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(54) **A method in a reel-up and a reel-up**

(57) A method in a reeler and a reeler, wherein a reeling nip (N1) is formed by a reeling core (5) or a growing machine reel (R) and at least one loop of an endless supporting member (1), which is substantially continuous

in the axial direction of the reeling core (5). In the method the tension profile of the endless supporting member (1) is determined from the measured variables proportional to the tension of the endless supporting member (1).

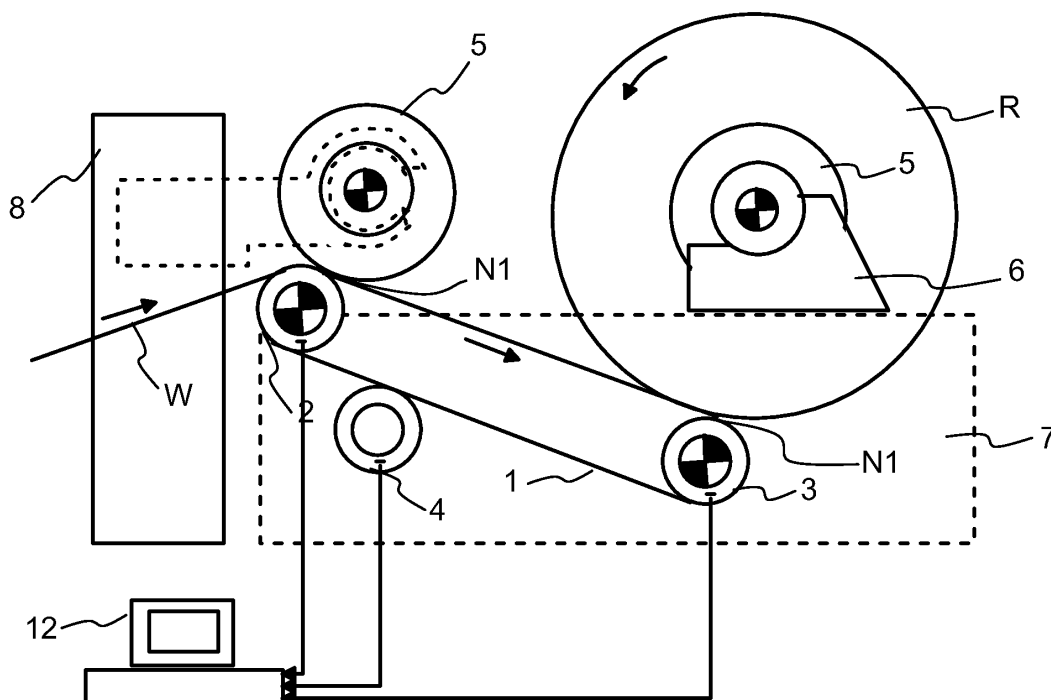


Fig. 1

Description

Field of the invention

[0001] The invention relates to a method in a reeler, wherein the reeling nip is formed by a reeling core or a growing machine reel and at least one loop of an endless supporting member that is substantially continuous in the axial direction of the reeling core. The invention also relates to a reeler for implementing the aforementioned method.

Background of the invention

[0002] In the final end of a machine manufacturing paper, paperboard, soft tissue or the like or a finishing apparatus for paper, paperboard or soft tissue or the like, a paper web which is typically several meters wide and which has been produced and/or treated in the preceding machine sections, is reeled around a reeling shaft, i.e. a reel spool to form a machine reel. In this reeling up process a reeling cylinder that is bearing-mounted rotatable is typically used for guiding the paper web on the machine reel, wherein the nip contact between the reeling cylinder and the machine reel is utilized to influence the quality of the reel produced thereby. The ends of the reel spool are affected by means of a suitable loading mechanism to adjust the nip contact between the machine reel that is being formed and the reeling cylinder. Such reeling concepts and loading methods related thereto are disclosed, for example, in the Finnish patent 91383 and in the corresponding US patent 5,251,835, as well as in the Finnish patent application 950274 and in the corresponding US patent 5,690,298.

[0003] The measurement of the cross-directional profile of such a reeler is disclosed for example in the US patent 5,048,353 in which one or several sensors operating on piezoelectric principle have been installed on the surface layer of the reeling cylinder, said sensors reacting to the pressure prevailing in the nip. The sensors have been installed spirally around the length of the reeling cylinder so that they measure the cross-directional profile of the pressure prevailing in the reeling nip.

[0004] In addition, the publication EP-860391 discloses a reeler, in which the web is guided on a reel via a supporting member formed of several endless belts or wires arranged next to each other in the longitudinal direction of the guide roll, said supporting member being passed via the guide rolls. Thus, by means of the belt loops it is possible to attain a long reeling nip having an even pressure in the area of the lower half of the reel. The aim is to control the pressure through the tension of individual belt loops. According to the publication, it is possible to profile the nip pressure on the basis of the measured tension of individual belt loops. It is a problem in this solution that because the supporting member is composed of several belt loops arranged next to each other in the longitudinal direction of the guide roll, it is

difficult to monitor the condition of the belts, and maintain and repair them. Furthermore, it is difficult to control the rotation speed of separate belt loops, and it requires separate controlling means. It is also difficult to hold the belts moving in the machine direction in their correct locations in the longitudinal direction of the guide rolls so that they do not drift on top of each other. In addition, each belt loop requires separate belt tensioning means for controlling the pressure of the reeling nip, which means cause a lack of space in the surroundings of the reeler.

[0005] WO publication 98/55384 discloses a reeler in which the reeling nip is formed by means of a loop of a supporting member and a reel spool. The total tension of the belt is controlled by means of load cells attached to a guide roll guiding the belt. The total tension of the belt thus attained is also used for controlling the nip pressure of the reeling nip.

[0006] Further, from a Finnish patent publication 20010621 it is known to measure the cross-directional (i.e. CD-directional) tension profile of the texture conveying the paper web, i.e. the wire or the felt. This profile data has been used for the process control taking place on the range of influence of the texture.

[0007] Both when using a conventional reeler based on a reeling cylinder and a belt reeler utilizing a supporting member according to the above-mentioned EP publication 860391 and WO publication 98/55384 there is a basic problem in the reeling process: it is difficult to get an even cross-directional profile in the machine reel that is being produced. Consequently, the irregularities produced in the reeling, such as creases caused by the slackness of the belt, and local dents caused by excessive tension of the web, transfer to the customer rolls. In the above-mentioned publications attempts have been made to solve this problem by means of controlling the cross-directional linear pressure of the reeling nip. This is, however, difficult, because the controlling requires exact measuring results. The measurement of the total tension of the belt used in the reeling as presented in the above-mentioned publications is not an accurate enough variable for accurate controlling.

Brief description of the invention

[0008] The purpose of the present invention is thus to provide a method in a reeler, by means of which the above-mentioned problems can be avoided and the tension profile of a belt reeler or the cross-directional linear load profile of the reeling nip can be accurately and reliably determined, in which belt reeler, i.e. a reel up, the reeling nip is formed by means of a flexible supporting member, such as belt or a wire, in the form of an endless loop that is continuous in the axial direction of the reeling core. Variables proportional to the tension of a supporting member are measured and from the tension profile determined from them it is possible to calculatively determine the cross-directional linear load profile (i.e. CD-profile) of the reeling nip, or other parameters connected to

the operation of the supporting member. If the target of the measurement is the cross-directional linear load profile of the reeling nip, the above-mentioned parameters can be determined directly from that. It is also an aim of the invention to provide a reeler implementing the aforementioned method.

[0009] The method in a reeler according to the invention is **characterized in that** the tension profile of the endless supporting member is determined from the measured variables proportional to the tension of the endless supporting member.

[0010] The reeler according to the invention is, in turn, **characterized in that** the reeler comprises means for determining the tension profile of the endless supporting member from the measured variables proportional to the tension of the supporting member.

[0011] The other, dependent claims present some preferred embodiments of the invention.

[0012] In this description and in the claims the term endless supporting member refers to a flexible belt or wire in the form of an endless loop that is substantially continuous in the axial direction of the reeling core, the width of which belt or wire is substantially equal to the width of the web to be reeled, and which travels in the machine direction by the effect of the rotating movement of the guide rolls. The belt reeler, in turn, refers to a reeler in which the reeling nip is formed by means of the above-presented supporting member and a growing machine reel. The reeling core refers to a core or a reel spool, around which the web of paper, paperboard, tissue or the like is reeled.

[0013] The variables proportional to the tension of the endless supporting member that is substantially continuous in the longitudinal direction of the reeling core, or the cross-directional linear load profile of the reeling nip are measured with at least one measuring sensor placed in at least one guide roll controlling the supporting member or in the supporting member itself. Of the measured variables proportional to the tension of the supporting member is determined the cross-directional tension profile of the supporting member. The measuring sensor is, for example, a sensor operating on piezoelectric principle, for example an EMFi film, which changes the pressure or force directed to it into an electric output signal. Other sensors operating on piezoelectric principle, such as, for example, PVDF film and separate piezocrystal sensors, can also be used in the measuring. It is also possible to use other capacitive, resistive and inductive sensors suitable to be attached on the surface of the roll or on the supporting member, as well as other sensors measuring pressure or force in order to measure tension. For example, strain gauges can be attached on the surface of the roll or the supporting member suitably spaced to measure the tension of the supporting member, of which measurement it is possible to form a tension profile. Suitable sensors are typically of such a type that they are capable of changing the pressure or load exerted thereto into a signal that can be conducted via a suitable con-

ductor or wirelessly to a data processing unit, in which it can be processed in a manner known from processing of measurement signals.

[0014] When the above-mentioned sensors are attached to the guide roll, they measure the load or pressure directed by the supporting member to the surface of the guide roll, in which case a greater pressure/force is directed to the sensor at the tight zones of the belt than at the slack zones, in which case a cross-directional tension profile of the supporting member, i.e. a CD-profile is created. Thus, in the calculation of the tension profile of the supporting member it is possible to utilize either the pressure/load measured in the direction of radius, perimeter or axis of the guide roll, or both, depending on the measuring method.

[0015] When sensors attached to the guide roll are used in the measuring, they are arranged to the roll either to circle the roll in a spiral-like manner over its entire length or to extend over the length of the roll directly in its axial direction. The film-like sensors can be placed to the roll as a narrow band or as separate sequential strips. The sensors can be arranged either on the surface of the roll, on top of the roll coating or under the coating layer/layers in such a manner, however, that the coating over the sensor does not cause significant deterioration of the measuring accuracy.

[0016] The measuring results provided by the sensors attached to the roll are transferred advantageously wirelessly from the roll, for example, by means of a slide ring or a transfer method based on telemetry.

[0017] As stated above, the sensors attached to the supporting member may also be point-like sensors, narrow, band-like sensors or separate strips positioned successively. The sensors are arranged to the supporting member in such a manner that they extend substantially over its width. The measuring sensors can be arranged so that they replace the wire threads or they can be arranged between the wire threads. The essential aspect is that they do not leave marks on the web to be reeled. The supporting member can also be formed entirely of several overlapping layers, at least one of which operates as the sensor performing the measurements.

[0018] The measuring sensors arranged to the supporting member measure the variables needed for determining the tension profile of the supporting member in the reeling nip, i.e. when the part of the supporting member comprising the measuring sensors and the reel spool or the machine reel that is being formed are in contact with each other. The cross-directional linear load profile of the reeling nip is attained directly from these measurements, and a calculatory conversion tension profile -> cross-directional profile of the linear load is not necessary.

[0019] The measurement results from the measuring sensors attached to the supporting member can be transferred out of the sensor in a number of different ways, for example by means of slide wires positioned on the surface of the supporting member and brushes attached

to one guide roll, wherein the measurement information can be transferred outside through the guide roll. The measurement information can be transferred out of the supporting member in a wireless manner as well, for example by means of a transmitter positioned in the supporting member, and the signal transmitted by said transmitter is received in a receiver positioned in the vicinity of the supporting member. Inside the loop of the supporting member it is also possible to place a beam-like data transmission means perpendicularly to the width of the supporting member and transmitting information in a contactless or contact-oriented manner.

[0020] From the tension profile of the endless supporting member determined from the measurements of the supporting member, it is possible to determine the cross-directional linear load profile of the reeling nip of the belt reeler, by means of which it is possible to determine the structure of the growing machine reel. In addition, it is possible to determine other parameters of the machine reel, such as the diameter profile of the machine reel forming in the reeling. In addition, the tension profile of the supporting member can be utilized in monitoring the condition of the supporting member, in monitoring the position of the supporting member and in determining the average tension of the supporting member. If the measured variable is the cross-directional linear load profile of the reeling nip, the above-mentioned parameters can be determined directly from the measurement results.

[0021] In the belt reeler the endless supporting member travels in the machine direction of the paper machine guided by at least two guide rolls. In the measurement of variables proportional to the tension of the supporting member using guide rolls according to the invention it is substantial, that at least one guide roll used in the measurement is after the reeling nip in the machine direction. It has surprisingly been noted that the form of the surface of the growing machine reel, i.e. the bumps and dents in the reel and therefore also the cross-directional linear load profile of the reeling nip in the longitudinal direction of the machine reel (in the CD-direction) is copied in the reeling nip to the endless supporting member that is in contact with the machine reel, and therefore it shows in the tension measurement results of the supporting member measured after the reeling nip and the tension profile formed from them.

[0022] The determination of the tension profile of the supporting member can also take place by placing the above-mentioned measuring sensors to two guide rolls in such a manner that one of the rolls is located before the reeling nip and the other one after it, in which case the measuring values proportional to the tension provided by the rolls and the tension profiles formed of them can be compared and the tension profile of the supporting member can be determined on the basis of their difference. If the tension profile is used in determining the cross-directional linear load profile of the reeling nip, it is advantageous to use the tension profile formed of at least

one of the measuring results attained from the roll comprising a measuring sensor, which roll directs the supporting member and is within the loop of the supporting member. Another tension profile used in the determination is formed on the basis of other measurements received from the guide roll that is in contact with the belt. The tension profile of the supporting member and the cross-directional linear load profile of the reeling nip can be determined from the difference between the thus formed tension profiles.

[0023] It is also possible to use a method where the cross-directional tension profile of the supporting member is determined on the basis of the measuring results of measuring sensors placed in at least one guide roll directing the supporting member, and so that the reeling nip is closed, i.e. the forming machine reel is in contact with the supporting member as well as without the machine reel contacting the supporting member. By comparing the formed cross-directional tension profile of the supporting member loaded with a machine reel to such a tension profile that is formed of an unloaded supporting member, it is possible to determine the form profile of the surface of the machine roll, i.e. the structure of the roll from these. Naturally, the cross-directional linear load profile of the reeling nip is also provided by the same difference.

[0024] According to the invention, the tension profile of the supporting member determined from the variables proportional to the tension of the supporting member or the measured cross-directional linear load profile of the reeling nip can also be utilized in monitoring the condition of the supporting member. Local wearing of the texture of the supporting member causes a change in the tension profile or the cross-directional linear load profile of the reeling nip, which can be recognised from the profile and thus information on the condition of the supporting member can be received. In this manner, it is possible to monitor the condition of the supporting member and to anticipate, for example, the need for changing the supporting member, i.e. the belt or the wire, before the worn or damaged supporting member has time to cause damages to the reeled web or other damages. Further, the tension profile of the supporting member determined from the variables proportional to the tension of the supporting member or the measured cross-directional linear load profile of the reeling nip according to the invention can also be applied in the belt reeler in monitoring the position of the supporting member in the longitudinal direction of the roll directing the supporting member and through that in adjusting the controller of the supporting member as well. The method of the patent publication FI-20012528 that is known as such can be applied here.

[0025] The measurement of variables proportional to the tension of the supporting member according to the invention and the determination of the tension profile of the supporting member is simple and fast. The sensors used in the measurement do not take space in the vicinity of the reeler and they can be easily placed to the guide

rolls in contact with the supporting member, and they do not cause wearing of the supporting member. When the sensors have been placed to the supporting member, it is possible to measure the cross-directional linear load profile of the reeling nip between the reel and the supporting member directly without measuring the variables proportional to belt tension. Thus, a calculatory conversion from the tension profile of the supporting member to the cross-directional linear load profile is not needed either. If the determination of the linear load profile of the reeling nip is performed calculatorily from the measurement results attained from the sensors, it does not require separate devices taking room at the reeler. The invention utilizes in a new and excellent manner the methods known as such for measuring the variables proportional to the tension of the texture of a paper machine and for determining the tension profile, or for measuring the cross-directional linear load profile of the reeling nip, and introduces new way to monitor the parameters connected to the operation of the supporting member, such as the condition of the supporting member and its position on the guide rolls.

Brief description of the drawings

[0026] In the following, the invention will be described in more detail with reference to the appended drawings, in which

- Fig. 1 illustrates schematically the main principle of a belt reeler in a side view,
- Fig. 2 shows schematically a guide roll used in the method according to the invention, in which guide roll is arranged a measuring sensor,
- Fig. 3 shows schematically another guide roll used in the method according to the invention, in which guide roll is arranged a measuring sensor,
- Fig. 4 shows a measurement arrangement according to the invention in a perspective view,
- Fig. 5 shows schematically a supporting member used in the method according to the invention in a top view from the side,
- Fig. 6 shows schematically another supporting member used in the method according to the invention in a top view from the side,
- Fig. 7 shows a cross-section of a supporting member used in the method according to the invention,
- Fig. 8 shows schematically the cross-directional tension profiles of the supporting member,

Fig. 9 shows schematically the cross-directional tension profiles of the supporting member used in connection with monitoring the condition of the supporting member, and

Fig. 10 shows schematically the cross-directional tension profiles of the supporting member used in connection with determining the location of the supporting member.

Detailed description of the invention

[0027] Fig. 1 illustrates a continuously operating reeler, 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 reeler is a so-called belt reeler 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 supporting member 1 is guided via two guide 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 guide 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 with the reel at a point where the member travels supported by the guide roll 2 on the surface of the roll. The second guide 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 reeling core, i.e. a reel spool 5 rotatable with a center drive of its own. It is possible for the reel spool 5 to move in the machine direction with respect to the loop of the supporting member 1, 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. In connection with the reeler, 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 guide 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.

[0028] In addition to the guide rolls 2 and 3, the endless belt loop 1 is also in contact with a guide roll 4, which can be provided with a drive or which can be driveless, and which guides the supporting member 1 from below the loop of the supporting member. Measuring means 9 measuring variables proportional to the tension of the supporting member are placed to at least one guide roll 2, 3 and/or 4. The measuring sensor 9 is, for example, a known sensor operating on piezoelectric principle, for example an EMFi film or PVDF film, which are capable of

changing a mechanical input variable, such as pressure or load into an electric output variable that can be processed by means of measurement technology. These membrane-like sensors are placed in a narrow, spiral-like band to circle the roll over its entire length, in which case it is ensured that measurement results are received from the entire length of the roll. The positioning of the band-like sensor 9 in the guide roll is shown in Fig. 2, in which the roll presented therein is marked with the reference numeral 2, but said roll can be any guide roll or traction roll guiding the supporting member.

[0029] In the placement of the sensor 9 the gradient of the rotation angle of the roll of the spiral is selected as suitable, for example according to the overlap angle of the belt loop, i.e. the supporting member 1. If necessary, for example in order to specify the measurement or in case an individual sensor is broken, several sensor spirals can be installed side by side over the length of the roll. An advantage of the in a spiral-like manner placed, band-like measuring sensors is that only one measuring channel per spiral is needed for transferring the measurement data out of the roll, which may take place wirelessly, for example by means of a telemetry transmitter 10 placed in the roll. The measurement data signal is received with a receiver 11. The receiver in itself can also comprise a data processing unit, where the measurement signals are processed and the tension profile is determined and the desired parameters are determined from it or the measurement signal can be transferred from the receiver 11 to the data processing unit 12 for processing. The EMFi film or the PVDF film can be placed in the roll also by placing individual film strips sequentially in a spiral-like manner to circle the roll over its entire length. The strip-like measuring sensors can also be positioned in the guide roll sequentially in the axial direction of the roll, as shown in Fig. 3. Thus, each sensor strip produces a measurement signal that represents the pressure exerted on the sensor element at the location of said strip, and by combining the measurements the tension profile of the supporting member is produced. The strip-like sensors each require a separate measurement channel. The guide roll used in the measuring can be any of the guide rolls of Fig. 1. It can therefore also be a drive roll, where the measuring sensors 9 are placed. It is most advantageous to use the guide roll located after the reeling nip N1, i.e. roll 3, because, for example, local bumps in the machine reel are copied to the tension profile of the belt in the reeling nip and thus appear easily in the tension profile of the supporting member.

[0030] Determining the cross-directional linear load profile of the reeling nip N1 takes place in the data processing unit 12 marked in Fig. 1 from the cross-directional tension profile of the supporting member 1 formed on the basis of the measurements from the guide roll in a calculatory manner by using transfer functions or, in the simplest way, by means of scaling factors.

[0031] Fig. 1 also shows a new reel spool 5, which is still in a primary reeling device 8, where it is accelerated

to web speed by using the primary reeling device and brought in contact with a guide roll 2, in which case a so-called hard nip has been formed. At this stage the variables proportional to the tension of the supporting member, and thus also the linear load profile of the reeling nip can be attained directly from the measuring sensor 9 attached to the roll 2. When the reeling progresses and the diameter of the machine reel R grows, the machine reel R is transferred to the transfer devices 6 and transferred forward in the machine direction along the supporting member 1. When the machine reel R has with the growth of the reel transferred away from nip contact with the guide roll 2, the measurement of variables is performed at the guide roll 2 or 3 closest to the machine reel R, which roll is equipped with a measuring sensor, most advantageously at the guide roll 3 that is after the reeling nip N1 in the machine direction.

[0032] Fig. 4 shows a supporting member 1, whose both guide rolls 2 and 3 are equipped with measuring means 9 and at least roll 3 is a drive roll. Both rolls 2 and 3 are placed inside the loop of the supporting member 1. The machine reel R being formed is in nip contact with the supporting member 1, thus forming a reeling nip N1. One change in the tension profile of the reeling nip N1, which has transferred to the supporting member in the reeling nip N1, has been illustrated with a wave form 12. Therefore, measured variables proportional to the tension are attained from both guide rolls 2 and 3, of which variables are determined tension profiles, whose difference can be used to determine the tension profile, and further from that, the cross-directional linear load profile of the reeling nip N1. Since the guide roll 2 is located before the reeling nip N1 in relation to the direction of movement of the supporting member according to the travel direction of the web, the measurement results from it and the tension profile formed from them are used as a reference profile, in which case the actual tension profile in the reeling nip is determined from the variables measured after the reeling nip and the difference of the tension profile and reference profile determined from them. In determining the cross-directional linear load profile of the reeling nip, it is also possible to use the measurement results from the guide roll 2 together with the measurement result from the guide roll 4 (not shown) placed advantageously below the supporting member 1.

[0033] Fig. 5 shows a possibility for measuring variables proportional to the tension of the supporting member, wherein the measuring sensor 9 is arranged to the supporting member 1. When the measuring sensors are arranged to the supporting member, they measure variables proportional to the tension of the supporting member in the reeling nip N1, i.e. when the measuring sensors 9 arranged to the supporting member 1 and the reel spool 5 or the machine reel R that is being formed are in contact with each other. The determination of the tension profile from the measurement results takes place in the data processing unit, as presented above. It is possible to obtain the cross-directional linear load profile of the reeling

nip directly from these measurements. When point-like sensors 9 are used in the measurement, they are arranged in a row within suitable intervals from each other, diagonally across the width of the supporting member 1, as shown in the figure. When a film-like narrow band sensor 9 is used, it is also positioned directly in a diagonal position across the width of the supporting member. This alternative is shown in Fig. 5 as well. The straight line formed both by the point-like and band-like sensors forms an angle α with the edge of the supporting member 1. The width of the angle is selected in accordance with the desired measurement resolution.

[0034] It is possible to provide the supporting member 1 with measuring sensors by positioning successive strip-like measuring sensors 9 perpendicularly across the width of the supporting member 1, as shown in Fig. 6. Fig. 6 also shows the positioning of measuring sensors 9 composed of strain gauges, which is conducted by positioning them successively, within a fixed distance from each other, and as shown in the preceding alternative, perpendicularly across the width of the supporting member 1. Strain gauges are able to separate a tension state in at least two different directions T_1 and T_2 , which are illustrated with arrows in Fig. 6.

[0035] The supporting member 1 can also be formed entirely so that it can measure variables proportional to the tension of the supporting member and/or the cross-directional linear load profile of the reeling nip N1. The supporting member can, for example, be formed of several overlapping layers, at least one of which operates as the sensor performing the measurements. Fig. 7 shows a cross-section of a supporting member 7 formed in layers, which supporting member comprises surface layers 13, between which there is a sensor layer 14 operating as a sensor. The sensor layer 14 can be, for example, an EMFi film, which is placed between protective layers. The sensor layer can naturally be placed elsewhere than between the layers as well.

[0036] It is also possible to determine the tension profile of the supporting member and further the cross-directional linear load profile of the reeling nip N1 by measuring variables proportional to the tension of the supporting member 1, which is loaded with a machine reel growing during continuous reeling, from one guide roll 2, 3, or 4 and by deducting from it the tension profile determined from the variables measured from the supporting member 1 alone. The measurement of variables of the supporting member 1 alone takes place with the same guide roll as the measurement of the loaded supporting member, but without the load of the growing machine reel, i.e. when the reeling process has for some reason been stopped. During the measurement it is, however, substantial that the supporting member moves conveyed by the guide rolls. Fig. 8, which shows determined cross-sectional tension profiles of the supporting member, illustrates this method. In Fig. 8 curve A shows the cross-sectional tension profile of the supporting member 1 loaded with a growing machine reel R, which profile is deter-

mined with some variable proportional to the tension or the supporting member, measured with a guide roll 2, 3 or 4. Curve B shows the tension profile of an unloaded supporting member 1 determined from the measurements of the same guide roll, and curve C shows the final tension profile of the growing machine reel R determined from the difference of curves A and B, i.e. the form profile of the surface. The measurement of the unloaded supporting member 1 can also be performed by loading the supporting member 1 with an empty reel spool 5. Since the reel spool is empty, the effect of the paper web W being reeled does not show in the tension profile B. The measurement can also be performed by using more than one guide rolls equipped with a measuring sensor, in which case the determination of the tension profile taking place on the basis of the measurements is more reliable.

[0037] The cross-directional measurement results of the tension profile of the supporting member or the cross-directional linear load profile of the reeling nip determined in connection with the invention can also be utilized in monitoring the supporting member. This possibility provides and great advantage, because the purchase and assembly expenses of separate systems are thus avoided and space is saved, because there is no need to assemble separate apparatuses for monitoring the supporting member. The measurement results can, for example, be utilized in monitoring the condition of the supporting member 1, which is illustrated in Fig. 9. For example, the wear of the supporting member, changes in the porosity or thickness, blockages in the openings between the wire threads forming the supporting member, and the wire threads breaking cause changes in the tension profile or in the cross-directional linear load profile of the reeling nip, where they can be detected. Any of the measurement results of the variables proportional to the tension of the guide roll 2, 3 or 4, which is in contact with the supporting member 1 and to which is placed a measuring sensors over its entire length, and the tension profile of the supporting member attained from that, or the cross-directional linear load profile measured by measuring sensor attached to the supporting member in the reeling nip can be used in monitoring the condition of the supporting member. The measurement of the variables proportional to the tension of the supporting member performed with the guide rolls for monitoring the condition of the supporting member are performed when the reeling nip N1 is open, i.e. when the reel spool 5 or the growing machine reel R are not in contact with the supporting member 1. In Fig. 9, curve D represents a tension profile formed of a supporting member 9 in a good condition on the basis of measurements or a cross-directional linear load profile of the reeling nip and curve E represents the tension/nip pressure profile curve of a supporting member that is worn or has experienced changes, wherein a change in the tension/nip pressure profile, which is marked in the figure with an arrow, can be detected. In identifying a change, it is possible to apply, for example, a neural network, which learns to identify the effect of the wear or

failure of the supporting member. Processing the measuring results and determining the condition monitoring parameters of the supporting member takes place in the data processing unit.

[0038] One possibility to utilize the measurement results of the tension profile of the supporting member determined in connection with the invention or the cross-directional linear load profile of the reeling nip is to monitor the location of the edges of the supporting member. The measurement results of the variables proportional to the tension of any guide roll 2, 3 or 4, which is in contact with the supporting member 1 and in which is placed a measuring sensor over the entire length of the roll, can be used in a manner known as such from the patent publication FI-20012528 for monitoring the position of the edge of the supporting member in the longitudinal direction of the guide roll. The measurement can be performed when the reeling nip N1 is either open or closed. The cross-directional linear load profile measured with measuring sensors attached to the supporting member in the reeling nip can be used for this purpose. In Fig. 10, curve F shows the CD-profile of the machine-directional tension determined from the supporting member 1 on the basis of the measurements. The dashed lines G and G' illustrate the location of the edges of the supporting member 1. If the supporting member travels over the allowed edge limits, it is easily and quickly detected from the profile and correction procedures can be performed. The location of the edges of the supporting member is also possible to monitor by assembling separate, short sensor spirals at both ends of the guide roll, which monitor the location of the edges of the supporting member both at their own end of the roll, but do not extend from one end of the guide roll to the other. It is also possible to place to the same guide roll both a sensor spiral extending over the entire length of the guide roll and short sensor rolls placed in the ends, in which case it is possible to determine the tension profile data and the location data of its edges from the measurements attained from the same guide roll.

[0039] 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. The supporting member 1 can, for example, be supported by more guide rolls than what is presented above in the description. Further, measuring sensors can be placed to all guide rolls or a part of the rolls can be without a measuring sensor, in which case they operate only as rolls guiding the belt loop. The invention can be applied in reelers of machines manufacturing paper, paperboard, tissue or a similar web-like product and in finishing devices connected to them.

Claims

1. A method in a reeler, wherein a reeling nip (N1) is

formed by a reeling core (5) or a growing machine reel (R) and at least one loop of an endless supporting member (1), that is substantially continuous in the axial direction of the reeling core (5), and in which method variables proportional to the tension of the endless supporting member (1) are measured, **characterized in that** the tension profile of the endless supporting member (1) is determined from the measured variables proportional to the tension of the endless supporting member (1).

2. The method according to claim 1, **characterized in that** the variables proportional to the tension of the endless supporting member (1) are measured with at least one guide roll (2, 3, 4) that is in contact with the supporting member (1), which guide roll operates as the guide roll of the loop of the endless supporting member (1) and is equipped with measuring means (9).
3. The method according to any claim 2, **characterized in that** the variables proportional to the tension of the endless supporting member (1) are measured with two guide rolls, one of which rolls (2) is located before the reeling nip (R) and the other roll (3) is located after the reeling nip (R), from which variables measured by the rolls (2,3) are separately determined the tension profiles of the endless supporting member and that from the difference of these determined tension profiles is determined an actual tension profile, from which is determined the cross-directional linear load profile of the reeling nip (N1).
4. The method according to any claim 3, **characterized in that** the tension profile of the supporting member (1) determined from the variables attained from the roll (2) located before the reeling nip (N1) are used as reference profile.
5. The method according to any claim 2, **characterized in that** the variables proportional to the tension of the endless supporting member (1) are measured without the loading of a growing machine reel (R) and loaded with a growing machine reel (R), and from the difference of the tension profiles determined from these measured variables is determined the final tension profile, from which is determined the cross-directional linear load profile prevailing in the reeling nip (N1).
6. The method according to claim 1, **characterized in that** the variables proportional to the tension of the endless supporting member (1) are measured and the cross-directional linear load profile of the reeling nip (N1) is determined.
7. The method according to claim 1, **characterized in that** the variables proportional to the tension of the

endless supporting member (1) are measured continuously, from which measurements is repeatedly determined the tension profile of the endless supporting member (1) and by means of that, one of the following is monitored: the condition of the supporting member (1) and the position of the supporting member (1) in the longitudinal direction of the guide roll (2, 3, 4).

8. The method according to claim 1, **characterized in that** from the determined tension profile of the endless supporting member (1) is determined one of the following: the average tension of the endless supporting member (1) and the diameter profile of the growing machine roll (R) forming in the reeling. 10 15
9. A reeler, wherein a reeling nip (N1) is formed by a reeling core (5) or a growing machine reel (R) and at least one loop of an endless supporting member (1) that is substantially continuous in the axial direction of the reeling core (5), and which the reeler comprises measuring means (9) for measuring variables proportional to the tension of the endless supporting member (1), **characterized in that** the reeler comprises means (12) for determining the tension profile of the endless supporting member (1) from the measured variables proportional to the tension of the supporting member (1). 20 25
10. The reeler according to claim 9, **characterized in that** the measuring means (9) are arranged to at least one guide roll (2, 3, 4) that is in contact with the supporting member (1), which guide roll operates as the guide roll of the loop of the endless supporting member (1). 30 35
11. The reeler according to claim 10, **characterized in that** the measuring means (9) are arranged to at least two guide rolls (2, 3, 4) that are in contact with the supporting member (1), which both rolls measure the tension profile of the endless supporting member (1). 40
12. The reeler according to any claim 10, **characterized in that** at least one guide roll (3, 4) used in the measurement is located after the reeling nip (N1) in the machine direction. 45
13. The reeler according to claim 10, **characterized in that** at least one guide roll (2, 3, 4) used in the measurement is a drive roll. 50
14. The reeler according to claim 10, **characterized in that** at least one guide roll (2, 3, 4) used in the measurement is a guide roll (2, 3) directing the supporting member (1) that is placed inside the loop of the supporting member (1). 55

15. The reeler according to claim 9, **characterized in that** the measuring means (9) are arranged to the supporting member (1).

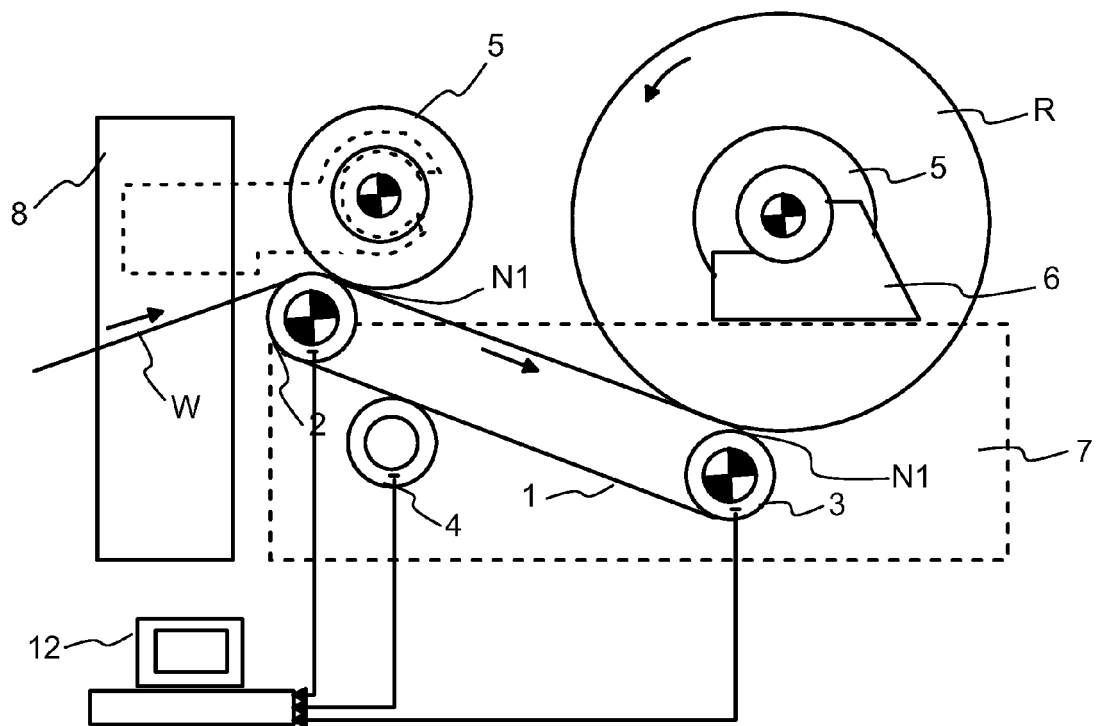


Fig. 1

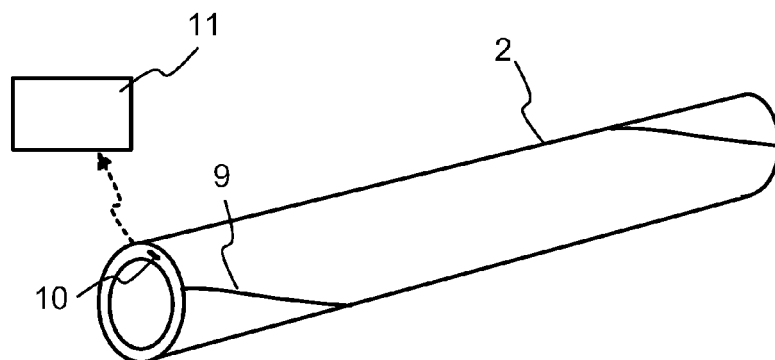


Fig. 2

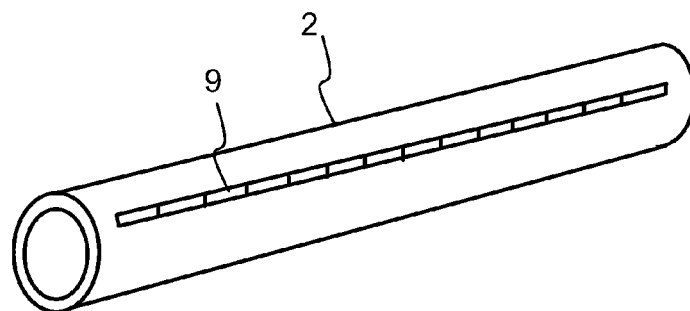


Fig. 3

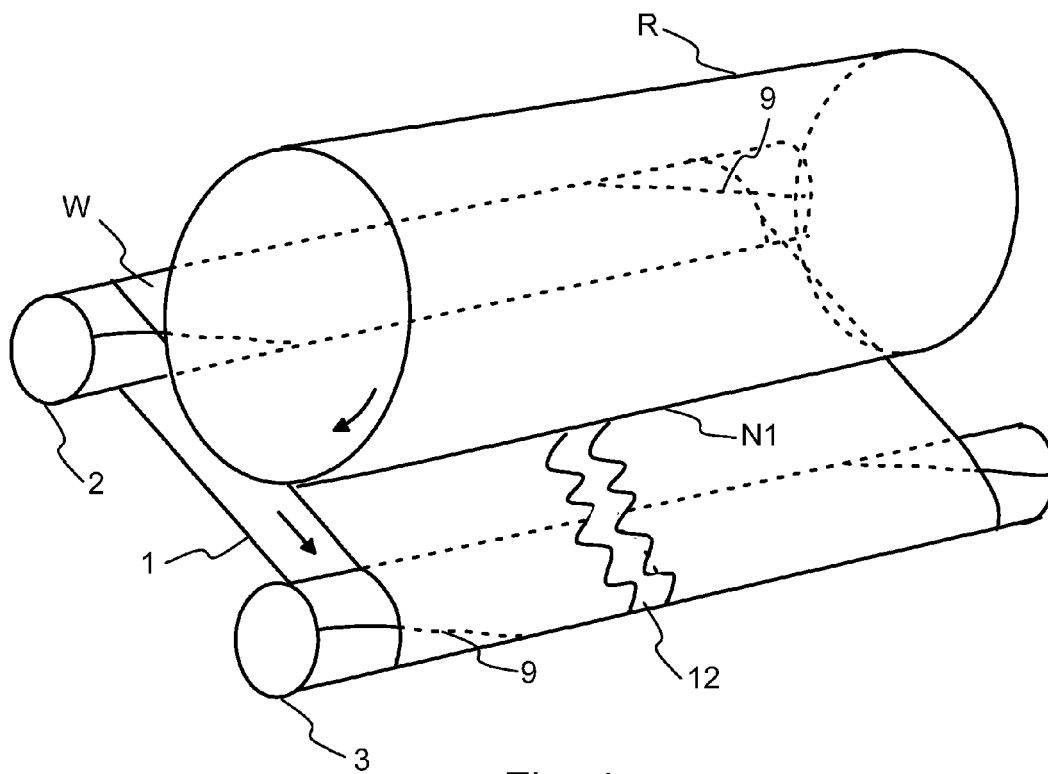


Fig. 4

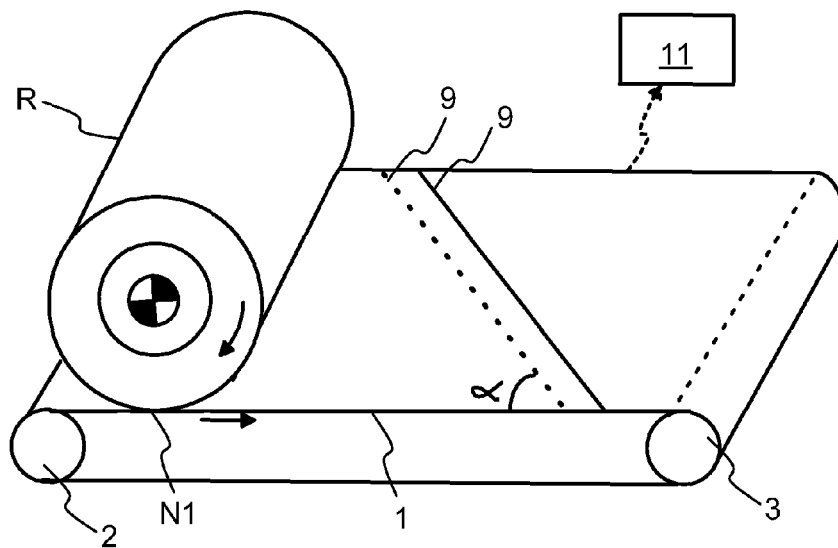


Fig. 5

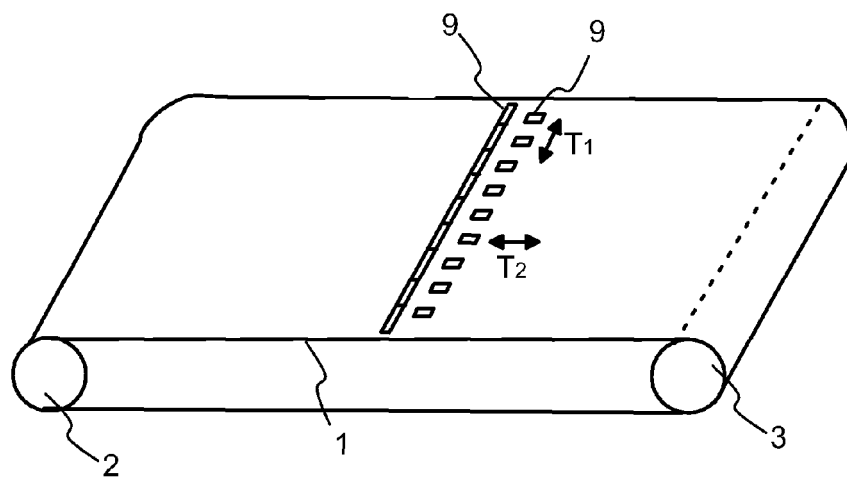


Fig. 6

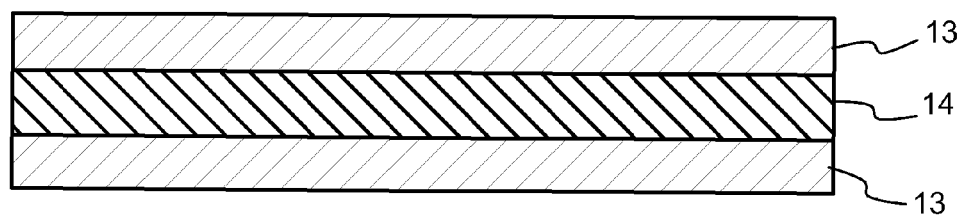


Fig. 7

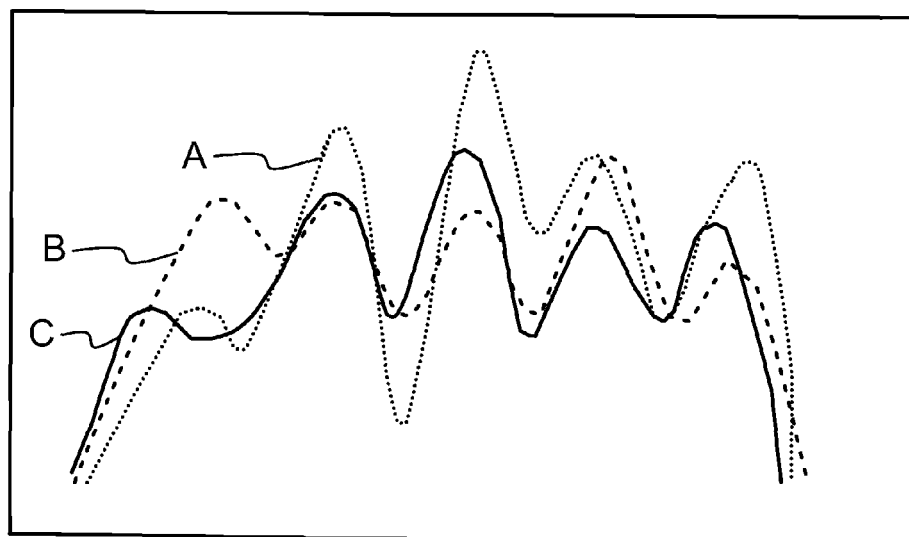


Fig. 8

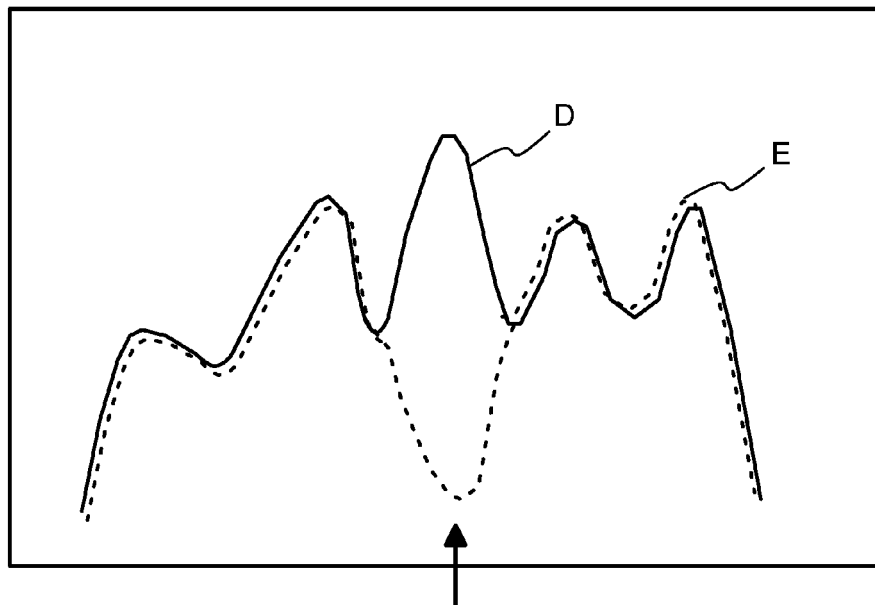


Fig. 9

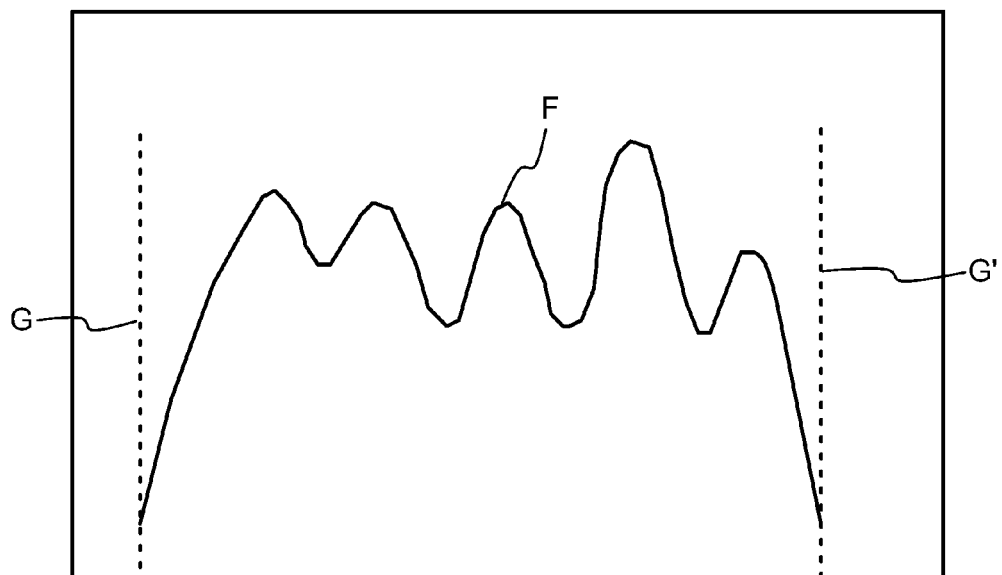


Fig. 10



EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		19 October 2010	Haaken, Willy
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EUROPEAN SEARCH REPORT

Application Number
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