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(54) A WINDER AND A METHOD FOR WINDING A WEB ROLL FROM A FIBROUS WEB

(57) The invention relates to a winder (1) for winding a web roll (2) from a fibrous web (W) such as a paper web or a web of non-woven material. The winder comprises a rotatably journalled core shaft (5) onto which the web can be wound to form a web roll. The winder (1) also comprises two winding drums (3, 4) arranged to engage the web roll (2) during winding to form nips (N_1, N_2) with the web roll (2) during winding. The winding drums (3, 4) are arranged to be movable away from the core shaft (5) to accommodate for increasing diameter of the web roll (2) as the diameter of the web roll (2) increases during winding. A rider roll (10) is arranged to act against the web roll (2) during winding to form a nip (N3) with the web roll (2) and the rider roll (10) is also arranged to be movable away from the core shaft (5) to accommodate for increasing diameter of the web roll (2) as the diameter of the web roll (2) increases during winding. At its axial ends, the core shaft (5) is journalled in a fixed element (11) that carries the weight of the core shaft (5) and the web roll (2) such that, during winding, the position of the core shaft (5) remains constant. The invention also relates to a method of winding in which the core shaft (5) is held in a constant position while the winding drums (3, 4) and the rider roll (5) move away from the core shaft (5) to accommodate for the growing diameter of the web roll (2).

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a winder for winding a web roll from a fibrous web such as a paper web or a web of non-woven material. The invention also relates to a method of winding a web roll from a fibrous web.

BACKGROUND OF THE INVENTION

[0002] Winders are commonly used for converting purposes when paper rolls that have been produced in a paper machine are converted into narrower rolls and the winder is commonly used in connection with slitters that are used to make the web narrower. An example of a winder is disclosed in US patent No. 5,320,299. Another winder is disclosed in WO 2013/056758 A1. Winders typically have winding drums/support drums on which the paper roll that is being wound is supported. Winders are also used for webs of non-woven material. The object of the present invention is to provide an improved winder and an improved winding method in which important parameters of the winding operation can be effectively controlled.

DISCLOSURE OF THE INVENTION

[0003] The invention relates to a winder for winding a web roll from a fibrous web such as a paper web or a web of non-woven material. The winder comprises a core shaft onto which the web can be wound to form a web roll. The core shaft has an axial extension and two axial ends and the core shaft is rotatably journalled at each axial end. The winder further comprises two winding drums arranged to engage the web roll during winding to form nips with the web roll during winding. The winding drums are arranged to be movable away from the core shaft to accommodate for increasing diameter of the web roll as the diameter of the web roll increases during winding. The winder also comprises a rider roll arranged to be capable of acting against the web roll during winding to form a nip with the web roll and the rider roll is arranged to be movable away from the core shaft to accommodate for increasing diameter of the web roll as the diameter of the web roll increases during winding. According to the invention, the core shaft is, at each of its axial ends, journalled in a fixed element that carries the weight of the core shaft and the web roll such that, during winding, the position of the core shaft remains constant.

[0004] In embodiments of the invention, the winding drums and the rider roll are arranged to be movable in a direction radially outwards from the core shaft in such a way that, during at least a part of the winding process, the angular distance between the winding drums and between the winding drums and the rider roll remains constant during winding.

[0005] Preferably, the winding drums and the rider roll are arranged to be movable in such a way that the angular distance between the winding drums is kept at 120° during winding.

[0006] The winder may optionally comprise at least one logic control unit and at least one actuator for moving each winder drum away from the core shaft. The at least one logic control unit may then be connected to the at least one actuator to control the movement of the winder drum.

[0007] The at least one logic control unit may preferably contain software code that is arranged to continuously calculate the diameter of the web roll based on web thickness and web speed and software code to cause the at least one actuator to move the winding drums to an extent corresponding to the increasing diameter of the web roll, i.e. to the increase in diameter of the web roll.

[0008] In embodiments of the invention, at least one of the winding drums may be connected to a force sensor arranged to detect the force in the nip between the at least one winding drum and the web roll. The force sensor may then be connected to the logic control unit and the logic control unit may contain software to keep the nip force between the web roll and the at least one winding drum within predetermined limits.

[0009] In embodiments of the invention, the winder may comprise at least one logic control unit and at least one actuator for moving the rider roll towards or away from the core shaft and the at least one logic control unit may then be connected to the at least one actuator to control the movement of the rider roll. In some such embodiments, the at least one logic control unit may contain software code that is arranged to continuously calculate the diameter of the web roll based on web thickness and web speed and software code to cause the at least one actuator to move the rider roll to an extent corresponding to the increasing diameter of the web roll.

[0010] In other embodiments, the rider roll can be connected to a force sensor to arranged to detect the force in the nip between the rider roll and the web roll and the force sensor can be connected to the logic control unit and the logic control unit may contain software to keep the nip force between the web roll and the rider roll within predetermined limits.

[0011] Conceivably, there could be different logic control units for the rider roll and the winding drums but it can also be so that one and the same logic control unit controls the movement of both the rider roll and the winding drums.

[0012] The method also relates to a method of winding a web roll from a fibrous web such as a paper web or a web of non-woven material. In the inventive method, the web is wound to a web roll on a core shaft which core shaft has an axial extension and two axial ends and which core shaft is rotatably journalled at each axial end such that it can rotate during winding. The method comprises using two winding drums and a rider roll to engage the web roll during winding as the web is wound to a web roll

on the core shaft such that the rider roll and the winding drums form nips with the web roll. The method also comprises moving the rider roll and the winding drums during winding such that the movement of the rider roll and the winding drums matches the rate at which the diameter of the web roll increases during winding. According to the inventive method, the core shaft is, at each of its axial ends, journalled in a fixed element that carries the weight of the core shaft and the web roll such that the core shaft is kept in a constant position during winding.

[0013] In embodiments of the inventive method, the rider roll and the winding drums are moved radially away from the core shaft during winding in such a way that, during at least a part of the winding process, the angular distance between the winding drums and between the rider roll and the winding drums remains constant. Preferably, the angular distance between the winding drums is kept at 120° during winding and wherein the angular distance between the rider roll and each winding drum is kept at 120° during winding.

[0014] In embodiments of the inventive method, the method comprises calculating the rate at which the diameter of the web roll grows based on web thickness and web speed and moving the rider roll and the winding drums such that the movement of the rider roll and the winding drums and the rider roll matches the rate at which the diameter of the web roll increases.

[0015] In other embodiments, the inventive method comprises detecting the force in at least one of the nips formed between the rider roll and the web roll or between one of the winding drums and the web roll and moving the rider roll or winding drum that forms a nip in which the force has been detected such that the force in that nip remains within predetermined limits.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Figure 1 is a schematic representation of a known method for winding a fibrous web to a web roll.

Figure 2 is a schematic representation of the inventive method for winding a web to a web roll.

Figure 3 is a schematic representation of a winder that can be used for winding a web into a web roll using the inventive method of the present invention.

Figure 4 is a schematic representation of how the winding drums may be movably arranged

Figure 5 is a schematic representation of the core shaft 5.

Figure 6 is a schematic representation of an alternative way in which the winding drums may be movable arranged.

DETAILED DESCRIPTION OF THE INVENTION

[0017] The inventive method will now be explained with reference to Figure 1 and to Figure 2. Figure 1 shows a known method of winding a web on a core shaft 5 to form a web roll 2. Figure 1 illustrate three different stages in a process and should be "read" from left to right. In the winding process, two winding drums 3, 4 and a rider roll 10 engage the web roll 2 in nips N_1, N_2, N_3 as can be seen in Figure 1. In Figure 1, the growth of the web roll 2 is illustrated in such a way that, to the left in Figure 1, the beginning of the winding process is shown in which the web W is just beginning to be wound on the core shaft 5. In the middle of Figure 1, the winding process is shown at a later stage when the web roll 2 has already been formed and attained a certain diameter as can be seen in the middle of Figure 1. To the right in Figure 1, the winding process is shown at an even later stage when the diameter of the web roll 2 has become even greater. As can be seen in Figure 1, the winding drums 3, 4 have their axis of rotation in a plane marked by the broken line L. As can also be seen in Figure 1, the winding drums 3, 4 remain at the level of that plane (the plane marked by the broken line L). This means that their vertical position remains constant during winding. However, as the web roll 2 becomes larger and larger, the core shaft 5 moves vertically away from the plane marked by the broken line L, the core shaft 5 moves upwards. In the same way, the rider roll 10 also moves upwards. When the diameter of the web roll 2 increases, the weight of the web roll 2 will also increase which can alter the nip forces in the nips N_1, N_2 that are formed between the winding drums 3, 4 and the web roll 2. The weight of the core shaft 5 and the web roll 2 is at least to a part carried by the winding drums 3, 4. If no action is taken, the nip forces will increase during winding which may result in uneven properties of the web roll and an inferior quality of the final product. To prevent this from happening, various measures for compensating the increased weight have been proposed. For example, in the applicant's own European patent application Ni. 16160363.4, it has been proposed that carrier chucks in which the core shaft is journalled can be movable by an actuator to create a compensating force. While such compensation may give excellent results, it is still necessary to take special measures for such compensation. The present invention solves the technical problem in a different way as will be explained in the following.

[0018] With reference to Figure 2, the inventive method will now be explained. Just like Figure 1, Figure 2 should be "read" from left to right and Figure 2 illustrates the winding process at different stages. To the left in Figure 1, the beginning of the winding is illustrated. In the middle of Figure 2, a later stage is shown and to the right in Figure 2, an even later stage is shown. As can be seen in Figure 2, the core shaft 5 remains at all times during the winding at the same vertical level, i.e. in the horizontal plane indicated by the broken line L. In contrast to the

process shown in Figure 1, both the rider roll 10 and the winding drums 3, 4 move away from the horizontal plane indicated by the broken line L. The winding drums 3, 4 move downwards while the rider roll 10 moves upwards. As will be explained, the weight of the web roll 2 and the core shaft 5 is not carried by the winding drums 3, 4 but by a fixed element.

In the inventive method of winding a web roll 2 from a fibrous web W, the fibrous web (W) is wound to a web roll 2 on the core shaft 5. The core shaft 5 is rotatably journalled at each axial end such that it can rotate during winding. It will now be understood that the method comprises using two winding drums 3, 4 and a rider roll 10 to engage the web roll 2 during winding as the web W is wound to a web roll 2 on the core shaft 5 such that the rider roll 10 and the winding drums form nips N_1, N_2, N_3 with the web roll 2.

[0019] According to the inventive method, the core shaft 5 is, at each of its axial ends, journalled in a fixed element 11 that carries the weight of the core shaft 5 and the web roll 2 such that the core shaft 5 is kept in a constant position during winding. This can be achieved, for example, by placing the bearings in which the core shaft is journaled in a fixed element such as a frame that carries the bearings. Thereby, the fixed element can also carry the weight of the growing web roll 2. In this way, the weight of the growing web roll 2 does not have to be carried by the winding drums 3, 4 and the winding drums 3, 4 are used only to provide a suitable nip force between the winding drums 3, 4 and the web roll 2. While the core shaft 5 remains in its position, the rider roll 10 and the winding drums 3, 4 are moved during the winding such that the movement of the rider roll 10 and the winding drums 3, 4 matches the rate at which the diameter of the web roll 2 increases during winding. In this way, the nip forces in the nips N_1, N_2, N_3 can be kept constant. Thereby, winding of the web roll 2 becomes even and the final product achieves excellent quality. In Figure 2, it can be seen how the winding drums 3, 4 and the rider roll 10 move away from the core shaft 5 in the direction of arrows R, S, T. That the core shaft 5 is carried/supported at its axial ends by a fixed element 11 can also be expressed in terms of the weight of the core shaft 5 and the web roll 2 being carried by a fixed element.

[0020] In preferred embodiments of the inventive method, the rider roll 10 and the winding drums 3, 4 are moved radially away from the core shaft 5 during winding in such a way that, during at least a part of the winding process, the angular distance between the winding drums 3, 4 and between the rider roll 10 and the winding drums 3, 4 remains constant. In the right part of Figure 2, the angle or angular distance between the winding drums 3, 4 and between the rider roll 10 and the winding drums 3, 4 is indicated by the symbol α. By keeping the angular distance α constant, more even conditions during winding can be achieved. Preferably, the angular distance α between the winding drums 3, 4 is kept at 120° during winding and the angular distance α between the rider roll 10 and each winding drum 3, 4 is kept at 120° during winding. By keeping a constant angular distance of 120°, even conditions can be achieved and the final product attains a higher quality.

[0021] The movement of the rider roll 10 and the winding drums 3, 4 can be controlled in different ways. In some embodiments of the invention, movement of the rider roll 10 and the winding drums 3, 4 can be controlled in the following way. The rate at which the diameter of the web roll 2 grows is calculated based on web thickness and web speed (known parameters) and the rider roll 10 and the winding drums 3, 4 are moved away from the core shaft 5 such that the movement of the rider roll 10 and the winding drums 3, 4 away from the core shaft 5 matches the rate at which the diameter of the web roll 2 increases.

[0022] In other embodiments of the invention, the movement of the rider roll 10 and the winding drums 3, 4 can be controlled in a different way. In such embodiments, the force in at least one of the nips N_1, N_2, N_3 formed between the rider roll 10 and the web roll 2 or between one (or both) of the winding drums is detected/measured. If the detected force deviates from a predetermined value such that it lies outside predetermined limits, the rider roll 10 or/and the winding drum(s) 3,4 that form(s) a nip N_1, N_2, N_3 in which the force has been detected is moved such that the force in that nip N_1, N_2, N_3 remains within predetermined limits. Of course, the forces in all three nips N_1, N_2, N_3 can be measured/detected and both the rider roll 10 and the winding drums 3, 4 can be moved. It should be understood that the rider roll 10 and the winding drums 3, 4 would normally be moved radially away from the core shaft 5 as the web roll 2 grows. However, they can also be moved radially towards the core shaft 5, for example if the detected force in one of the nips N_1, N_2, N_3 should be found to be too low. The inventive method can be used for winding any fibrous web such as a paper web W or a web of non-woven material. For example, it may be used for winding a tissue paper web having a basis weight in the range of 15 g/m^2 - 35 g/m^2.

[0023] The inventive winder for carrying out the inventive method will now be explained with reference to Figures 3 - 6. As can be seen in Figure 3, the winder 1 for winding a web roll 2 may have a frame 19. The winder 1 comprises a core shaft 5 onto which the web can be wound to form a web roll. With reference to Figure 5, the core shaft 5 has an axial extension and two axial ends 6, 7. Each axial end 6, 7 is journalled in a bearing 8, 9 such that the core shaft can rotate about its axis A. The bearings 8, 9 may be of any type that allows the core shaft 5 to rotate. The core shaft 5 may suitably be driven at one of its axial ends by a drive arrangement which is not shown but which is known as such by those skilled in the art to which the invention pertains. Optionally, the core shaft 5 may be driven at both its axial ends but a drive for the core shaft 5 would normally be used only at one of the axial ends. The drive arrangement can be used

to rotate the core shaft during winding. As can be seen in Figure 3, the winder 1 comprises two winding drums 3, 4 that are arranged to engage the web roll 2 during winding to form nips N_1, N_2 with the web roll 2 during winding. In Figure 3, a possible way of making the winding drums 3, 4 movable is shown. The winding drums 3, 4 may have axle stubs 25, 26 that can glide in guide slots 24 located in the frame 19. The guide slots 24 may suitably be slanted as indicated in Figure 3 such that the winding drums 3, 4 can perform a movement that has both a vertical and a horizontal component. Actuators 13, 14 such as hydraulic cylinders may be arranged to move the axle stubs 25, 26 in the guide slots 24 such that the winding drums 3, 4 can move radially away from the core shaft 5 or radially towards the core shaft. It should be understood that the actuators 13, 14 do not have to be hydraulic cylinders but that any kind of actuator may be used, for example electromechanical actuators or any kind of actuator that the skilled person deems suitable for the purpose. The winding drums 3, 4 are arranged to be movable away from the core shaft 5 to accommodate for the increasing diameter of the web roll 2 as the diameter of the web roll 2 increases during winding. The winder 1 also comprises a rider roll 10 that is arranged to be capable of acting against the web roll 2 during winding to form a nip N_3 with the web roll 2. The rider roll 10 is also arranged to be movable away from the core shaft 5 to accommodate for increasing diameter of the web roll 2 as the diameter of the web roll 2 increases during winding. In Figure 3, it can be seen how the rider roll 10 is carried by a carrier beam 23 that can be lifted by at least one actuator 15 that may be, for example, a hydraulic cylinder. According to the invention, the core shaft 5 is journalled in a fixed element 11 that carries the weight of the core shaft 5 and the web roll 2 such that, during winding, the position of the core shaft (5) remains constant. That the fixed element 11 carries the core shaft 5 and the web roll 2 can also be expressed in terms of the fixed element being arranged to and capable of carrying the weight of the core shaft 5 and the web roll 2.

[0024] It should be understood that, in the embodiment shown in Figure 3, the axial ends of the core shaft 5 are journalled in bearings 8, 9 each of which is firmly fixed to the fixed element 11 such that also the axial ends of the core shaft 5 are firmly held by the fixed element 11 and the core shaft 5 remains fixed in its position such that it cannot perform any other movement than rotation about its axis A. The fixed element 11 may be a carrier beam that is fixedly connected to the frame 19 or forms a part of the frame. In this way, the fixed element 11 may simply be the same thing as the machine frame 19 or a part of the machine frame 19. During winding, the weight of the growing web roll 2 will now be carried by the fixed element 11 and the winding drums 3, 4 only have to provide a suitable nip force in the nips N_1, N_2. It should be understood that the fixed element 11 need not necessarily be a carrier beam in the frame 19 but that it could be anything which is fixed in position and capable of taking the weight of the growing web roll 2. For example, the fixed element 11 could even be an element which does not even form part of the frame 19 but is carried directly by the machine floor.

[0025] As explained with reference to the method, the winding drums 3, 4 and the rider roll 10 may be arranged to be movable in a direction radially outwards from the core shaft 5 in such a way that, during at least a part of the winding process, the angular distance α between the winding drums 3, 4 and between the winding drums 3, 4) and the rider roll 10 remains constant during winding. In preferred embodiments, the winding drums 3, 4 and the rider roll 10 are arranged to be movable in such a way that the angular distance between the winding drums 3, 4 is kept at 120° during winding.

[0026] Preferably, the winder comprises at least one logic control 12 unit and at least one actuator 13, 14 for moving each winder drum 3, 4 away from the core shaft 5 (or towards the core shaft) and the at least one logic control 12 unit may be connected to the at least one actuator 13, 14 to control the movement of the winder drum 3, 4. The logic control unit 12 may be, for example, a programmable computer.

[0027] In some embodiments, the at least one logic control unit 12 contains software code (i.e. a computer program) that is arranged to continuously calculate the diameter of the web roll 2 based on web thickness and web speed and software code to cause the at least one actuator 13, 14 to move the winding drums 3, 4 to an extent corresponding to increasing diameter of the web roll 2.

[0028] In the same way, the winder may comprise at least one logic control unit 12 and at least one actuator 15 for moving the rider roll 10 towards or away from the core shaft 5. The at least one actuator may be, for example, one or several hydraulic actuator(s) arranged to be capable of lifting or lowering the rider roll beam 23 that is indicated in Figure 3. It should be understood that the at least one actuator 15 does not have to be a hydraulic actuator but that any kind of actuator may be used, for example electromechanical actuators or any kind of actuator which the skilled person may find suitable for the purpose. The at least one logic control unit 12 may be connected to the at least one actuator 15 for moving the rider roll 10 to control the movement of the rider roll 10 such that the logic control unit may give commands to the at least one actuator 15 to cause the at least one actuator to move the rider roll away from or towards the core shaft 5. Just as with the logic control unit for the winding drums 3, 4, the at least one logic control unit 12 for the rider roll 10 may contain software code/a computer program that is arranged to continuously calculate the diameter of the web roll 2 based on web thickness and web speed and software code to cause the at least one actuator 15 to move the rider roll 10 to an extent corresponding to increasing diameter of the web roll 2.

[0029] It should be understood that one and the same logic control unit 12 may be used to control the movement

of both the rider roll 10 and the winding drums 3, 4. Such an embodiment is shown in Figure 3 but embodiments are also conceivable in which there is a separate logic control unit 12 for the rider roll 10 and a separate logic control unit for the winding drums 3, 4.

[0030] Another embodiment will now be explained with reference to Figure 3 and to Figure 4. At least one of the winding drums 3, 4 is connected to a force sensor 16, 17 that is arranged to detect the force in the nip N_1, N_2 between the at least one winding drum 3, 4 and the web roll 2 and the force sensor 16 is connected to the logic control unit 12. The logic control unit 12 may then contain software to keep the nip force between the web roll 2 and the at least one winding drum 3, 4 within predetermined limits. When the logic control unit 12 receives a signal from a force detector 16, 16 that indicates that the force in a nip N_1, N_2 is too low, the logic control unit orders the actuator for that nip N_1, N_2 to move the winding drum 3, 4 towards or away from the core shaft 5 such that the nip force in that nip reaches a level that lies within predetermined limits.

[0031] In the same way, the rider roll 10 may be connected to a force sensor 18 that is arranged to detect the force in the nip N_3 between the rider roll 10 and the web roll 2. The force sensor 18 is connected to the logic control unit 12 and the logic control unit 12) contains software to keep the nip force between the web roll 2 and the rider roll (10) within predetermined limits by sending orders from the logic control unit 12 to the actuator(s) 15 connected to the rider roll beam to cause the rider roll beam 23 to be lifted or lowered such that the rider roll 10 moves towards or away from the core shaft 5.

[0032] It should be understood that the arrangements shown in this application for moving the rider roll 10 and the winding drums 3, 4 are only shown as examples. The skilled person being aware of different solutions for performing mechanical movement will readily be aware of many other possibilities.

[0033] With reference to Figure 6, an alternative way of moving the winding drums 3,4 will now be briefly discussed. The winding drums 3, 4 may be journalled in blocks 21, 22 that are placed on a threaded bar 20. The external threads of the threaded bar may be arranged to engage internal threads of small motor-driven actuators (not shown) placed inside the blocks 21, 22 such that rotation of the motor-driven actuators in the blocks 21, 22 cause the blocks 21, 22 and the winding drums 3, 4 in which they are journalled to move away from each other in the axial direction of the threaded bar 20. The threaded bar 20 may in turn be arranged such that it can be lifted or lowered in the direction of arrow K.

[0034] It should be understood that, while the invention has been described above in terms of a winder and a method of winding, these categories only reflect different aspects of one and the same invention. The inventive method may thus comprise such steps that would be the inevitable result of operating the inventive winder, regardless of whether such steps have been explicitly mentioned or not. In the same way, the inventive winder may comprise means for performing all functions of the inventive method.

[0035] Optionally, the winding drums 3, 4 and/or the rider roll 10 may be driven at one of their axial ends - or both ends - in order to assist the drive arrangement of the core shaft 5 if this is deemed necessary. The winding drums and/or the rider roll would thus have a drive arrangement of their own. Optionally, only one of the winding drums 3, 4 could be driven while the other one is not driven.

[0036] In both the inventive winder and the inventive method, the core shaft is carried at each axial end by a fixed element such that the weight of the growing web roll is carried by the fixed elements at the axial ends of the core shaft. In this way, the weight of the web roll does not have to be carried by the winding drums.

[0037] Therefore, thanks to the invention, the weight of the growing web roll need not be carried by the winding drums. The winding drums 3, 4 and the rider roll 10 can be used exclusively to ensure that there is a correct nip pressure in the nips N_1, N_2, N_3 formed between the web roll 2 and the rider roll 10 and the winding drums 3, 4. The result is a winding process that can be well controlled such that the final product has a high quality.

Claims

1. A winder (1) for winding a web roll (2) from a fibrous web (W) such as a paper web or a web of non-woven material, the winder (1) comprising: a core shaft (5) onto which the web can be wound to form a web roll, the core shaft (5) having an axial extension and two axial ends (6, 7) and the core shaft (5) being rotatably journalled at each axial end; two winding drums (3, 4) arranged to engage the web roll (2) during winding to form nips (N_1, N_2) with the web roll (2) during winding, the winding drums (3, 4) being arranged to be movable away from the core shaft (5) to accommodate for increasing diameter of the web roll (2) as the diameter of the web roll (2) increases during winding; a rider roll (10) arranged to be capable of acting against the web roll (2) during winding to form a nip (N3) with the web roll (2) and the rider roll (10) being arranged to be movable away from the core shaft (5) to accommodate for increasing diameter of the web roll (2) as the diameter of the web roll (2) increases during winding, ***characterized in that***, at each of its axial ends (6, 7), the core shaft (5) is journalled in a fixed element (11) that carries the weight of the core shaft (5) and the web roll (2) such that, during winding, the position of the core shaft (5) remains constant.

2. A winder according to claim 1, wherein the winding drums (3, 4) and the rider roll (10) are arranged to be movable in a direction radially outwards from the

core shaft (5) in such a way that, during at least a part of the winding process, the angular distance between the winding drums (3. 4) and between the winding drums (3, 4) and the rider roll (10) remains constant during winding.

3. A winder according to claim 2, wherein the winding drums (3, 4) and the rider roll (10) are arranged to be movable in such a way that the angular distance between the winding drums (3, 4) is kept at 120° during winding.

4. A winder according to claim 1, wherein the winder comprises at least one logic control (12) unit and at least one actuator (13, 14) for moving each winder drum (3, 4) away from the core shaft (5) and wherein the at least one logic control (12) unit is connected to the at least one actuator (13, 14) to control the movement of the winder drum (3, 4).

5. A winder according to claim 4, wherein the at least one logic control unit (12) contains software code that is arranged to continuously calculate the diameter of the web roll (2) based on web thickness and web speed and software code to cause the at least one actuator (13, 14) to move the winding drums (3, 4) to an extent corresponding to increasing diameter of the web roll (2).

6. A winder according to claim 4, wherein at least one of the winding drums (3, 4) is connected to a force sensor (16, 17) arranged to detect the force in the nip (N1, N2) between the at least one winding drum (3, 4) and the web roll (2) and wherein the force sensor (16) is connected to the logic control unit (12) and the logic control unit (12) contains software to keep the nip force between the web roll (2) and the at least one winding drum (3, 4) within predetermined limits.

7. A winder according to any of claims 1 or 4, wherein the winder comprises at least one logic control unit (12) and at least one actuator (15) for moving the rider roll (10) towards or away from the core shaft (5) and wherein the at least one logic control unit (12) is connected to the at least one actuator (15) for moving the rider roll (10) to control the movement of the rider roll (10).

8. A winder according to claim 7, wherein the at least one logic control (12) unit contains software code that is arranged to continuously calculate the diameter of the web roll (2) based on web thickness and web speed and software code to cause the at least one actuator to move the rider roll (10) to an extent corresponding to increasing diameter of the web roll (2).

9. A winder according to claim 7, wherein the rider roll (10) is connected to a force sensor (18) arranged to detect the force in the nip (N_3) between the rider roll (10) and the web roll (2) and wherein the force sensor (18) is connected to the logic control unit (12) and the logic control unit (12) contains software to keep the nip force between the web roll (2) and the rider roll (10) within predetermined limits.

10. A winder according to claim 4 and claim 7, wherein the same logic control unit (12) controls the movement of the rider roll (10) and the winding drums (3, 4).

11. A method of winding a web roll (2) from a fibrous web (W) such as a paper web or a web of non-woven material and in which method the fibrous web (W) is wound to a web roll (2) on a core shaft (5) which core shaft (5) has an axial extension and two axial ends (6. 7) and which core shaft (5) is rotatably journalled at each axial end (6, 7) such that it can rotate during winding, the method comprising: using two winding drums (3, 4) and a rider roll (10) to engage the web roll (2) during winding as the web (W) is wound to a web roll (2) on the core shaft (5) such that the rider roll (10) and the winding drums form nips (N_1, N_2, N_3) with the web roll (2); moving the rider roll (10) and the winding drums (3, 4) during winding such that the movement of the rider roll (10) and the winding drums (3, 4) matches the rate at which the diameter of the web roll (2) increases during winding, ***characterized in that***, at each of its axial ends (6, 7), the core shaft (5) is journalled in a fixed element (11) that carries the weight of the core shaft (5) and the web roll (2) such that the core shaft (5) is kept in a constant position during winding.

12. A method according to claim 11, wherein the rider roll (10) and the winding drums (3, 4) are moved radially away from the core shaft (5) during winding in such a way that, during at least a part of the winding process, the angular distance between the winding drums (3, 4) and between the rider roll (10) and the winding drums (3, 4) remains constant.

13. A method according to claim 12, wherein the angular distance between the winding drums (3, 4) is kept at 120° during winding and wherein the angular distance between the rider roll (10) and each winding drum (3, 4) is kept at 120° during winding.

14. A method according to claim 11, wherein the method comprises calculating the rate at which the diameter of the web roll (2) grows based on web thickness and web speed and moving the rider roll (10) and the winding drums (3, 4) away from the core shaft (5) such that the movement of the rider roll (10) and the winding drums (3, 4) away from the core shaft

(5) matches the rate at which the diameter of the web roll (2) increases.

15. A method according to claim 11, wherein the method comprises detecting the force in at least one of the nips (N_1, N_2, N_3) formed between the rider roll (10) and the web roll (2) or between one of the winding drums (3, 4) and the web roll (2) and moving the rider roll (10) or winding drum (3, 4) that forms a nip (N_1, N_2, N_3) in which the force has been detected such that the force in that nip (N_1, N_2, N_3) remains within predetermined limits.

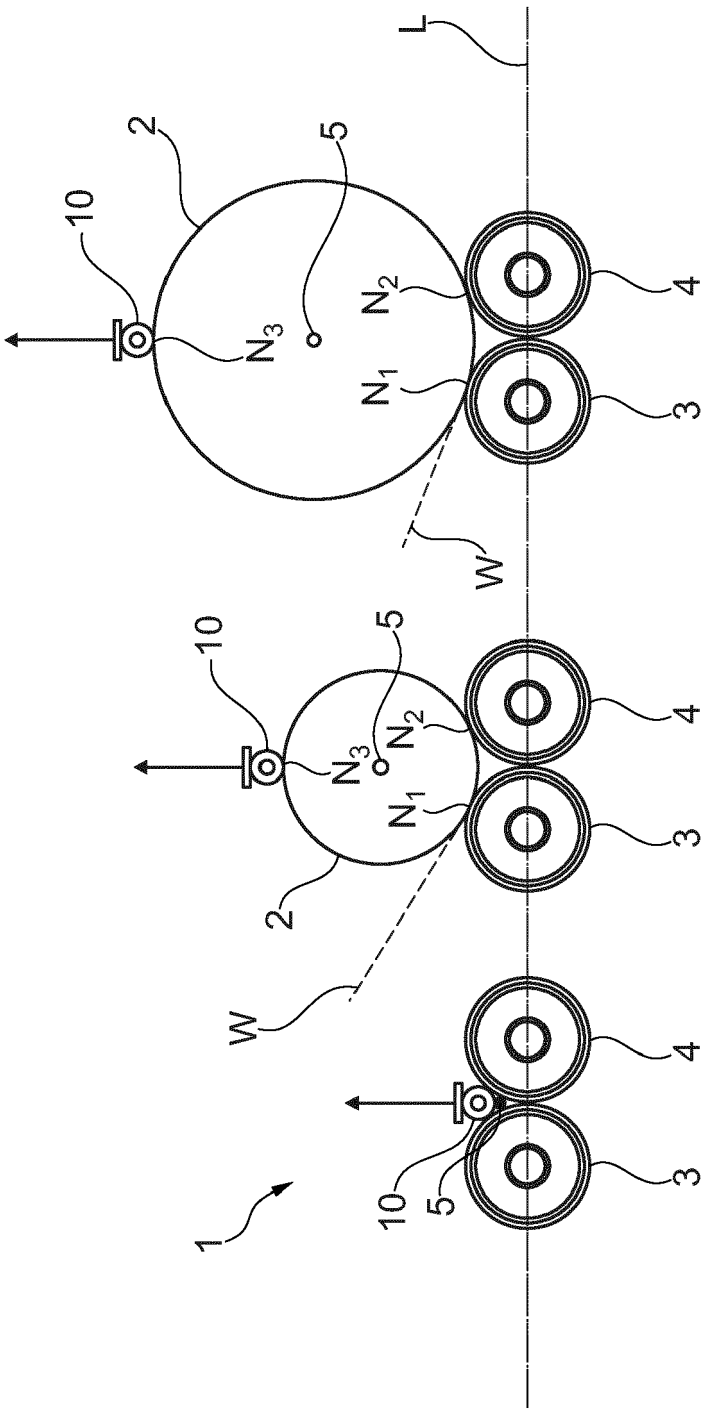


Fig. 1

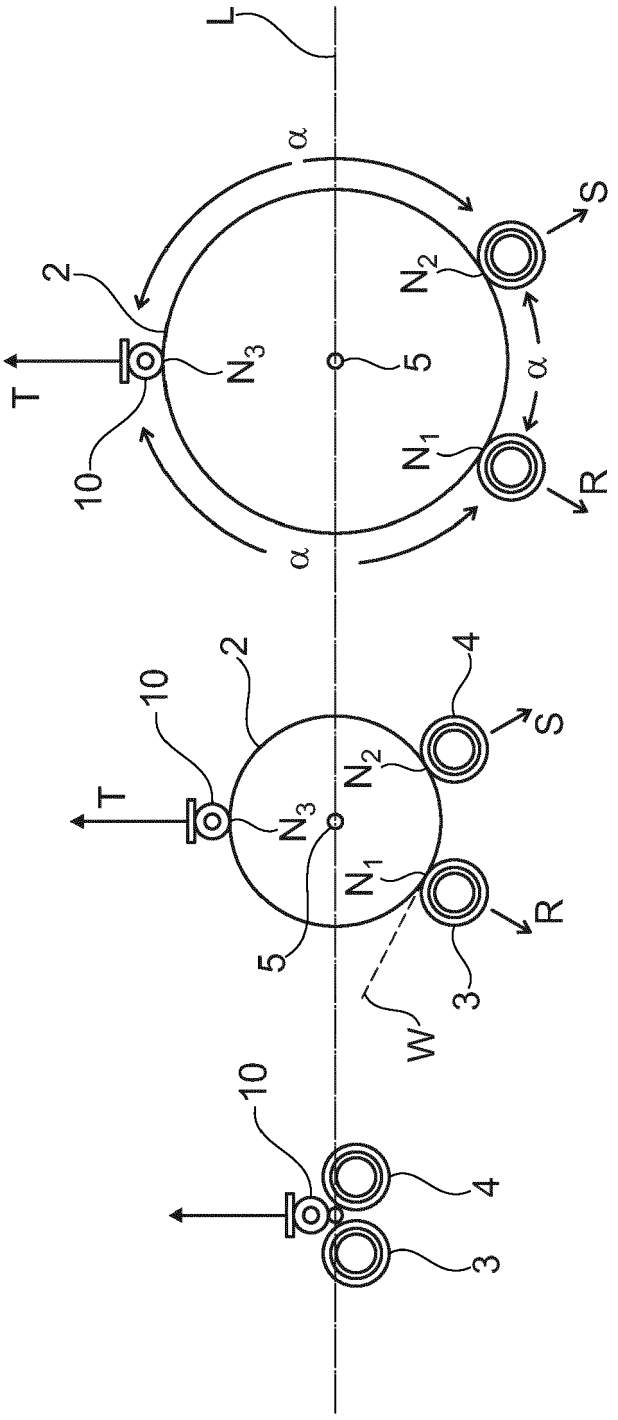


Fig. 2

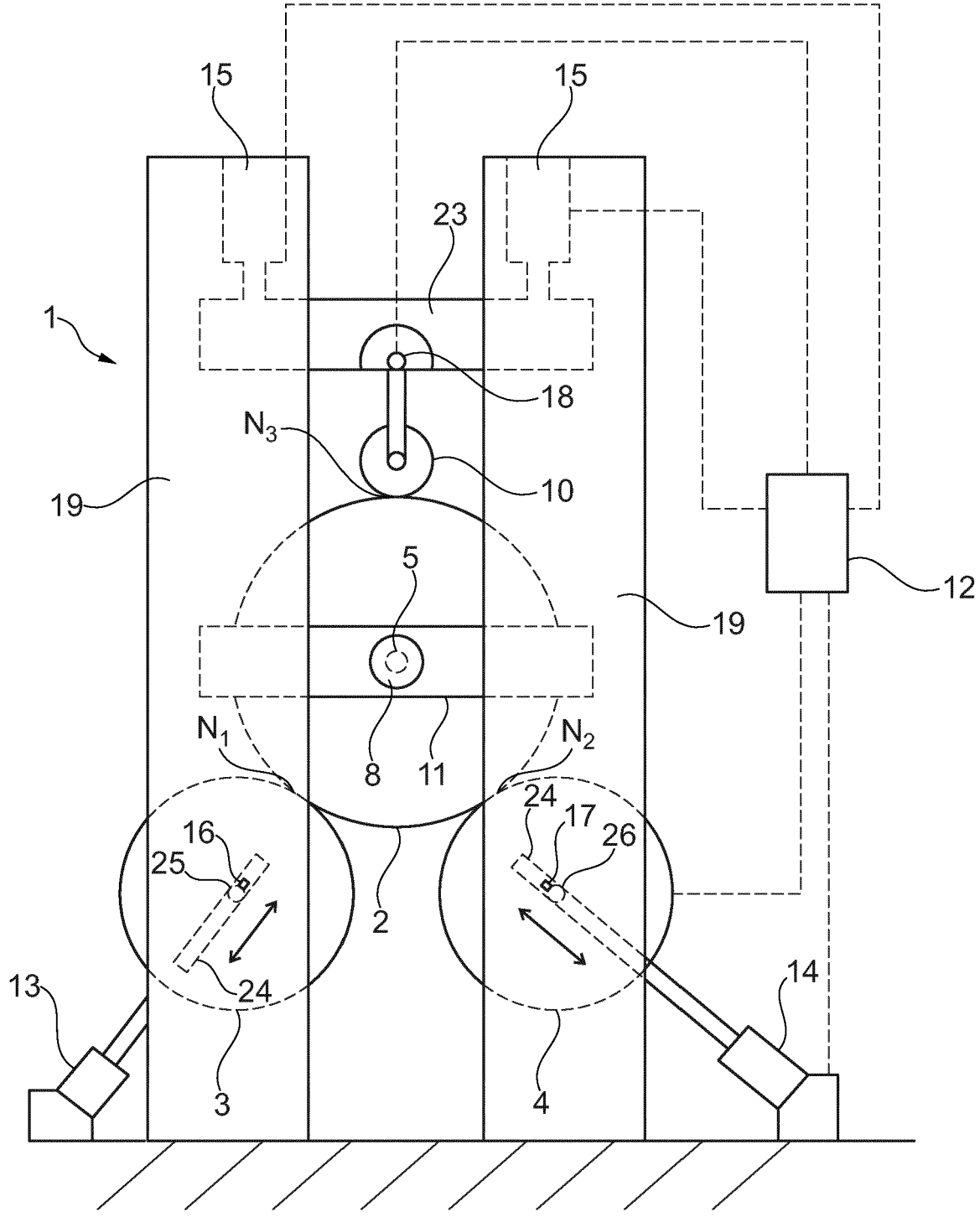


Fig. 3

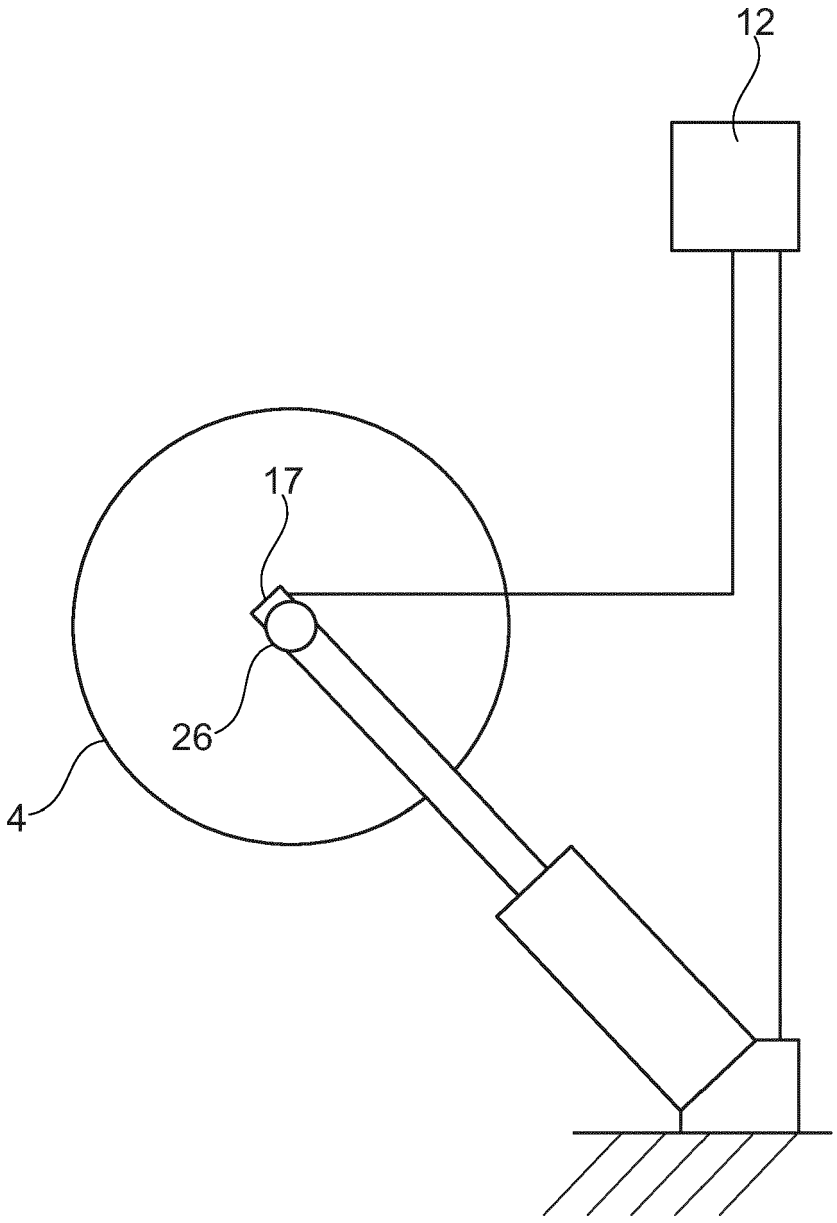


Fig. 4

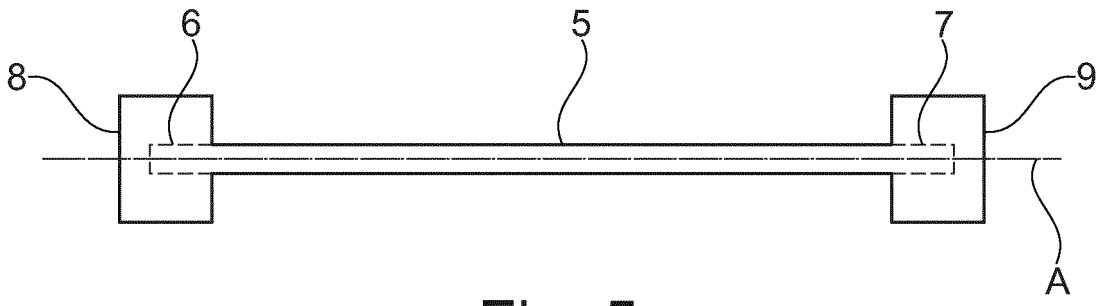


Fig. 5

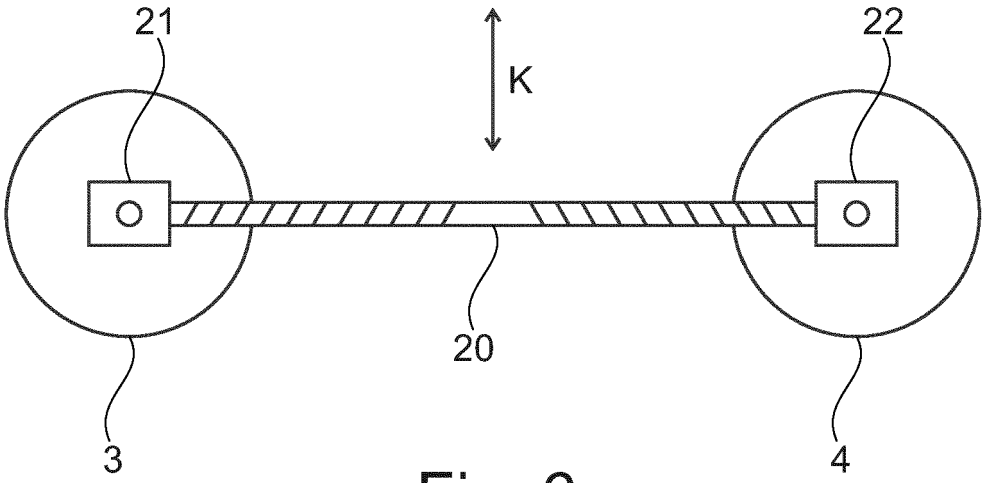


Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 4264

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 November 2016	Haaken, Willy

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