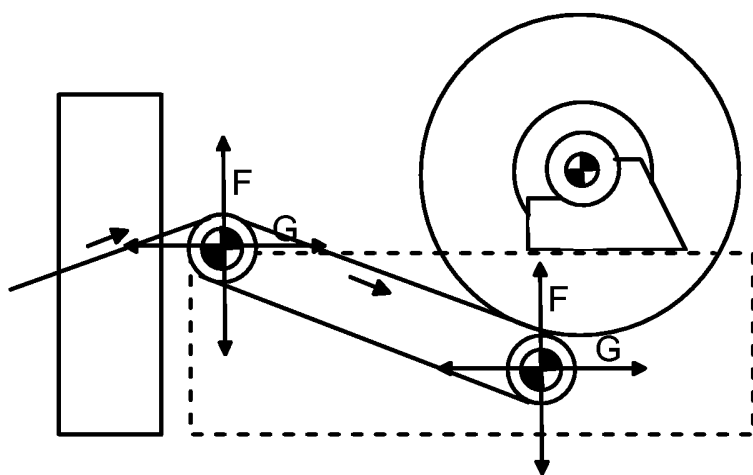
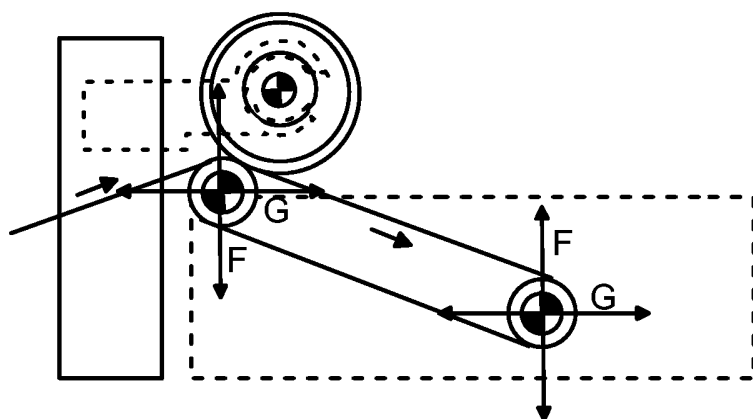
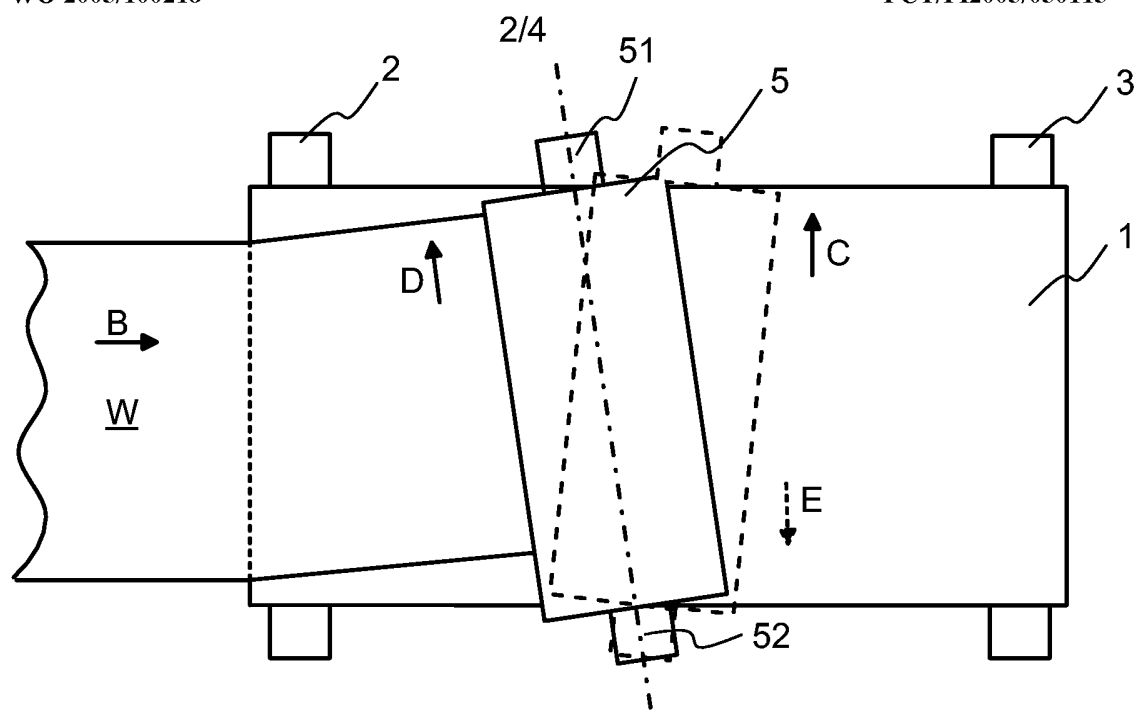


Fig. 2b



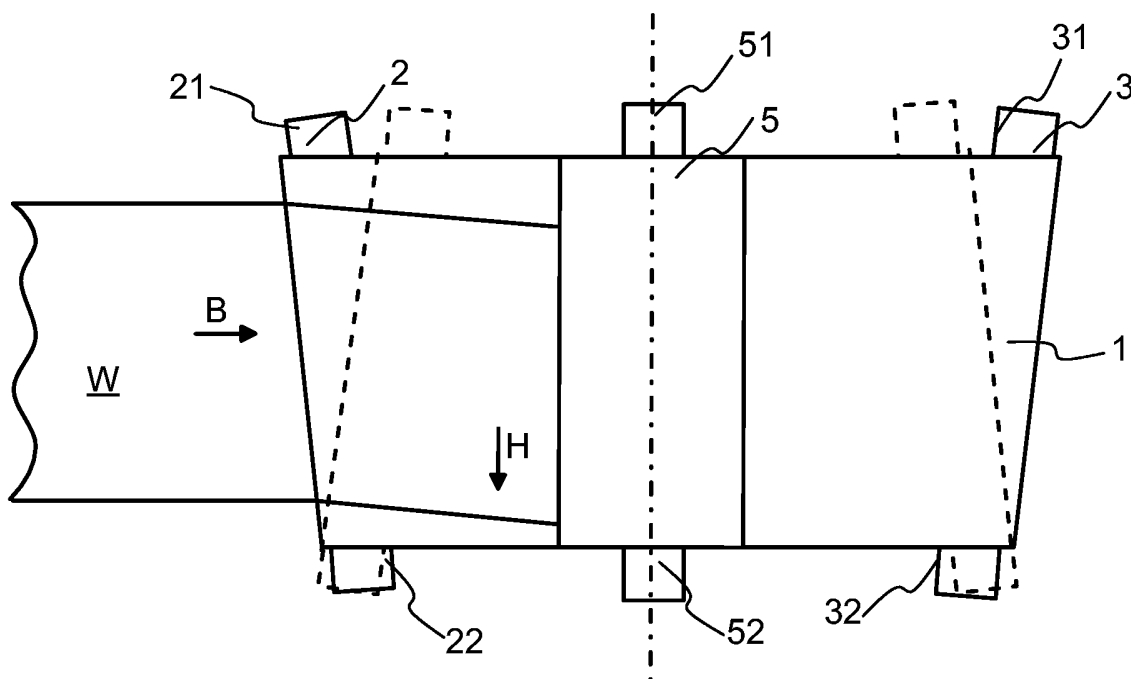


Fig. 3c

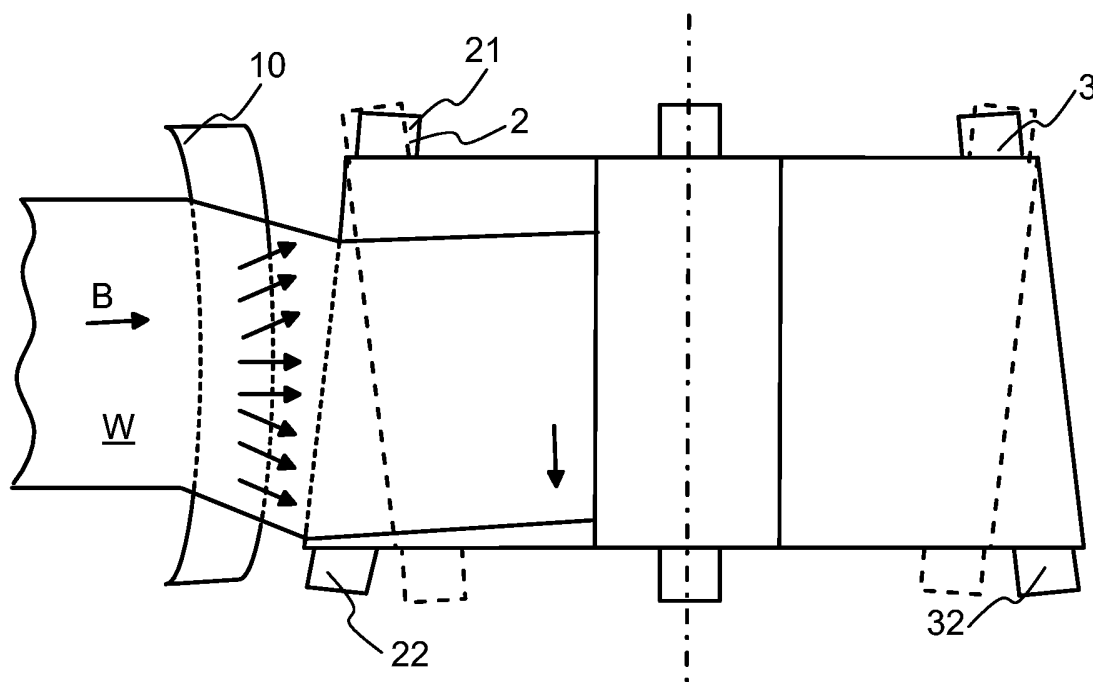


Fig. 3d

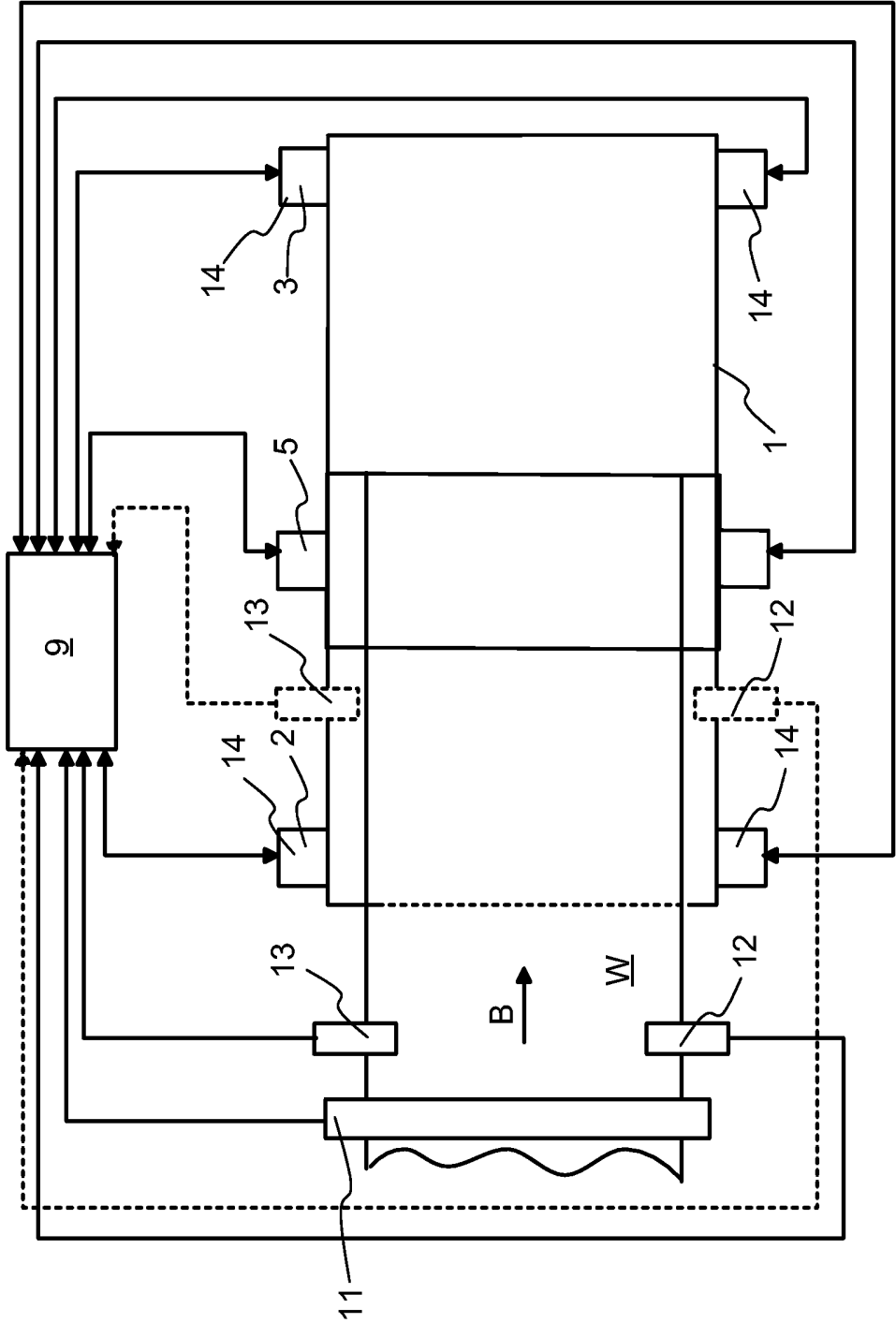


Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP2005/050115

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B65H18/22 B65H23/02

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)

IPC 7 B65H

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/55608 A (VALMET CORPORATION; NISKANEN, HEIKKI) 4 November 1999 (1999-11-04)	1, 2
A	the whole document	3-32
A	US 6 354 531 B1 (AALTO ESA ET AL) 12 March 2002 (2002-03-12) cited in the application column 6, line 19 - line 50	1, 17
	----- -/--	

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

☒ Patent family members are listed in 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 document 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

10 August 2005

Date of mailing of the international search report

22/08/2005

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Haaken, W

INTERNATIONAL SEARCH REPORT

International Application No

PCT/FI2005/050115

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 959 032 A (VOITH SULZER PAPIERTECHNIK PATENT GMBH; VOITH PAPER PATENT GMBH) 24 November 1999 (1999-11-24) cited in the application paragraph '0018! - paragraph '0020! paragraph '0031! - paragraph '0036! paragraph '0040! paragraph '0046! - paragraph '0050! paragraph '0058!; claims; figures -----	1,17
A	WO 00/26131 A (VALMET CORPORATION; RAUTAKORPI, TIMO; VERA-EJAENKORVA, JANNE; ENWALD, P) 11 May 2000 (2000-05-11) cited in the application claims; figures -----	1,17
A	US 6 698 681 B1 (GUY FREDRICK ADDISON ET AL) 2 March 2004 (2004-03-02) -----	
A	US 6 536 705 B1 (BOECK KARL JOSEF) 25 March 2003 (2003-03-25) -----	

INTERNATIONAL SEARCH REPORT

mation on patent family members

International Application No

PCT/FI2005/050115

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9955608	A	04-11-1999	FI 980908 A 15-11-1999
		AT 902599 A 15-07-2005	
		AU 3607899 A 16-11-1999	
		CA 2330070 A1 04-11-1999	
		DE 19983147 T0 12-04-2001	
		WO 9955608 A1 04-11-1999	
		US 6820834 B1 23-11-2004	
US 6354531	B1	12-03-2002	AT 265385 T 15-05-2004
		AU 2524199 A 06-09-1999	
		CA 2320975 A1 26-08-1999	
		DE 69916798 D1 03-06-2004	
		DE 69916798 T2 31-03-2005	
		EP 1056669 A1 06-12-2000	
		WO 9942395 A1 26-08-1999	
		JP 2002503613 T 05-02-2002	
EP 0959032	A	24-11-1999	DE 19822261 A1 25-11-1999
		DE 19852257 A1 18-05-2000	
		AT 247066 T 15-08-2003	
		CA 2272111 A1 18-11-1999	
		DE 59906562 D1 18-09-2003	
		EP 0959032 A1 24-11-1999	
		US 6311922 B1 06-11-2001	
		AT 259748 T 15-03-2004	
		DE 59908571 D1 25-03-2004	
		EP 1000893 A1 17-05-2000	
		US 6402082 B1 11-06-2002	
WO 0026131	A	11-05-2000	FI 982390 A 30-06-2000
		AT 260859 T 15-03-2004	
		AU 1273400 A 22-05-2000	
		CA 2349193 A1 11-05-2000	
		DE 69915339 D1 08-04-2004	
		DE 69915339 T2 22-07-2004	
		EP 1135317 A1 26-09-2001	
		WO 0026131 A1 11-05-2000	
		JP 2002528364 T 03-09-2002	
		US 6536704 B1 25-03-2003	
US 6698681	B1	02-03-2004	AU 2003223781 A1 04-05-2004
		WO 2004033350 A1 22-04-2004	
US 6536705	B1	25-03-2003	DE 19939506 A1 22-02-2001
		FI 20001836 A 21-02-2001	
		US 2003075637 A1 24-04-2003	