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(54) A METHOD FOR MONITORING A WEB HANDLING ARRANGEMENT

(57) A method (300) for monitoring a web handling arrangement (100) holding a web (102) of packaging material, said web handling arrangement (100) comprising a first roller (104) and a second roller (108), wherein the first and second roller (104, 108) are placed at a distance (D) from each other such that a web slack (112) is formed, wherein a first motor (106) is positioned upstream or in the first roller (104) and a second motor (110) is positioned downstream or in the second roller (110), wherein a first sensor (114), for detecting a mark (116) on the web (102), is positioned between the first motor (106) and the first roller (104) and a second sensor (118), for detecting the mark (116), is positioned between the second roller (108) and the second motor (110), said method comprising receiving (302) first speed data (120) from the first motor (106); receiving (304) second speed data (122) from the second motor (110); receiving (306) initial web slack data (126) representing an initial web slack (WS-I) at the first point of time; determining (308) a non-compensated length of the web slack (112) at a second point of time based on the first and second speed data (120, 122) for a time period spanning from a first point of time to the second point of time and the initial web slack data (126); receiving (310) first registration data (128) from the first sensor (114), said first registration data (128) pertaining to a detection of the mark (116) at the first point of time; receiving (312) second registration data (130) from the second sensor (118), said second registration data (130) pertaining to a detection of the mark (116) at a third point of time; and determining (314) a compensated length of the web slack (112) at the third point of time based on the non-compensated length and a time difference between the second and third point of time.

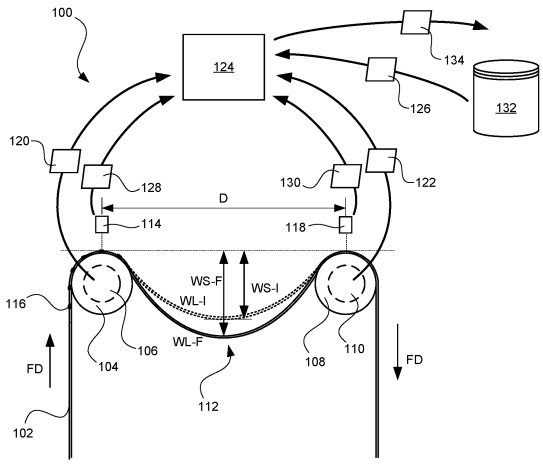

Fig. 1

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Description

Technical Field

[0001] The invention relates to a method for monitoring a web handling arrangement holding a web of packaging material, a control unit for upgrading a web handling arrangement, a packaging machine and a computer program product.

Background Art

[0002] Today it is common practice to use roll-fed packaging systems within the food industry. The general concept of such system is that a web of packaging material is formed into a tube by making a so-called longitudinal sealing. After forming the tube, this is filled with food product from above via a food product pipe. In a lower end of the tube, transversal sealings are provided. After cutting the transversal sealing in two, packages with top and bottom fins are formed. These packages may thereafter be fed into a final folder for folding the packages into their final shape, e.g. a brick-shaped form. To facilitate the folding, crease lines may be provided in the web of packaging material. One example of such roll-fed systems is Tetra Brik® marketed by Tetra Pak®.

[0003] An effect of that the web is fed continuously throughout the packaging system, sometimes also referred to as filling machine or packaging machine, is that impressive production speeds can be achieved, which in turn provides for cost efficiency. A challenge with these speeds is however that control systems of the packaging systems have to be adapted thereto. A minor error in determining a position of the web may have severe consequences when running at speeds above 10 000 packages per hour. For instance, having a misalignment such that caps are applied incorrectly onto the web may result in that the machine has to be stopped such that adjustments of the control system can be made. Such stop will result in that packaging material with incorrectly placed caps will end up as waste, and if the misalignment was not detected quickly, there may also have been produced filled food packages with incorrectly placed caps that also will end up as waste. In addition, the stop will also result in that the filling machine has to be re-started, which also will result in packaging material and food product losses. Thus, by having an increased control of the web as this is fed through the filling machine, the number of stops can be reduced, which in turn will result in less packaging material and food product losses.

[0004] There is at least one known technique today for monitoring the web as this is passing through the filling machine. This technique comprises having a light-based sensor placed above a web slack such that a length of the web constituting the web slack can be estimated. Web slacks may be used for several purposes in the filling machine. For instance, web slacks may be used as a web buffer for an automatic splicing unit (ASU) such that an empty packaging material reel can be replaced by a new packaging material reel without stopping the filling machine. Another reason for having the web slacks is in order to provide for that intermittent movements, also referred to as indexed movements, can be provided in a direct-injection moulding concept (DIMC) station for applying opening devices onto the web. By having web buffers both upstream and downstream such DIMC station, it is made possible to have the web continuously moved within the filling machine apart from in the DIMC station.

[0005] Even though there are systems today that can provide for that a position of the web can be accurately determined within filling machines, there is a need for such systems that are more cost-efficient and, in some circumstances, also more accurate and reliable.

Summary

[0006] It is an object of the invention to at least partly overcome one or more of the above-identified limitations of the prior art. In particular, it is an object to provide a method and a device that can cost-efficiently, reliably and accurately determine a length of a web held in a web slack. By doing so, it is made possible to buffer the web without the risk, or at least a reduced risk, of losing track of the positioning of the web downstream a web buffer, or more generally a web handling arrangement.

[0007] According to a first aspect it is provided a method for monitoring a web handling arrangement holding a web of packaging material, said web handling arrangement comprising a first roller and a second roller, wherein the first and second roller are placed at a distance from each other such that a web slack is formed, wherein a first motor is positioned upstream or in the first roller and/or a second motor is positioned downstream or in the second roller, wherein a first sensor, for detecting a mark on the web, is positioned between the first motor and the first roller and a second sensor, for detecting the mark, is positioned between the second roller and the second motor, said method comprising receiving first speed data; receiving second speed data; receiving initial web slack data representing an initial web slack at the first point of time; determining a non-compensated length of the web slack at a second point of time based on the first and second speed data for a time period spanning from a first point of time to the second point of time and the initial web slack data; receiving first registration data from the first sensor, said first registration data pertaining to a detection of the mark at the first point of time; receiving second registration data from the second sensor, said second registration data pertaining to a detection of the mark at a third point of time; and determining a compensated length of the web slack at the third point of time based on the non-compensated length and a time difference between the second and third point of time.

[0008] The first speed data pertains to a rotational speed of the first roller. This data may be received from

the first motor, from a sensor measuring the first speed data by observing the web over time or a combination thereof. In a similar manner, the second speed data pertains to a rotational speed of the second roller. This data may be received from the second motor, from a sensor measuring the second speed data by observing the web over time or a combination thereof.

[0009] An advantage with using the first and second sensor is that the non-compensated length can be adjusted such that the length of the web held between the first and second roller can be more accurately determined compared to if only the length is determined based on the first and second speed data.

[0010] Further, if comparing to the alternative of having a light-based sensor for measuring a distance between the web slack and a horizontal reference level, i.e. the level at which the light-based sensor is placed, using the first and second sensor for detecting the mark of the web comes with the advantage that even though properties of the web is affected, such that a form of the web slack is in turn affected, this will not affect the first and second registration data from the first and second sensor, respectively. Put differently, the form of the web slack may be changed without affecting the accuracy of the measurements of the first and second sensor. This is however not the case if using the light-based sensor placed above the web slack. Having the properties of the web changed as an effect of a stop may depend on the type of packaging material used. In case having a carton-based packaging material, a stiffness of the web due to crystallization may occur.

[0011] The mark may be detected directly or indirectly. For instance, it may be the same mark that is detected both by the first and second sensor. However, in case each sub-portion of the web is provided with marks and a distance between two consecutive marks are set, the second registration data may detect the mark indirectly by detecting another mark in another sub-section.

[0012] A further advantage is that the mark may be used for other purposes as well. For instance, the mark may be used for tracing the sub-portion and the package formed by the sub-portion. In addition to using the mark for several purposes, sensors already present in the packaging machine may also serve the purpose of determining the compensated length of the web slack.

[0013] The mark may be a printed mark, a magnetic mark, a mechanical mark, an electronic circuit or a combination thereof.

[0014] The packaging material may comprise a number of layers and at least one of these layers is a cellulose-based layer, such as a carton-based layer.

[0015] Using cellulose-based material may have the effect that different batches may have different properties. For instance, different fiber lengths may result in that the web slack is formed differently. In addition, different cellulose batches may be affected differently by hydrogen peroxide. Thus, due to the special circumstances related to cellulose, the proposed method will be particularly beneficial for such material.

[0016] The web handling arrangement may be placed downstream a web sterilization station such that effects on properties of the packaging material during web sterilization is compensated for.

[0017] The web may comprise a number of sub-portions, each arranged to be formed into a package and each comprising an opening device dedicated area, wherein the web handling arrangement may be placed upstream an opening device applicator such that a risk of having opening devices applied outside the opening device dedicated areas is reduced.

[0018] So-called design correction is today commonly used in packaging machines. By being able to more accurately compensate for sliding on the rollers and other mechanical imperfections, it is made possible to further improve this design correction.

[0019] The opening device applicator may be an injection moulding device arranged to penetrate the opening device dedicated areas such that the opening devices are provided on both sides of the web.

[0020] For an injection moulding device, not only design correction is needed, but it is also needed to provide indexed movements. Thus, having the web handling arrangement described herein can provide for that the design correction is achieved at the same time as the indexed movements.

[0021] In case the opening device dedicated area are prepared for that plastic material should be passed through the web, correct positioning is of particular relevance. The opening device dedicated areas may be prepared in that perforations are provided in the cellulose-based layer of the packaging material.

[0022] The number of sub-portions of the web may each comprise a printing dedicated area, wherein the web handling arrangement may be placed upstream a printing station such that a risk of having printing made outside the printing dedicated area can be reduced.

[0023] Each sub-portion of the web may be provided with a package-specific mark.

[0024] An advantage with this is that the mark may have dual purposes. By being package-specific, it can be used for traceability purposes. In addition, the mark may also be used for determining the compensated length of the web slack.

[0025] The time difference may pertain to that the web is sliding against the first and/or second roller and/or roller surface inaccuracies and/or roller eccentricity of the first and/or second roller. A position difference may be linked to the time difference in such a way that the position difference is related to a difference between a position of the web at the second point of time and a position of the web at the third point of time.

[0026] According to a second aspect it is provided a control unit for upgrading a web handling arrangement for holding a web of packaging material, said control unit being configured to receive first speed data, to receive second speed data, to receive initial web slack data

representing an initial web slack at a first point of time, to determine a non-compensated length of the web slack at a second point of time based on the first and second speed data for a time period spanning from the first point of time to the second point of time and the initial web slack data, to receive first registration data from a first sensor for detecting a mark on the web, said first registration data pertaining to a detection of the mark at the first point of time, wherein the first sensor is positioned between the first motor and a first roller of the web handling arrangement, wherein the first motor is positioned upstream or in the first roller, to receive second registration data from a second sensor for detecting the mark, said second registration data pertaining to a detection of the mark at a third point of time, wherein the second sensor is positioned between a second roller and the second motor of the web handling arrangement, wherein the second motor is positioned downstream or in the second roller, and to determine a compensated length of the web slack at the third point of time based on the non-compensated length and a time difference between the second and third point of time.

[0027] The same features and advantages described above with respect to the first aspect also apply to this second aspect.

[0028] The time difference may pertain to that the web is sliding against the first and/or second roller and/or roller surface inaccuracies and/or roller eccentricity of the first and/or second roller.

[0029] According to a third aspect it is provided a packaging machine comprising a web handling arrangement comprising a control unit according to the second aspect, and a web sterilization station placed upstream the web handling arrangement.

[0030] The same features and advantages described above with respect to the first aspect also apply to this third aspect.

[0031] The packaging machine may further comprise an opening device applicator placed downstream the web handling arrangement.

[0032] The packaging machine may further comprise a printing station placed downstream the web handling arrangement.

[0033] According to a fourth aspect it is provided a computer program product comprising instructions, which when the program is executed by a control unit, cause the control unit to carry out the steps of the method of the first aspect.

[0034] The same features and advantages as described above with respect to the first aspect also apply to this fourth aspect.

[0035] Still other objectives, features, aspects and advantages of the invention will appear from the following detailed description as well as from the drawings.

Brief Description of the Drawings

[0036] Embodiments of the invention will now be described, by way of example, with reference to the accompanying schematic drawings, in which

Fig. 1 generally illustrates a web handling arrangement comprising a first and a second sensor for detecting a mark of the web.

Fig. 2 generally illustrates a packaging machine comprising the web handling arrangement illustrated in fig. 1.

Fig. 3 is a flow chart illustrating a method for monitoring the web handling arrangement illustrated in fig. 1.

Detailed Description

[0037] Fig. 1 illustrates a web handling arrangement 100 for holding a web 102 of packaging material by way of example. The web handling arrangement 100 may form part of a packaging machine, also referred to as filling machine or packaging system. The arrangement may be used for buffering the web, and in such case, the arrangement may be referred to as a web buffer. By way of example, the web handling arrangement 100 may be used as an enabler for an automatic splicing unit (ASU). By being able to buffer the web before a reel of packaging material is removed it is namely possible to continue to run the packaging machine during a switch of reels by using the web held in the web handling arrangement. Another example is to use the web handling arrangement 100 for enabling indexed movements, also referred to as intermittent movements, in a direct injection moulding concept (DIMC) station arranged to apply opening devices onto the web 102.

[0038] As illustrated, the web handling arrangement 100 can comprise a first roller 104 that may be driven by a first motor 106 and a second roller 108 that may be driven by a second motor 110. The web 102 is fed from the first roller 104 to the second roller 108 in a feeding direction FD. As illustrated, the first and second roller 104, 108 may be placed at a distance D from each other. In a space between the first and second roller 104, 108, a web slack 112 can be formed. The web slack may change overtime. For instance, in case the web handling arrangement 100 is used for enabling the packaging machine to operate during the switch of reels, the web slack may be increased before the switch takes place and during the switch when no web is unrolled from the reel, the web slack may be decreased. In the example illustrated in fig. 1, an initial web slack WS-I (dotted lines) and a final web slack WS-F (full lines) are provided. As illustrated, the web slack 112 is increased between an initial stage and a final stage. Put differently, an initial web length WL-I, held at the initial stage, is shorter than a final web length WL-F held at the final stage.

[0039] Even though illustrated with both the first and second motor 106, 110, it is possible to have only one of the two rollers 104, 108 motor-driven. Put differently, one of the rollers 104, 108 may be a driven roller and the other

may be an idle roller. In case the first motor 106 is not forming part of the first roller 104 as illustrated, it may be placed upstream the first roller 104 provided that the web 102 is tensioned. In a similar manner, in case the second motor 110 is not forming part of the second roller 108, the second motor 110 may be placed downstream the second roller 108 provided that the web 102 is tensioned. By way of example, the first roller 104 may be motor-driven and the second roller 108 may be dragged, that is, non-motor-driven. To measure a speed of the web at the second roller 108, an encoder may be provided, or any other means for registering movement of the web. Further, a device placed downstream the second roller 108 may provide for that the web is tensioned such that the web slack can be controlled. Even though illustrated in fig. 1 that the web 102 is fed in the feeding direction FD, the web 102 may also be fed in the opposite direction. In case the feeding direction is changed, there may also be a switch from, by way of example, having the first roller 104 being motor-driven to having the second roller 106 being motor-driven.

[0040] A first sensor 114 may be placed at the first roller 104 as illustrated. Even though illustrated as being placed straight above the first roller 104, the first sensor 114 may also be placed upstream the first roller 104 provided for that the web 102 is tensioned between a position of the first sensor and the first roller. In a similar manner, a second sensor 118 may be placed at the second roller 108, or downstream the second roller 108 provided for that the web is tensioned between the second roller and the second sensor.

[0041] The first sensor 114 and the second sensor 118 can be arranged to detect a mark 116 on the web 102. The mark 116 may come in different forms. For instance, the mark may be a printed mark, such as a QR code, Data-Matrix code or the like. Another option is that the mark is a magnetic mark, e.g. the mark may be formed by a number of magnetic particles provided inside the packaging material. Still an option is that the mark is a mechanical mark, e.g. the mark may comprise one or several cut-outs in the packaging material. A further option is to have the mark embodied as an electronic circuit, e.g. an RFID device. It is also possible to the mark 116 being a combination of different types, e.g. magnetic particles in combination with cut-outs.

[0042] As stated above, the first and second sensor 114, 118 may be arranged to detect the mark 116, that is, determining that the mark is present in a field of view of the first and second sensor, respectively. For instance, in case the mark is embodied as the QR code, the first sensor 114 may be used not only for detecting the mark, but also to read the mark such that a sub-portion of the web passing the first sensor can be identified. In case the sub-portions of the web, which are later on formed into the packages, each is provided with a package-specific code, it can be determined when a specific sub-portion is passing the first sensor 114. Having the first sensor 114 configured in this way provides for that the web 102 can be traced in the packaging machine. Having the first sensor 114 configured not only to detect, but also to read, provides for that an existing sensor in the packaging machine, placed upstream the web slack 112 can be used as the first sensor 114. In a similar manner, in case an existing sensor is provided downstream the web slack 112, e.g. a magnetic reader or a vision-based sensor used for design correction, this existing sensor can be used as the second sensor 118.

[0043] By having the first and second motor 106, 110, first speed data 120 and second speed data 122, respectively, can be provided. The first speed data 120 represents a rotational speed for the first roller 104 and the second speed data 122 represents a rotational speed for the second roller 108 between a first point of time to a second point of time. By using these two pieces of information it is made possible to estimate the final web slack WS-F based on the initial web slack WS-I, i.e. how a distance between the web 102 and a horizontal reference line is changing from the initial stage to the final stage. Further, it is possible to estimate the final web length WL-F based on the initial web length WL-I by using the first and second speed data 120, 122. The first and second speed data 120, 122 may, as illustrated, be transferred from the first and second motor 106, 110, respectively, to a control unit 124. The control unit 124 may be a data processing device, comprising a processor, a memory and a transceiver, suitable for performing the mentioned calculations. Initial web slack data 126 may be provided, as illustrated, to the control unit 124 from a database 132.

[0044] By determining the final web length WL-F based on the first and second speed data 120, 122, a non-compensated length of the web slack 112 at the second point of time can be provided. The reason for it being non-compensated is that any sliding of the web 102 with respect to the first roller 104 and/or the second roller 108 will not be taken into account. In addition, roller surface inaccuracies and/or roller eccentricity will not be taken into account. Put differently, if not having perfectly cylindrical rollers this will not be taken into account when determining the web length based on the first and second speed data.

[0045] To be able to compensate for these potential sources of errors without having a light-based sensor placed above the web slack 112, it is possible to make use of first registration data 128 provided to the control unit 124 by the first sensor 114, and second registration data 130 provided to the control unit 124 by the second sensor 118. The first registration data 128 pertains to a detection of the mark 116 in the first point of time and the second registration data 130 pertains to a detection of the mark 116 in a third point of time. In case there is no sliding between the web 102 and the rollers, the third point of time will correspond to the second point of time, but in case there is sliding occurring, the rollers are not perfectly cylindrical, and so forth, there will be a time difference between the third and second point of time. By using this time difference, or more specifically a position difference

linked to the time difference, it is possible to determine a compensated length based on the non-compensated length. The time difference may be positive or negative. The time difference may, as pointed out above, be linked to the position difference. More particularly, the position difference may be a difference between a first position of the web at the second point of time and a second position of the web at the third point of time. Put differently, the position difference may be a spatial difference while the time difference is a temporal difference.

[0046] Once having determined the compensated web length in the control unit 124, output data 134 pertaining to the compensated web length can be transferred from the control unit 124. For instance, the output data 134 can be transferred to a station placed downstream the web handling arrangement 100 such that settings can be adjusted accordingly. For instance, in case the station placed downstream is a DIMC station for applying opening devices, time points for opening and closing of moulds may be adjusted in accordance with the compensated web length, thereby lowering a risk that injection molded opening devices are applied more accurately in terms of position on the web 102.

[0047] Fig. 2 schematically illustrates by way of example a packaging machine 200 comprising two web handling arrangements 100 as illustrated in fig. 1. In short, a reel of packaging material is provided in a packaging material (PM) reel receiver 202. The web 102 is unrolled from the PM reel and fed from the PM reel receiver 202 to a web sterilization station 204. This station may comprise a hydrogen peroxide bath, as illustrated, for removing bacteria, germs, spores and other unwanted microorganisms from the web 102, but other techniques may also be used for sterilization, e.g. Low-Voltage Electron Beam (LVEB) technology. Downstream the sterilization station 204, a first instance of the web handling arrangement 100 may be placed. An advantage of having the web handling arrangement 100, as described above, placed downstream the web sterilization station 204 is that in case the web 102 is mechanically affected by a treatment in the web sterilization station 204, this may accurately be compensated for. For instance, in case a stop of the packaging machine 202 results in that the web 102 is placed for a longer period of time than planned in the hydrogen peroxide bath, an increased exposure of the hydrogen peroxide to the web 102 can result in that the web slack 112 is changing character. For instance, the final web slack WS-F may occur at a different position, i.e. a maximum distance between the web 102 and the horizontal reference line may change position due to the changed mechanical properties of the web 102. The changed properties may be a result of that crystallization occurs as an effect of that the web is held for a longer period of time in the hydrogen peroxide bath due to the stop of the packaging machine 200. Thus, using an approach with the first and second sensor 114, 118 as described above provides for that more robust measurements with respect to the web slack 112 can be made compared to using a light-based sensor placed above the web slack 112.

[0048] As described above, by having the web handling arrangement 100 placed downstream the PM reel receiver 202, it is made possible to provide a web buffer such that by using an automatic splicing unit (ASU) can replace an empty reel with a new one without stopping the packaging machine 200.

[0049] Downstream the first instance of the web handling arrangement 100, an opening device applicator 206 can be provided. This applicator can be a direct injection moulding concept (DIMC) station provided with two moulds for providing opening devices onto the web 102. To provide intermittent movements in the opening device applicator 206, a second instance of the web handling arrangement 100 can be provided downstream the opening device applicator 206. Put differently, by having two web buffers, provided by the first and second instance of the web handling arrangement 100, it is made possible to provide intermittent movement, also referred to as indexed movements, in the opening device applicator 206, and continuous movement of the web 102 outside the opening device applicator 206.

[0050] As illustrated, downstream the second instance of the web handling arrangement 100, a printing station 208 can be provided. The printing station 208 may be a digital printing station that is printed part or the whole web 102 before this is transformed into packages 216. An advantage of having the second instance of the web handling arrangement 100 provided upstream the printing station 208 is that so-called design correction may take place. Put differently, positing of the web 102 can be adapted such that printing provided by the printing station 208 is placed correctly with respect to the web 102. For instance, the design correction may result in that the printing is placed correctly, that is, in line with pre-set expectations, with respect to sub-portions and/or crease lines of the web 102.

[0051] Downstream the printing station 208, the web 102 may be formed into a tube in a tube forming station 210. This station may be comprise web guiding rollers and a longitudinal sealing station. Food product may be filled into the tube from above via a product pipe 211. In a lower end of the tube, transversal sealings may be formed by a transversal sealing station 212. In this station, the tube may also be cut such that the packages 216 are formed. To be shaped into their final shape, e.g. by having a top fin and bottom fin provided in the transversal sealing station 212 folded such that the packages 216 are formed into brick-shaped packages, a forming station 214 may be provided downstream the transversal sealing station 212.

[0052] Fig. 3 is a flowchart illustrating a method 300 for monitoring the web handling arrangement 100 holding the web 102 of packaging material. The method may comprise receiving 302 the first speed data 120 from the first motor 106; receiving 304 the second speed data 122 from the second motor 110; receiving 306 the initial web

slack data 126 representing the initial web slack WS-I at the first point of time; determining 308 the non-compensated length of the web slack 112 at the second point of time based on the first and second speed data 120, 122 for the time period spanning from the first point of time to the second point of time and the initial web slack data 126; receiving 310 the first registration data 128 from the first sensor 114, said first registration data 128 pertaining to a detection of the mark 116 at the first point of time; receiving 312 the second registration data 130 from the second sensor 118, said second registration data 130 pertaining to the detection of the mark 116 at the third point of time; and determining 314 the compensated length of the web slack 112 at the third point of time based on the non-compensated length and the time difference between the second and third point of time.

[0053] From the description above follows that, although various embodiments of the invention have been described and shown, the invention is not restricted thereto, but may also be embodied in other ways within the scope of the subject-matter defined in the following claims.

Claims

1. A method (300) for monitoring a web handling arrangement (100) holding a web (102) of packaging material, said web handling arrangement (100) comprising a first roller (104) and a second roller (108), wherein the first and second roller (104, 108) are placed at a distance (D) from each other such that a web slack (112) is formed, wherein a first motor (106) is positioned upstream or in the first roller (104) and a second motor (110) is positioned downstream or in the second roller (110), wherein a first sensor (114), for detecting a mark (116) on the web (102), is positioned between the first motor (106) and the first roller (104) and a second sensor (118), for detecting the mark (116), is positioned between the second roller (108) and the second motor (110), said method comprising

receiving (302) first speed data (120);
receiving (304) second speed data (122);
receiving (306) initial web slack data (126) representing an initial web slack (WS-I) at the first point of time;
determining (308) a non-compensated length of the web slack (112) at a second point of time based on the first and second speed data (120, 122) for a time period spanning from a first point of time to the second point of time and the initial web slack data (126);
receiving (310) first registration data (128) from the first sensor (114), said first registration data (128) pertaining to a detection of the mark (116) at the first point of time;
receiving (312) second registration data (130) from the second sensor (118), said second registration data (130) pertaining to a detection of the mark (116) at a third point of time; and
determining (314) a compensated length of the web slack (112) at the third point of time based on the non-compensated length and a time difference between the second and third point of time.

2. The method (300) according to claim 1, wherein the mark (116) is a printed mark, a magnetic mark, a mechanical mark, an electronic circuit or a combination thereof.

3. The method (300) according to any one of the preceding claims, wherein the packaging material comprises a number of layers and at least one of these layers is a cellulose-based layer, such as a carton-based layer.

4. The method (300) according to any one of the preceding claims, wherein the web handling arrangement (100) is placed downstream a web sterilization station (204) such that effects on properties of the packaging material during web sterilization is compensated for.

5. The method (300) according to any one of the preceding claims, wherein the web (102) comprises a number of sub-portions, each arranged to be formed into a package (216) and each comprising an opening device dedicated area, wherein the web handling arrangement (100) is placed upstream an opening device applicator (206) such that a risk of having opening devices applied outside the opening device dedicated areas is reduced.

6. The method (300) according to claim 5, wherein the opening device applicator (206) is an injection moulding device arranged to penetrate the opening device dedicated areas such that the opening devices are provided on both sides of the web (102).

7. The method (300) according to any one of the claims, wherein the number of sub-portions of the web (102) each comprises a printing dedicated area, wherein the web handling arrangement (100) is placed upstream a printing station (208) such that a risk of having printing made outside the printing dedicated area is reduced.

8. The method (300) according to any one of the preceding claims, wherein each sub-portion of the web (102) is provided with a package-specific mark.

9. The method (300) according to any one of the preceding claims, wherein the time difference pertains

to that the web (102) is sliding against the first and/or second roller (104, 108) and/or roller surface inaccuracies and/or roller eccentricity of the first and/or second roller (104, 108).

10. A control unit (124) for upgrading a web handling arrangement (100) for holding a web (102) of packaging material, said control unit (124) being configured

to receive first speed data (120),
to receive second speed data (122),
to receive initial web slack data (126) representing an initial web slack (WS-I) at a first point of time,
to determine a non-compensated length of the web slack (112) at a second point of time based on the first and second speed data (120, 122) for a time period spanning from the first point of time to the second point of time and the initial web slack data (126),
to receive first registration data (128) from a first sensor (114) for detecting a mark (116) on the web (102), said first registration data (128) pertaining to a detection of the mark (116) at the first point of time, wherein the first sensor (114) is positioned between the first motor (106) and a first roller (104) of the web handling arrangement (100), wherein the first motor (106) is positioned upstream or in the first roller (104),
to receive second registration data (130) from a second sensor (118) for detecting the mark (116), said second registration data (130) pertaining to a detection of the mark (116) at a third point of time, wherein the second sensor (118) is positioned between a second roller (108) and the second motor (110) of the web handling arrangement (110), wherein the second motor (110) is positioned downstream or in the second roller (110), and
to determine a compensated length of the web slack (112) at the third point of time based on the non-compensated length and a time difference between the second and third point of time.

11. The control unit according to claim 10, wherein the time difference pertains to that the web (102) is sliding against the first and/or second roller (104, 108) and/or roller surface inaccuracies and/or roller eccentricity of the first and/or second roller (104, 108).

12. A packaging machine (200) comprising

a web handling arrangement (100) comprising a control unit (124) according to claim 10 or 11, and
a web sterilization station (204) placed upstream the web handling arrangement (100) .

13. The packaging machine (200) according to claim 12, further comprising
an opening device applicator (206) placed downstream the web handling arrangement (100).

14. The packaging machine (200) according to claim 12 or 13, further comprising
a printing station (208) placed downstream the web handling arrangement (100).

15. A computer program product comprising instructions, which when the program is executed by a control unit (124), cause the control unit (124) to carry out the steps of the method (300) of any one of the claims 1 to 9.

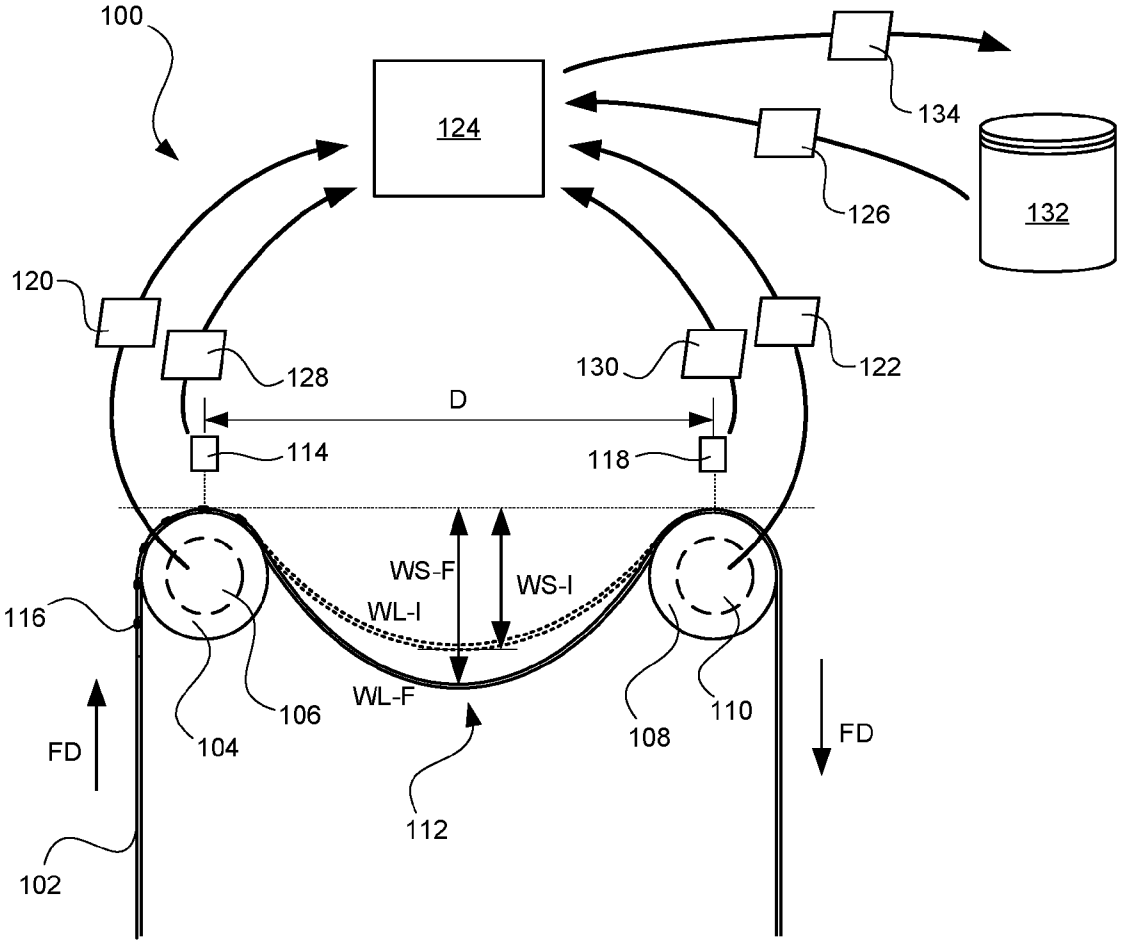
100
124
134
126
132
120
128
130
122
D
114
118
WS-F
WS-I
WL-I
116
106
104
WL-F
108
110
FD
FD
112
102

Fig. 1

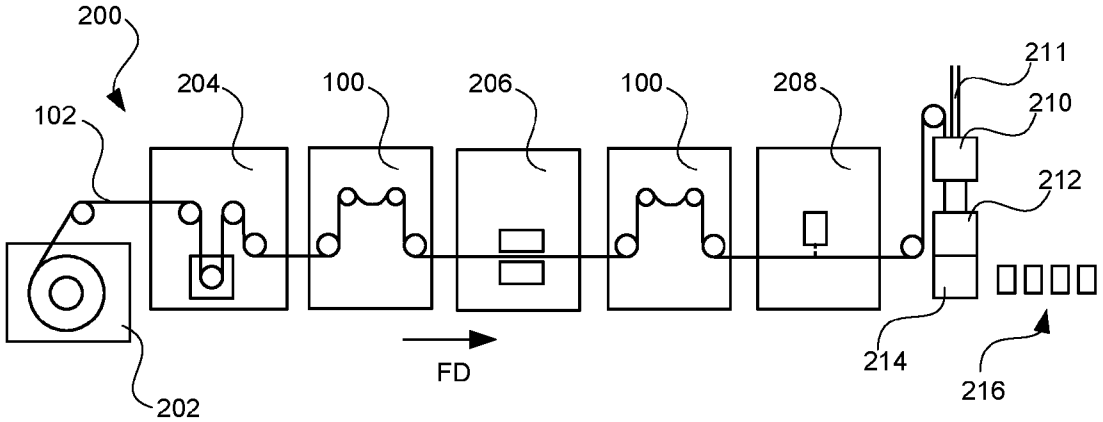
200
204
100
206
100
208
211
210
212
102
FD
214
216
202

Fig. 2

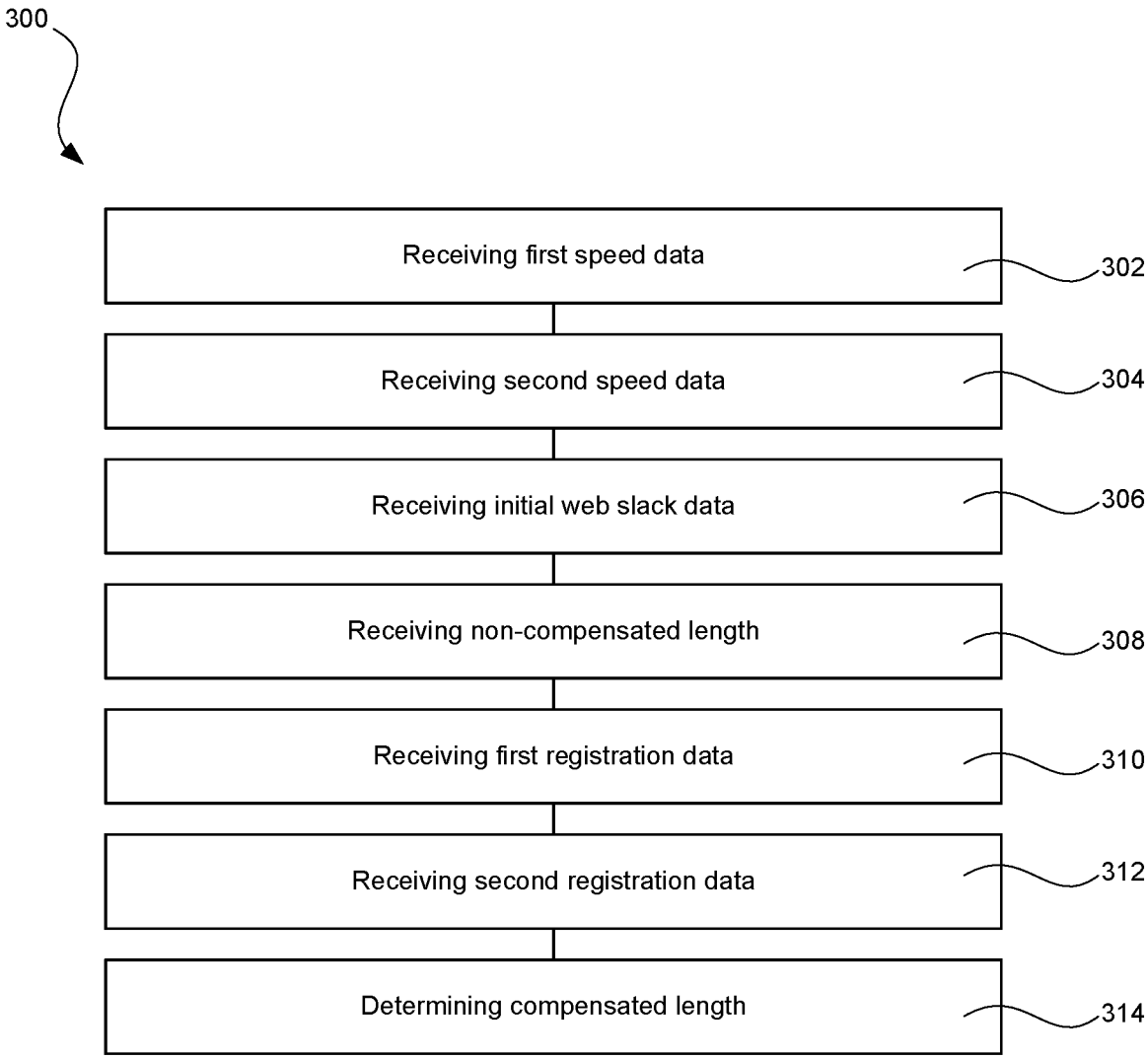
300
Receiving first speed data
302
Receiving second speed data
304
Receiving initial web slack data
306
Receiving non-compensated length
308
Receiving first registration data
310
Receiving second registration data
312
Determining compensated length
314

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 2136

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 3 725 692 A1 (TETRA LAVAL HOLDINGS & FINANCE [CH]) 21 October 2020 (2020-10-21) * paragraphs [0001], [0088] - [0095] * * figures 1, 2 *	1-15	INV. B65H20/32 B65B9/20 B65B41/16
A	EP 3 246 262 A1 (ISHIDA SEISAKUSHO [JP]) 22 November 2017 (2017-11-22) * paragraphs [0001] - [0002], [0007] - [0008], [0027], [0038] - [0040] * * paragraphs [0053] - [0056], [0065], [0083] - [0085], [0095] - [0096] * * figures 1, 6 *	1,12,15	
A	GB 2 249 782 A (TOKYO AUTOMATIC MACH WORKS [JP]) 20 May 1992 (1992-05-20) * page 1, paragraph 1 * * page 6, line 14 - page 7, line 17 * * page 10, line 1 - page 11, line 6 * * figure 1 *	1,12,15	

TECHNICAL FIELDS SEARCHED (IPC)

B65H
B65B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 February 2025	Cescutti, Gabriel

CATEGORY OF CITED DOCUMENTS

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06-02-2025

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3725692 A1	21-10-2020	CN 113453987 A	28-09-2021
		EP 3725692 A1	21-10-2020
		JP 7605757 B2	24-12-2024
		JP 2022530862 A	04-07-2022
		US 2022194639 A1	23-06-2022
		WO 2020212280 A1	22-10-2020
EP 3246262 A1	22-11-2017	AU 2015377541 A1	17-08-2017
		CN 107074390 A	18-08-2017
		EP 3246262 A1	22-11-2017
		JP 2016132454 A	25-07-2016
		US 2018016047 A1	18-01-2018
		WO 2016113962 A1	21-07-2016
GB 2249782 A	20-05-1992	AU 641060 B2	09-09-1993
		CN 1061756 A	10-06-1992
		GB 2249782 A	20-05-1992
		HK 183995 A	15-12-1995
		JP 2903496 B2	07-06-1999
		JP H04182250 A	29-06-1992
		KR 920009672 A	25-06-1992
		MY 106901 A	30-08-1995
		SG 30585 G	18-09-1995

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82