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(54) **DEVICE AND METHOD FOR ROLLING STRIPS OF MATERIAL**

VORRICHTUNG UND VERFAHREN ZUM WALZEN VON MATERIALSTREIFEN

DISPOSITIF ET PROCÉDÉ DE LAMINAGE DE BANDES DE MATÉRIAU

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Description

Field of the Invention

[0001] The present invention generally relates to the field of rolling strips of material, e.g. carpets, using a winding machine. In particular, it relates to a compact and reliable winding solution that allows to form rolls having a small inner and a large outer diameter, as well as uniformly wound windings and even end faces.

Background of the Invention

[0002] Various applications are known where strips of carpet are to be formed into rolls for easy handling and storage, e.g. after production or laundering of the carpet. Similarly, strips of isolation material, films, paper and the like, are rolled into spiral wound rolls before packaging. To automate this task, winding machines have been developed for facilitating rolling up carpets and other materials.

[0003] In these winding machines the strip is rolled up on itself within a defined space. Such a winding space is bordered by several conveyor belts and/or rollers, causing the strip of material to successively contact these conveyor belts and/or rollers, thereby forming a spirally wound roll. In this, a common difficulty is to keep the strip forming the roll properly tensioned throughout the entire operation, such that a cylindrical roll with uniform density throughout all windings is obtained. This rolling quality needs to be guaranteed even when a long strip of carpet or other material, and thus a large diameter of the wound roll, is provided. Moreover, to obtain a roll with even end faces, telescoping during rolling, i.e. a relative axial shift of subsequent concentric layers of the rolled strips of material with respect to each other, is to be avoided. Finally, initiation of the roll formation must be achieved in a reliable way, thereby striving for a small inner diameter of the wound roll to limit the obtained roll volume.

[0004] Various solutions have been described in the prior art attempting to provide a winding machine for rolling strips of carpet or other materials. A first group of known solutions makes use of a winding space defined by three bearing points for the material being rolled-up. E.g., in US4573644 the winding space is defined by two endless belt conveyors and pivotally supported fingers, in US5305963 two endless belt conveyors and a compression roll are used, and in DE3714721 the winding space is defined by three systems of alternating conveyor belts.

[0005] Generally spoken, three contact points between the driven winding space borders and the strip of material is a minimum to enable the roll formation, but may result in loosely wound rolls, certainly when considering large roll diameters. Moreover, in US4573644 and DE3714721 a pivoting mechanism is used to displace respectively the fingers or third belt conveyor following the increasing diameter of the wound roll. As a result, the third bearing point is shifted to a position not being equally spaced anymore with the other two bearing points. This prevents the windings to be properly tensioned over the whole circumference, and at a certain level of roll diameter the roll may simply jump out of the winding space which is not well bordered anymore. Consequently, the solution is limited to small end diameters, and thus limited lengths of strips.

[0006] In US5305963, which discloses a device for rolling strips of material according to the preamble of claim 1, instead of using a pivoting mechanism, the third contact point is displaced by an outward movement of the compression roll in a substantially straight line rather than in an arc. In this way, a balanced disposition of the three bearing points is restored during rolling. However, the linear movement of the compression roll requires an extensive system of telescoping rods, arms and pivots, making the machine voluminous. Moreover, the solution of US5305963 focusses on the winding of compressible materials, e.g. strips of isolation material, where the compression roll has a limited contact surface with the material in order to enable sufficient compression of the strip during rolling. On the other hand, for rolling other materials like e.g. carpets, a larger contact surface at all contact points is preferred, causing a more uniform movement and tensioning of the windings. However, simply enlarging the diameter of the compression roll would prevent the formation of rolls with small inner diameter. Furthermore, the mechanism used in US5305963 for moving the compression roll cannot simply be transformed into moving e.g. a conveyor belt. Finally, US5305963 uses a horizontal and an inclined belt conveyor, where the head of the strip entering the winding space may tend to remain on the horizontal belt conveyor, thereby getting stuck between the ends of both conveyors. This limits the operational reliability of the provided system.

[0007] In US2005/0056163, another type of winding machine is described, where three continuous belts define a circular cavity establishing generally circumferential contact with the material. In this way, the compressible material is under compressive pressure as it is being rolled and consistent and uniformly shaped rolls are obtained. The circular cavity is defined by the positions of six belt rollers, which are moved following a linear displacement when the roll diameter grows. Accordingly, a mechanism is required to compensate for the changing belt length being in contact with the wound roll and to keep the belts under tension. Such a mechanism makes the machine complex and voluminous. Moreover, the circular positions of the belt rollers hamper easy ejection of the roll being formed. Finally, at the starting position, where the six belt rollers are positioned close to each other, the size of the circular cavity they define cannot be reduced to a very small size, due to the required diameter of the belt rollers themselves. Consequently, starting at a very small inner dimeter of the wound roll is impossible in this case.

[0008] It is an objective of the present invention to disclose a device and method for rolling strips of material, that resolves the above described shortcomings of the prior art solutions. More particularly, it is an objective to present a compact and reliable solution that allows to form rolls having a small inner and a large outer diameter, as well as uniformly wound windings and even end faces.

Summary of the Invention

[0009] According to a first aspect of the present invention, the above identified objectives are realized by a device for rolling strips of material, where

- the device comprises multiple conveyor belt systems;
- each of the conveyor belt systems comprises one or more endless belts supported on parallel rollers for longitudinal movement in response to rotation of the rollers; and
- the conveyor belt systems are configured to define a winding space for rolling the strips of material about a rotation axis parallel with the rotation axis of the rollers,

characterised in that

- the device comprises a positioning system configured to move at least one of the conveyor belt systems following a translation, such that the winding space is altered in accordance with the changing diameter of rolled material.

[0010] Thus, the invention concerns a device for rolling strips of material. A strip of material may be a carpet, e.g. a tufted or woven carpet, a wall to wall carpet, a carpet runner, etc. A strip of material may also refer to other types of material, like e.g. a strip of isolation material, artificial grass, furnishing fabrics, film, paper, etc. Rolling a strip of material comprises rolling up, i.e. starting from a strip and forming a wound roll, as well as unrolling, i.e. starting from a wound roll and unroll to obtain a strip.

[0011] The device according to the invention comprises multiple conveyor belt systems. This implies that during operation the device uses at least two conveyor belt systems to enable rolling. Optionally, the device may comprise more than two conveyor belt systems, or a mix of conveyor belt systems and one or more forming rollers or compression rolls. Typically, the device has the function of a rolling mechanism within a complete winding machine, where the latter comprises other components like a feeding system, a roll extracting system, a packaging system, etc.

[0012] Each of the conveyor belt systems comprises one or more endless belts supported on parallel rollers for longitudinal movement in response to rotation of the rollers. A conveyor belt system may e.g. comprise two parallel rollers with an endless loop of carrying medium that rotates about them. That carrying medium may comprise one endless belt or may be subdivided into multiple endless belts. Typically, such multiple endless belts are mutually parallel, each of them forming an endless loop. Typically, the one or more endless belts are tensioned, thereby defining in unloaded condition a substantially flat surface extending between the parallel rollers. In possible embodiments, a roller is cylindrical, where the axis of the cylinder is the rotation axis of the roller. In other embodiments, a roller may comprise multiple pulleys, each of them carrying an endless belt and being positioned on a common shaft, where the axis of the shaft is the rotation axis of the roller. In possible embodiments, each of the conveyor belt systems may comprise its own set of rollers. In other embodiments, a roller may be shared between two conveyor belt systems, i.e. both of the conveyor belt systems each comprise the shared roller and a separate roller. One or both of the rollers are powered, moving the one or more endless belts forward. The latter results in a longitudinal movement of the one or more endless belts from one roller to another.

[0013] The conveyor belt systems are configured to define a winding space for rolling the strips of material about a rotation axis parallel with the rotation axis of the rollers. A winding space is a space in which the roll is rolled up or unrolled on its own, i.e. without the roll being placed on e.g. a mandrel. In possible embodiments, the winding space is defined by conveyor belt systems only. In other embodiments additional forming rollers or compression rolls may contribute in defining the winding space During operation, a strip of material is fed into the winding space, and the conveyor belt systems cause the strip to successively contact the belt surfaces, thereby forming a spirally wound roll. Similarly, a wound roll put in the winding space may be unrolled by successively contacting the belt surfaces defining the winding space. The winding space is defined by conveyor belt systems and potentially additional compression rolls, in the sense that those systems force the strip of material to form a roll within that space. It does not mean however, that the winding space is a closed space or that it is completely physically bordered by conveyor belt systems or compression rolls.

[0014] The rotation of the roll during rolling up or unrolling occurs about a rotation axis being substantially parallel with the rotation axis of the rollers supporting the conveyor belt systems. Different shapes of winding space may occur in respective embodiments, e.g. the winding space may be triangular, rectangular, squared, circular, etc. Moreover, the number of contact points between the roll being wound and the conveyor belt systems or forming rollers defining the winding space may vary across different possible embodiments.

[0015] The device comprises a positioning system configured to move at least one of the conveyor belt systems following a translation, such that the winding space is altered in accordance with the changing diameter of rolled material. During rolling-up, the diameter of the wound roll gradually grows. Similarly, during unrolling, the diameter of the roll gradually diminishes. As such, the size of the winding space needs to be adapted accordingly. For this purpose, the device comprises a positioning system that is configured to move at least one of the conveyor belt systems during rolling. The conveyor belt system that is moved, is moved as a whole, i.e. the rollers and one or more belts comprised in the conveyor belt systems are moved together without changing their relative positions. The movement is such that the winding space is altered in accordance with the changing roll diameter. This implies that the movement takes place in a plane perpendicular to the rotation axis.

[0016] Furthermore, the movement is such that it follows a translation. A translation of an object in a specific plane is defined as a displacement in which every point of the object has the same travelled path. In other words, no rotational movement of the object takes place in that specific plane. For example, in a linear translation, every point of the object is displaced over the same distance and following the same direction. In another example, every point follows a path defined by two consecutive line segments. In yet another example, every point follows the same curved trajectory. Thus, considering a cross section of a conveyor belt system in a plane perpendicular to the rotation axis, and considering a direction defined by the rollers in that plane, the movement of the conveyor belt system is such that the cross section moves in said plane, thereby not changing said direction relative to non-moving parts of the device.

[0017] In example embodiments, one conveyor belt system may be moved following a translation, or two conveyor belt systems may be moved, or more of them may be moved. Moreover, in possible embodiments, two conveyor belt systems may be moved, each of them following a different translation. E.g., one conveyor belt system may be translated perpendicular to the direction defined by its two rollers, while another conveyor belt system may be translated in line with the direction defined by its two rollers.

[0018] The invention is advantageous compared to solutions known in the prior art, because of various aspects. Firstly, the use of conveyor belt systems for rolling a strip of material ensures a proper contact zone between the roll surface and the belt surfaces, thereby enabling a reliable movement of the strip without overcompressing the material at specific contact points. Furthermore, by making use of driven conveyor belt systems, the belts do not drag on the material being rolled, thereby avoiding traces on the rolled material. Conveyor belt systems may also easily be configured to carry or support the roll during winding.

[0019] Moreover, in contrast to solutions known in the prior art where a pivoting mechanism is used to adapt the winding space according to the changing roll diameter, the translational movement of one or more conveyor belt systems allows to scale the winding space uniformly, while keeping the contact points between the belt surfaces and the material equally distributed across the roll. This contributes to a high rolling quality, where rolls with uniformly wound windings are being formed. Moreover, it avoids the risk of the roll unintentionally jumping out of the winding space at higher rolling diameters, which allows for reliable rolling of high-length strips.

[0020] Furthermore, the translational movement of the conveyor belt system(s) allows to rescale the winding space ranging from a space practically zero, to a very large space. Contrary to prior art solutions using a moving compression roll, where the minimal size of the winding space is limited due to the space taken by the compression roll, the translational movement of a conveyor belt system allows to obtain a very small winding space, e.g. by using separate belts on the moving system alternating with belts on non-moving conveyor belts systems. Consequently, rolling-up can be started at a very small inner diameter, which leads to less voluminous wound rolls, even for high-length strips.

[0021] Another advantage of the invention is that the positioning system is configured to move a conveyor belt system as a whole. This implies that the length and tension of the one or more belts is not changed during the movement of the conveyor belt system, such that no additional system is needed to compensate for the changing length or to keep the belts tensioned. This contributes to obtaining a simple and compact device. Moreover, also a translational movement of a conveyor belt system can be accomplished with a simple and compact system, e.g. using one or more linear guides.

[0022] Optionally, the translation is such that the direction of the at least one of the conveyor belt systems, defined by the relative position of the rollers in a plane perpendicular to the rotation axis, is maintained. Thus, considering a conveyor belt system that is moving following a translation in a plane perpendicular to the rotation axis of the roll being wound, during that translation the direction of the moving conveyor belt system remains unchanged. The direction of that conveyor belt system is defined by considering the cross sections of the conveyor's rollers in the plane perpendicular to the rotation axis, e.g. considering a straight line between the centre points of those cross sections. This direction may e.g. also be the direction of substantially straight belts running between two rollers. Keeping the relative position of the rolls implies that the angles between belts of different conveyor belt systems are maintained during adaptation of the winding space. Consequently, a uniform scaling of the winding space is obtained, while keeping the contact points between the belt surfaces and the material equally distributed across the roll. This contributes to a high rolling quality, where rolls with uniformly wound windings are being formed. Moreover, it avoids the risk of the roll unintentionally jumping out of the winding space at higher rolling diameters, which allows for reliable rolling of high-length strips

[0023] Optionally, the translation is such that length of the at least one of the conveyor belt systems, defined by the mutual distance of the rollers in a plane perpendicular to the rotation axis, is maintained. This implies that for the moving conveyor belt system, during its translation, the length of the belts extending between the rollers, does not change. Consequently, the length and tension of the one or more belts is not changed during the movement of the conveyor belt system, such that no additional system is needed to compensate for a changing belt length or to keep the belts tensioned. This contributes to obtaining a simple and compact device.

[0024] Optionally, at least two of the conveyor belt systems each comprise a series of individual endless belts, where the respective series are configured to alternate with one another. Thus, the device comprises at least two conveyor belt systems with alternating belts. This means that each of those conveyor belt systems comprises multiple individual endless belts, the belts being separated from each other and typically being substantially parallel. Considering e.g. two conveyor belt systems, comprising respectively a first and a second series of individual belts, the belts of the second series alternate with the belts of the first series in the spaces between the belts of the first series. Providing such alternating belts has the advantage that it allows to easily rescale the winding space according to the changing roll diameter. Indeed, while moving one conveyor belt system, its movement is not obstructed by another conveyor belt system, as their alternating belts simply are crossing without intersecting. As such, simply moving the conveyor belt system as a whole suffices to adapt the winding space, without the need for changing belt lengths or tensioning. Furthermore, as the movement of a conveyor belt system is not prevented by other conveyor belt systems, a winding space being practically zero can be obtained. In this, the minimal size of the winding space is not limited by the space taken by a compression roll or belt rollers. Therefore, the invention allows to form rolls having a very small inner diameter. Furthermore, by defining the winding space making use of alternating belts, the head of a strip entering the winding space will be prevented to get stuck between two conveyor belt systems. This contributes to a reliable solution.

[0025] Optionally, the one or more endless belts comprise a non-curved surface configured to border said winding space. For example, a conveyor belt system may comprise two parallel rollers and the one or more belts extending between those two rollers define a substantially flat surface contacting the roll being wound. This implies that the winding space defined by these conveyor belt systems has physical borders being substantially straight lines in a plane perpendicular to the rotation axis. Providing non-curved endless belts has the advantage that the conveyor belt system is simple and robust, while enabling sufficient contact between the belts and the material being wound.

[0026] Optionally, the device comprises at least three conveyor belt systems. In an example embodiment, the three conveyor belt systems may define a triangular winding space. In another embodiment, the device may comprise three conveyor belt systems and one or more additional compression rolls. In yet another embodiment, the device may comprise more than three conveyor belt systems, e.g. four conveyor belt systems defining a rectangular or square winding space.

[0027] Optionally, the device comprises four conveyor belt systems, configured to define a square winding space. This implies that the winding space is defined by four substantially straight lines in the plane perpendicular to the rotation axis, of which intersecting lines are substantially perpendicular. It does not mean however that four physical borders are present that fully close the winding space. For example, a gap may be left between two conveyor belt systems in order to allow the strip of material to enter the winding space. A square winding space has the advantage that four contact points with the wound roll are obtained, being equally distributed across its circumference. This allows to obtain a roll with a quite perfect circular cross section and uniformly wound windings.

[0028] Optionally, the sides of the square winding space each are at an angle of 45° with the horizontal ground position of the device. This means that, relative to a horizontal ground, the four conveyor belt systems have an inclined direction, defining a square winding space with an angle pointing upwards and an angle pointing downwards. This has the advantage that during rolling the roll will easily find a stable position through its own weight, which contributes to obtaining uniformly wound windings. Moreover, a tube can easily be fed into the winding space, after which the strip of material entering the winding space will tilt the tube and start rolling on the tube. As such, the device allows to form rolls being wound on a tube. Furthermore, the inclined conveyor belt systems allow for an easy ejection of the roll, where e.g. by pivoting one of the systems, the roll leaves the winding space automatically due to gravity.

[0029] Optionally, the multiple conveyor belt systems comprise a first conveyor belt system, and the positioning system is configured to move the first conveyor belt system following a first linear translation, where the direction of the first linear translation makes an angle of 45° with the surface of the first conveyor belt system. Thus, a particular conveyor belt system is considered, referred to as a first conveyor belt system, which is configured to move during winding, following a linear translation. A linear translation implies that, in a plane perpendicular to the rotation axis, all points of the first conveyor belt system move following a straight line. Moreover, the direction of this linear translation makes an angle of 45° with the non-curved surface defined by the one or more belts of the first conveyor belt system. As this non-curved surface makes an angle of 45° with a horizontal ground position of the device, this implies that the direction of the linear translation is vertical, i.e. substantially perpendicular to the horizontal ground position. In this way, the vertical linear translation of the first conveyor belt system allows to easily rescale the square winding space, according to the changing diameter of the wound roll.

[0030] In an example embodiment, the first linear translation may be non-driven, e.g. merely being induced by the changing diameter of the rolled material. For example, as the diameter grows the roll may simply push the first conveyor belt system upwards, thereby causing it to move on vertical guides. In another embodiment, the first linear translation may be driven, e.g. by an electric motor.

[0031] Optionally, the multiple conveyor belt systems comprise a second conveyor belt system, the positioning system is configured to move the second conveyor belt system following a second linear translation, where the direction of the second linear translation is parallel with the surface of the second conveyor belt system. Thus, another particular conveyor belt system is considered, referred to as a second conveyor belt system, which is configured to move during winding, following a linear translation. The linear translation is such that the second conveyor belt system is moved substantially parallel with its own non-curved surface defined by its one or more belts. This allows to easily rescale the square winding space during rolling. Moreover, it provides the possibility, in an example embodiment, to leave a gap between the second conveyor belt system and another conveyor belt system defining the square winding space, by simply controlling how much the second conveyor belt system is translated. Such a gap allows to easily feed the strip of material into the winding space.

[0032] Optionally, the square winding space comprises a gap adapted to feed the strip of material into the winding space. This implies that the square winding space is not fully closed by physical borders, but a gap is present to allow a strip of material to enter the winding space. In an embodiment, this gap may be set at minimal size, i.e. leaving just enough space to pass the strip, while maximally surrounding the roll being formed with belt surfaces.

[0033] Optionally, the device comprises a component configured to set the pressure by one or more of the conveyor belt systems on the rolled material. For example, the device may be set such that the roll being wound encounters a counter-pressure caused by the conveyor belt systems defining the upper sides of the winding space. For certain types of material or certain material qualities, it may be advantageous to roll-up under such a pressure, while other materials need to be rolled-up without pressure. The pressure may be set using a counterweight, a piston, a hydraulic cylinder, etc. This has the advantage that for different types or qualities of material an optimal rolling quality can be obtained.

[0034] Optionally, the winding space is defined such that ejection of the rolled material and feeding of the strip of material both take place at the same side of the winding space. This has the advantage that all the equipment needed for feeding the strip of material to the rolling device and all the equipment needed for processing the roll after winding may be located at the same side of the rolling device, while having a compact design for the rolling device itself. Moreover, feeding and ejecting at the same side of the device has the advantage that no unrolling of the wound roll occurs during ejection. Therefore, no closing of the roll before ejection is needed.

[0035] According to a second aspect of the present invention, the above identified objectives are realized by an apparatus comprising

- a device according to the first aspect of the invention;
- a feeding system configured to feed a strip of material to the device;
- a sensing unit configured to measure the alignment of the strip of material relative to said feeding system;
- an edge control system configured to adapt the position of the device relative to the feeding system according to said alignment.

[0036] Thus, the second aspect of the invention concerns an apparatus comprising a device for rolling a strip of material and a feeding system adapted to feed the strip to the rolling device. Furthermore, the apparatus comprises a sensing unit, e.g. a photocell, sensor, camera, etc. The sensing unit is adapted to measure the alignment of the strip of material when feeding the strip of material to the winding space. The alignment is defined as the orientation of the strip with respect to the rotation axis of the rolling movement. If the strip is fed to the winding space while its side edges are not perpendicular to the rotation axis, a risk for telescoping during rolling occurs. As such, a misalignment may be detected by the sensing unit. Moreover, the apparatus comprises an edge control system configured to adapt the position of the device relative to the feeding system. For example, when the device is on a horizontal ground plane, the entire device is moved in this plane, e.g. using wheels riding on the ground plane. The direction and amount of this movement is based on the alignment, or misalignment, detected by the sensing unit. This allows to form a roll where the side edges of the strip are perpendicular to the rotation axis, such that telescoping of the roll during winding is avoided. This contributes to obtaining rolls with even end faces.

[0037] According to a third aspect of the present invention, the above identified objectives are realized by a method for rolling strips of material, comprising:

- providing a device comprising multiple conveyor belt systems, each of the conveyor belt systems comprising one or more endless belts supported on parallel rollers for longitudinal movement in response to rotation of the rollers, and the conveyor belt systems being configured to define a winding space for rolling the strips of material about a rotation axis parallel with the rotation axis of the rollers;
- rolling strips of material inside the winding space;
- moving at least one of the conveyor belt systems following a translation, such that the winding space is altered in accordance with the changing diameter

of rolled material.

Brief Description of the Drawings

[0038]

Fig. 1 shows a cross section, perpendicular to the rotation axis of the roll 200 being wound, of an embodiment of the device 100 according to the invention, together with a feeding system 105 and a supporting system 116 for carrying the roll 200 after ejection from the device 100. Fig. 2 gives a closer view of the rolling mechanism of Fig. 1. Both Fig.1 and Fig. 2 illustrate a situation with small roll diameter, i.e. at the start of rolling-up.

Fig. 3 shows a cross section, perpendicular to the rotation axis of the roll 200 being wound, of an embodiment of the device 100 according to the invention, together with a feeding system 105 and a supporting system 116. Fig. 4 gives a closer view of the rolling mechanism of Fig. 3. Both Fig.3 and Fig. 4 illustrate a situation with larger roll diameter, i.e. at the end of rolling-up.

Fig. 5 shows a cross section, perpendicular to the rotation axis of the roll 200 being wound, of an embodiment of the device 100 according to the invention, together with a feeding system 105 and a supporting system 116. Fig. 5 illustrates a situation after ejection of the roll 200 from the device 100.

Fig. 6 and Fig. 7 both give a 3D-representation of the device 100 according to the invention.

Fig. 8 gives a 3D view taken from within the winding space 400, when looking downwards, i.e. towards the ground position.

Fig. 9 gives a 3D view taken from within the winding space 400, when looking upwards.

Fig. 10 gives a closer view on the winding space 400 of Fig. 4.

Detailed Description of Embodiment(s)

[0039] Fig. 1 and Fig. 3 show an embodiment of the device 100 according to the invention, together with a feeding system 105 and a supporting system 116 for carrying the roll 200 after ejection from the device 100. In the further discussion we consider the situation of a roll being wound, i.e. starting from a strip of material, during rolling a roll 200 is formed. Fig. 1 shows the device 100 when rolling just has started, while Fig. 3 shows the device 100 at the end of a rolling cycle. Fig. 2 and Fig. 4 give a closer view of the device 100 shown in Fig. 1 and Fig. 3 respectively. Rolling happens within a winding space 400, which is also shown in Fig. 10.

[0040] The device 100 comprises a frame 602, shown in the 3D-views of Fig. 6 and Fig. 7. Typically, the frame allows the device 100 to be standing on a floor being substantially flat. The direction of the ground level, indicated as 117 in Fig. 1 is defined as horizontal. The direction perpendicular to the horizontal direction 117, in the plane of Fig. 1, is defined as vertical. In the cross section shown in Fig. 1, 2, 3 and 4, rolling of the material occurs about a rotation axis being substantially perpendicular to the plane of the figure.

[0041] In the embodiment of the figures, the device 100 comprises four conveyor belt systems: 101, 102, 103 and 104. The conveyor belt system 102 comprises two rollers 201, 203 and endless belts 207. The conveyor belt system 104 comprises two rollers 600, 208 and endless belts 401. The conveyor belt system 101 comprises endless belts 206, a roller 202 and a roller 205. The latter roller 205 is used in common by both the conveyor belt systems 101 and 103. The conveyor belt system 103 comprises the shared roller 205, a roller 204, and endless belts 402. In the shown embodiment, the rollers 201, 203, 600, 208, 202, 205 and 204 are cylindrical, where the axis of the cylinder is the rotation axis of the roller. The rollers 201, 203, 600, 208, 202, 205 and 204 are mutually parallel, and each of them is substantially parallel with the rotation axis of the rolling movement. In the cross section shown in Fig. 1, 2, 3 and 4 the axis of the rollers 201, 203, 600, 208, 202, 205, 204 is substantially perpendicular to the plane of the figure. In other embodiments, a roller may comprise multiple pulleys, each of them carrying an endless belt and being positioned on a common shaft, where the axis of the shaft is the rotation axis of the roller.

[0042] In the shown embodiment, each of the conveyor belt systems comprises multiple endless belts, as can be seen in the 3D-representations of Fig. 6 and 7, and in the views given in Fig. 8 and Fig. 9. The multiple endless belts comprised in one conveyor belt system are separated and mutually parallel. Moreover, the multiple belts comprised in one conveyor belt system alternate with the multiple belts of another conveyor belt system. Fig. 8 shows a view made from within the winding space 400, when looking downwards. As such, a view on the conveyor belts systems 101 and 103 is given. Fig. 8 shows that the endless belts 402 of conveyor belt system 103 alternate with the endless belts 206 of conveyor belt system 101. Both series of belts are supported on a common roller 205. The roller 205 is driven by an electric motor 111. Fig. 9 shows a view made from within the winding space 400, when looking upwards. As such, a view on the conveyor belts systems 102 and 104 is given. Fig. 9 shows that the endless belts 207 of conveyor belt system 102 alternate with the endless belts 401 of conveyor belt system 104. Fig. 6 shows that the roller 203, comprised in conveyor belt system 102, is driven by an electric motor 601. Fig. 4 shows that the roller 208, comprised in conveyor belt system 104, is driven by an electric motor 110. In the embodiment shown in the figures, the three driven rollers, 205, 208 and 203, each have their own motor. This has the advantage that speed and tensioning of the belts comprised in the various conveyor belt systems can be controlled individually. In other embodiments, however, a single drive in common by multiple conveyor belt systems may be present.

[0043] In the embodiment illustrated in the given figures, the four conveyor belt systems 101, 102, 103, 104 together define a square winding space 400, in which a roll 200 is formed during rolling. The cylindrical rollers 201, 203, 600, 208, 202, 205 and 204 are configured to rotate about their axis, thereby causing a longitudinal movement of the endless belts. During operation, a strip of material is fed into the winding space 400 through the gap 1000, indicated in Fig. 10. The conveyor belt systems 101, 102, 103, 104 cause the strip to successively contact the belt surfaces, thereby forming a spirally wound roll 200. As such, the roll 200 is rolled up on its own, i.e. without the roll being placed on e.g. a mandrel. Remark that for the clearness of representation the strip of material being fed to the winding space 400 during rolling is not shown in the figures. For the same reason, individual windings comprised in the roll 200 have not been drawn.

[0044] In the embodiment shown, the winding space 400 is square in shape, where the belts of different conveyor belt systems cross each other at angles being substantially 90°. In this way a roll with perfect circular cross section is obtained. Moreover, the square winding space 400 provides four equidistant contact points with belts across the circumference of the roll 200, such that uniformly wound windings are obtained. Moreover, in the embodiment shown, the square shape of the winding space 400 is tilted relatively to the horizontal ground position 117, i.e. its straight sides are at an angle of 45° with the horizontal ground position 117. This is due to the inclined positioning, at 45° relative to the ground 117, of the different conveyor belt systems 101, 102, 103, 104. In this way, the position of the roll 200 is kept stable during rolling, due to its own weight, contributing to obtain uniformly wound windings.

[0045] In the embodiment shown, the winding space 400 is almost completely bordered by belt surfaces, comprised in the endless belts 207, 401, 206, 402, except for the gap 1000. In this way, the roll 200 cannot leave the winding space during rolling, at any stage of the rolling cycle. This allows to start a small inner diameter, and to end up at large outer diameter. The belt surfaces bordering the winding space 400 also prevent the strip to get stuck in between individual conveyor belt systems.

[0046] In other embodiments of the invention, more or less than four conveyor belt systems may be provided to define the winding space. For example, three conveyor belt systems may be used to define a triangular winding space. In yet another embodiment, the conveyor belt system 104 may be absent, while the three other conveyor belt systems 101, 102, 103 still define a square winding space, being opened at one side.

[0047] Comparing Fig. 2 and Fig. 4 shows that during rolling the winding space 400 is rescaled according to the growing roll diameter. In the embodiment shown, the rescaling of the winding space 400 is established due to a first translational movement of the conveyor belt system 102 and a second translational movement of the conveyor belt system 104. The first translational movement has a vertical direction, i.e. the conveyor belt system 102 is moved upward during rolling, on linear guides 404 being indicated on Fig. 4. During this first translation, also the conveyor belt system 104 is moved upward, together with the conveyor belt system 102. The second translation includes a translation of the conveyor belt system 104 in line with its own direction. Thus, when moving the system 102 vertically, the system 104 shifts more into the winding space 400, thereby closing the winding space 400, but leaving a gap 1000. The alternating belts of the various conveyor belt systems 101, 102, 103, 104 allow to easily rescale the winding space 400, by moving each of the conveyor belt systems 102 and 104 as a whole, i.e. without changing the length or direction of the belts 207 respectively 401.

[0048] The scaling mechanism as described above allows for a simple and compact mechanism to establish the rescaling of the winding space 400. Adapting the winding space 400 according to the growing roll diameter allows to keep a perfect square winding space 400 at any stage of the rolling cycle, thereby guaranteeing uniformly wound windings. In other embodiments, the rescaling of the winding space 400 according to the changing roll diameter, may be realised otherwise. For example, embodiments are possible where the conveyor belt systems 102 and 104 each are translated in a direction perpendicular to their own belt surfaces to establish the rescaling of the winding space 400. In another example embodiment, all of the conveyor belt systems 101, 102, 103, 104 may be translated to enable the rescaling.

[0049] In the shown embodiment, the first translation is not driven by an electric motor or any other drive system requiring external energy. Instead, the vertical movement of the conveyor belt systems 102 and 104 is induced by the growing diameter of the roll, where the roll itself pushes upwards to these conveyor belt systems 102, 104. A toothed rail 107 ensures a synchronous upward movement over the entire width of the device 100, the width being defined as the dimension parallel with the rotation axis of the rollers. Other embodiments are possible however, where the first translation is e.g. driven by an electric motor and controlled based on a measured roll diameter. In the embodiment shown, the weight of the systems 102 and 104 is balanced by means of a counterweight 112, using a cable 108 running over a wheel 109. When both the weight 112 and the systems 102, 104 are in balance, no pressure is executed on the roll 200 being wound by the systems 102, 104. A counter-pressure can be established however, by means of a pneumatic cylinder 403. It allows to set a chosen pressure, by means of a proportional valve. In this way, rolling can be done pressure-free or under a chosen pressure, depending on e.g. the material type or material quality.

[0050] In the shown embodiment, the second translational movement of the conveyor belt system 104 is driven by an electric motor 106. For example, this movement is controlled based on a measured vertical position of the conveyor belt system 102. E.g., when the system 102 moves upward in the first translation, the system 104 shifts into the winding space 400 proportionally to the upward movement. In another embodiment the second translation of the conveyor belt system 104 may be controlled based on a measured size of the gap 1000. In this case, the system 104 shifts into the winding space 400 until a predefined gap 1000 is obtained.

[0051] The feeding system 105 allows to feed a strip of material towards the device 100. It comprises a frame 120, and an endless belt 118 supported on rollers 119. To start rolling, one end of the strip of material is positioned on the endless belt 118. For example, it is positioned with the head edge perpendicular to the plane of Fig. 1, thus parallel with the rotation axis of the rolling in device 100, and the side edges perpendicular to the rotation axis of the rolling in device 100. If no telescoping happens during rolling, then a roll 200 with even end faces is obtained. Optionally, a tube, e.g. in plastic or cardboard, may be provided into the winding space 400 before the feeding of the strip of material into the winding space 400 starts. A tube may be provided automatically out of a tube dispenser, or it may be put manually in the winding space 400. Due to the light weight of the tube, the head of the strip of material will lift the tube when entering the winding space 400, such that rolling occurs around the tube, and a roll 200 with inner tube is being formed.

[0052] Fig. 5 shows how, after ending the rolling cycle, the roll 200 may be ejected from the device 100. In possible embodiments, the roll 200 may first be packaged in e.g. a film, plastic or paper, or be closed with a tag, before being ejected from the winding space 400. For ejection, the conveyor belt systems 102 and 104 are fixed as to keep them at their maximal vertical position, e.g. using a pneumatic cylinder or motor. Next, the conveyor belt system 103 is pivoted using pneumatic cylinders 114. As shown in Fig. 6 two of such cylinders 114 are present in this embodiment, which allow to pivot the complete conveyor belt system 103. Fig. 5 shows that by pivoting the system 103, the winding space 400 is opened, such that the roll 200 can leave the winding space 400. After ejection of the roll 200, the conveyor belt systems 102 and 104 are brought back to their starting position, e.g. using a pneumatic cylinder or motor, ready to start a new rolling cycle.

[0053] Fig. 5 shows that after having pivoted the conveyor belt system 103 to open the winding space 400, the roll 200 will automatically roll out of the winding space 400, under its own weight, due to the inclination of 45° of the conveyor belt system 101. After being ejected, the roll 200 ends up on a supporting system 116. From there on, further process steps may be executed. As shown in the embodiment of Fig. 5, ejection of the roll 200 and feeding of the strip of material both occur at the same side of the device 100. The gap 1000 being present in the winding space 400 for feeding is simply enlarged to allow for ejection, by pivoting the conveyor belt system 103. In this way a simple and robust ejection mechanism is provided, while the rolling device 100 is given a compact design enabling rolling and rescaling of the winding space 400. Feeding and ejecting at the same side of the device 100 also has the advantage that the roll 200 will not start unrolling during ejection. As such, the roll 200 needs not to be closed before ejection.

[0054] Fig. 7 shows that a sensing unit 700, e.g. a photocell, may be provided to measure the alignment of the strip of material when feeding the strip of material to the winding space 400. The sensing unit 700 cannot be seen in the cross sections shown in Fig. 1 to 5. To better illustrate its positioning, however, the sensing unit 700 is symbolically presented in Fig. 10, where its sensing direction is indicated with an arrow 1001. The sensing unit 700 allows to detect whether the side edges of the strip are perpendicular to the rotation axis when the strip is fed to the winding space 400. Alternatively, other types of sensor units 700 may be used, e.g. a camera, light sensor, etc. As shown in the embodiment of Fig. 7, the sensor unit 700 is fixed to the frame 602 using bars 701. It measures the alignment of the strip, at the transfer between the feeding system 105 and the conveyor belt system 103.

[0055] The measurement of the sensing unit may be used by an edge control system, being configured to adapt the position of the device 100 relative to the feeding system 105. This means that the entire device 100 is moved within a horizontal plane, e.g. using wheels 115 and driven by a motor 113. In this way, the rotation axis of the device 100 can be repositioned such that it becomes perpendicular again to the edges of the strip entering the device 100. This prevents telescoping during rolling, contributing to obtain rolls 200 with even end faces.

[0056] Although the present invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that the invention is not limited to the details of the foregoing illustrative embodiments, and that the present invention may be embodied with various changes and within the scope of the appended claims. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein. In other words, it is contemplated to cover any and all modifications, variations or equivalents that fall within the scope of claims and whose essential attributes are claimed in this patent application. It will furthermore be understood by the reader of this patent application that the words "comprising" or "comprise" do not exclude other elements or steps, that the words "a" or "an" do not exclude a plurality, and that a single element, such as a computer system, a processor, or another integrated unit may fulfil the functions of several means recited in the claims. Any reference signs in the claims shall not be construed as limiting the respective claims concerned. The terms "first", "second", third", "a", "b", "c", and the like, when used in the description or in the claims are introduced to distinguish between similar elements or steps and are not necessarily describing a sequential or chronological order. Similarly, the terms "top", "bottom", "over", "under", and the like are introduced for descriptive purposes and not necessarily to denote relative positions.

[0057] The term 'perpendicular' or 'substantially perpendicular' to a direction is in this context defined as making an angle of 90° with this direction, with a tolerance of plus or minus 10°, preferably 5°, more preferably 3°. The term 'parallel' or 'substantially parallel' with a direction is in this context defined as making an angle of 0° with this direction, with a tolerance of plus or minus 10°, preferably 5°, more preferably 3°.

Claims

1. A device (100) for rolling strips of material, where

- said device (100) comprises multiple conveyor belt systems (102);
- each of said conveyor belt systems (102) comprises one or more endless belts (207) supported on parallel rollers (201, 203) for longitudinal movement in response to rotation of said rollers (201, 203); and
- said conveyor belt systems (102) are configured to define a winding space (400) for rolling said strips of material about a rotation axis parallel with the rotation axis of said rollers (201, 203),

characterised in that

- said device (100) comprises a positioning system configured to move at least one of said conveyor belt systems (102) following a translation, such that said winding space (400) is altered in accordance with the changing diameter of rolled material (200).

2. A device (100) according to claim 1, wherein said translation is such that the direction of said at least one of said conveyor belt systems (102), defined by the relative position of said rollers (201, 203) in a plane perpendicular to said rotation axis, is maintained.

3. A device (100) according to claim 2, wherein said translation is such that length of said at least one of said conveyor belt systems (102), defined by the mutual distance of said rollers (201, 203) in a plane perpendicular to said rotation axis, is maintained.

4. A device (100) according to one of the preceding claims, wherein at least two of said conveyor belt systems (102) each comprise a series of individual endless belts (207), where said respective series are configured to alternate with one another.

5. A device (100) according to one of the preceding claims, wherein said one or more endless belts (207) comprise a non-curved surface configured to border said winding space (400).

6. A device (100) according to one of the preceding claims, wherein said device (100) comprises at least three conveyor belt systems (102).

7. A device (100) according to claim 5 and 6, wherein said device (100) comprises four conveyor belt systems (102), configured to define a square winding space (400).

8. A device (100) according to claim 7, wherein the sides of said square winding space (400) each are at an angle of 45° with the horizontal ground position (117) of said device (100).

9. A device (100) according to claim 8, wherein

said multiple conveyor belt systems (102) comprise a first conveyor belt system (102), and said positioning system is configured to move said first conveyor belt system (102) following a first linear translation, where the direction of said first linear translation makes an angle of 45° with said surface of said first conveyor belt system (102).

10. A device (100) according to claim 9, wherein

said multiple conveyor belt systems (104) comprise a second conveyor belt system (104), and said positioning system is configured to move said second conveyor belt system (104) following a second linear translation, where the direction of said second linear translation is parallel with said surface of said second conveyor belt system (104).

11. A device (100) according to claim 7, wherein said square winding space (400) comprises a gap

(1000) adapted to feed said strip of material into said winding space (400).

12. A device (100) according to one of the preceding claims, wherein
said device (100) comprises a component (403) configured to set the pressure by one or more of said conveyor belt systems (102) on said rolled material (200).

13. A device (100) according to one of the preceding claims, wherein
said winding space (400) is defined such that ejection of said rolled material (200) and feeding of said strip of material both take place at the same side of said winding space (400).

14. An apparatus comprising

- a device (100) according to one of the preceding claims;
- a feeding system (105) configured to feed a strip of material to said device (100);
- a sensing unit (700) configured to measure the alignment of said strip of material relative to said feeding system (105);
- an edge control system configured to adapt the position of said device (100) relative to said feeding system (105) according to said alignment.

15. A method for rolling strips of material, comprising:

- providing a device (100) comprising multiple conveyor belt systems (102), each of said conveyor belt systems (102) comprising one or more endless belts (207) supported on parallel rollers (201, 203) for longitudinal movement in response to rotation of said rollers (201, 203), and said conveyor belt systems (102) being configured to define a winding space (400) for rolling said strips of material about a rotation axis parallel with the rotation axis of said rollers (201, 203);
- rolling said strips of material inside said winding space (400);
- moving at least one of said conveyor belt systems (102) following a translation, such that said winding space (400) is altered in accordance with the changing diameter of rolled material (200).

Patentansprüche

1. Vorrichtung (100) zum Walzen von Materialstreifen, wobei

- die Vorrichtung (100) mehrere Förderbandsysteme (102) umfasst;
- jedes der Förderbandsysteme (102) ein oder mehrere Endlosbänder (207) umfasst, die auf parallelen Rollen (201, 203) zur Längsbewegung als Reaktion auf eine Drehung der Rollen (201, 203) gelagert sind; und
- die Förderbandsysteme (102) dazu konfiguriert sind, einen Wickelraum (400) zum Walzen der Materialstreifen um eine Drehachse parallel zu der Drehachse der Rollen (201, 203) zu definieren,

dadurch gekennzeichnet, dass

- die Vorrichtung (100) ein Positioniersystem umfasst, das dazu konfiguriert ist, mindestens eines der Förderbandsysteme (102) einer Translation folgend derart zu bewegen, dass der Wickelraum (400) entsprechend dem sich verändernden Durchmesser des Walzmaterials (200) geändert wird.

2. Vorrichtung (100) nach Anspruch 1, wobei
die Translation derart ist, dass die Richtung des mindestens einen der Förderbandsysteme (102), die durch die relative Position der Rollen (201, 203) in einer Ebene senkrecht zu der Drehachse definiert ist, beibehalten wird.

3. Vorrichtung (100) nach Anspruch 2, wobei
die Translation derart ist, dass die Länge des mindestens einen der Förderbandsysteme (102), die durch den gegenseitigen Abstand der Rollen (201, 203) in einer Ebene senkrecht zu der Drehachse definiert ist, beibehalten wird.

4. Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei
mindestens zwei der Förderbandsysteme (102) jeweils eine Reihe von einzelnen Endlosbändern (207) umfassen, wobei die jeweiligen Reihen derart konfiguriert sind, dass sie sich gegenseitig abwechseln.

5. Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei
das eine oder die mehreren Endlosbänder (207) eine nicht gekrümmte Oberfläche umfassen, die dazu konfiguriert ist, den Wickelraum (400) zu begrenzen.

6. Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei die Vorrichtung (100) mindestens drei Förderbandsysteme (102) umfasst.

7. Vorrichtung (100) nach Anspruch 5 und 6, wobei
die Vorrichtung (100) vier Förderbandsysteme (102) umfasst, die dazu konfiguriert sind, einen quadratischen Wickelraum (400) zu definieren.

8. Vorrichtung (100) nach Anspruch 7, wobei die Seiten des quadratischen Wickelraums (400) jeweils einen Winkel von 45° zu der horizontalen Bodenposition (117) der Vorrichtung (100) aufweisen.

9. Vorrichtung (100) nach Anspruch 8, wobei

die mehreren Förderbandsysteme (102) ein erstes Förderbandsystem (102) umfassen, und das Positionierungssystem dazu konfiguriert ist, das erste Förderbandsystem (102) einer ersten linearen Translation folgend zu bewegen, wobei die Richtung der ersten linearen Translation einen Winkel von 45° zu der Oberfläche des ersten Förderbandsystems (102) bildet.

10. Vorrichtung (100) nach Anspruch 9, wobei

die mehreren Förderbandsysteme (104) ein zweites Förderbandsystem (104) umfassen, und
das Positionierungssystem dazu konfiguriert ist, das zweite Förderbandsystem (104) einer zweiten linearen Translation folgend zu bewegen, wobei die Richtung der zweiten linearen Translation parallel zu der Oberfläche des zweiten Förderbandsystems (104) ist.

11. Vorrichtung (100) nach Anspruch 7, wobei der rechteckige Wickelraum (400) einen Spalt (1000) umfasst, der dazu ausgelegt ist, den Materialstreifen in den Wickelraum (400) zuzuführen.

12. Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei
die Vorrichtung (100) eine Komponente (403) umfasst, die dazu konfiguriert ist, den Druck durch eines oder mehrere der Förderbandsysteme (102) auf das Walzmaterial (200) einzustellen.

13. Vorrichtung (100) nach einem der vorhergehenden Ansprüche, wobei
der Wickelraum (400) derart definiert ist, dass ein Auswurf des Walzmaterials (200) und das Zuführen des Materialstreifens beide auf derselben Seite des Wickelraums (400) stattfinden.

14. Einrichtung, umfassend

- eine Vorrichtung (100) nach einem der vorhergehenden Ansprüche;
- ein Zuführsystem (105), das dazu konfiguriert ist, der Vorrichtung (100) einen Materialstreifen zuzuführen;
- eine Erfassungseinheit (700), die dazu konfiguriert ist, die Ausrichtung des Materialstreifens im Verhältnis zu dem Zuführsystem (105) zu messen;
- ein Kantensteuersystem, das dazu konfiguriert ist, die Position der Vorrichtung (100) im Verhältnis zu dem Zuführsystem (105) gemäß der Ausrichtung anzupassen.

15. Verfahren zum Walzen von Materialstreifen, umfassend:

- Bereitstellen einer Vorrichtung (100), umfassend mehrere Förderbandsystemen (102), wobei jedes der Förderbandsysteme (102) ein oder mehrere Endlosbänder (207) umfasst, die auf parallelen Rollen (201, 203) zur Längsbewegung als Reaktion auf eine Drehung der Rollen (201, 203) gelagert sind, und wobei die Förderbandsysteme (102) dazu konfiguriert sind, einen Wickelraum (400) zum Walzen der Materialstreifen um eine Drehachse parallel zu der Drehachse der Rollen (201, 203) zu definieren;
- Walzen der Materialstreifen innerhalb des Wickelraums (400);
- Bewegen mindestens eines der Förderbandsysteme (102) einer Translation folgend derart, dass der Wickelraum (400) entsprechend dem sich verändernden Durchmesser des Walzmaterials (200) geändert wird.

Revendications

1. Dispositif (100) destiné à l'enroulement de bandes de matériau,

- ledit dispositif (100) comprenant de multiples systèmes de courroie transporteuse (102) ;
- chacun desdits systèmes de courroie transporteuse (102) comprenant une ou plusieurs courroies sans fin (207) supportées sur des rouleaux parallèles (201, 203) pour un mouvement longitudinal en réponse à la rotation desdits rouleaux (201, 203) ; et
- lesdits systèmes de courroie transporteuse (102) étant conçus pour définir un espace de bobinage (400) destiné à l'enroulement desdites bandes de matériau autour d'un axe de rotation parallèle à l'axe de rotation desdits rouleaux (201, 203),

caractérisé en ce que

- ledit dispositif (100) comprend un système de positionnement conçu pour déplacer au moins l'un desdits systèmes de courroie transporteuse (102) suite à une translation, de sorte que ledit espace de bobinage (400) soit modifié conformément au diamètre changeant du matériau enroulé (200).

2. Dispositif (100) selon la revendication 1, ladite translation étant de sorte que la direction dudit au moins un desdits systèmes de courroie transporteuse (102), définie par la position relative desdits rouleaux (201, 203) dans un plan perpendiculaire audit axe de rotation, soit maintenue.

3. Dispositif (100) selon la revendication 2, ladite translation étant de sorte que la longueur dudit au moins un desdits systèmes de courroie transporteuse (102), définie par la distance mutuelle desdits rouleaux (201, 203) dans un plan perpendiculaire audit axe de rotation, soit maintenue.

4. Dispositif (100) selon l'une des revendications précédentes, au moins deux desdits systèmes de courroie transporteuse (102) comprenant chacun une série de courroies sans fin individuelles (207), où lesdites séries respectives sont conçues pour s'alterner l'une avec l'autre.

5. Dispositif (100) selon l'une des revendications précédentes, ladite ou lesdites courroies sans fin (207) comprenant une surface non incurvée conçue pour border ledit espace de bobinage (400).

6. Dispositif (100) selon l'une des revendications précédentes, ledit dispositif (100) comprenant au moins trois systèmes de courroie transporteuse (102).

7. Dispositif (100) selon la revendication 5 et 6, ledit dispositif (100) comprenant quatre systèmes de courroie transporteuse (102), conçus pour définir un espace de bobinage carré (400).

8. Dispositif (100) selon la revendication 7, lesdits côtés dudit espace de bobinage carré (400) étant chacun à un angle de 45° par rapport à la position au sol horizontale (117) dudit dispositif (100).

9. Dispositif (100) selon la revendication 8,

lesdits multiples systèmes de courroie transporteuse (102) comprenant un premier système de courroie transporteuse (102), et
ledit système de positionnement étant conçu pour déplacer ledit premier système de courroie transporteuse (102) suivant une première translation linéaire, où la direction de ladite première translation linéaire fait un angle de 45° avec ladite surface dudit premier système de courroie transporteuse (102).

10. Dispositif (100) selon la revendication 9,

lesdits multiples systèmes de courroie transporteuse (104) comprenant un second système de courroie transporteuse (104), et
ledit système de positionnement étant conçu pour déplacer ledit second système de courroie transporteuse (104) suivant une seconde translation linéaire, où la direction de ladite seconde translation linéaire est parallèle à ladite surface dudit second système de courroie transporteuse (104).

11. Dispositif (100) selon la revendication 7, ledit espace de bobinage carré (400) comprenant un espace (1000) adapté pour alimenter ledit espace de bobinage (400) en bande de matériau.

12. Dispositif (100) selon l'une des revendications précédentes, ledit dispositif (100) comprenant un composant (403) conçu pour régler la pression par un ou plusieurs desdits systèmes de courroie transporteuse (102) sur ledit matériau enroulé (200).

13. Dispositif (100) selon l'une des revendications précédentes, ledit espace de bobinage (400) étant défini de sorte que l'éjection dudit matériau enroulé (200) et l'alimentation en bande de matériau s'effectuent toutes deux du même côté dudit espace de bobinage (400).

14. Appareil comprenant

- un dispositif (100) selon l'une des revendications précédentes ;
- un système d'alimentation (105) conçu pour alimenter ledit dispositif (100) en bande de matériau ;
- une unité de détection (700) conçue pour mesurer l'alignement de ladite bande de matériau par rapport audit système d'alimentation (105) ;
- un système de commande de bord conçu pour adapter la position dudit dispositif (100) par rapport audit système d'alimentation (105) selon ledit alignement.

15. Procédé permettant l'enroulement de bandes de matériau, comprenant :

- la fourniture d'un dispositif (100) comprenant de multiples systèmes de courroie transporteuse (102), chacun desdits systèmes de courroie transporteuse (102) comprenant une ou plusieurs courroies sans fin (207) supportées sur des rouleaux parallèles (201, 203) pour un mouvement longitudinal en réponse à la rotation desdits rouleaux (201, 203), et lesdits systèmes de courroie transporteuse (102) étant conçus pour définir un espace de bobinage (400) destiné à

l'enroulement desdites bandes de matériau autour d'un axe de rotation parallèle à l'axe de rotation desdits rouleaux (201, 203) ;
- l'enroulement desdites bandes de matériau à l'intérieur dudit espace de bobinage (400) ;
- le déplacement d'au moins l'un desdits systèmes de courroie transporteuse (102) suite à une translation, de sorte que ledit espace de bobinage (400) soit modifié conformément au diamètre changeant du matériau enroulé (200).

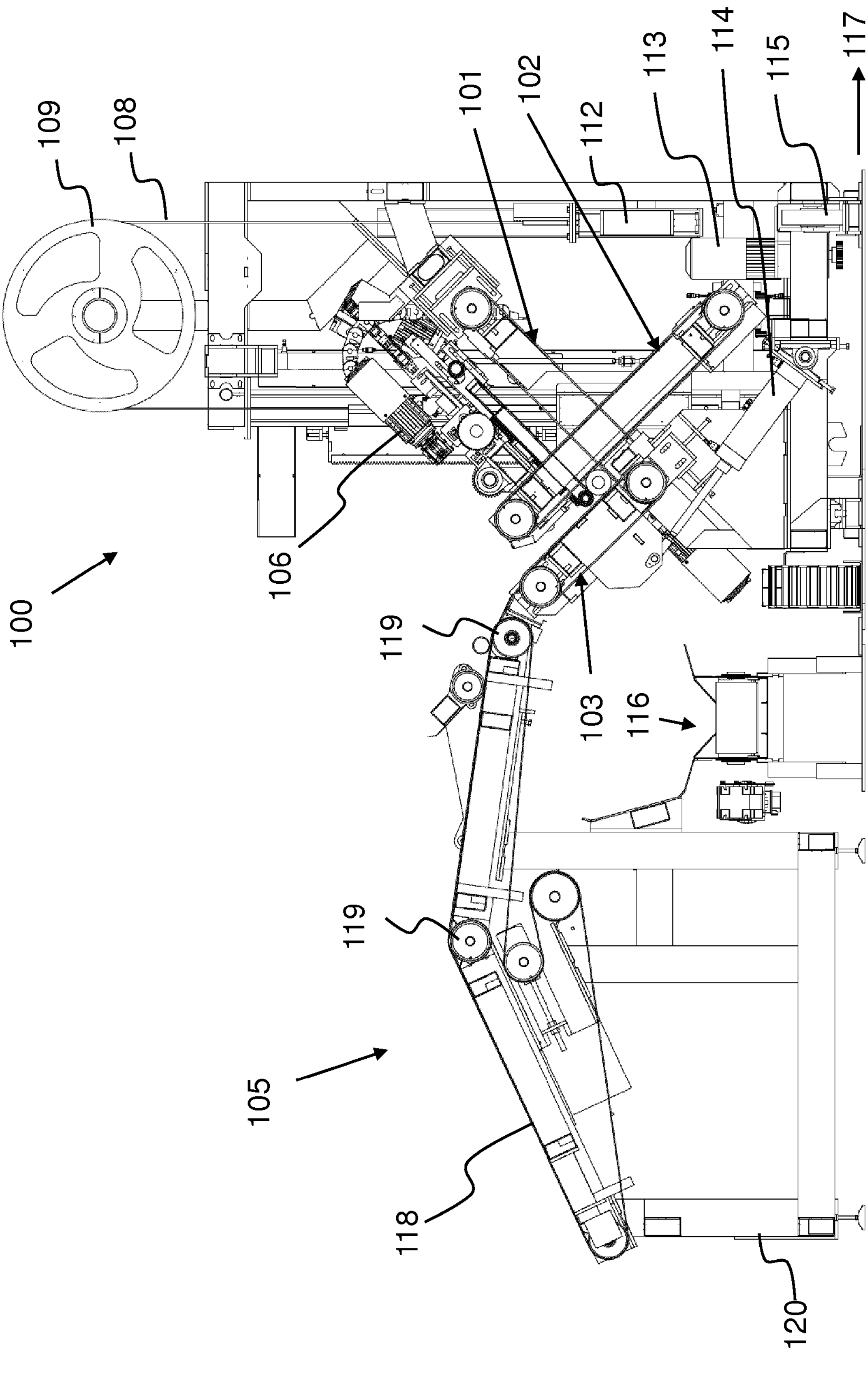

100
101
102
103
105
106
108
109
112
113
114
115
116
117
118
119
119
120

Fig. 1

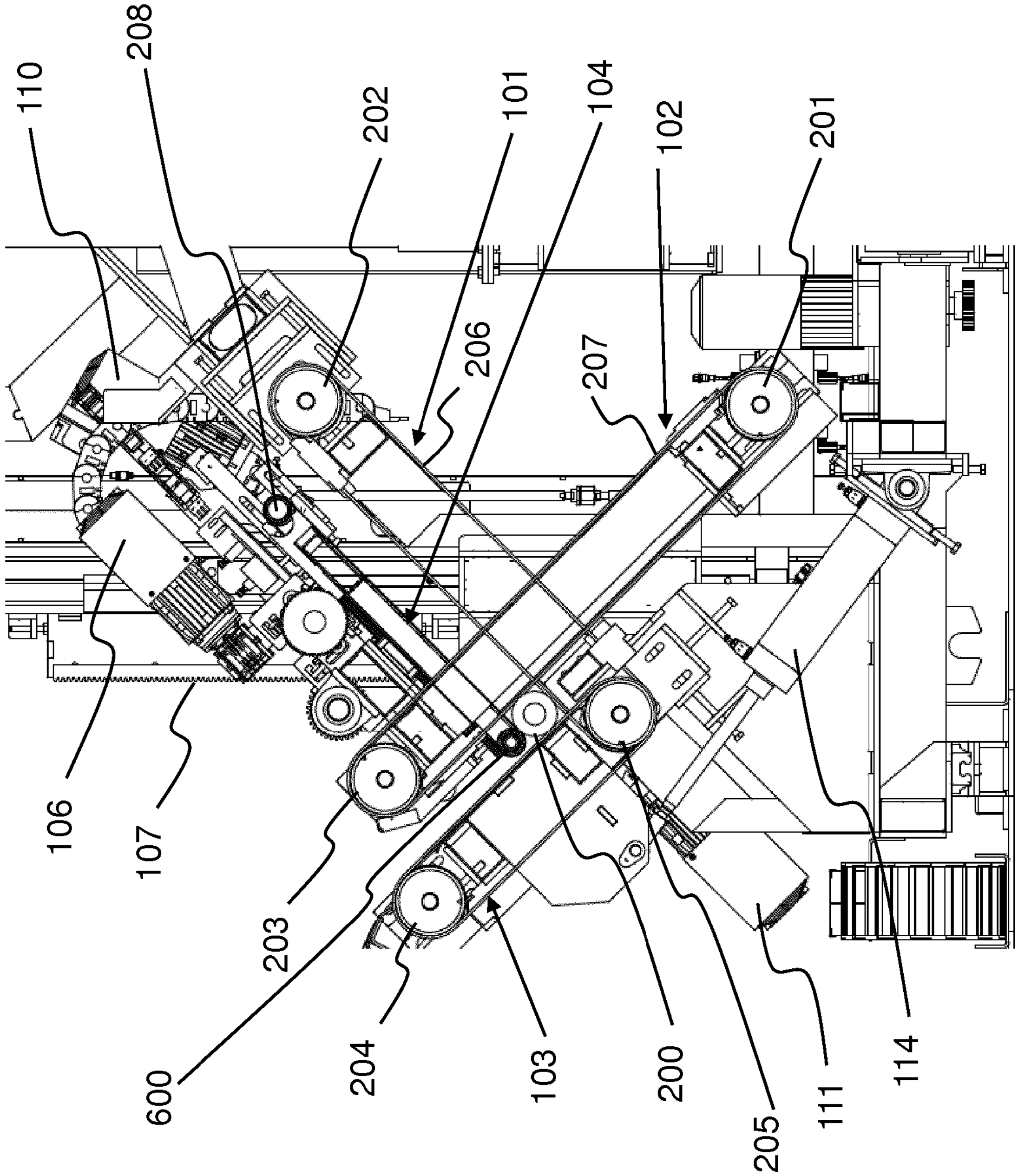
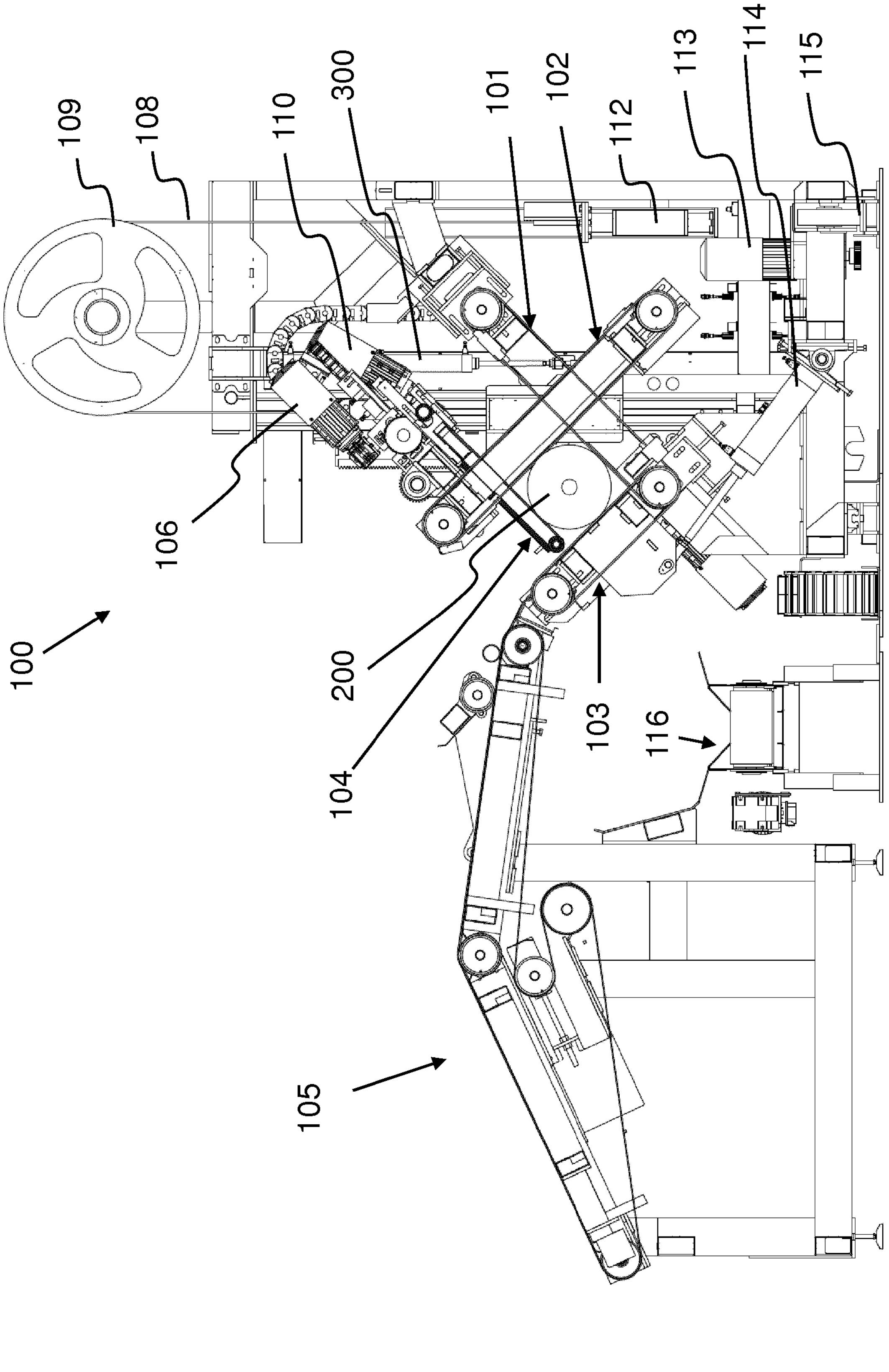

110
208
202
101
104
102
201
206
207
106
107
203
600
204
103
200
205
111
114

Fig. 2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101
102
103
104
105
106
108
109
110
112
113
114
115
116
200
300

Fig. 3

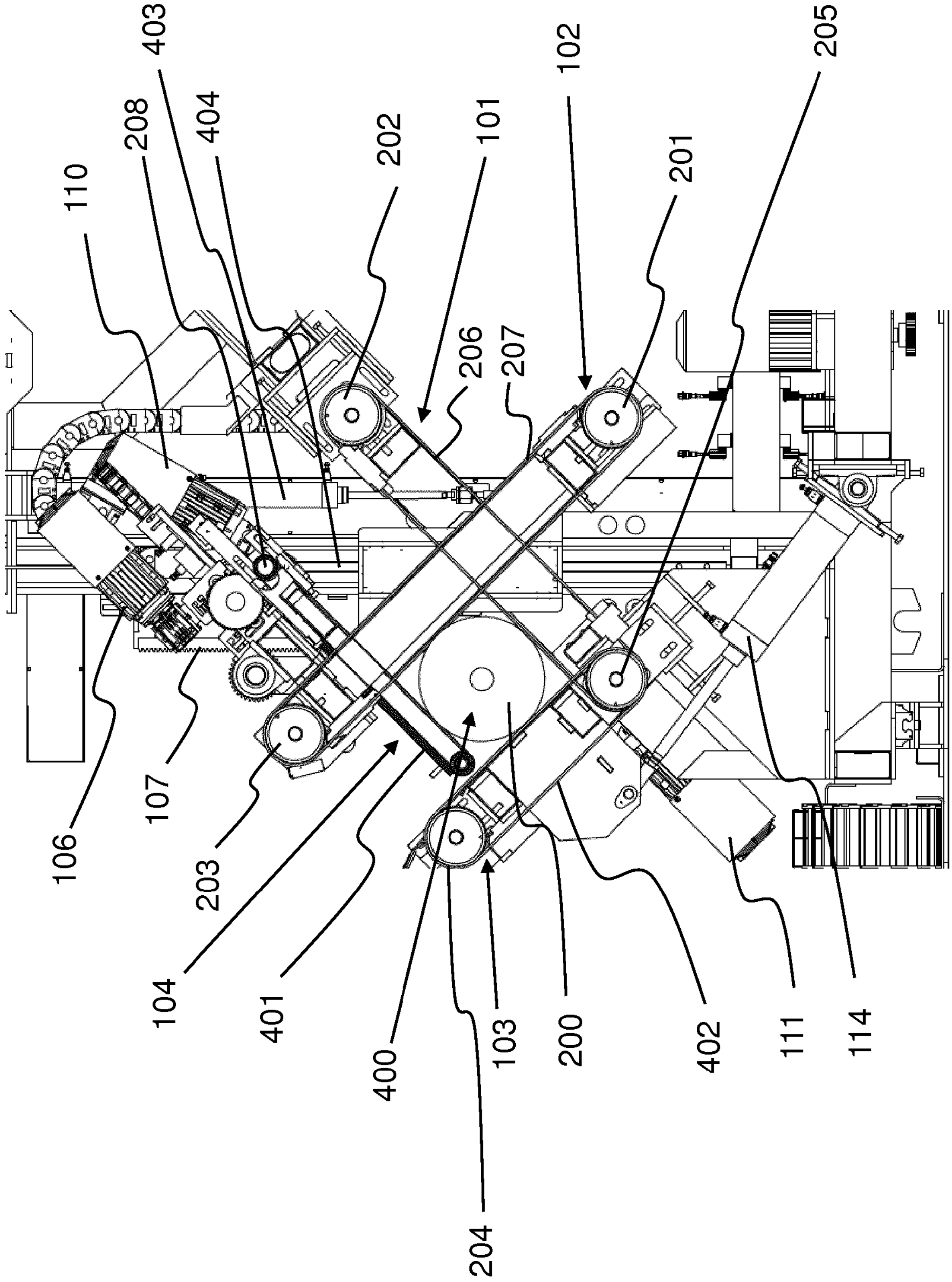
403
102
205
208
404
202
101
201
110
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Fig. 4

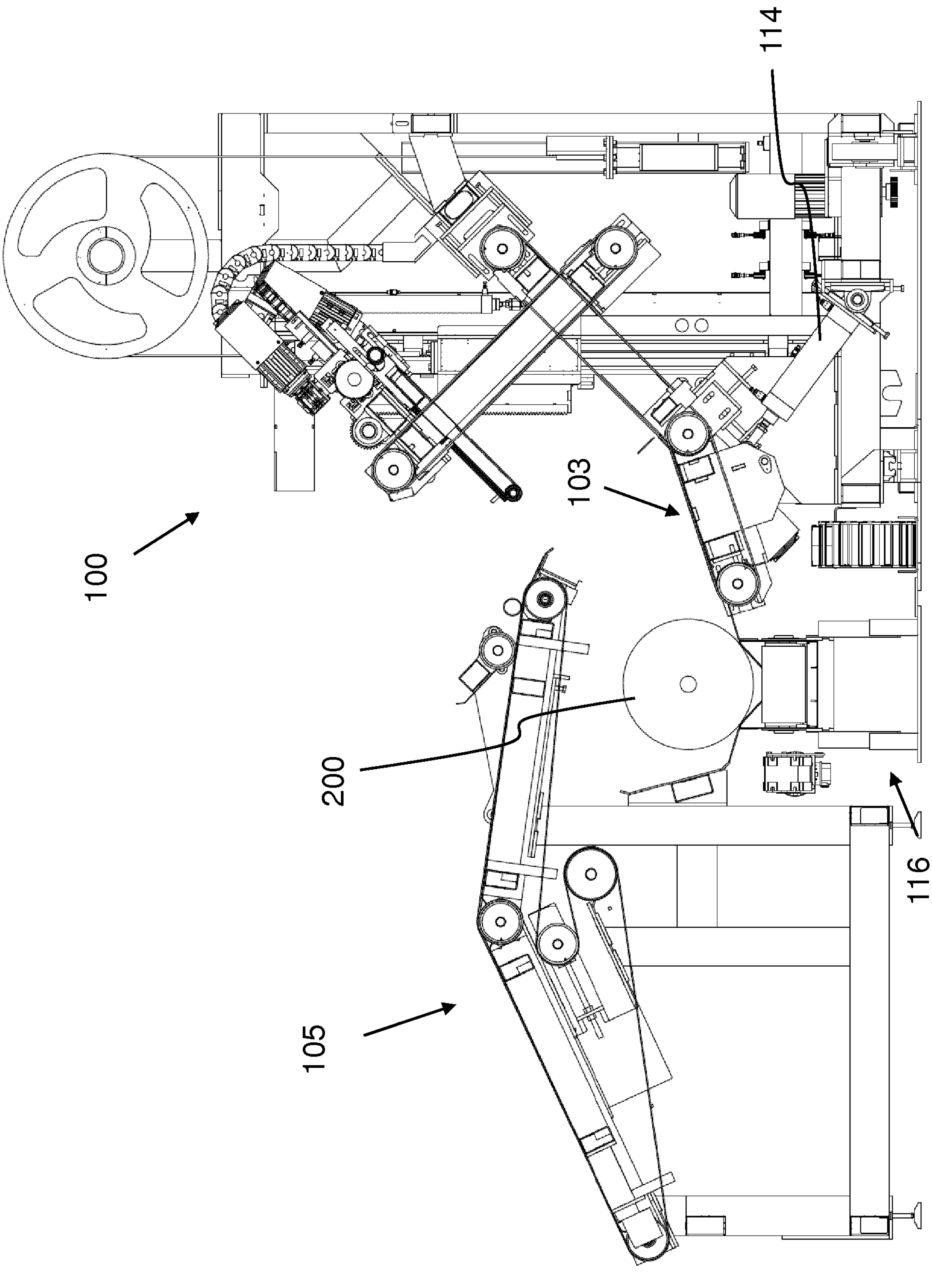

Fig. 5

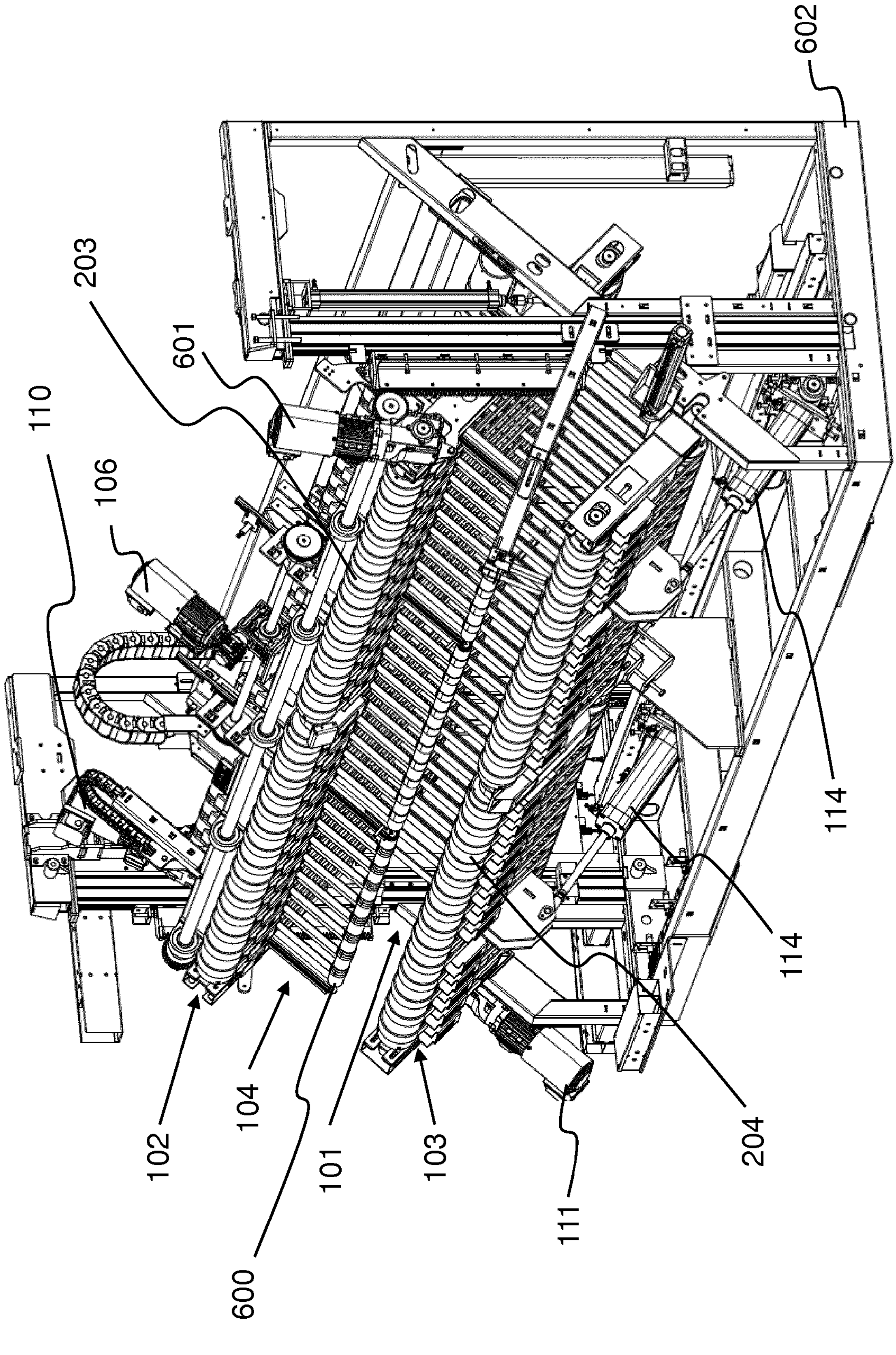

Fig. 6

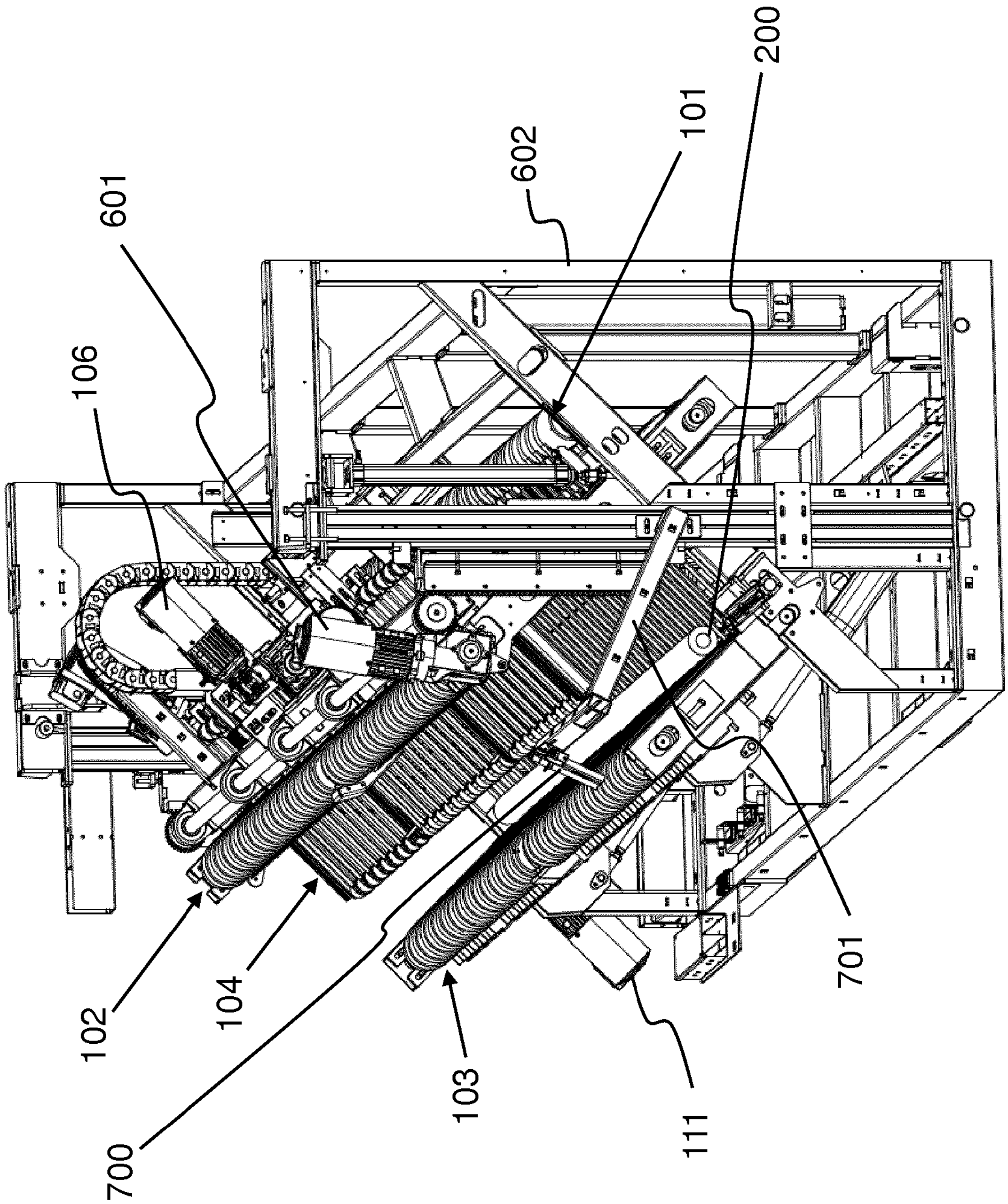

Fig. 7

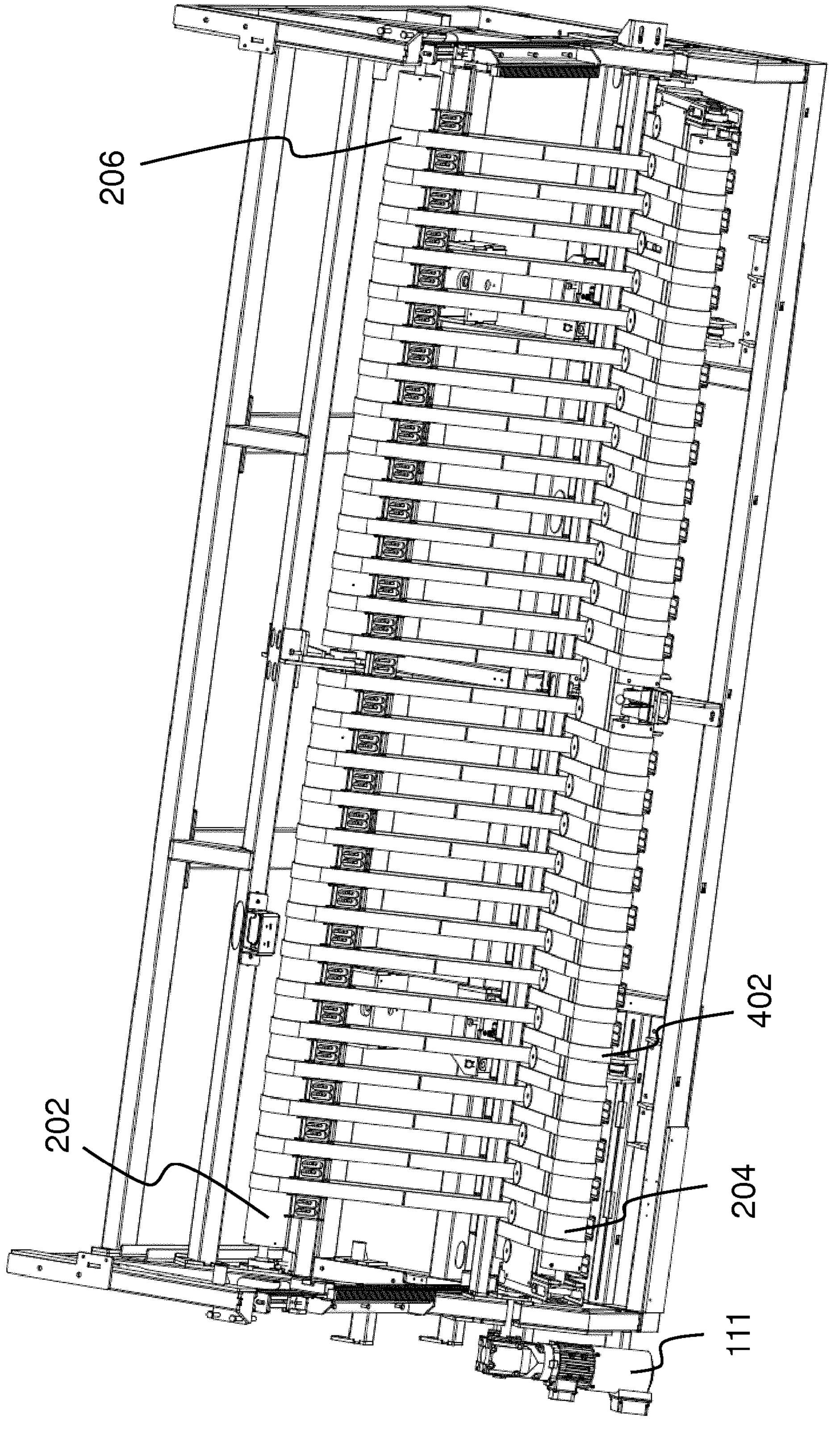

Fig. 8

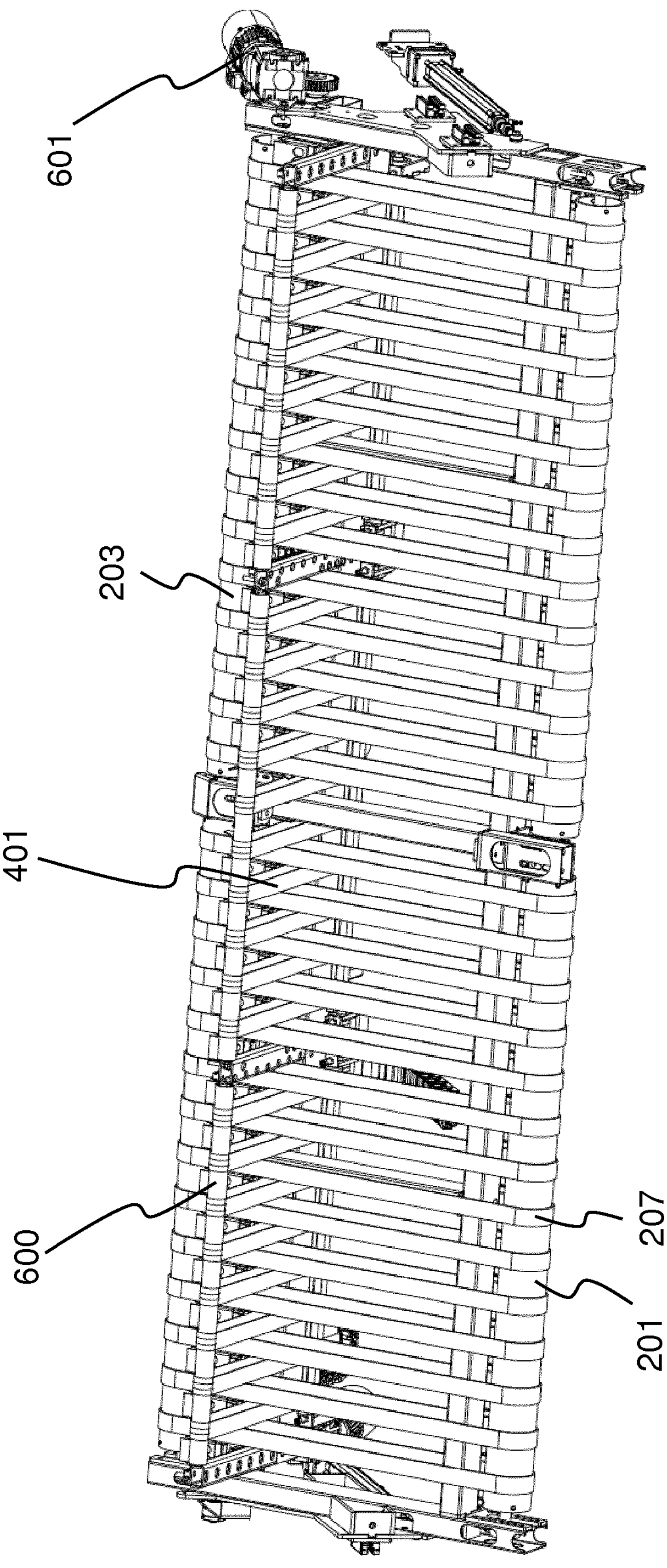

Fig. 9

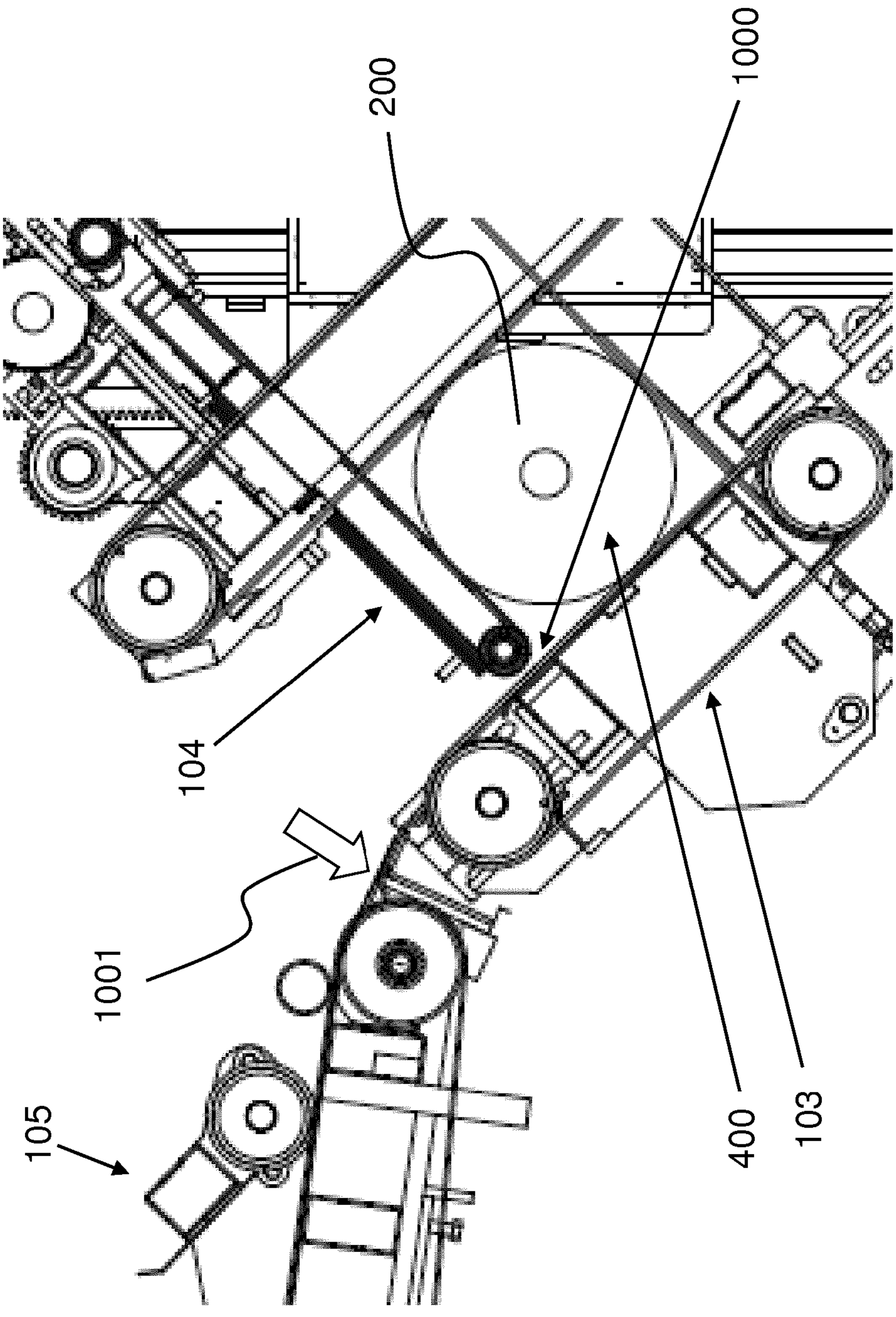

Fig. 10

REFERENCES CITED IN THE DESCRIPTION

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