(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 754 087 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.12.2020 Bulletin 2020/52

(51) Int Cl.:
D06C 21/00 *(2006.01)*

(21) Application number: **20179929.3**

(22) Date of filing: **15.06.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **17.06.2019 IT 201900009201**

(71) Applicant: **Santex Rimar Group S.r.l.**
36070 Trissino VI (IT)

(72) Inventors:
- **MANDRUZZATO, Giulio**
  I-36070 Trissino, Vicenza (IT)
- **NICOLETTI, Andrea**
  I-36070 Trissino, Vicenza (IT)

(74) Representative: **Zanettin, Gianluigi**
Jacobacci & Partners S.p.A.
Piazza Mario Saggin, 2
35131 Padova (IT)

(54) APPARATUS FOR COMPACTING A CONTINUOUS TEXTILE SUBSTRATE BY MEANS OF ELASTIC BELT

(57) The invention relates to an apparatus for compacting a continuous textile substrate (T) by means of elastic belt. The apparatus (1) comprises: - a heatable rotating cylinder (10); - an endless belt (20) movable along a closed path to support and transport the textile substrate (T) in contact with a side surface portion (10a) of said heatable rotating cylinder (10), said belt being elastically deformable in elongation; - a roller system (31, 32, 33, 34, 35) on which said belt (20) is wound in an elongation pretensioning state. The roller system comprises a plurality of idle return rollers (33, 34, 35) and a plurality of motorized rollers (31, 32) operable so as to make said belt (20) slide along said closed path imposing on said belt an additional elongation tension state at a first section (T1) of said path extending - with respect to an advancement direction (X) of the belt - upstream of a second section (T2) of said path in which said belt (20) is maintained in contact with the rotating cylinder. The apparatus (1) comprises means (40) for guiding the textile substrate (T) between the belt (20) and said heatable cylinder (10) along said second section (T2) of said path. The roller system comprises a motorized drive roller (31), a motorized brake roller (32), a first idle return roller (33), which is arranged between said motorized brake roller and said motorized brake roller, and a second idle return roller (34). The first section (T1) of the path extends between the motorized brake roller (32) and the motorized drive roller (31), passing in partial winding around the first idle return roller (33), while the second section (T2) of the path extends between the motorized drive roller (31) and the second idle return roller (34). The closed path is completed by a third section (T3) extending between the second idle return roller (34) and the motorized brake roller (32). In use along the third section (T3) of the path, the belt (20) is in a relaxed tension state with respect to the first section (T1) of the path.

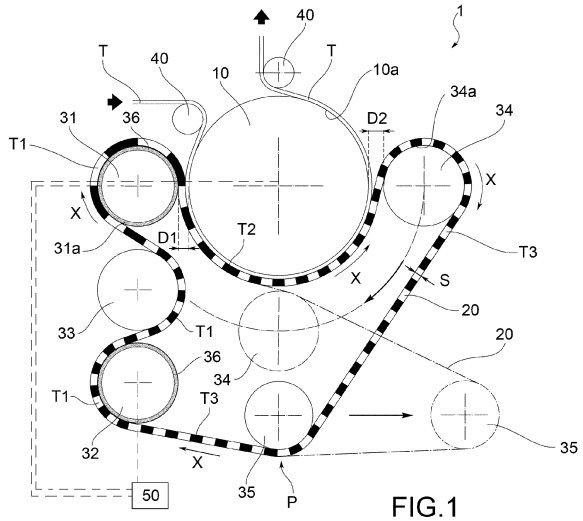

FIG.1

EP 3 754 087 A1

Description

Field of application

[0001] The present invention relates to an apparatus for compacting a continuous textile substrate by means of elastic belt.

Prior art

[0002] As is known, the compacting process of fabrics or textile substrates is one of the main processes in the field of textile finishing and has the purpose of giving stability to the fabrics before going to the manufacturing step.

[0003] Usually the stability and compaction of the fabric is imparted with machinery with consolidated technology which use a change in the curvature of a felt or rubber belt on which the fabric on which to impart the compaction is placed. The change of curvature of the support (felt or rubber belt) then imparts a longitudinal retraction to the fabric which is then pressed against a hot cylinder, which stabilizes the compacting effect ensuring the dimensional stability of the fabric once it leaves the machine.

[0004] All fabrics (whether orthogonal or knitted), after being produced, require a stabilization and compaction process which makes them suitable for being cut for sewing. Compacting machines are therefore used extensively in finishing processes. The compaction values obtainable depend on the degree of initial stability of the fabric produced. The degree of initial stability of a fabric in turn depends on the type of material it is made of.

[0005] Frequently, it is necessary to carry out several passes of the same fabric through compacting machines in order to obtain the desired compaction result. This is particularly the case if the tissue originally had a high degree of instability. All of this lengthens treatment times and affects production costs.

[0006] The need to reduce the times of fabric compaction processes is therefore very felt in the sector, especially in the case of fabrics (for example made of viscose) which are characterized by high degrees of initial instability.

[0007] Over time, different alternative technical solutions have been proposed, which aimed to make compaction systems more efficient. However, these solutions have proved to be not completely satisfactory.

[0008] In more detail, the compacting (or shrinking) treatment of fabrics is carried out essentially by means of a so-called "compression" technique which is based on the use of a substantially deformable belt, to which the fabric to be compacted is tightly coupled. The deformation of the belt in the longitudinal direction of advancement, by means of mechanical means suitable for the purpose, substantially consists of the succession of a first expansion step and a second contraction step. The fabric, engaged integrally with the deformable surface of the belt, undergoes, in particular during the contraction step, a "compression" in the direction of advancement, that is, a compaction of its structure and, ultimately, a longitudinal shrinking.

[0009] The deformability of the belt may be determined by the type and features of the material of which it is made and also by the type of mechanical stress exerted thereon by the mechanical means adapted to deform it. Thus, deformations by pressing of the belt are known which cause the expansion (elongation) thereof followed by a contraction (shortening) to the initial relaxed state; or deformations by variation of peripheral speed of the belt obtained by sliding it on rollers or cylinders with different radius of curvature with an alternately convex and concave path which alternately cause an increase (lengthening) and a decrease (shortening) of peripheral speed; or, finally, deformations by longitudinal traction of the belt (elongation) followed by a release of the traction (shortening) to the initial relaxed state.

[0010] GB patent 563 638 describes an apparatus for compacting fabrics which aims to improve the prior art by using an endless elastic belt supported and guided by rollers, one of which rotates at a variable speed and higher than the roller that precedes it. In this way, the portion of the belt comprised between said two rollers is placed in an elongated state, while in the following section, as tension is relaxed, the belt undergoes a longitudinal contraction equal to the previous elongation.

[0011] The fabric, coupled to the belt at the elongated portion thereof, follows it in the subsequent relaxed portion, partially winding around a rotating and heated cylinder, also undergoing a corresponding longitudinal contraction or shrinkage.

[0012] This technique, however, is not free from drawbacks, the first of which concerns the fact that the elastic belt is rotated between the guide rollers in a completely and naturally relaxed state. Consequently, in the tension release section, subsequent to that in which the longitudinal traction that causes the elongation thereof is applied, the belt returns completely to its naturally relaxed state, without maintaining any minimum residual tension that allows it to transport and effectively guide the fabric during the shrinking step and not even offer any control of its own path around its guide rollers.

[0013] A further negative aspect is linked to the fact that the elastic belt, which is therefore extendable in length, subjected to longitudinal traction also deforms transversely with a consequent and uncontrollable decrease in width. When the tensile stress ceases, both dimensions of the belt tend to regain the original size, that is to say, it re-widens and since, as mentioned, it has not maintained any minimum residual tension, its surface tends to flow loosely and not outstretched, transmitting such irregularities to the fabric coupled thereto.

[0014] The technical solution proposed in European patent application EP1657340A1 partially overcomes the drawbacks described above.

[0015] In more detail, this solution provides for a pretensioning traction to be applied to the elastic belt in such a way that it maintains a minimum residual tension at the

end of the release step of the traction which caused the elongation thereof.

[0016] In more detail, the tissue compaction apparatus described in EP1657340A1 comprises a heated rotating cylinder around which an elastic belt is partially wound. The elastic belt is moved by a plurality of motorized rollers and idle return rollers according to a predefined closed path.

[0017] The roller apparatus is configured in such a way that by operating on the relative position of one of the rollers it is possible - during assembly of the belt on the rollers - to pre-tension the belt itself with respect to its relaxed state. During operation of the apparatus, with respect to this basic state of pre-tensioning, the elastic belt is further stretched by elongation before coming into contact with the cylinder. When the belt comes into contact with the fabric in the winding section around the cylinder, the belt is free to contract longitudinally, thereby dragging the fabric with it in a relative movement with respect to the cylinder. In this way, the fabric is dragged by the longitudinal contraction movement of the elastic belt and is thus compacted longitudinally.

[0018] In particular, as shown in Figure 2 of EP1657340A1, the tensioning of the elastic belt (in addition to the pre-tensioning state) is achieved by the combined action of two triads of rollers which are arranged in diametrically opposite positions with respect to the rotating cylinder. A first triad of rollers is positioned immediately upstream of the heated cylinder (upstream of the first contact point of the belt with the cylinder), while a second triad of rollers is positioned downstream of the cylinder (downstream of the point of detachment of the belt from the cylinder). Between the two triads, in the path section of the elastic belt opposite to that of contact with the cylinder, there is an idle return roller. The rollers of the first triad are all motorized and rotate at the same first tangential speed, with alternating directions of rotation. In the second triad, the first rollers that the belt encounters are motorized and rotate at the same second tangential speed, with alternating directions of rotation. The third roller of the second triad is instead idle.

[0019] Operationally, the elastic belt is elastically stretched by the entire path section opposite to that of winding around the cylinder, differentiating the tangential speeds that the two triads of rollers impose on the elastic belt. In particular, the first tangential speed (i.e. imposed by the first triad of rollers) is higher than the second tangential speed (i.e. imposed by the second triad of rollers) by a value ranging from 20% to 60%.

[0020] The compaction apparatus described above allows the compaction process to be improved by virtue of the belt pre-tensioning, but the results obtained are however not completely satisfactory. The compaction apparatus described above still does not allow precise control of the elongation of the elastic belt and therefore of the degree of tension imposed on the belt itself. In particular, the roller handling apparatus does not allow completely eliminating slippage of the elastic belt with respect to the guide rollers. This adversely affects the efficiency of the compaction process.

[0021] Finally, the stresses imposed by the compaction apparatus described above on the elastic belt cause early wear of the belt itself.

Disclosure of the invention

[0022] Therefore, the object of the present invention is to eliminate in whole or in part the drawbacks of the prior art cited above, by providing an apparatus for compacting fabrics by means of elastic belt which allows the tension of the elastic belt to be controlled more precisely so as to make the fabric compaction process more efficient.

[0023] A further object of the present invention is to provide an apparatus for compacting fabrics by means of elastic belt which allows the stresses imposed on the elastic belt to be reduced.

[0024] A further object of the present invention is to provide an apparatus for compacting fabrics by means of elastic belt which is simple and cost-effective to manufacture.

[0025] A further object of the present invention is to provide an apparatus for compacting fabrics by means of elastic belt which may be managed in an operationally simple manner.

Brief description of the drawings

[0026] The technical features of the invention, according to the aforesaid aims, may clearly be seen in the content of the claims below, and its advantages will become more readily apparent in the detailed description that follows, made with reference to the accompanying drawings, which illustrate one or more purely exemplary and non-limiting embodiments thereof, in which:

- Figure 1 shows a schematic view of an apparatus for compacting fabrics by means of elastic belt according to a preferred embodiment of the present invention;
- Figure 2 shows an enlarged view of a detail of the diagram of Figure 1 relating to the passage area of the elastic belt from a brake roller to an idle cylinder; and
- Figure 3 shows an enlarged view of a detail of the diagram of Figure 1 relating to the passage area of the elastic belt from a drive roller to a heatable rotating cylinder.

Detailed description

[0027] With reference to the accompanying drawings, reference numeral 1 indicates as a whole an apparatus for compacting a continuous textile substrate by means of an elastic belt according to the invention.

[0028] Advantageously, the textile substrate T may be of any type; in particular it may be an orthogonal (shuttle)

fabric or a knitted fabric. The textile substrate may be formed by any type of fiber used for shuttle and knitted fabrics.

[0029] As schematically illustrated in Figure 1, the compacting apparatus 1 comprises:

- a heatable rotating cylinder 10;
- an endless belt 20 which is elastically deformable in elongation and is movable along a closed path to support and transport a textile substrate T in contact with a side surface portion 10a of said heatable rotating cylinder 10;
- a roller system 31, 32, 33, 34, 35 on which the belt 20 is wound in an elongation pre-tensioning state.

[0030] In turn, such a roller system comprises a plurality of idle return rollers 33, 34, 35 and a plurality of motorized rollers 31, 32.

[0031] The motorized rollers 31, 32 may be operated so as to slide the belt 20 along the aforementioned closed path, imposing an additional tensional state of elongation on the belt with respect to the pretensioning one at a first section T1 of said path which extends - with respect to a direction of advancement X of the belt - upstream of a second section T2 of such a path in which said belt 20 is kept in contact with the rotating cylinder.

[0032] The compacting apparatus 1 further comprises means 40 for guiding a textile substrate T between the belt 20 and the heatable cylinder 10 along the second section T2 of such a closed path.

[0033] Operationally, the compacting action on the textile substrate T takes place along the aforementioned second section T2 of the closed path. At such a second section T2, the elastic belt contracts elastically, passing from the additional tensional state of elongation, which was imposed thereon upstream in the first section T1, to a state close to that of pretensioning. The textile substrate T, which in the second section T2, by virtue of the frictional forces, moves integrally with the belt 20, undergoes the contraction of the belt itself, and in turn contracts longitudinally, compacting itself.

[0034] According to a general embodiment of the invention, the aforementioned roller system comprises:

- a motorized drive roller 31;
- a motorized brake roller 32;
- a first idle return roller 33, which is arranged between the motorized brake roller 31 and the motorized brake roller 32; and
- a second idle return roller 34.

[0035] With reference to the direction of advancement X of the belt 20 along the closed path, the motorized drive roller 31 is the roller placed immediately upstream of the heatable cylinder 10, while the second idle return roller 34 is the roller placed immediately downstream of the heatable cylinder 10.

[0036] The first section T1 of the aforementioned closed path (at which the belt 20 is in use elastically elongated, receiving an additional tensional state of elongation with respect to the pretensioning one) extends between the motorized brake roller 32 and the motorized drive roller 31, passing in partial winding around the first idle return roller 33.

[0037] The second section T2 of path (at which the belt 20 in use contracts itself, losing the additional tensional state of elongation to return to the pretensioning state) extends between the motorized drive roller 31 and the second idle return roller 34.

[0038] The above closed path is completed by a third section T3 of path extending between the second idle return roller 34 and the motorized brake roller 32. In use, along such a third section T3 of path, the belt 20 is in a relaxed tension state with respect to the first section T1 of path, substantially corresponding to the pretensioning state.

[0039] The "closed path" corresponds to the total extension of the belt 20 when mounted in pretension on the roller system. The closed path is not affected by local contractions and local elongations of the belt.

[0040] Thanks to the invention, a section of path - distinct from that of contraction in contact with the cylinder - is introduced into the closed path, in which the belt is free to progressively return to the pretensioning state, without being subject to an additional elongation state.

[0041] On the other hand, in the prior art solutions which provide for the pretensioning of the belt, referring to the tensional state of the belt, the closed path of the belt is divided into only two sections:

- a first "elongation" section, which extends from a brake roller arranged immediately downstream of the heatable cylinder to a drive roller arranged immediately upstream of the heatable cylinder; and
- a second "contraction" section, which extends from the drive roller to the brake roller, partially winding the heatable cylinder.

[0042] According to the prior art, the belt is therefore continuously stressed in elongation or contraction, without actually being able to remain in the pretensioning state, that is in the state of minimum elongation, which may be considered the rest state. In fact, already immediately downstream of the brake roller, the belt begins to undergo the elongation action exerted by the drive roller.

[0043] Conversely, thanks to the invention, the aforementioned third section T3 has been introduced in the closed path, in which the belt - after having contracted in the second section T2 - is free to remain in the pretensioning state. In other words, the third section T3 may be considered a rest section for the belt, as opposed to the first elongation section T1 and the second contraction section T2.

[0044] This has a number of advantages:

- the tensional elongation action exerted on the belt

is concentrated on a shorter section of path (being equal the extension of the closed path and the second section T2); in this way, by acting on the speeds of the motorized drive and brake rollers, it is possible to control more precisely the elongation imposed on the belt, with consequent better control on the compacting action of the textile substrate;

- the belt is less mechanically stressed, since, after having contracted, it is free to reach the rest state and remain so for a certain section; the reduction of stress on the belt allows the useful life of the belt itself to be extended.

[0045] Preferably, the motorized drive 31 and brake 32 rollers, the idle return rollers 33, 34, 35, as well as the heatable cylinder 10 are made of metal, preferably steel.

[0046] According to a particularly preferred embodiment of the invention, as illustrated in the accompanying figures, the motorized brake roller 32 and the motorized drive roller 31 are both provided with a rubber coating 36 which covers the respective cylindrical side surfaces intended to contact the belt 20.

[0047] By virtue of the rubber coating 36 of the motorized rollers, the friction coefficient between the motorized rollers and the belt is increased with respect to the case of contact of the belt on the bare surface of the cylinder, typically smooth metal.

[0048] Operatively, the increase in the friction coefficient reduces the risk of slipping between the belt and the rollers. This contributes to improving the control over the elongation action of the belt and therefore to increasing the efficiency of the compaction process of the textile substrate.

[0049] Preferably, both the first idle return roller 33 and the second idle return roller 34, unlike the two motorized rollers 31 and 32, are not rubber-coated. In other words, both the first idle return roller 33 and the second idle return roller 34 are provided with a cylindrical side surface, preferably made of metal material, intended to come into direct contact with the belt 20 without the interposition of a rubber coating covering such a cylindrical side surface.

[0050] Operatively, since the idle return rollers 33 and 34 are not rubber-coated and the elastic belt 20 comes into direct contact with their metal side surface, the friction between the belt and the idle rollers is reduced. In this way, by virtue of the reduction of friction, the belt encounters fewer obstacles in its elastic extension and subsequent contraction.

[0051] Operationally, the additional tensional state of elongation is imposed on the belt 20 by acting on the speeds of the motorized drive roller 31 and the motorized brake roller 32, so as to create a difference between the tangential speeds of the side surfaces of the two rollers (intended to contact the belt). The tensional state of elongation (measurable for example by percentage of elongation with respect to the pretensioning state) increases as the difference in these speeds increases.

[0052] Advantageously, the apparatus 1 may comprise a control unit 50, preferably electronic, configured to control the rotation of the motorized drive roller 31 and of the motorized brake roller 32 so that said two motorized rollers 31, 32 rotate in the same direction and so that the tangential speed Vt of the motorized drive roller 31 is higher than the tangential speed Vf of the motorized brake roller 32 according to a predefined ratio Vf/Vt.

[0053] Advantageously, such a predefined ratio Vf/Vt between the tangential speed of the motorized brake roller 32 and the tangential speed of the motorized drive roller 31 is adjustable as a function of the extent of additional longitudinal elongation to be imposed on the belt at the first section of path T1.

[0054] Preferably, said predefined ratio Vf/Vt is between 0.5 and 0.9, and preferably equal to 0.7.

[0055] Preferably, the heatable rotating cylinder 10 is motorized. By "heatable cylinder" it is meant in particular a cylinder provided with or associated to heating means. The heating means can be of any type suitable for the purpose, i.e. heating the surface of the rotating cylinder.

[0056] Advantageously, the control unit 50 is configured to control the rotation of the heatable cylinder so that its tangential speed (referred to the side surface 10a) is as close as possible to and preferably equal to the tangential speed of the motorized drive roller 31.

[0057] It was possible to verify that in these conditions the best results are obtained in terms of compaction of the textile substrate. In other words, under these conditions, the efficiency of the compaction process is increased.

[0058] Preferably, the motorized drive roller 31, the motorized brake roller 32 and the first idle return roller 33 are positioned in relation to each other such that the above first section T1 of the closed path has a length extension not exceeding 35% of the entire closed path, and preferably not lower than 10%.

[0059] Advantageously, as schematically shown in Figure 1, the motorized drive roller 31, the motorized brake roller 32 and the first idle return roller 33 are positioned in relation to each other so as to assume a compact configuration. By compact configuration it is meant a configuration in which said three rollers 31, 32, and 33 are in close proximity to each other when compared with the other rollers 34 and 35 of the roller system.

[0060] The "compact configuration" is essentially aimed at reducing as much as possible the extension of the first section T1 of the path in favor of the third section T3 of the path.

[0061] In particular, said three rollers 31, 32, and 33 may be arranged to form a triad of rollers with aligned centers of rotations. This choice is preferred from a constructive point of view as it allows a reduction in the overall dimensions and simplifies the support structure of the rollers themselves. However, configurations of the triad of rollers may be provided in which the rollers are not aligned with each other.

[0062] Preferably, the motorized drive roller 31, the

motorized brake roller 32 and the first idle return roller 33 are positioned in relation to each other such that the winding angle of said belt 20 around the motorized drive roller 31 and the motorized brake roller 32 is not lower than 90°.

[0063] In particular, as shown schematically in Figure 1, the belt is installed on the triad of rollers so as to follow an S-path between the three rollers. In particular, the two motorized rollers 31 and 32 contact the belt on its inner surface, while the first idle return roller 33 contacts the belt on its outer surface. The first idle return roller 33, interposed between the two motorized rollers 31 and 32, may thus push the belt against them, favoring the winding of the belt. The "push" action of the return roller and therefore the effect in terms of winding may be calibrated by operating on the nominal diameters of the rollers and/or on the relative position of the centers of rotation.

[0064] Operatively, the higher the winding angle of the belt on the drive roller 31 and the brake roller 32, the greater the friction that is generated between the motorized rollers and the belt and therefore the more efficient the dragging action of the rollers on the belt, with reduction of the phenomena of slippage between roller and belt.

[0065] This contributes to improving the control over the elongation action of the belt and therefore to increasing the efficiency of the compaction process of the textile substrate.

[0066] As already mentioned above, with reference to the direction of advancement X of the belt 20 along the closed path, the motorized drive roller 31 is the roller placed immediately upstream of the heatable cylinder 10, while the second idle return roller 34 is the roller placed immediately downstream of the heatable cylinder 10.

[0067] Preferably, the motorized drive roller 31 and the second idle return roller 34 are positioned with respect to the cylinder 10 so that:

- the distance D1 between the side surface 31a of the motorized drive roller 31 and the side surface 10a of the cylinder 10 is equal to or less than the thickness S of the belt 20; and
- the distance D2 between the side surface 10a of the cylinder 10 and the side surface 34a of the second idle return roller 34 is equal to or greater than the thickness S of the belt 20.

[0068] Preferably, the aforesaid distance D1 is less than the thickness S of the belt 20 by a value of between about 0% and about 50%; the aforementioned distance D2 is greater than the thickness S of the belt 20 by a value of between about 0% and about 100%.

[0069] Advantageously, the aforesaid second idle return roller 34 is movable with respect to the other rollers 31, 32, 33 to vary their relative position and allow:

- assembly and disassembly of the belt on said roller system;
- belt maintenance operations; and
- pretensioning of the belt 20.

[0070] According to a particularly preferred embodiment, shown in Figure 1, the second idle return roller 34 is movable with respect to the other rollers 31, 32, 33 along an arc of circumference concentric to the axis of rotation of the cylinder 10 between a position of maximum winding of the belt around the cylinder and a position of minimum winding around the cylinder.

[0071] For this purpose, the second idle return roller 34 is slidably engaged at both its axial ends to a guide (not shown in the accompanying Figures) shaped according to said arc of circumference.

[0072] Advantageously, the second idle return roller 34 is lockable both in the aforementioned two extreme positions of the aforementioned arc of circumference, and in one or more intermediate positions, so as to adjust the extension of said second section T2 of the closed path and therefore the degree for winding the belt around the cylinder 10. In this way it is possible to calibrate the compaction effect on the textile substrate according to the requests dictated by the type of fiber and the result to be obtained. In this way, it is also possible to improve and decrease the friction effect of the belt on the hot cylinder precisely due to the decrease in the winding angle. This has a benefit on the result of the compaction process.

[0073] The locking of the second idle return roller 34 along the aforesaid shaped guide may be carried out by means of brackets which also include the bearings suitable for rotating the pin of the roller and which may be fixed, for example, by means of screws to the support structure of the apparatus. In particular, the fixing of the roller takes place at shoulders suitably perforated in advance along said guide in predefined angular positions corresponding to the adjustment positions to be provided.

[0074] Preferably, as shown in Figure 1, the arc of circumference has an extension of 90°. Arcs of circumference with smaller widths may be provided according to operational needs.

[0075] The adjustment of the position of the second idle return roller 34 with respect to the cylinder 10 modifies the tensioning state of the belt.

[0076] Preferably, as illustrated in Figure 1, the apparatus 1 comprises a third idle return roller 34 which engages the belt at the third section T3 of the path and is movable with respect to the other rollers 31, 32, 33 to compensate for the position variations of the second idle return roller 34.

[0077] Similarly to what is provided for the second idle return roller 34, the third idle return roller 35 is also slidably engaged at both its axial ends to a suitably shaped guide (not shown in the accompanying Figures). The third idle roller 35 may also be fixed and stopped also in intermediate positions between two maximum and minimum compensation positions. The fixing may take place by

means of brackets which include the roller bearings and which will be fixed by screws at the shoulders of the apparatus suitably perforated at the predefined positions.

[0078] Preferably, like the first and second idle return rollers 33 and 34, also the third idle return roller 35 is not rubber-coated. In other words, also the third idle return roller 35 is provided with a cylindrical side surface, preferably made of metal material, intended to come into direct contact with the belt 20 without the interposition of a rubber coating covering such a cylindrical side surface.

[0079] Operationally, as already mentioned in relation to the idle return rollers 33 and 34, also for the third idle return roller 35, by virtue of the absence of rubber-coating and therefore of the fact that the elastic belt 20 comes into direct contact with the metal side surface of such a third idle roller 35, the friction between the belt and the idle roller is reduced. In this way, by virtue of the reduction of friction, the belt encounters fewer obstacles in its sliding, avoiding localized tensions due to friction.

[0080] Preferably, the above belt 10 is elastically deformable in elongation for a percentage between 5% and 100% of its length in the relaxed state before pre-tensioning and, preferably in its pre-tensioning state, for a percentage between 30% and 50% with respect to its relaxed length.

[0081] Preferably, the belt 20 has a thickness S comprised between about 4.0 mm and about 16.0 mm and, preferably, of about 10 mm.

[0082] The belt 20 may be made of a substantially extensible and elastic material, in particular of natural or synthetic rubber, or combinations thereof. Advantageously, the material may contain additives suitable for improving the mechanical and heat resistance features thereof.

[0083] The invention allows several advantages to be achieved, some of them already described.

[0084] The apparatus for compacting textile substrates by means of elastic belt according to the invention allows the tension of the elastic belt to be controlled more precisely so as to make the fabric compacting process more efficient.

[0085] The apparatus for compacting textile substrates by means of elastic belt according to the invention allows the stresses imposed on the elastic belt during use to be reduced.

[0086] The apparatus for compacting textile substrates by means of elastic belt according to the invention is simple and cost-effective to manufacture.

[0087] The apparatus for compacting textile substrates by means of elastic belt according to the invention may be managed in an operationally simple way.

[0088] Further advantages obtainable with the compacting apparatus according to the invention are listed below:

- High precision of belt elongation thanks to the use of rubber rollers;
- Perfect drive guarantee without belt slippage on the drive and brake rollers thanks to the wide winding angle on the rollers themselves (given by the interposed idle roller)
- High process speed, high productivity
- High compaction efficiency, high compaction value for all fabrics
- It does not require having to go over the same fabric several times in the apparatus to obtain a correct compaction value (process carried out in one step)
- Possibility to treat both orthogonal (shuttle) and knitted fabrics
- Possibility to treat all types of fiber used for shuttle and knitted fabrics
- Excellent compaction results at high speed even with viscose fiber fabrics
- Excellent results of compaction at high speeds even with cotton fiber and jeans-like fabrics

[0089] Of course, it may take, in its practical embodiment, also shapes and configurations other than the above without departing from the present scope of protection.

[0090] Furthermore, all details may be replaced with technically equivalent elements and dimensions, shapes and materials used may be any according to the needs.

Claims

1. An apparatus for compacting a continuous textile substrate (T) by means of elastic belt, comprising:

- a heatable rotating cylinder (10);
- an endless belt (20) movable along a closed path to support and transport the textile substrate (T) in contact with a side surface portion (10a) of said heatable rotating cylinder (10), said belt being elastically deformable in elongation;
- a roller system (31, 32, 33, 34, 35) on which said belt (20) is wound in an elongation pretensioning state, wherein said roller system comprises a plurality of idle return rollers (33, 34, 35) and a plurality of motorized rollers (31, 32) operable so as to make said belt (20) slide along said closed path imposing on said belt an additional elongation tension state at a first section (T1) of said path extending - with respect to an advancement direction (X) of the belt - upstream of a second section (T2) of said path in which said belt (20) is maintained in contact with the rotating cylinder;
- means (40) for guiding said textile substrate (T) between said belt (20) and said heatable cylinder (10) along said second section (T2) of said path, **characterized in that** said roller system comprises a motorized drive roller (31), a motorized brake roller (32), a first idle return roller (33), which is arranged between said motorized

brake roller and said motorized brake roller, and a second idle return roller (34), and **in that** the first section (T1) of said path extends between said motorized brake roller (32) and said motorized drive roller (31), passing in partial winding around said first idle return roller (33), while said second section (T2) of path extends between said motorized drive roller (31) and said second idle return roller (34), wherein said closed path is completed by a third section (T3) extending between said second idle return roller (34) and said motorized brake roller (32), in use along said third section (T3) of path said belt (20) being in a relaxed tension state with respect to the first section (T1) of path.

2. Apparatus according to claim 1, wherein said motorized brake roller (32) and said motorized drive roller (31) are both provided with a rubber coating covering the respective cylindrical side surfaces intended to come into contact with said belt (20).

3. Apparatus according to claim 2, wherein said first idle return roller (33) is provided with a cylindrical side surface made of metal material, intended to come into direct contact with said belt (20) without the interposition of a rubber coating covering said cylindrical side surface.

4. Apparatus according to claim 1, 2 or 3, wherein said second idle return roller (34) is provided with a cylindrical side surface made of metal material, intended to come into direct contact with said belt (20) without the interposition of a rubber coating covering said cylindrical side surface.

5. Apparatus according to one or more of the preceding claims wherein said motorized drive roller (31), said motorized brake roller (32) and said first idle return roller (33) are positioned in relation to each other such that said first section (T1) of the closed path has a length extension not exceeding 35% of the entire closed path, and preferably not lower than 10%.

6. Apparatus according to one or more of the preceding claims, wherein said motorized drive roller (31), said motorized brake roller (32) and said first idle return roller (33) are positioned in relation to each other such that the winding angle of said belt (20) around said motorized drive roller (31) and around said motorized brake roller (32) is not lower than 90°.

7. Apparatus according to one or more of the preceding claims, comprising a control unit (50) configured to control the rotation of said motorized drive roller (31) and said motorized brake roller (32) so that said two motorized rollers (31, 32) rotate in the same direction and so that the tangential speed (Vt) of said motorized drive roller (31) is higher than the tangential speed (Vf) of said motorized brake roller (32) according to a predefined ratio (Vf/Vt).

8. Apparatus according to claim 7, wherein said predefined ratio (Vf/Vt) between the tangential speed of said motorized brake roller (32) and the tangential speed of said motorized drive roller (31) is adjustable as a function of the extent of longitudinal elongation to be imposed on said belt at said first section (T1) of said path (T1).

9. Apparatus according to claim 8, wherein said predefined ratio (Vf/Vt) is between 0.5 and 0.9, and preferably equal to 0.7.

10. Apparatus according to one or more of the preceding claims, wherein said heatable cylinder (10) is motorized.

11. Apparatus according to claim 7, 8 or 9 and claim 10, wherein said control unit (50) is configured to control the rotation of said heatable cylinder (10) so that its tangential speed - referred to its side surface (10a) - is as close as possible to and preferably equal to the tangential speed of the motorized drive roller (31).

12. Apparatus according to one or more of the preceding claims, wherein said second idle return roller (34) is movable with respect to the other rollers (31, 32, 33) to vary its relative position and allow the assembly and pretensioning of said belt (20) on said roller system.

13. Apparatus according to one or more of the preceding claims, wherein said second idle return roller (34) is movable with respect to the other rollers (31, 32, 33) along an arc of circumference concentric to the rotation axis of the cylinder (10) between a maximum winding position of the belt around said cylinder and a minimum winding position around said cylinder and is lockable in one or more intermediate positions between said two positions to adjust the extension of said second section (T2) of the closed path
and wherein said apparatus (1) comprises a third idle return roller (34) that engages said belt at said third section (T3) of the path and is movable with respect to the other rollers (31, 32, 33) to compensate for the position variations of said second idle return roller (34) and thus maintain the pretension of said belt.

14. Apparatus according to claim 13, wherein said first idle return roller (34) is provided with a cylindrical side surface made of metal material, intended to come into direct contact with said belt (20) without

the interposition of a rubber coating covering said cylindrical side surface.

15. Apparatus according to one or more of the preceding claims, wherein said belt (10) is elastically deformable in elongation for a percentage between 5% and 100% of its length in the relaxed state before pre-tensioning and, preferably in its pre-tensioning state, for a percentage between 30% and 50% with respect to its relaxed length.

16. Apparatus according to one or more of the preceding claims, wherein a distance (D1) between the side surface (31a) of the motorized drive roller (31) and the side surface (10a) of the cylinder (10) is equal to or lower than the thickness (S) of the belt (20) and wherein a distance (D2) between the side surface (10a) of the cylinder (10) and the side surface (34a) of the second idle return roller (34) is equal to or greater than the thickness (S) of the belt (20).

17. Apparatus according to claim 16, wherein the distance (D1) between the side surface (31a) of the motorized drive roller (31) and the side surface (10a) of the cylinder (10) is lower than the thickness (S) of the belt (20) by a value comprised between about 0% and about 50% and wherein the distance (D2) between the side surface (10a) of the cylinder (10) and the side surface (34a) of the second idle roller (34) is greater than the thickness (S) of the belt (20) by a value comprised between about 0% and about 100%.

18. Apparatus according to one or more of the preceding claims, wherein the belt (20) has a thickness (S) between about 4.0 mm and about 16.0 mm and, preferably, about 10 mm.

19. Apparatus according to one or more of the preceding claims, wherein the belt (20) is made of natural or synthetic rubber, or a combination of natural rubber and synthetic rubber.

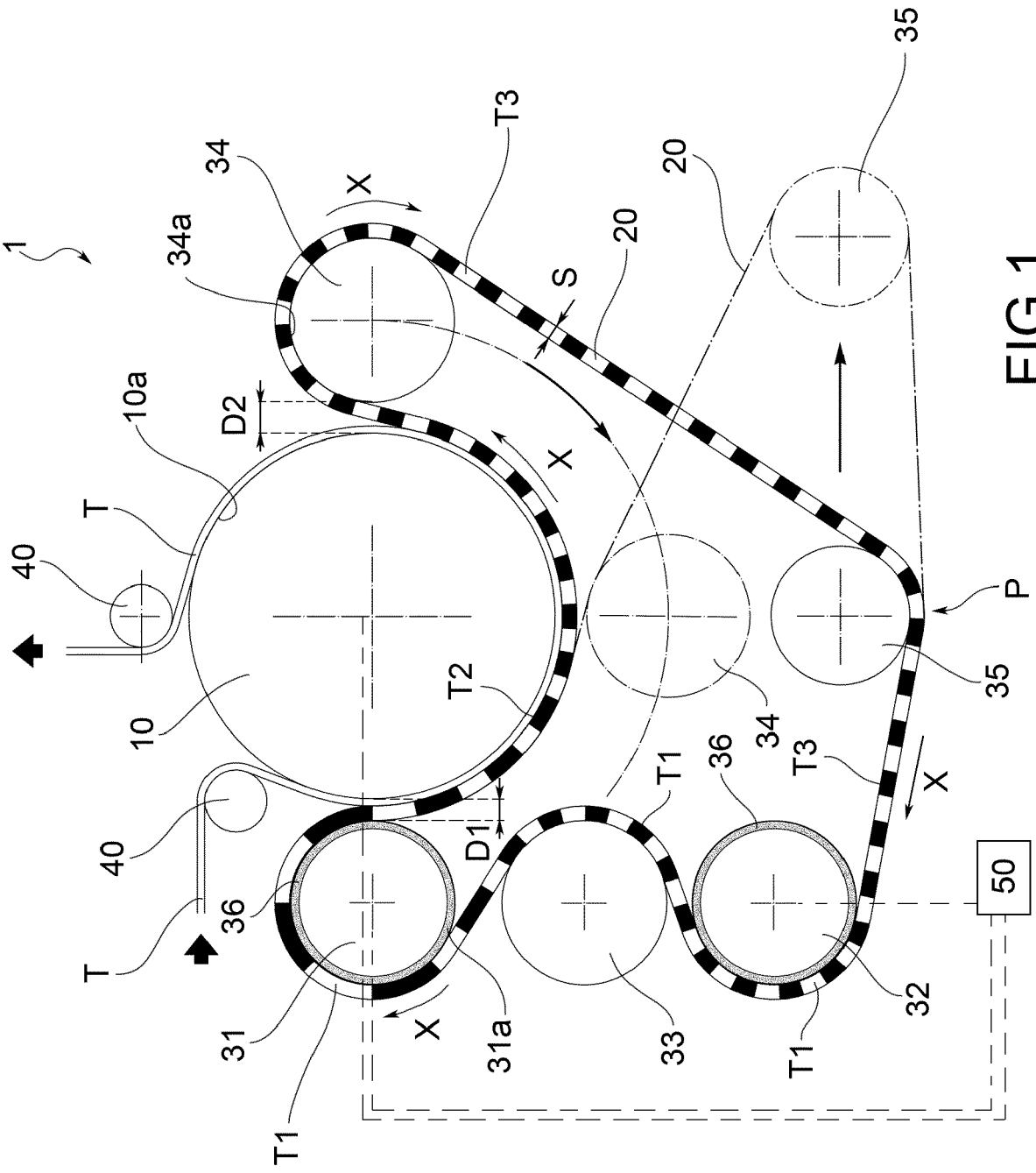
1
34
34a
X
T3
S
20
20
35
10a
D2
T
40
X
10
T2
34
P
35
T
T1
36
T3
X
40
D1
36
50
T
31
X
31a
33
T1
32
T1

FIG.1

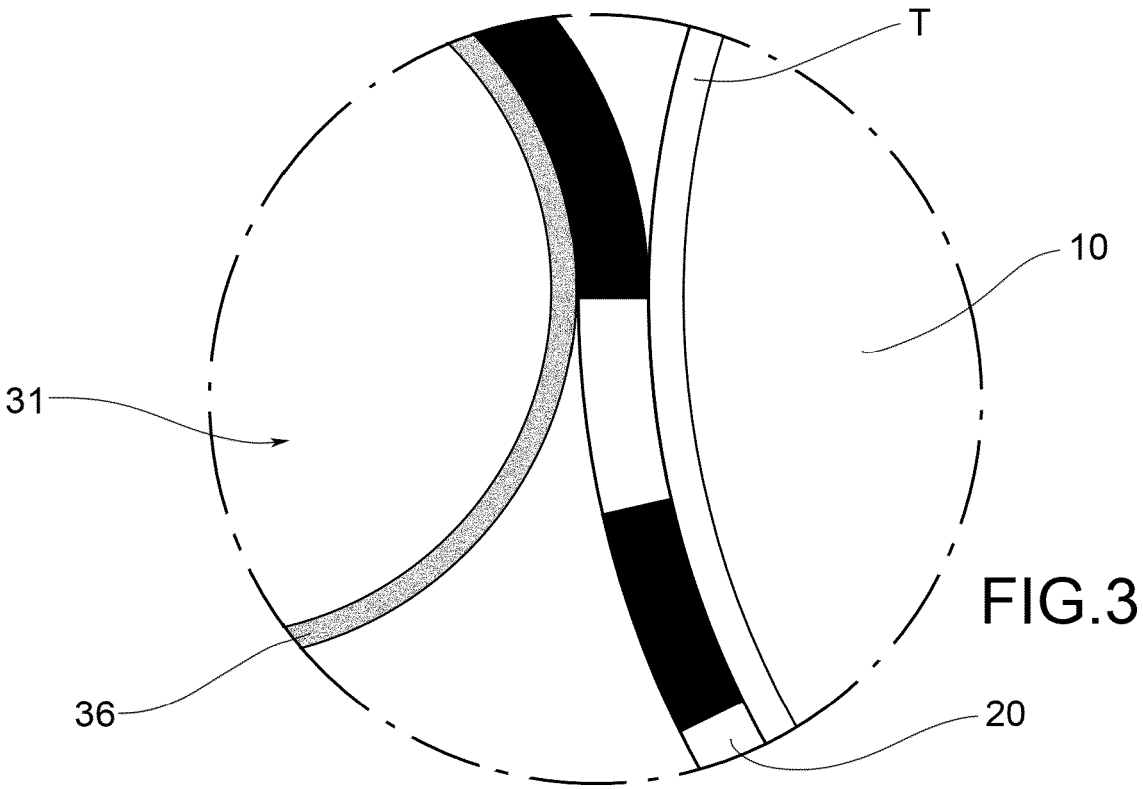

FIG.3

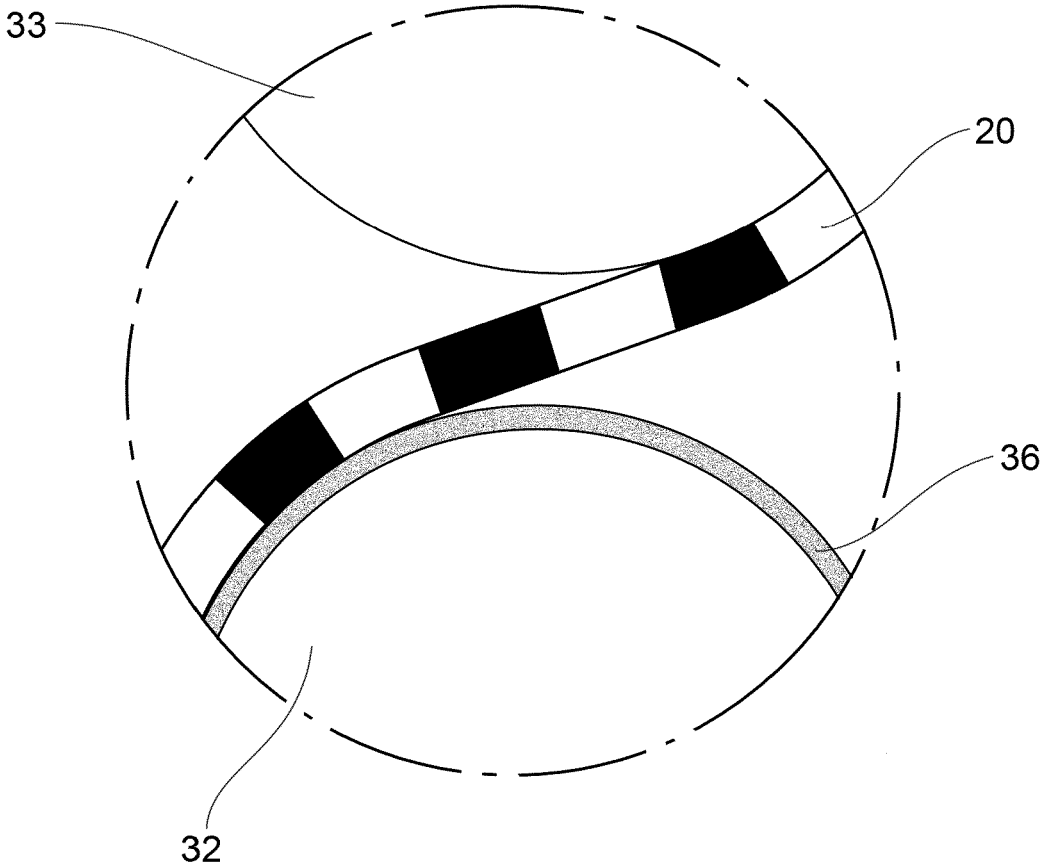

FIG.2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 17 9929

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	JP S51 136992 A (HOKUSHIN TETSUKOUSHIYO KK) 26 November 1976 (1976-11-26) * the whole document *	1-11,15, 16,18,19	INV. D06C21/00
Y	US 2 374 482 A (JOHN HADFIELD JAMES ET AL) 24 April 1945 (1945-04-24) * page 1, right-hand column, lines 30-49; figures 1,2 * * page 2, left-hand column, lines 14-24,50-52,67-70; claim 1 * * page 2, right-hand column, lines 60-63 *	1-11,15, 16,18,19	
A,D	EP 1 657 340 A1 (SPEROTTO RIMAR S R L [IT]) 17 May 2006 (2006-05-17) * paragraph [0065]; claims 1,10,14,15; figures *	1	
A	JP S49 108310 A (.) 15 October 1974 (1974-10-15) * figure 1 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

D06C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 November 2020	Humbert, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 17 9929

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-11-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP S51136992 A	26-11-1976	NONE	
US 2374482 A	24-04-1945	NONE	
EP 1657340 A1	17-05-2006	CN 1811041 A	02-08-2006
		EP 1657340 A1	17-05-2006
		KR 20060054163 A	22-05-2006
		TW 200628657 A	16-08-2006
		US 2006112526 A1	01-06-2006
JP S49108310 A	15-10-1974	NONE	

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- GB 563638 A **[0010]**
- EP 1657340 A1 **[0014] [0016] [0018]**