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(54) Title: SLITTER-WINDER ASSEMBLY HAVING A SENSOR SYSTEM

(57) Abstract: A slitter-winder assembly with a sensor system comprises a slitter for slitting a web material into a plurality of web strips, a plurality of rollers including carrier rollers for winding a plurality of individual rolls of web strips on winding cores, and a detection means for detecting winding nip pressure profiles and/or web tension profiles of the individual rolls to be wound, wherein at least one of said plurality of rollers is a pressing roller having a pressure sensitive sensor arranged thereon, which extends in a machine cross direction.

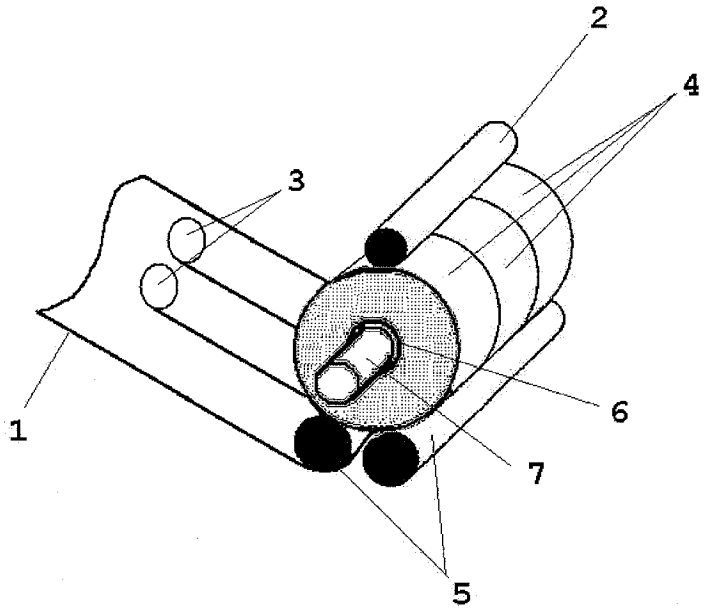

Fig. 1

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SLITTER-WINDER ASSEMBLY HAVING A SENSOR SYSTEM

Description

BACKGROUND OF THE INVENTION

The present invention relates to a slitter-winder assembly having a sensor system, and specifically to a slitter-winder assembly having a sensor system which includes a pressure sensitive sensor, such as an EMFi-sensor.

DESCRIPTION OF THE RELATED ART

It is known in the art of paper making to slit a full width paper or cardboard web to part webs before winding the same to customer rolls. Then, the rolls are wrapped and shipped to the customer. However, there exists a problem in that an alignment deviation of the rolls can occur during winding the web to rolls, so that a slit part of the web, i.e. a web strip overlaps with an adjacent web strip. Thereby, the desired evenly distributed tension of the web on each roll can no longer be ensured, or the web can even break by too high tension in parts of the web where the strips overlap each other.

Furthermore, as already known, a tension profile of the web on each roll is a substantial factor in a printing process as well as in the fields of paper making, finishing and further processing. Furthermore, the tension profile has an impact on the alignment of press pixels, the operation of folder units etc., when the paper is used for printing.

It has been observed that the diameter and hardness profiles and tension profiles of the rolls have a clear inverse correlation when unwinding a roll with a "bad" profile. The tension profile problem can be caused, for example, by the variations of the diameter of the roll being unwound. At the sections of the cross-direction of the web in which the diameter of the roll is small, significantly high web tension exists and at sections of the web in which the diameter of the roll is large, a low web tension exists and, therefore, a loose area prevails. Thus, the need exists to exactly control web tension at certain parts of the paper making process.

In order to measure a web tension, WO2006/075055 A1 describes a paper machine in which a measuring roller for measuring a web tension profile of a paper or cardboard web is arranged in contact with the web in an open draw of the web passing subsequent roller nips. In particular, the measuring roller comprises an EMFi-sensor (electromechanical film sensor) on its outer surface in order to measure the web tension of the web across its entire CD-(Machine Cross Direction)-width. Thereby, it is possible to detect an uneven distribution of tension in the web for feedback controlling a paper making process.

Until now, however, there is no method known by means of which it is possible to obtain a profile map of one or several customer rolls onto each of which a strip of a slit web is wound.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a slitter-winder assembly, wherein the above mentioned issues are coped with.

This object is achieved by a slitter-winder assembly having the features of claim 1.

In particular, a slitter-winder assembly according to the invention has a sensor system and further comprises a slitter, such as circular slitting blades, for slitting a web material into a plurality of web strips, winding cores for winding a plurality of individual rolls of web strips onto, a plurality of rollers including a sensing roller, at least one pressure sensitive sensor arranged on the sensing roller and extending in a machine cross direction (a CD-direction), and a detection means for detecting winding nip pressure profiles and/or web tension profiles of the individual rolls. Here, it is to be noted that, several winding cores may be produced by cutting one single winding core.

The sensing roller is preferably positioned in contact with the paper rolls, such that the sensing roller acts either as a pressing roller pressing the web strips onto the plurality of rolls or as a roller carrying the weight of the wound paper roll. Alternatively, in case the sensing roller is positioned away from the paper rolls, the sensing roller acts as a guiding roller which is only in contact with the web in a position upstream of the rolls, so that the web strips are merely guided to the plurality of rolls by means of the sensing roller.

The slitter-winder assembly in accordance with the present invention can further comprise a control means for controlling an accurate winding of each web strip to the respective customer roll. The control means is adapted to prevent the web strips from being wound on the rolls in an overlapping manner by itself in combination

with an intervening regulating means or the like or by acting as an alerting means in order to alert an operator of a possible inaccurate situation. Also, the slitter-winder assembly can further comprise a storing means for storing the measured profiles in a computer, in a separate mobile memory device, in RFID tags or the like. In this way, the storing means can be provided for every individual customer roll so that the storing means storing the profile of a respective roll can be delivered to a customer together with the respective roll.

Alternatively, the storing means can be adapted to print the profiles onto every individual roll in form of a printing device for printing, for example, a barcode onto the outer web layer of the roll, a respective winding core, a roll cover or the like.

The winding cores provided for every customer roll are preferably carried by a common winding shaft, wherein the winding cores are fixedly held by the winding shaft which is directly driven in a rotating manner in order to rotate the winding cores.

Alternatively, it is a further possibility that the rolls are wound onto the winding cores carried by the common winding shaft by rotating carrier rollers. Here, the web is guided around one carrier roller to the paper rolls, wherein the sensing roller contacts the web rolls in a position away from the carrier rollers. Also, the carrier roller can be the sensing roller.

As to the specific structure of the sensing roller, the at least one pressure sensitive sensor preferably consists of a single sensor strip which extends over the

entire width of the sensing roller in order to cover the entire width of the web to be wound.

Alternatively, the at least one pressure sensitive sensor consists of a plurality of stripe shaped sensors arranged across the entire width of the sensing roller. Here, for example, each sensor could be provided for measuring the profile of one single web strip to be wound to a roll.

In a further alternative, the at least one pressure sensitive sensor comprises an array of several sensors which are arranged next to each other along the entire width of the sensing roller. With several single sensors, it is possible to obtain all different kinds of sensor patterns depending on the profile to be measured. Also, by employing single sensors, it is possible to exchange a single defective sensor individually instead of exchanging a whole sensor strip or the like.

The at least one pressure or force sensitive sensor is preferably arranged in a spiral shape along the sensing roller, so that only a small part at a time contacts the measuring zone or area. Alternatively, all different kinds of sensor arrangements can be established, such as a circular sensor arrangement, a linear sensor arrangement or the like. Here, the at least one pressure sensitive sensor is preferably arranged directly on a surface of the sensing roller. Alternatively, the sensor could be arranged underneath the surface of the sensing roller, or underneath a cover layer provided on the outside of the sensing roller.

The at least one pressure sensitive sensor is preferably an EMFi-sensor. Alternatively, any other kind of pressure sensitive sensor can be used, such as a piezo-sensor or

the like. Furthermore, the web material can be a fibrous web material, a metal foil, a plastic foil or the like.

With the above described sensor system for a slitter-winder assembly, it is possible to achieve an online measuring system for measuring, for example, a nip pressure force acting on the sensing roller in the slitter-winder assembly. With a spiral-like pressure sensitive sensor such as an EMFi-sensor being provided on the sensing roller of the slitter-winder assembly, a force profile acting on the sensing roller can be measured by the sensor system online, i.e. during manufacturing the paper web in a paper manufacturing machine. The pressure sensitive sensor can be provided on the surface of an already existing pressure roller with low costs since a functioning measurement and data transfer technique, for example a wireless data transfer technique, has already been developed. Therefore, it is possible to apply the sensor system in a slitter-winder assembly of an already existing paper manufacturing machine along with only small changes and therefore low costs.

In the printing process, the web tension profile (and thus runnability and break sensitivity) of the individual rolls is influenced by the form profile (shape) of the roll, the length profile of the web and the elasticity profile of the web, which can be measured by a sensor system according to the invention. Traditionally, the latter two factors play a major role in different kinds of analyses, even though it can be verified based on the measurements that the form profile of the roll is, with respect to the tension profile, dominating when unwinding the roll.

The measurements can even reveal a dominating effect of the roll form profile on the tension profile occurring during running of the web.

The slitter-winder assembly having the sensor system substantially functions as follows:

The pressure sensitive sensor provided on the sensing roller gives out, for example, a nip load profile for the whole width of the sensing roller and reports pressure differences along the sensing roller indicative of pressure differences along the width of a single roll or among different customer rolls. Thus, the pressure measurement indicates already before winding whether the diameter of one roll is smaller than the diameters of the other rolls, which difference can cause a deviation of the roll. Therefore, a problem such as high tension, vibrations and bouncing can be detected early in that the level of the nip load profile at the roll in question starts to increase or decrease. This means that vibration bursts are displayed in the measured profile. Therefore, information on e.g. vibration points can be gathered from the respective profiles and analyzed.

The sensor system can also give out alerts if any roll starts to deviate due to a smaller diameter, because the measurement can reveal the position of each roll in the CD-direction. The sensor system can further indicate if the strips of the web to be wound on the rolls start to overlap each other during winding.

Furthermore, it can be recognized if the measured profile is constantly oblique, e.g. all the time in the same direction. In, for example, two-drum winders, an oblique profile can indicate that the force controls of the

loading roll on the tending and drive side may be unequal. In multistation winders, the oblique profile may indicate that differences between arm A and arm B forces exist. If stations in the multistation winder run with the same nip load, the nip measurements of the stations can be compared with each other.

For example, the pressure sensitive sensor may give out signals indicative of the following information:

- detailed position of the web strips on the winding cores and the location of the paper rolls by means of the measurement profile, whereby it can be detected if the web strips are wound together or peel from the paper rolls, or even if the paper rolls fall down, for example in case of a multistation winder;
- hardness and diameter profile of each roll which can be used on a paper machine, a calender etc. for optimising profiles; and
- map of the density, hardness and form (=diameter) profile of the roll for the whole duration of winding (whereby e.g. a profile variation is visible in the measurement profile); the map can be saved in an escort memory to be delivered along with the roll to a customer.

Moreover, when the tension profile is measured before or after the slitting of the paper or cardboard web, it is possible to differentiate, inter alia, the tension profile of each roll, the average/minimum/maximum of each set of rolls, and the differences in the tension profile of the web on each roll.

The winding cores in a slitter-winder assembly in accordance with the invention are held by 6'' (= 15,24cm) chucks from the inside of the winding core. In case the winder has 6'' (= 15,24cm) adapters for the winder and the winding core does not run into chucks and running of the winding core is started, a strong peak can be measured, which can be used for controlling the winder.

Furthermore, the measurement results of the pressure sensitive sensor can be used to adjust preceding processes and to optimise the previous manufacturing process so that the tension profiles are feedback controlled. Here, the slitter-winder assembly could be automatized by means of the sensor system in combination with a computer or the like, wherein the positions of the web based on the position data of the web edge or the slitting position obtained from the measurement can be feedback controlled automatically. It is also possible to define the accurate position of the web strips on the winding cores in the CD-direction, whereby the alignment of the winding cores and the identification of the deviation of the roll surface can be ensured and a reliable prevention of the rolls being wound together can be provided.

Moreover, as it is possible to detect paper wrapping to the core and respective nip loads increasing with the sensor system of the invention, damages of a possibly used soft roller can be prevented. Furthermore, by using a slitter-winder assembly according to the invention in multistation winders, it is possible to control at rough level that the widths and the positions of paper rolls are correct. Likewise, if trims are not cut, it is possible to recognize when the trims run to the rolls, which would be displayed and seen as a widening of the

rolls. Also, as a web braking and an undesired wrapping around the paper rolls can be displayed with a slitter-winder assembly according to the invention, it is possible to give out a warning of a flying out of the web. Therefore, a braking of the web can be controlled before flying out occurs.

With the sensor system of the invention, it is further possible to measure the nip load profile online with one single sensor, whereby it would be possible to store the hardness and diameter profile of each roll along the roll width in an escort memory in order to pass it on to a customer or to feedback the same in the paper machine calender in order to improve the web profile. Thereby, it is conceivable to deliver the respective measurement data directly on the paper web wound to the roll e.g. by means of RFID-tags.

Also, with the sensor system of the invention, it is further possible to measure a winding speed. This means that then there would be two different ways to measure the speed: measurements by the sensor system and by the drive control of the winder. Thus, controlling the slitter-winder assembly can be increased significantly.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention will be explained by way of preferred embodiments using the attached drawing figures, in which:

Fig. 1 is a perspective view of a slitter-winder assembly in a paper manufacturing machine; and

Figs. 2 (a) to (d) show several possible arrangements of a pressure sensitive sensor on a sensing roller of the slitter-winder assembly.

DESCRIPTION OF EMBODIMENTS

Fig. 1 shows a slitter-winder assembly in a paper manufacturing machine in accordance with the present invention. The manufactured paper or cardboard web 1 in this embodiment is slit by two circular slitter blades 3 into three web strips and guided around one of two carrier rollers 5 to several paper rolls 4. Here, the carrier rollers 5 are used to rotatingly drive the rolls 4 such that each web strip is wound around a respective winding core 6. The winding cores 6 are held by a common winding shaft 7 during winding. Furthermore, a pressing roller 2 is positioned away from the carrier rollers 5, wherein the pressing roller 2 is held in contact with all rolls 4. Here, at least one of the pressing roller 2 and the carrier rollers 5 is a sensing roller comprising a pressure sensitive sensor. In this embodiment, the pressing roller 2 is the sensing roller comprising the pressure sensitive sensor 21, as can be seen in Fig. 2.

There are several possibilities to arrange the pressure sensitive sensor 21 on the sensing roller, as can be seen in Figs. 2(a) to 2(d). In 2(a), a spiral sensor 21 is shown, which is arranged across the entire width of the pressing roller 2. The dashed line in Fig. 2(a) shows the overlapping area of the web 1 with the pressing roller 2.

Fig. 2(b) shows an arrangement of several spiral sensors 21, which are, similar to Fig. 2(a), arranged in the overlapping area of the web 1 with the pressing roller 2 (dashed line) in a steep manner in order to obtain more

accurate CD-resolution on the edges. Fig. 2(c) and Fig. 2(d) show further possibilities of arranging the sensor 21 on the pressing roller 2.

By arranging the sensor 21 as described above on a pressing roller 2 of a winder-slitter assembly, it is possible to measure, inter alia, a tension profile of the web 1 and a nip profile of the winder nip and, thus, the form profile of the paper rolls 4.

INDUSTRIAL APPLICABILITY OF THE INVENTION

Based on the values measured by the sensing roller, the tension profile and break sensitivity of the next process device is predicted based on inverse correlation. The form profile and the tension profile of the rolls 4 are combined into two key figures:

1. deviation (e.g. standard deviation, 2-sigma etc.) which shows variation in the CD-direction of the rolls 4, and
2. skewness which shows the amount and direction of the skewness of the profile.

These figures are transferred e.g. as a "profile map" for the use of the control system in the next process.

In case it is desired to optimise the runnability of the slitter-winder assembly, the measurement point is located on the windup before the slitter-winder assembly, wherein the roll profile can also be adjusted with the adjustments of the paper machine.

Thus, the tension profile of each paper roll 4 can be adjusted based on the form profile measurement. By including the profile measurement into the system before

the winding-up, it is possible to optimise the actual implementable tension profile on the slitter-winder assembly. The profile of each roll 4 has to be adjusted in order to achieve an appropriate tension profile. In addition, length, moisture etc. profiles also have to be controlled.

Therefore, a measuring and/or adjusting system in a fibrous-web machine can be provided, in which the form profile of each roll 4 is advantageously determined by utilising the profile measurement of the winding nip during the run of a windup and/or slitter-winder assembly, based on the form profile measurement of each roll 4, the tension profile of each roll 4 of the next process device during use and/or created as the end-product is determined/predicted and/or adjusted. In case a winder of the slitter-winder assembly has 6”

Furthermore, the measurement of the winding nip between the sensing roller and the rolls 4 correlates with the thickness profile of the paper web 1 and inversely even with the tension profile of the paper web 1. From the measurement, e.g. a profile map of the whole machine reel can be obtained. Because the winders are not able to treat the paper web 1, the measurement is a quite detailed description of the profiles of the paper web 1 on each roll 4.

Therefore, it is possible to provide a feedback profile measurement for the profile adjustments of e.g. a calender provided later in the paper making process. As the web wrapping around the paper roll can be controlled by a slitter-winder assembly according to the invention, it can be recognized by means of the profile measurement if the paper web 1 wraps around anyone of the other

rollers, such as the carrier rollers 5 or the pressing roller 2, and not around the winding core 6. Also, it can be recognized by means of the measurement, if the paper web 1 in a multistation winder runs around the winding drum.

Furthermore, the roll profile directly correlates with the web profile of the whole machine reel. The roll profile of each roll 4 can be saved as a profile map in the MD- and CD-directions.

The roll profile map obtained from the winder preceding the next process such as printing is saved and brought along with each roll 4 in order to be used in the unwinding process, for example, of a printing machine. When unwinding paper on an unwinder, the profile situation of each moment is read from the roll profile map and a feedback coupling is established for the tension etc. profile adjustments of the process. The measurement includes each measurement value measured from one edge to the other edge of the CD-profile. Also the cumulative CD-profile of each roll 4 is known for the entire roll row. By means of the feedback coupling, one knows each moment the momentary CD-profile of the web strips going to the printing and the expected CD-profile for each roll 4 being unwound. The measurement data is utilised so that the profile adjustments of the printing machine are revised predicatively, because the profiles of each roll 4 being unwound are known beforehand.

It is furthermore possible to locate the sensing roller separately on the unwinder or reel of an offline calender. Then one to two separate measuring rollers are required for each calender.

The measurement results can further be used for feedforward control in the adjustments of the calender. The profile measurement of the reel performed in an earlier process stage is feedback controlled to the calender adjustments. This accelerates the profile adjustments of the calender, because already from the first metres of each roll 4, the momentary profile and the cumulative profile of the whole roll are known.

With the sensor system of the invention, it is furthermore possible to measure tissue softness or bulkiness. Here, the pressure sensitive sensor may alternatively be located inside each roll 4. The sensor measures the nip pressure and nip length (or nip impulse shape/area/nip time). Roll softness can be determined from the signals of nip pressure and nip length. For example, between fixed intervals, the dependency between the nip force and the nip length will be measured and a so called softness indicator is calculated. Thereby, in order to achieve the above effect, unreliable laser sensors or similar optical sensors are not needed, which prevents dust problems. Thereby, softness of a web is measured by a new method. Of course other quality measurements can be done with the same system, for example to measure a sheet caliper (thickness) and a sheet profile, which is impossible to measure with a scanner. The softness/bulkiness can be indicated as a "tissue quality index", which is also a quality value for the tissue product customer. Thereby, the reel-up constitutes also an online quality measurement device measuring a value that was not possible to measure with conventional methods so far.

The resolution of the CD-profile measurement implemented by the pressure sensor is defined by the width of the

active area of the pressure sensitive sensor 21 and its installation angle. The narrower the active area and the larger the angle of the installation, for example the spiral angle (i.e. slope), the better the cross-directional resolution of the measurement.

Practical issues limit improving the cross-directional resolution of the measurement implemented by individual sensors with the above-mentioned factors. The active area of the pressure sensitive sensor cannot be narrowed from the present area (4 mm) because of the limits of manufacturing technique and, additionally, the sensitivity of the sensor 21 weakens. The maximum of the spiral angle of the sensor 21 in the tension profile measurement is defined by the overlap angle of the web 1. The rotation angle of the sensor spiral has to be below the overlap angle of the web 1. Requirements have come up to provide a better resolution, even of a few centimetres, especially for the measurement of a tension profile, to observe damp streaks.

Therefore, several pressure sensitive sensors 21 can be installed in the same line in the cross-direction side by side spirally, whereby the resolution is obtained to improve in the proportion of the number of the sensors 21. The rotational angle of each spiral is just below the overlap angle of the web 1.

The sensors 21 can be installed side by side, whereby the profile is formed by combining the partial profiles measured by three spiral sensors side by side, such as can be seen in the second uppermost drawing in Fig. 2. An alternative is also the arrangement in which the profile is measured by a traditional whole-width sensor and on the edges (in the area in which better resolution is

required) are installed steep sensor spirals, whereby precise partial profiles are obtained in the area of the edges, as can be seen in the third uppermost drawing in Fig. 2.

The method is not limited to the arrangements described above but it can also be applied in other ways by installing partial-width spirals in the cross-direction of the sensing roller. The method can also be applied for other pressure sensitive sensors than EMFi-sensors. The method is applicable in measuring both the web tension profile (web and fabrics) and the nip profiles.

The slitter-winder or reel assembly having the sensor system according to the invention is furthermore in the position to recognize normal air pressure changes. In tissue paper making, it is very useful to measure web tension and small profile differences accurately from a tissue sheet. Thereby, a tissue roll nip can be measured. The sensing roller comprising the pressure sensitive sensor 21 is able to measure the whole nip line or part of it. The sensor 21 can be very short in MD-direction, so that it can measure the nip impulse time, length (MD- and CD-direction) and shape accurately. The nip length/impulse is proportional to a nip load and gives a more accurate measurement than conventional load cells. Also, in two-drum winders, a nip line position changes at the roll as the roll grows. Here, the position of the nip line can be measured with a sensor system according to the invention. Moreover, as the roll grows depending on the nip load, the width of the nip increases, which also can be displayed using the sensor system of the invention. This information can be compared to the calibrated nip load control.

Furthermore, the sensor system including the pressure sensitive sensor 21 is better than, for example, a laser sensor system. Laser is not useful in a tissue mill because of the dust problems. An EMFi-sensor as an example for the pressure sensitive sensor can be safely provided inside the roll. Thereby, the system can measure a total nip line force very accurately and a nip CD-profile, problems in linear load control, a nip length and a nip shape can be detected. The measurement can be used for linear load control and for diagnostic purposes.

It is also possible to control creping in tissue making lines with the sensing roller between a yankee cylinder and the web roll. The sensing roller measures accurate web tension differences (CD-profile and even very small MD-changes). This signal is used for controlling the creping and/or for a diagnostic system to find out problems in creping.

Another possibility is to use the sensing roller according to the invention for controlling the dust blow-boxes and sheet stabilizers. The EMFi-sensor can be configured to measure very small pressure changes near blow-boxes (web tension or air pressure) and to control the stabilizers so that the web is stable.

Claims

1. Slitter-winder assembly having a sensor system, comprising

a slitter (3) for slitting a web material (1) into a plurality of web strips;

a plurality of rollers (2, 5) including carrier rollers (5) for winding a plurality of individual rolls (4) of web strips on winding cores (6); and

a detection means for detecting winding nip pressure profiles and/or web tension profiles of the individual rolls to be wound,

wherein at least one of said plurality of rollers (2, 5) is a sensing roller (2, 5) having a pressure sensitive sensor (21) arranged thereon, which extends in a machine cross direction (CD).

2. Slitter-winder assembly according to claim 1, wherein said plurality of rollers (2, 5) includes a pressing roller (2) for pressing said web strips onto said plurality of rolls (4).

3. Slitter-winder assembly according to claim 1 or claim 2, wherein said plurality of rollers (2, 5) includes a guiding roller (2) for guiding said web strips.

4. Slitter-winder assembly according to any one of the preceding claims, further comprising a control means for preventing said web strips from being wound on said rolls (4) in an overlapping manner.

5. Slitter-winder assembly according to any one of the preceding claims, further comprising a storing means for storing said profiles.

6. Slitter-winder assembly according to claim 5, wherein said storing means is provided for every individual roll (4) in order to be delivered together with said roll (4).

7. Slitter-winder assembly according to claim 5, wherein said storing means prints said profiles onto every individual roll (4).

8. Slitter-winder assembly according to any one of the preceding claims, wherein said at least one pressure sensitive sensor (21) consists of a single sensor which extends over the entire width of said sensing roller (2, 5).

9. Slitter-winder assembly according to any one of the preceding claims, wherein said at least one pressure sensitive sensor (21) consists of a plurality of stripe shaped sensors arranged across the entire width of said sensing roller (2, 5).

10. Slitter-winder assembly according to claims 1 to 8, wherein said at least one pressure sensitive sensor (21) comprises an array of several sensors which are arranged next to each other along the entire width of said sensing roller (2, 5).

11. Slitter-winder assembly according to any one of the preceding claims, wherein said at least one pressure sensitive sensor (21) is arranged in a spiral shape along said sensing roller (2, 5).

12. Slitter-winder assembly according to any one of the preceding claims, wherein said at least one pressure sensitive sensor (21) is arranged on a surface of said sensing roller (2, 5).

13. Slitter-winder assembly according to any one of the preceding claims, wherein said at least one pressure sensitive sensor (21) is an EMFi-sensor.

14. Slitter-winder assembly according to any one of the preceding claims, wherein said web material (1) is a fibrous web material.

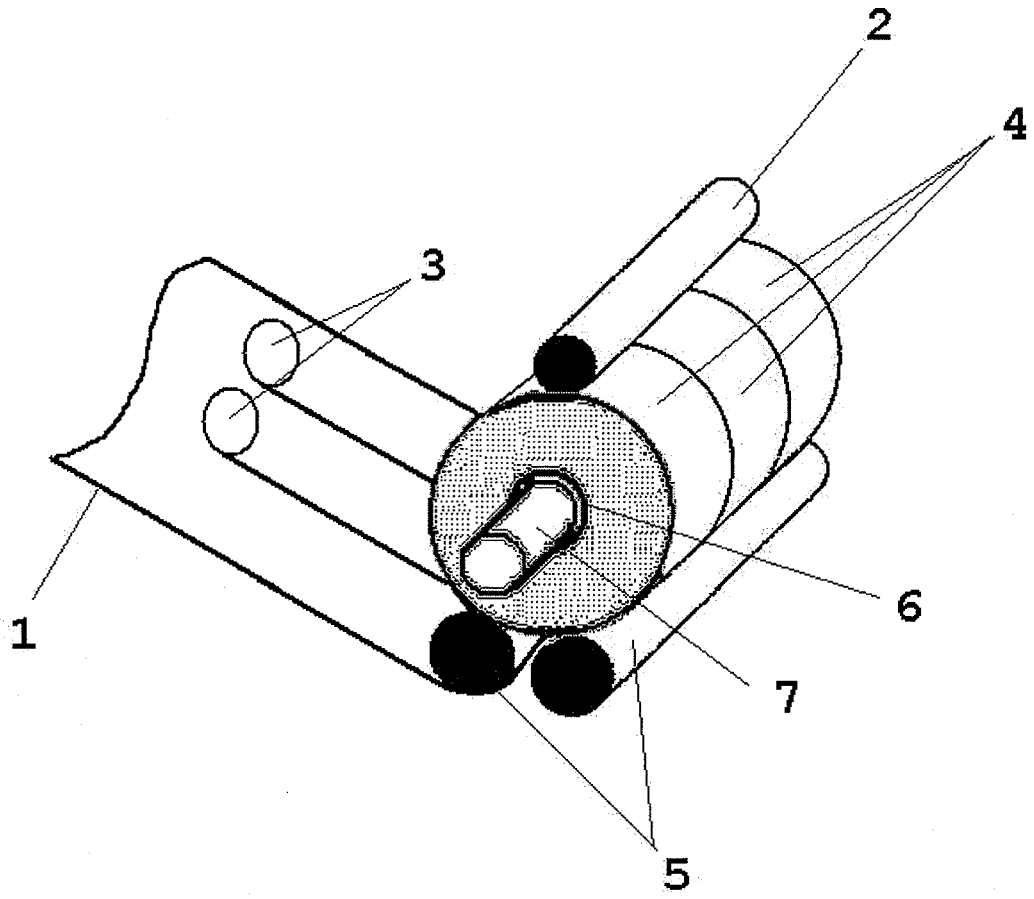

Fig. 1

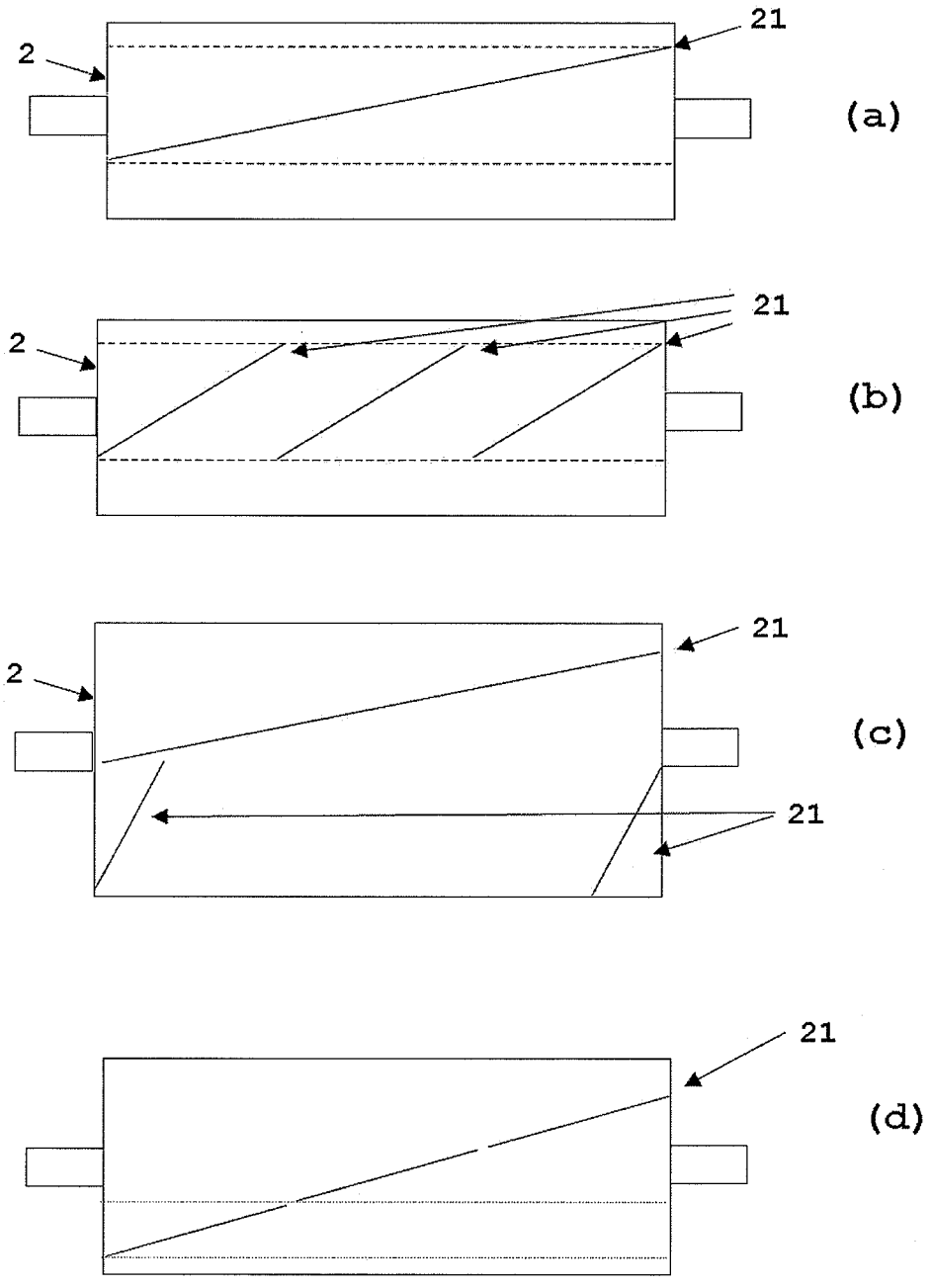

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/051718

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01L5/00

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)
G01L

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 2006/075055 A (METSO PAPER INC [FI]; INNALA MATTI [FI]; KINNUNEN JORMA [FI]; KOSKELAI) 20 July 2006 (2006-07-20) cited in the application abstract page 1, line 3 - page 4, line 19 claims 1-18 figures 1-5	1-14
X	EP 1 369 186 A (BWG BERGWERK WALZWERK [DE]) 10 December 2003 (2003-12-10) paragraph [0001] - paragraph [0028] claims 1-15 figures 1-1-12	1-14

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

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2009	28/04/2009

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/051718

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