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(54) **Improved apparatus for rolling up compressible fibrous materials**

Apparat zum Aufrollen von zusammenpressbaren Faserstoffmaterialien

Appareil pour enrouler des matériaux fibreux compressibles

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Description

[0001] The present invention relates to an improved apparatus for rolling up compressible fibrous materials.

[0002] In particular, the invention relates to formation of rolls starting from bands or ribbons of compressible fibrous materials such as mineral-fibre felts intended for use typically in the building field for heat insulation and/or soundproofing of walls, attics and so on.

[0003] It is known that mineral-fibre felts, such as felts made of glass wool, are widely used for heat insulation or soundproofing purposes in a variety of fields and, as above mentioned, they particularly apply to the building field.

[0004] The insulation capabilities, both as regards heat insulation and soundproofing, of felts made of glass wool depend, as known, on the felt thickness.

[0005] On the other hand, in order to make mineral-wool ribbons commercially desirable, packaging techniques capable of minimizing the volume taken up by felts as much as possible have been increasingly widespread.

[0006] From the above it appears that, on the one hand, the glass wool felt thickness is required to be maximum during setting up, so as to ensure high performance in terms of heat insulation/soundproofing and, on the other hand, there is an opposite requirement of minimizing the volume taken up by the felts in order to enable an easy and cheap transportation of same.

[0007] In order to meet these requirements, different packaging techniques have been set up in the past which consist in rolling up the glass wool ribbon under compressed conditions, so as to form a cylindrical roll capable of being stably housed in an outer envelope of paper or plastic material so that transportation of same can take place without taking up too much room.

[0008] Obviously, from the point of view of bulkiness, it is certainly useful that the felt thickness should be reduced as much as possible even if, on the other hand, the springing-back capability of the product, when the latter is disengaged from package and then installed, is to be taken into due account too.

[0009] In order to ensure an efficient reduction in volumes and at the same time an efficient material spring-back on installation, it is absolutely necessary that:

1. the whole ribbon submitted to packaging should be compressed in a uniform manner and to an extent as much as possible closest to the springing-back limit of the product;
2. during packaging, tearing and in particular delamination of the fibrous material should be avoided, as this would involve unevenness and structural discontinuity in the fibrous material and, as a result, unevenness in the subsequent operating behaviour of same.

[0010] According to a presently used technique, the

glass wool ribbon is conducted through a space delimited by two conveyor belts and a pressure roller. In particular, the conveyor belts are inclined and converge towards each other so as to define a predetermined solid angle, whereas the pressure roller is disposed within the solid angle formed by the two above mentioned belts at a given distance from the ideal corner defined by the latter. The conveyor belts and roller draw the felt in a rotation movement about itself. In particular the pressure roller is displaced in such a manner that the space in which the glass wool roll is being formed progressively increases. Depending on the different embodiments, the pressure roller is suitably counterbalanced and is allowed to move freely during formation of the glass wool roll (packaging by passive compression), or it is moved by appropriate drive means and control members following a law previously set by the apparatus (rolling up by active compression).

[0011] Obviously, apparatuses provided with an active control on the pressure roller are capable of performing a continuous adjustment of the action exerted by the roller on the felt, so that an as much as possible uniform compression and felt processing is carried out during the whole rolling-up operation.

[0012] A rolling-up apparatus providing an active compression control is disclosed widely and in detail in EP 0 140 785A.

[0013] Practically, in accordance with teachings in the EP 0 140 785A, which corresponds to the preamble of claim 1, rolling up is controlled by an active intervention of the pressure roller imposing a predetermined thickness, which is preferably constant or slightly decreasing during rolling, to each coil of the felt being rolled up, in order to substantially achieve a uniform compression over the whole felt length, so that, during the installation step, a product having a uniform spring-back and, as a result, constant insulation features over the whole longitudinal extension thereof, is correspondingly obtained.

[0014] While rolling-up apparatuses provided with an active-compression roller have been widely used, they however have highlighted some serious drawbacks.

[0015] Firstly, compression carried out by the roller takes place by suitably managing and constantly controlling the radial position of the roller relative to the glass wool roll being formed and the peripheral speed of the pressing roller itself. For this reason, arrangement of sophisticated and precise controls relative to the roller position and speed, depending on the number of rolled-up coils, is required. In other words, during the whole rolling up operation, management of the pressure roller substantially takes place both as regards its peripheral speed of contact with the material to be rolled up and as regards its movement speed transverse to its own axis, which results in heaviness in carrying out controls on the whole apparatus.

[0016] In addition, since the pressure roller continuously varies its tangential speed, so as to conform itself, coil by coil, to the compression requirements of the roll

being rolled up, this pressure roller surely also exerts a remarkable and varying action tangentially directed towards the compressible ribbon. This inevitably causes tangential stresses at the contact area between the fibrous material and the pressure roller surface, which stresses give rise to delaminations of the fibrous material, breakage of many fibres and therefore structural discontinuities in the fibrous material that would partly impair performance of same in operation.

[0017] It is finally to point out that typically rolling-up devices involving an active compression produce a varying radial action on the perimeter of the roll being formed that gives rise to some deformation in the shape of the transverse section of said roll, which deformation may jeopardise the final steps of applying an outer paper sheath to the roll for blocking the fibre roll once the latter has reached the desired diameter sizes, or make this final steps difficult.

[0018] Under this situation, it is a fundamental object of the present invention to provide an improved apparatus for packaging fibrous compressible materials in the form of rolls, which is capable of improving the traditional-apparatus behaviour.

[0019] In particular, it is an important object of the invention to provide an apparatus capable of managing rolling-up control in a simple and direct manner, while minimizing the delamination problems and achieving a high and uniform compression of the material being processed.

[0020] The foregoing and further objects that will become more apparent in the progress of the following description are substantially achieved by an improved apparatus for rolling up compressible fibrous materials in accordance with the features recited in claim 1.

[0021] Further embodiments of the invention are defined in the dependent claims.

[0022] Further features and advantages will be best understood from the detailed description of a preferred, non-exclusive embodiment of an improved apparatus for rolling up compressible fibrous materials in accordance with the present invention. This description will be taken hereinafter, by way of non-limiting example, with reference to the accompanying drawings, in which:

- Fig. 1 is a diagrammatic side view showing an apparatus in accordance with the present invention;
- Fig. 2 is a view taken along line II-II in Fig. 1.

[0023] With reference to the drawings, an improved apparatus for rolling up compressible fibrous materials in accordance with the present invention has been generally identified by reference numeral 1.

[0024] In particular, it is to note that apparatus 1 will be adapted for use in rolling up materials such as mineral-fibre ribbons or bands, felts made of glass wool for example.

[0025] Apparatus 1 comprises at least one conveyor member 2, and at least one deflection member 3, preferably

consisting of respective conveyor belts such disposed as to define a solid angle (γ) of predetermined opening. More specifically, as shown in the accompanying drawings, the conveyor belt 2 has a corresponding operating stretch 2a, the horizontal one in this case, over which the ribbon of compressible fibrous material 4 to be rolled up is placed. In turn, the deflection member or belt 3 operates at an end region 2b of the conveyor belt 2 and has a respective operating stretch 3a directly in contact with the roll being formed and defining said angle (γ).

[0026] Operating at this solid angle is a restricting member 5, consisting for example of a roller (see the accompanying figures) or a conveyor belt (not shown); the restricting member 5, in cooperation with the conveyor member and deflection member, defines a rolling-up space 6 for the compressible fibrous-material ribbon which, by virtue of the movements imparted by said members 2, 3, 5, can be coiled up, thus progressively increasing its diameter, as better clarified in the following of the present description.

[0027] In order to enable a diameter increase of the roll being formed within the rolling-up space 6, the restricting member 5 is operatively connected to first drive means 7 moving this member away from an ideal corner 8 defined by angle γ , at a predetermined displacement speed Vs.

[0028] Preferably it is to note that the restricting member 5 is radially movable relative to the roll being formed, following a trajectory constantly lying in a flat surface bisecting the solid angle γ .

[0029] In other words, as rolling-up goes on, the restricting roller or belt 5 moves away from corner 8 of the solid angle γ , thereby enabling a radial roll increase and ensuring an appropriate control of the shape and compression to which the different coils are submitted. Apparatus 1 is also provided with an auxiliary unit 10 for feeding sheet material 11 suitable for carrying out final packaging of the roll, once the latter has reached the desired diameter sizes.

[0030] After the above statements given in a general way, the most important aspects of the apparatus of the invention will be now described in detail.

[0031] It is to point out first of all that, in an original manner, apparatus 1 comprises detecting means 12 which can be associated with the conveyor member and/or deflection member and/or restricting member.

[0032] The detecting means 12 is arranged to generate a signal 13 proportional to the reaction load transmitted by the roll being rolled up onto the respective one of said members 2, 3, 5; a control unit 14 cooperates with the detecting means 12 and is active on its own drive means 7 to vary the displacement speed Vs of the restricting member 5 depending on signal 13 generated by the detecting means 12 in accordance with a preset law. In other words, the detecting means 12 is operatively associated with at least one of said members 2, 3, 5, the conveyor member 2 for example, and is capable

of detecting the reaction load transmitted by the roll to the conveyor member, thereby generating an output signal 13 proportional to the amount of said load.

[0033] Obviously, the reaction load lying, for example, on the conveyor member will be partly due to the weight of the material being gradually wound up and partly due to the force, and therefore pressure, that the restricting member 5 exerts on the fibrous-material roll as the latter is being formed.

[0034] From a manufacturing point of view, the detecting means may comprise at least one load cell 15, 16, 17 placed close to the conveyor member 2 and/or deflection member 3 and/or restricting member 5 and capable of outputting a signal 13 proportional to the reaction load transmitted by the roll being wound up to the corresponding one of said members provided with the load cell itself.

[0035] Typically the load cell or cells used will be interposed between the concerned deflection, conveyor or restricting members and a fixed support. It should be noted that generally use of several load cells is preferred, which cells are usually disposed at the conveyor member 2 and have offset positions relative to each other. In accordance with a preferential solution, the load cells 15 are at least two in number (see Fig. 2), spaced apart from each other transversely of the ribbon 4 of compressible material to be rolled up and put close to the conveyor member at a region 18 substantially underlying the rolling-up space of the ribbon itself.

[0036] In more detail, since the load cells 15, 16, 17 must substantially give a response proportionate to the load transmitted by the restricting member to the roll being processed, installation of these load cells is advantageously provided at a region defined by displacement of the restricting member from its minimum-distance condition from corner 8 (beginning of winding-up) to its maximum-distance condition from the same corner of the solid angle (end of winding-up).

[0037] Obviously, if the load cells are wished to be disposed also or exclusively on the deflection member, the same remarks as above relating to the load cells associated with the conveyor member are to be taken into account.

[0038] Still in accordance with the invention, it should be pointed out that the conveyor member 2, which, as said, preferably consists of a conveyor belt, is moved by second drive means 19 at a peripheral speed V_{p1} of contact with the fibrous material which is preferably substantially constant. Also to note is the fact that the deflection member 3, also preferably consisting of a conveyor belt, is moved by third drive means 20 at a peripheral speed V_{p2} of contact with the fibrous material which is preferably substantially constant.

[0039] The same is valid with reference to the restricting member, which in its practical accomplishment may consist both of a roller and of a conveyor belt moved at a substantially constant peripheral speed V_{p3} of contact with the compressible fibrous material ribbon.

[0040] In other words, the restricting roller or belt, in addition to being moved away from the corner of the solid angle γ by the first drive means 7 at a speed V_s , is also moved around its own axis at the peripheral speed V_{p3} by fourth drive means 21 associated therewith.

[0041] Advantageously, the detecting means 12 of apparatus 1 may comprise an energetic-absorption sensor 22, 23, 24 associated with the above mentioned second and/or third and/or fourth drive means for example, so as to pick up the energetic consumption therefrom which is necessary for keeping the peripheral speed V_{p1} , V_{p2} , V_{p3} of the respective members always constant.

[0042] It is in fact to note that the load transmitted by the restricting roller or belt 5 to ribbon 4 can become known and therefore be adjusted by for example evaluating the energetic absorption required by the second drive means 13 to keep the peripheral speed V_{p1} of the conveyor belt 2 constant. It is in fact apparent that the resistance to movement offered by the conveyor member 2 is linked to the load lying thereon and therefore to the pressure exerted by member 5 onto the roll being formed.

[0043] The same is obviously valid with reference to the energetic-absorption sensors 23, 24, optionally associated with the third and/or fourth drive means 20, 21.

[0044] It is also to note that the detecting means in accordance with the present invention may comprise a combined solution including load cells and energetic-absorption sensors in order to send the control unit 14 several signals 13 which at all events are all linked to the load transmitted by the restricting member 5 to the ribbon being wound up. The control unit will then be such programmed as to manage movement (i.e. speed V_s) of the restricting member 5, so that the load transmitted instant by instant to the ribbon being wound up may comply with a preset law.

[0045] Preferably the control unit will operate the first drive means by varying the displacement speed V_s of the restricting member, so as to keep the reaction load transmitted by the restricting member to the roll substantially constant during most of the winding-up operation.

[0046] Practically, by virtue of the improved apparatus in reference and the particular nature of the detecting means 12, as well as the cooperation of this means with the control unit 14, and due to the presence of the different drive means, rolling-up with a controlled compression can be carried out in a very efficient manner without being it necessary to know the position of the restricting member or pressure roller instant by instant. In fact, independently of said position, the load and consequently pressure exerted by the restricting member 5 is perfectly adjusted by the detection carried out by the absorption sensors and/or load cells cooperating with the control unit.

[0047] In accordance with a further advantageous aspect of the invention, apparatus 1 further comprises a precompression device 25 operating upstream of the

rolling-up space 6 relative to the feeding direction of the compressible-material ribbon.

[0048] The precompression device 25 is capable of causing a predetermined compression on the fibrous-material ribbon 4 before the latter comes to the rolling-up space 6.

[0049] Practically, the precompression device comprises a conveyor belt active on the fibrous material on the opposite side relative to the operating stretch 2a of the conveyor member 2. This precompression device in particular has an active portion 25a operating on the fibrous material and exerting a compression action thereon, which is directed perpendicularly to the predetermined feeding direction of the fibrous material itself.

[0050] It is to note that the operating stretch 2a of the conveyor belt 2 is rectilinear and converges towards the active portion 25a, which is rectilinear as well, of device 25, moving close to the rolling-up space 6. Practically, the operating stretch of the conveyor member and the active portion 25a of the precompression device define a precompression acute angle α .

[0051] It is also important to point out that preferably the active portion 25a of the precompression device has a peripheral speed V_{p4} having a component (p), parallel to the peripheral speed V_{p1} of the operating stretch 2a of the conveyor belt 2, and a component (o), perpendicular to the peripheral speed V_{p1} of the operating stretch 2a of the conveyor member. The parallel component (p) is in particular of same modulus, direction and way as the peripheral speed V_{p1} of the operating stretch 2a of the conveyor member 2, so that the device 25 does not exert any tangential action on the compressible-material ribbon, which action could cause undesired delaminations.

[0052] It is finally to note that movement means (not shown) associated with the precompression device can be provided for moving said precompression device close to and away from the rolling-up space and/or for moving this device in a manner adapted to vary the width of the precompression angle α . The control unit 14 is active on the movement means to progressively move the precompression device away from the rolling-up space as the material is coiled up, so that a distance d between the perimetric edge of the roll being wound and the precompression device is maintained substantially unchanged.

[0053] The invention achieves important advantages.

[0054] First of all the improved apparatus in question enables a perfectly controlled rolling-up by directly processing a detected signal 13 at the pressure exerted by the restricting member on the roll being processed. This enables a very precise control to be carried out in the compression action imposed to each individual coil of the roll, independently of the position of the restricting member, and consequently independently of the diameter bulkiness taken by the roll instant by instant. In conclusion, an excellent coiling-up is reached while the necessary control systems are greatly reduced relative to

the traditional art.

[0055] By providing a combination of load detections (load cells) with energetic-absorption detections (absorption sensors), so as to instantaneously supply the control unit 14 with a reliable control signal, quality of rolling-up is advantageously improved.

[0056] Since a compression device operating upstream of the rolling-up space and cooperating with the detecting means and the control unit has been provided, the apparatus is also very advantageous for achieving an excellent packaging with a high percentage of compression of the processed ribbon, the geometry of the roll being always respected.

Claims

1. An improved apparatus for rolling up compressible fibrous materials, comprising:

- at least one conveyor member (2) having a corresponding operating stretch (2a) over which a ribbon of compressible fibrous material (4) to be coiled up is placed;
- at least one deflection member (3) cooperating with the conveyor member and defining a solid angle (γ) of predetermined opening with said conveyor member;
- at least one restricting member (5) operating at said solid angle (γ) between the conveyor member and deflection member so as to define, together with them, at least one rolling-up space (6) for the ribbon of compressible fibrous material (4);
- first drive means (7) active on the restricting member (5) to move the latter away from an ideal corner (8) defined by the solid angle (γ), according to a predetermined displacement speed (V_s) as the compressible ribbon is rolled-up,

characterized in that it comprises detecting means (12) operatively associated with at least one of said members (2, 3, 5) and arranged to generate a signal (13) proportional to a reaction load transmitted from the roll being coiled up to the respective one of said members; and

- a control unit (14) active on the first drive means (7) to vary the displacement speed (V_s) of the restricting member (5) depending on the signal (13) generated by the detecting means according to a preset law.

2. An apparatus as claimed in claim 1, characterized in that the detecting means (12) is operatively associated with the conveyor member (2).

3. An apparatus as claimed in claim 1, characterized in that the detecting means (12) is associated with the deflection member (3).
4. An apparatus as claimed in claim 1, characterized in that the detecting means (12) is associated with the restricting member (5).
5. An apparatus as claimed in anyone of the preceding claims, characterized in that the detecting means (12) associated with the conveyor and/or deflection and/or restricting members comprises at least one load cell (15, 16, 17) arranged to output said signal (13) proportional to the reaction load transmitted by the roll being rolled-up to the corresponding one of said members.
6. An apparatus as claimed in claim 5, characterized in that the detecting means (12) associated with the conveyor member (2) comprises a plurality of load cells (15), preferably two in number, spaced apart from each other transversely of the ribbon of compressible material to be coiled up.
7. An apparatus as claimed in claim 6, characterized in that said plurality of load cells (15) are in alignment with each other transversely of the ribbon of compressible fibrous material and are disposed at a region (18) substantially underlying the rolling-up space (6) of the ribbon itself.
8. An apparatus as claimed in anyone of claims 1 to 7, characterized in that said conveyor member (2), preferably consisting of at least one conveyor belt, is moved at a substantially constant peripheral speed (Vp1) of contact with the ribbon of compressible fibrous material (4).
9. An apparatus as claimed in claim 8, characterized in that it comprises second drive means (19) arranged to move the conveyor member (2) at said substantially constant peripheral speed (Vp1), said detecting means (12) comprising at least one energetic-absorption sensor (22) associated with the second drive means (19).
10. An apparatus as claimed in anyone of claims 1 to 7, characterized in that said deflection member (3), preferably consisting of at least one conveyor belt, is moved at a substantially constant peripheral speed (Vp2) of contact with the ribbon of compressible fibrous material (4).
11. An apparatus as claimed in claim 10, characterized in that it comprises third drive means (20) arranged to move the deflection member (3) at said substantially constant peripheral speed (Vp2), said detecting means (12) comprising an energetic-absorption sensor (23) associated with the third drive means (20).
12. An apparatus as claimed in anyone of claims 1 to 7, characterized in that said restricting member (5), preferably consisting of a roller or a conveyor belt, is moved at a substantially constant peripheral speed (Vp3) of contact with the ribbon of compressible fibrous material.
13. An apparatus as claimed in claim 12, characterized in that it comprises fourth drive means (21) arranged to move the restricting member (5) at said substantially constant peripheral speed (Vp3), said detecting means (12) comprising an energetic-absorption sensor (24) associated with the fourth drive means.
14. An apparatus as claimed in anyone of claims 5 to 7, characterized in that said control unit (14) is active on the first drive means (7) to vary the displacement speed (Vs) of the restricting member (5) depending on the signal (13) generated by said at least one load cell (15, 16, 17).
15. An apparatus as claimed in anyone of claims 9, 11 and 13, characterized in that said control unit (14) is active on the first drive means (7) to vary the displacement speed (Vs) of the restricting member depending on the signal (13) generated by said at least one absorption sensor (22, 23, 24).
16. An apparatus as claimed in anyone of claims 9, 11 and 13, characterized in that said control unit (14) is active on the first drive means (7) to vary the displacement speed (Vs) of the restricting member depending both on the signal (13) generated by said at least one load cell (15, 16, 17) and on the signal (13) generated by said at least one energetic-absorption sensor (22, 23, 24).
17. An apparatus as claimed in anyone of claims 14 to 16, characterized in that said control unit (14) operates the first drive means (7) by varying the displacement speed (Vs) of the restricting member (5) to keep the reaction load transmitted by the restricting member itself to the roll substantially constant.
18. An apparatus as claimed in anyone of the preceding claims, characterized in that it comprises at least one precompression device (25) operating upstream of the rolling-up space (6) relative to a feeding direction of the ribbon of compressible fibrous material (4), said precompression device being active on the ribbon itself to cause a predetermined compression thereof before said ribbon reaches the rolling-up space (6).

19. An apparatus as claimed in claim 18, characterized in that the precompression device (25) operates at the conveyor member (2) and is active on the fibrous material (4) on the opposite side relative to an operating stretch (2a) of the conveyor member itself over which the ribbon of compressible fibrous material is placed. 5
20. An apparatus as claimed in claim 19, characterized in that the precompression device (25) has at least one active portion (25a) operating on the fibrous material (4) and exerting a compression action thereon which is directed perpendicularly to the predetermined feeding direction of the fibrous material itself towards the rolling-up space (6). 10 15
21. An apparatus as claimed in claim 20, characterized in that the precompression device (25) comprises at least one conveyor mat or belt, said active portion (25a) on the fibrous material being defined by a rectilinear stretch converging with said operating stretch (2a) of the conveyor belt (2) on moving close to the rolling-up space (6), to cause a predetermined precompression on the fibrous material. 20 25
22. An apparatus as claimed in claim 21, characterized in that the conveyor member (2) comprises at least one conveyor mat having an operating stretch (2a) of rectilinear conformation inclined at an acute precompression angle (α) relative to said active portion (25a). 30
23. An apparatus as claimed in claim 21, characterized in that the active portion (25a) of the precompression device (25) has a peripheral speed (V_{p4}) having a component (p), parallel to a peripheral speed (V_{p1}) of the operating stretch of the conveyor belt (2), and a component (o), perpendicular to the peripheral speed of the operating stretch of the conveyor member, said parallel component (p) being substantially of same modulus, direction and way as the peripheral speed (V_{p1}) of the operating stretch of the conveyor member (2). 35 40
24. An apparatus as claimed in claim 18, characterized in that it comprises movement means operatively associated with the precompression device (25) to move said device close to and away from the rolling-up space and/or movement means operatively active on the precompression device (25) to angularly move said device and vary said precompression angle (α). 45 50
- Patentansprüche** 55
1. Apparat zum Aufrollen von zusammenpressbaren Fasermaterialien, umfassend:
- mindestens ein Förderorgan (2), das einen entsprechenden Arbeitsabschnitt (2a) aufweist, oberhalb dem ein aufzurollendes, zusammenpressbares Faserstoffmaterialband (4) gelegt wird;
 - mindestens ein Abweisorgan (3), das mit dem Förderorgan zusammenwirkt und mit diesem letzteren einen festen Winkel ($\square$) vorgegebenen Betrages festlegt;
 - mindestens ein Aufnahmeorgan (5), das im Bereich des festen Winkels ($\square$) zwischen dem Förderorgan und dem Abweisorgan wirkt, um mit diesem letzteren mindestens einen Aufwickelraum (6) des zusammenpressbaren Faserstoffmaterialbandes (4) festzulegen;
 - erste Antriebsmittel (7), die am Aufnahmeorgan (5) wirken, um dieses letztere von einer durch den Winkel ($\square$) festgelegten, idealen Kante (8) gemäß einer vorgegebenen Verstellgeschwindigkeit (V_s) allmählich mit dem Aufrollen des zusammenpressbaren Bandes wegzubewegen,
- dadurch gekennzeichnet, dass er Erfassungsmittel (12) umfasst, die wirksam mindestens einem der genannten Organe (2, 3, 5) zugeordnet und bereitgestellt sind, ein Signal (13) zu erzeugen, das zur Reaktionslast proportional ist, die von der aufzurollenden Rolle dem entsprechenden Organ übertragen wird, und
- eine Überwachungseinheit (14), die auf die ersten Antriebsmittel (7) wirkt, um die Verstellgeschwindigkeit (V_s) des Aufnahmeorgans (5) in Abhängigkeit des durch die Erfassungsmittel erzeugten Signals (13) gemäß einem vorgegebenen Gesetz zu ändern.
2. Apparat nach Anspruch 1, dadurch gekennzeichnet, dass die Erfassungsmittel (12) wirksam dem Förderorgan (2) zugeordnet sind.
3. Apparat nach Anspruch 1, dadurch gekennzeichnet, dass die Erfassungsmittel (12) dem Abweisorgan (3) zugeordnet sind.
4. Apparat nach Anspruch 1, dadurch gekennzeichnet, dass die Erfassungsmittel (12) dem Aufnahmeorgan (5) zugeordnet sind.
5. Apparat nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, dass die dem Förderorgan und/oder Arbeitsorgan und/oder dem Aufnahmeorgan zugeordneten Erfassungsmittel mindestens eine Lastzelle (15, 16, 17) umfassen, die bereitgestellt ist, am Ausgang das genannte Signal (13) zu liefern, das der Reaktionslast proportional ist, die von der aufzurollenden Rolle dem entspre-

chenden Organ übertragen wird.

6. Apparat nach Anspruch 5, dadurch gekennzeichnet, dass die dem Förderorgan (2) zugeordneten Erfassungsmittel (12) eine Vielzahl von, bevorzugter Weise mindestens zwei Lastzellen (15) umfassen, die voneinander quer zum zusammenpressbaren, aufzurollenden Materialband (4) beabstandet sind. 5
7. Apparat nach Anspruch 6, dadurch gekennzeichnet, dass die Vielzahl von Lastzellen (15) zueinander quer zum zusammenpressbaren Fasermaterialband aneinandergereiht und in einem Bereich (18) angeordnet sind, der im wesentlichen unterhalb des Aufrollraumes (6) des Bandes selbst liegt. 10 15
8. Apparat nach einem beliebigen der Ansprüche von 1 bis 7, dadurch gekennzeichnet, dass das bevorzugter Weise aus mindestens einem Förderband bestehende Förderorgan (2) sich mit einer im wesentlichen konstanten Umfangsgeschwindigkeit (Vp1) in Berührung mit dem zusammenpressbaren Fasermaterialband (4) bewegt. 20 25
9. Apparat nach Anspruch 8, dadurch gekennzeichnet, dass er zweite Antriebsmittel (19) umfasst, die bereitgestellt sind, das Förderorgan (2) gemäß der genannten im wesentlichen konstanten Umfangsgeschwindigkeit (Vp1) zu bewegen, wobei die Erfassungsmittel (12) mindestens einen dem zweiten Antriebsmittel (18) zugeordneten Energieaufnahmesensor (22) umfassen. 30
10. Apparat nach einem beliebigen der Ansprüche von 1 bis 7, dadurch gekennzeichnet, dass bevorzugter Weise das aus mindestens einem Förderband bestehende Abweisorgan (3) sich mit einer im wesentlichen konstanten Umfangsgeschwindigkeit (Vp2) in Berührung mit dem zusammenpressbaren Fasermaterialband (4) bewegt. 35 40
11. Apparat nach Anspruch 10, dadurch gekennzeichnet, dass er dritte Antriebsmittel (12) umfasst, die bereitgestellt sind, das Abweisorgan (3) gemäß einer im wesentlichen konstanten Umfangsgeschwindigkeit (Vp2) zu bewegen, wobei die Erfassungsmittel (12) einen den dritten Antriebsmitteln (20) zugeordneten Energieaufnahmesensor (23) umfassen. 45 50
12. Apparat nach einem beliebigen der Ansprüche von 1 bis 7, dadurch gekennzeichnet, dass das bevorzugter Weise aus einer Rolle oder einem Förderband bestehende Aufnahmeorgan (5) sich mit einer im wesentlichen konstanten Umfangsgeschwindigkeit (Vp3) in Berührung mit dem zusammenpressbaren Fasermaterialband bewegt. 55

13. Apparat nach Anspruch 12, dadurch gekennzeichnet, dass er vier Antriebsmittel (21) umfasst, die bereitgestellt sind, das Aufnahmeorgan (5) gemäß einer im wesentlichen konstanten Umfangsgeschwindigkeit (Vp3) zu bewegen, wobei die Erfassungsmittel (12) einen den vierten Antriebsmitteln zugeordneten Energieaufnahmesensor (24) umfassen.
14. Apparat nach einem beliebigen der Ansprüche von 5 bis 7, dadurch gekennzeichnet, dass die Überwachungseinheit (14) auf die ersten Antriebsmittel (12) wirkt, um die Verstellgeschwindigkeit (Vs) des Aufnahmeorgans (5) in Abhängigkeit des Signals (13) zu ändern, das von mindestens einer Lastzelle (15, 16, 17) erzeugt wird. 10 15
15. Apparat nach mindestens einem der Ansprüche 9, 11 und 13, dadurch gekennzeichnet, dass die Überwachungseinheit (14) auf die ersten Antriebsmittel (7) wirkt, um die Verstellgeschwindigkeit (Vs) des Aufnahmeorgans in Abhängigkeit des Signals (13) zu ändern, das von mindestens einem Energieaufnahmesensor (22, 23, 24) erzeugt wird. 20 25
16. Apparat nach einem beliebigen der Ansprüche 9, 11 und 13, dadurch gekennzeichnet, dass die Überwachungseinheit (14) auf die ersten Antriebsmittel (7) wirkt, um die Verstellgeschwindigkeit (Vs) des Aufnahmeorgans sowohl in Abhängigkeit des von mindestens einer Lastzelle (15, 16, 17) erzeugten Signals (13) als auch in Abhängigkeit des von mindestens einem Energieaufnahmesensor (22, 23, 24) erzeugten Signals (13) zu ändern. 30 35
17. Apparat nach einem beliebigen der Ansprüche von 14 bis 16, dadurch gekennzeichnet, dass die Überwachungseinheit (14) die ersten Antriebsmittel (7) steuert, indem die Verstellgeschwindigkeit (Vs) des Aufnahmeorgans (5) geändert wird, um die vom Aufnahmeorgan selbst der Rolle übertragene Reaktionslast im wesentlichen konstant zu halten. 40 45
18. Apparat nach einem der beliebigen vorstehenden Ansprüche dadurch gekennzeichnet, dass er mindestens eine Vorpresseeinrichtung (25) umfasst, die vor dem Aufrollraum (6) gegenüber einer Vorschubrichtung des zusammenpressbaren Fasermaterialbandes (4) wirkt, wobei die Vorpresseeinrichtung auf das Band selbst wirkt, um eine vorgegebene Pressung zu bewirken, bevor dieses letztere im Aufrollraum (6) ankommt. 50 55
19. Apparat nach Anspruch 18, dadurch gekennzeichnet, dass die Vorpresseeinrichtung (25) im Bereich des Förderorgans (2) wirkt und am Fasermaterialband (4) an der gegenüber dem Arbeitsabschnitt (2a) des Fördermittels selbst abgewandten Seite

wirksam ist, oberhalb dessen das zusammenpressbare Fasermaterialband gelegen ist.

20. Apparat nach Anspruch 19, dadurch gekennzeichnet, dass die Vorpresseinrichtung (25) mindestens einen auf das Fasermaterial (4) wirksamen Abschnitt (25) aufweist, der auf diesem eine Pressung ausübt, die senkrecht zur vorgegebenen Vorschubrichtung des Fasermaterials selbst in Richtung des Aufrollraumes (6) gerichtet ist. 5 10
21. Apparat nach Anspruch 20, dadurch gekennzeichnet, dass die Vorpresseinrichtung (25) mindestens eine Fördermatte umfasst, wobei der auf das Fasermaterial wirksame Abschnitt (25a) durch einen geraden Abschnitt festgelegt ist, der mit dem wirksamen Abschnitt (2a) des Förderorgans (2) in Annäherung an den Aufrollraum (6) zusammenläuft, um eine vorgegebene Vorpressung am Fasermaterial zu bewirken. 15 20
22. Apparat nach Anspruch 21, dadurch gekennzeichnet, dass das Förderorgan (2) mindestens eine Fördermatte mit einem wirksamen Abschnitt (2a) gerader Ausbildung umfasst, der gegenüber dem wirksamen Abschnitt (25a) um einen spitzen Vorpresswinkel α geneigt ist. 25
23. Apparat nach Anspruch 21, dadurch gekennzeichnet, dass der wirksame Abschnitt (25a) der Vorpresseinrichtung (25) eine Umfangsgeschwindigkeit (V_{p4}) mit einer Komponente (p), die zur Umfangsgeschwindigkeit (V_{p1}) des wirksamen Abschnittes des Förderbandes (2) parallel ist, und einer Komponente (o) aufweist, die zur Umfangsgeschwindigkeit des wirksamen Abschnittes des Förderorgans senkrecht ist, wobei die parallele Komponente (p) im Modul, Richtung und Sinn gleich der Umfangsgeschwindigkeit (V_{p1}) des wirksamen Abschnittes des Förderorgans (2) ist. 30 35 40
24. Apparat nach Anspruch 18, dadurch gekennzeichnet, dass er wirksam der Vorpresseinrichtung (25) zugeordnete Verstellmittel, um diese letztere anzunähern und zu entfernen, und/oder Verstellmittel umfasst, die auf die Vorpresseinrichtung (25) wirken, um diese letztere im Winkel zu verstellen und den Vorpresswinkel (α) zu ändern. 45 50

Revendications

1. Appareil amélioré pour enrouler des matériaux fibreux compressibles, comprenant: 55
- au moins un organe transporteur (2) ayant un tronçon correspondant de travail (2a) au-dessus duquel est mis un ruban de matériau fi-

- breux compressible à enrouler;
- au moins un organe de déviation (3) coopérant avec l'organe transporteur et définissant un angle solide (γ) d'ouverture prédéterminée avec ledit organe transporteur;
- au moins un organe de limitation (5) agissant en correspondance dudit angle solide (γ) entre l'organe transporteur et l'organe de déviation de manière à définir, avec ces derniers, au moins un espace d'enroulement (6) du ruban de matériau fibreux compressible (4);
- des premiers moyens moteurs (7) actifs sur l'organe de limitation (5) pour causer le mouvement de ce dernier en éloignement d'un coin idéal (8) défini par ledit angle solide (γ), suivant une vitesse de déplacement prédéterminée (V_s) au fur et à mesure que le ruban compressible est enroulé,

caractérisé en ce qu'il comporte des moyens de détection (12) associés, lors de leurs fonctionnement, à l'un au moins desdits organes (2, 3, 5) et destinés à engendrer un signal (13) proportionnel à une charge de réaction transmise par le rouleau en cours d'enroulement à l'organe respectif; et

- une unité de contrôle (14) active sur les premiers moyens moteurs (7) pour changer la vitesse de déplacement (V_s) de l'organe de limitation (5) en fonction du signal (13) engendré par les moyens de détection suivant une loi préétablie.

2. Appareil selon la revendication 1, caractérisé en ce que les moyens de détection (12) sont associés, pour leur fonctionnement, à l'organe transporteur (2).
3. Appareil selon la revendication 1, caractérisé en ce que les moyens de détection (12) sont associés à l'organe de déviation (3).
4. Appareil selon la revendication 1, caractérisé en ce que les moyens de détection (12) sont associés à l'organe de limitation (5).
5. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que les moyens de détection (12) associés à l'organe transporteur et/ou de déviation et/ou de limitation comportent au moins une cellule de charge (15, 16, 17) destinée à émettre ledit signal (13) proportionnel à la charge de réaction transmise par le rouleau en cours d'enroulement à l'organe correspondant.
6. Appareil selon la revendication 5, caractérisé en ce que les moyens de détection (12) associés à l'organe transporteur (2) comportent une pluralité de cel-

lules de charge (15), de préférence au nombre de deux, écartées les unes des autres transversalement par rapport au ruban de matériau compressible à enrouler.

7. Appareil selon la revendication 6, caractérisé en ce que ladite pluralité de cellules de charge (15) sont en alignement les unes avec les autres transversalement au ruban en matériau fibreux compressible et sont disposées dans une zone (18) essentiellement placée au-dessous de l'espace d'enroulement (6) du ruban lui-même.
8. Appareil selon l'une quelconque des revendications 1 à 7, caractérisé en ce que ledit organe transporteur (2), comportant de préférence au moins une courroie transporteuse, est mû à une vitesse périphérique (Vp1) sensiblement constante au contact du ruban de matériau fibreux compressible (4).
9. Appareil selon la revendication 8, caractérisé en ce qu'il comporte des deuxièmes moyens moteurs (19) destinés à causer le mouvement dudit organe transporteur (2) à ladite vitesse périphérique sensiblement constante (Vp1), lesdits moyens de détection (12) comportant au moins un capteur d'absorption énergétique (22) associé aux deuxièmes moyens moteurs (19).
10. Appareil selon l'une quelconque des revendications 1 à 7, caractérisé en ce que ledit organe de déviation (3), comportant de préférence au moins une courroie transporteuse, est mû à une vitesse périphérique (Vp2) sensiblement constante au contact du ruban de matériau fibreux compressible (4).
11. Appareil selon la revendication 10, caractérisé en ce qu'il comporte des troisièmes moyens moteurs (20) destinés à causer le mouvement de l'organe de déviation (3) à ladite vitesse périphérique (Vp2) sensiblement constante, lesdits moyens de détection (12) comportant un capteur d'absorption énergétique (23) associé aux troisièmes moyens moteurs (20).
12. Appareil selon l'une quelconque des revendications 1 à 7, caractérisé en ce que ledit organe de limitation (5), se composant de préférence d'un rouleau de transport ou d'une courroie transporteuse, est mû à une vitesse périphérique (Vp3) sensiblement constante, au contact du ruban de matériau fibreux compressible.
13. Appareil selon la revendication 12, caractérisé en ce qu'il comporte des quatrièmes moyens moteurs (21) destinés à causer le mouvement de l'organe de limitation (5) à ladite vitesse périphérique (Vp3) sensiblement constante, lesdits moyens de détec-

tions (12) comprenant un capteur d'absorption énergétique (24) associé aux quatrièmes moyens moteurs.

14. Appareil selon l'une quelconque des revendications 5 à 7, caractérisé en ce que ladite unité de contrôle (14) est active sur les premiers moyens moteurs (7) pour changer la vitesse de déplacement (Vs) de l'organe de limitation (5) en fonction du signal (13) engendré par ladite au moins une cellule de charge (15, 16, 17).
15. Appareil selon l'une quelconque des revendications 9, 11 et 13, caractérisé en ce que ladite unité de contrôle (14) est active sur les premiers moyens moteurs (7) pour changer la vitesse de déplacement (Vs) de l'organe de limitation en fonction du signal (13) engendré par ledit au moins un capteur d'absorption (22, 23, 24).
16. Appareil selon l'une quelconque des revendications 9, 11 et 13, caractérisé en ce que ladite unité de contrôle (14) est active sur les premiers moyens moteurs (7) pour changer la vitesse de déplacement (Vs) de l'organe de limitation en fonction soit du signal (13) engendré par ladite au moins une cellule de charge (15, 16, 17) soit du signal (13) engendré par ledit au moins un capteur d'absorption énergétique (22, 23, 24).
17. Appareil selon l'une quelconque des revendications 14 à 16, caractérisé en ce que ladite unité de contrôle (14) commande les premiers moyens moteurs (7) en changeant la vitesse de déplacement (Vs) de l'organe de limitation (5) pour maintenir sensiblement constante la charge de réaction transmise par l'organe de limitation lui-même au rouleau.
18. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce qu'il comporte au moins un dispositif de précompression (25) agissant en amont de l'espace d'enroulement (6) par rapport à une direction d'alimentation du ruban de matériau fibreux (4), ledit dispositif de précompression étant actif sur le ruban lui-même pour causer une compression prédéterminée de ce dernier avant qu'il atteigne l'espace d'enroulement (6).
19. Appareil selon la revendication 18, caractérisé en ce que le dispositif de précompression (25) opère en correspondance de l'organe transporteur (2) et est actif sur le matériau fibreux (4) au côté opposé par rapport à un tronçon de travail (2a) de l'organe transporteur lui-même au-dessus duquel est mis le ruban de matériau fibreux compressible.
20. Appareil selon la revendication 19, caractérisé en ce que le dispositif de précompression (25) a au

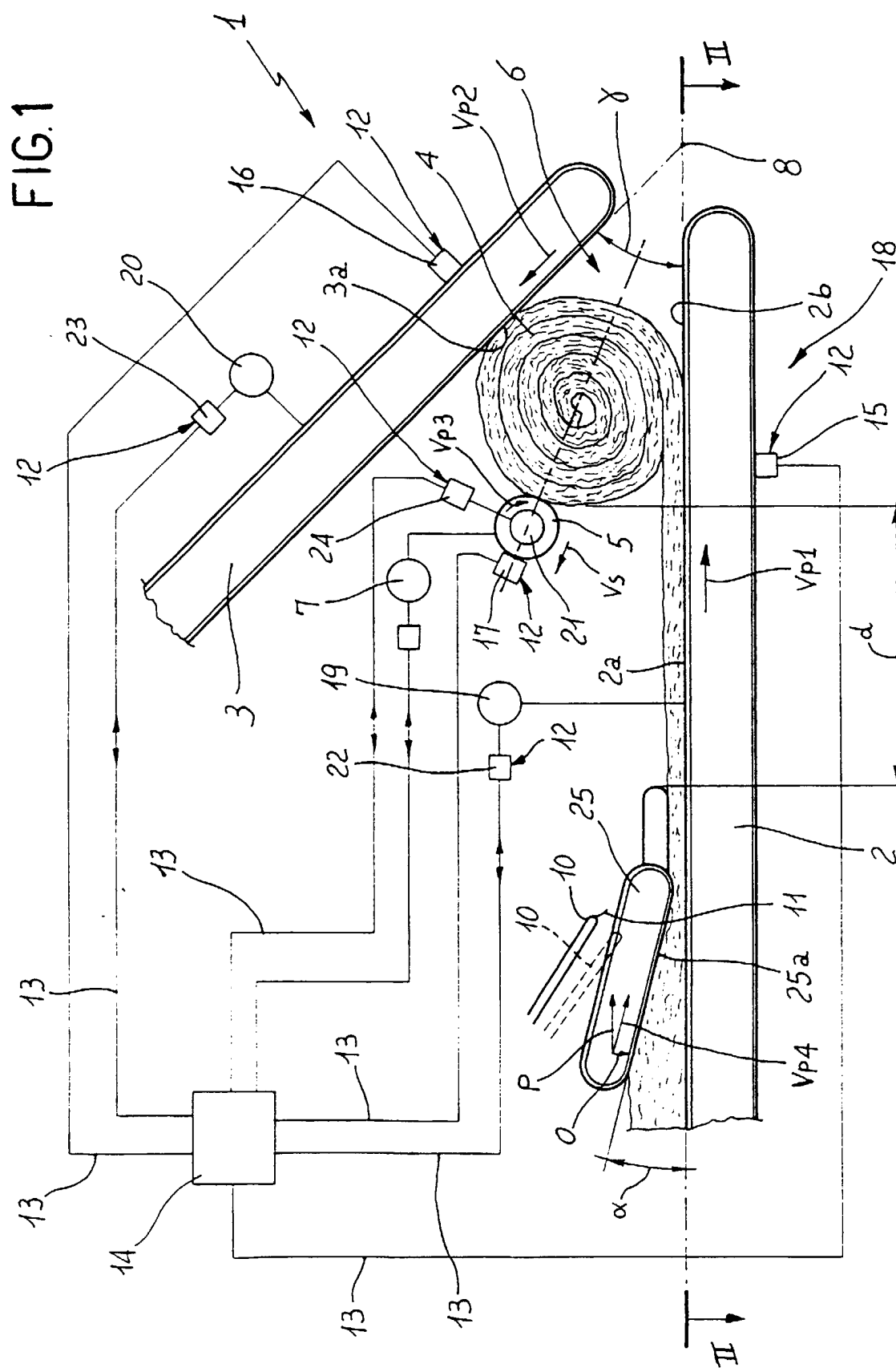
moins une portion active (25a) agissant sur le matériau fibreux (4) et exerçant sur ce dernier une action de compression dirigée perpendiculairement à la direction d'alimentation prédéterminée du même matériau fibreux vers l'espace de roulement (6).

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21. Appareil selon la revendication 20, caractérisé en ce que le dispositif de précompression (25) comporte au moins une courroie transporteuse ou un tapis roulant, ladite portion active (25a) sur le matériau fibreux étant définie par un tronçon rectiligne de convergence avec ledit tronçon de travail (2a) de la courroie transporteuse (2) qui se rapproche de l'espace d'enroulement (6), en vue de causer une précompression prédéterminée sur le matériau fibreux.
22. Appareil selon la revendication 21, caractérisé en ce que l'organe transporteur (2) comporte au moins un tapis roulant ayant un tronçon de travail (2a) de conformation rectiligne, incliné à former un angle aigu de précompression (α) par rapport à ladite portion active (25a).
23. Appareil selon la revendication 21, caractérisé en ce que la portion active (25a) du dispositif de précompression (25) a une vitesse périphérique (V_{p4}) ayant une composante (p) parallèle à la vitesse périphérique (V_{p1}) du tronçon de travail de la courroie transporteuse (2), et une composante (o) perpendiculaire à la vitesse périphérique du tronçon de travail de l'organe transporteur, ladite composante parallèle (p) ayant essentiellement les mêmes module, direction et sens que la vitesse périphérique (V_{p1}) du tronçon de travail de l'organe transporteur (2).
24. Appareil selon la revendication 18, caractérisé en ce qu'il comporte des moyens de mouvement associés pour leur fonctionnement au dispositif de précompression (25) en vue de rapprocher et éloigner ledit dispositif de l'espace d'enroulement, et/ou des moyens de mouvement qui sont actifs de manière opérationnelle sur le dispositif de précompression (25), pour effectuer le déplacement angulaire de ce dernier et varier ledit angle de précompression (α).

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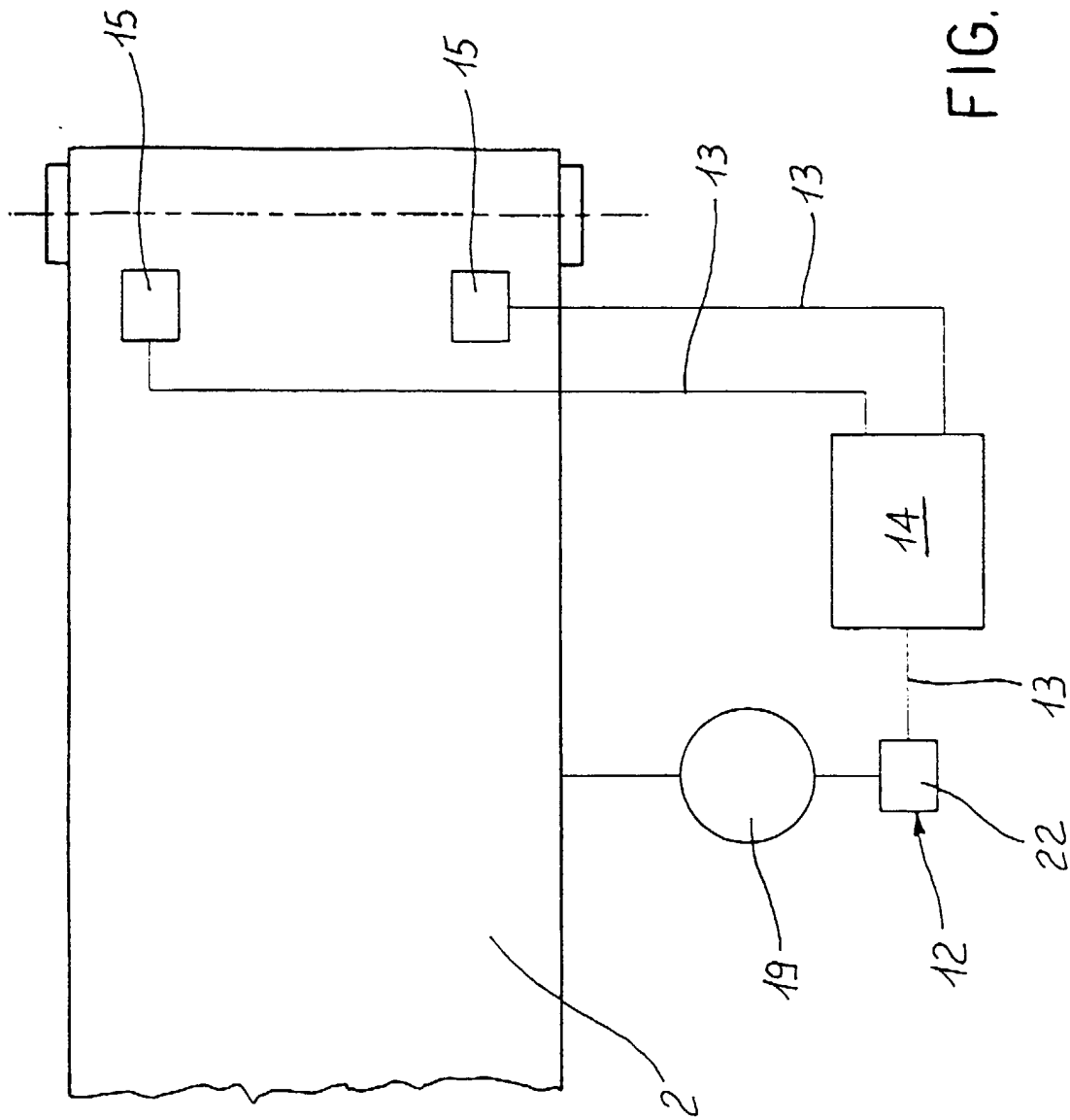


FIG. 2