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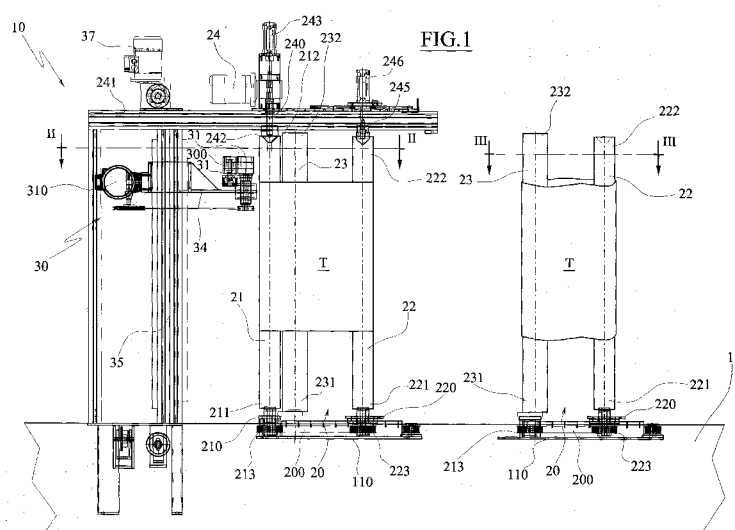
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(54) Title: A NAPPING MACHINE FOR TUBULAR SEAMLESS FABRICS



(57) Abstract: A napping machine (10) for tubular fabrics (T) characterised in that it comprises a support frame (11) of at least a ro-
tatable roller (20) insertable internally of a tubular fabric (T) to be napped and configured such as to draw the tubular fabric (T) in-
serted on the rotatable roller (20) in rotation, and at least an abrasive band (300) in relative motion to the rotatable roller (20) and
able to contact, on an opposite side of the rotatable roller (20), with the tubular fabric (T) in rotation.

A NAPPING MACHINE FOR TUBULAR SEAMLESS FABRICS

TECHNICAL FIELD

- 5 The present invention relates to a napping machine for tubular fabrics.
More in detail, the invention relates to a napping machine for seamless tubular fabrics, i.e. tubular fabrics with no (longitudinal) seams along the tubular shape, for realizing smoothed tubular fabrics, for example internally usable for manufacturing garments known as "seamless".

10 PRIOR ART

As is known, recently in the clothing field seamless garments have become more popular; these garments are made from tubular pieces of fabric made without longitudinal joining seams, but directly realized in a tubular form.

- These tubular fabric forms, for example, possibly cut, finished with hems,
15 assembled with other fabric or finishing elements or to other seamless tubular elements, define a garment known as seamless, which exhibits a high degree of comfort when worn, as well as exhibiting other peculiarities such as a high degree of elasticity and adaptability to the body of the wearer.

- The manufacturing of tubular fabrics of wearable dimensions makes it
20 however difficult to achieve, on an industrial scale, certain types of operation on the fabrics themselves, such as for example realizing a napped side.

- Napping fabrics is done using napping machines which are provided with an abrasive element, for example a sheet of sandpaper, which is rubbed in contact on the side of the fabric to be smoothed, thus partially napping and
25 increasing the volume of the fabric in the contact zone.

- In practice, these napping machines exhibit, as shown in prior documents D1-D2, a continuous transporter on which a long and wide tubular piece of flattened fabric (i.e. with the internal surfaces in reciprocal contact) which, during the advancing of the piece, passes through a napping station, for
30 example defined by two counter-rotating rollers equipped with sandpaper, which smooth the lower and upper surface of the flattened tubular piece.

The tubular piece napped in this way is then cut into congruent pieces for the

garment to be realised, turned inside-out so that the napped side is located internally of the garment and sewn-in so as to realise the garment, which will then exhibit seams and will be of the traditional type.

Further, the use of these machines leads to a considerable waste of material, as the lateral sides of the flattened tubular piece, at the fold lines of the flattened parts, are not correctly napped and therefore have to be cut away and eliminated.

An aim of the present invention is to obviate the above-mentioned drawbacks in the prior art, with a solution that is simple, rational and relatively inexpensive.

In practice, an aim of the invention is to realise a napping machine for industrial napping of tubular pieces of pre-formed fabric, for example seamless, which is at the same time uniform over a whole circumferential surface of the fabric destined to be napped and which involves a reduction, if not indeed a total elimination of the production wastes, thus realising a napping machine that is particularly efficient, rapid and functional.

Further, an aim of the invention is to make possible industrial realisation of seamless tubular fabrics (i.e. without longitudinal seams for closing the tubular piece) with an (internal) surface that is napped, for use in manufacture of garments, such as pullovers, fleeces, trousers, skirts, underwear, hosiery and others besides.

These aims are attained by the characteristics of the invention as recited in the independent claims. The dependent claims delineate preferred and/or particularly advantageous aspects of the invention.

DESCRIPTION OF THE INVENTION

In particular, the invention discloses a napping machine for tubular fabrics the peculiarity of which consists in the fact that it comprises a support frame of at least a rotatable roller (for example having a vertical axis) insertable internally of a tubular fabric to be napped and configured such as to draw the tubular fabric inserted on the rotatable roller in rotation, and at least an abrasive band in relative motion to the rotatable roller and able to contact, on an opposite side of the rotatable roller, with the tubular fabric in rotation.

With this solution, an entire preformed tubular surface can be napped easily and rapidly, making it possible to perform napping of tubular fabrics, for example of the above-mentioned seamless type.

The coefficient of friction between the tubular fabric inserted on the rotatable roller and the rotatable roller itself is preferably greater than the coefficient of friction between the tubular fabric and the abrasive band.

It is however possible for other fixing forces (with respect to the friction force), for example exerted by clip elements or the like, to retain the tubular fabric on the rotatable roller and enable the rotatable roller to draw the tubular fabric in rotation.

In a possible embodiment of the invention the napping machine might include a single rotatable roller, for example coated with a material having a high coefficient of friction such as sandpaper or rubber, on which the tubular fabric can be snugly inserted (which for example can be slightly stretched so as to be inserted on the rotatable roller) so as to be drawn in rotation thereby.

For example the single rotatable roller can exhibit an external diameter that is substantially greater than (or the same as) the internal diameter of the tubular fabric to be treated and the fabric exhibits, for example, an elasticity of its own, so that it can be stretched and inserted on the rotatable roller and, once released becomes substantially adherent to the rotatable roller so as to be drawn in rotation thereby.

In a further embodiment of the invention (preferred but not exclusive and illustrated in figures), the rotatable roller can be formed by two rotatable rollers that are substantially parallel and rotating in the same rotation direction, on which the tubular fabric can be substantially snugly inserted (which tubular fabric for example can be slightly stretched in order to be inserted on the rotatable rollers) so as to be drawn in rotation thereby.

For example the two rotatable rollers can be supported by a platform (for example a common platform to which they are for example associated rotatably at a respective end, for example the lower end).

The two (or more) rotatable rollers can be arranged at a reciprocal fixed distance or, preferably, can be configured so as to be able to vary the

reciprocal distance thereof.

In the first case, the external periphery of the rotatable rollers can be inscribed in a closed imaginary line, for example ovalled, the perimeter of which is greater than (or the same as) the perimeter of a transversal section of the tubular fabric to be inserted on the rotatable rollers.

In practice, the tubular fabric can exhibit, in this case too, an elasticity, so that it can be stretched and inserted on the rotatable rollers and, once released, becomes substantially adherent to the rollers so as to be drawn in rotation thereby.

In the second case (illustrated in the preferred embodiment described in the following), the external periphery of the rotatable rollers can be inscribed in a closed imaginary line, for example ovalled, having a variable configuration between a compact configuration, in which the perimeter of the closed imaginary line is smaller than the perimeter of a transversal section of the tubular fabric to be inserted on the rotatable rollers themselves, and an extended configuration, in which the perimeter of the closed imaginary line is greater than (or the same as) the perimeter of a transversal section of the tubular fabric to be inserted on the rotatable rollers themselves.

In practice, in the second case, the rotatable rollers, by facilitating the insertion of the tubular fabric on the rotatable rollers when in the compact configuration, function as a stretcher element for the tubular fabric when they are in the extended configuration.

In a further aspect of the invention, the abrasive band is supported and drawn in rotation by at least a support roller that is for example counter-rotating with respect to the rotatable roller and parallel with respect to the rotatable roller, for example at a rotation velocity (a little) different (or at most equal) to the rotation velocity of the rotatable roller.

The support roller supporting and drawing in rotation the abrasive band might equivalently be equi-rotating with respect to the rotatable roller (exhibiting for any rotation velocity a relative motion with respect to the tubular fabric supported by the rotatable roller and therefore exerting a rubbing action thereon).

In this way, the reciprocal rotation of the rotatable roller and the abrasive band is such that the abrasive band goes into contact with the whole circumferential surface of the tubular fabric.

The abrasive band is advantageously wound substantially in a loop fashion about at least a pair of the support rollers (i.e. rollers which are equi-rotating with respect to one another and counter-rotating with respect to the rotatable roller), the abrasive band going into contact with the tubular fabric at the free portion of abrasive band interposed between the pair of support rollers (preferably counter-rotating with respect to the rotating roller), for example a support roller whereof being motorized and a support roller whereof being driven.

In an aspect of the invention, the abrasive band can be slidably associated to the support frame with respect to a sliding direction parallel to the rotation axis of the rotatable roller.

In this way, the axial dimensions of the abrasive band can be modest while still enabling the napping of tubular fabrics having axial dimensions that are greater than an axial dimension of the abrasive band.

In a still further aspect of the invention, the rotatable roller exhibits at least a portion having a high coefficient of friction, for example high coefficient of friction meaning a high coefficient of friction between the tubular fabric and the portion of the rotatable roller such as to enable drawing the tubular fabric in rotation (without axial and/or circumferential rubbing) by the rotatable roller, in particular a coefficient of friction between the tubular fabric inserted on the rotatable roller and the rotatable roller itself that is higher (greater) than the coefficient of friction between the tubular fabric itself and the abrasive band.

The machine advantageously comprises cladding means configured such as to at least partially removably clad the portion having a high coefficient of friction of the rotatable roller.

With this solution the drawing in rotation of the tubular fabric is optimized (in particular the portion thereof having a high coefficient of friction) while at the same time the loading/inserting operations of the fabric of tubular form are

optimized, when the portion having a high coefficient of friction thereof is clad by the cladding means.

In an advantageous embodiment of the cladding means, the means comprise a cladding body provided with a longitudinal groove configured such as to house at least the portion having a high coefficient of friction of the rotatable roller, at least one from between the rotatable roller and the cladding body being associated movably to the support frame in a perpendicular direction to the rotation axis of the rotatable roller between a retracted position, in which the portion having a high coefficient of friction of the rotatable roller is located internally of the groove of the cladding body, and at least an extracted position, in which the portion having a high coefficient of friction of the rotatable roller is located at least partially externally of the groove.

The cladding body can exhibit an external surface that is substantially smooth or in any case having a low coefficient of friction so that the fabric having tubular form can slide thereon when it is to be inserted on the rotatable roller with the portion having a high coefficient of friction in a retracted position.

The cladding body advantageously comprises at least a pair of hinged shells with a hinge axis parallel to the longitudinal axis of the rotatable roller and mobile from a closed position to an open position in contrast to return means, the groove being delimited by the pair of shells in closed position.

A further aspect of the invention relates to a napping method for tubular fabric, for example without sewed seams, comprising steps of:

- arranging a tubular fabric with a surface to be napped located externally thereof;
- arranging a rotatable abrasive band;
- rotating the tubular fabric with respect to an axis thereof;
- rotating (for example counter-rotating) the abrasive band with respect to a counter-rotation axis parallel to the rotation axis of the tubular fabric and
- placing in contact an external surface to be napped of the tubular fabric in rotation with the rotating abrasive (for example counter-

rotating) band.

With this method the above-mentioned advantages of the machine of the invention can be attained.

The method can advantageously comprise a step of translating the rotating
5 (for example counter-rotating) abrasive band in contact with the external surface of the tubular fabric along a parallel direction to the rotation axis of the tubular fabric.

A further aspect of the invention provides a tubular fabric without joining longitudinal seams, obtained using the above-described method, comprising
10 at least a portion of napped wall along a whole circumference thereof.

For example, the tubular fabric comprises two opposite free longitudinal ends, each of which is for example folded on itself (by means of a hem), so as to realise two superposed axial portions, of which a first portion (internal in use, external when positioned on the napping machine described above) and
15 a second portion (external in use, internal when positioned on the napping machine) with respect to the tubular fabric, which superposed portions are divided by a fold line (for example one which becomes the free end of the tubular fabric itself) and sewn along a circumferential sewing line.

In an aspect of the invention, only the first portion (internal in use) exhibits
20 the napping on the only side which axially prolongs the napped portion of the tubular fabric.

In practice, the tubular fabric, with both ends free already finished and sewn along a circumferential sewing line, is treated according to the above-described method (using the napping machine described above) and is
25 substantially recognizable unequivocally and immediately with respect to the tubular fabrics obtained by means of napping machines that are different and of known type.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the invention will emerge from a reading of the
30 description that follows, provided by way of non-limiting example, with the aid of the figures of the accompanying tables.

Figure 1 is a lateral view of a portion of A napping machine according to the

invention.

Figure 2 is a view along section line II-II of figure 1.

Figure 3 is a view along section line III-III of figure 1.

Figure 4 is a view of figure 3 in a second operating position.

5 BEST WAY OF CARRYING OUT THE INVENTION

With particular reference to the figures, reference numeral 10 is used to denote in its entirety a fabric napping machine for realising a smoothing thereof.

10 In particular, the machine 10 is able to perform napping of tubular fabric T preforms of finite and substantially modest dimensions (both axially and circumferentially), comparable to those of the garment that is to be made.

Further, the tubular fabrics T, preferentially but not limitingly, are seamless, meaning that the fabric is formed, using weaving techniques, already in the tubular form and exhibiting no longitudinal seams (parallel or substantially
15 parallel to the axis of the tubular fabric) structuring the tubular form itself, for example seams closing folded ends of a sheet of fabric for the realization of the tubular piece.

It is, however, possible for the tubular fabric T being processed on the machine 10, though seamless, to have sewn parts, such as circumferential
20 hemming (not illustrated but described in the foregoing), cuts, holes, operations defining reliefs or recesses or other processes typical of the fabric.

The machine 10 comprises a support frame 11 with traditional ground support (not shown).

25 The machine 10 further comprises at least a rotatable roller 20 rotatably associated to the support frame 11.

The rotatable roller 20, for example, exhibits a longitudinal (and rotational) axis having a substantially vertical rotation.

The rotatable roller 20 for example exhibits a first end rotatably connected to
30 a support plate 110 in turn associated to the support frame 11.

The first end, for example, exhibits an end pin inserted in a cylindrical seating formed in the support plate 110, so as to enable rotation of the rotatable roller

20 about the central axis thereof.

The rotatable roller 20, for example, exhibits a second free end, so that a tubular fabric T can be pulled over the rotatable roller 20, from the side of the free end, and inserted on the rotatable roller.

- 5 The rotatable roller 20 exhibits a length that is substantially comparable to the length of the tubular fabric T (for example between 1 and 10 times the length of the tubular fabric T).

In practice the tubular fabric T can have a length that is shorter than or equal to the length of the rotatable roller 20.

- 10 The rotatable roller 20 comprises a first roller 21 provided with at least a portion having a high coefficient of friction and rotatably associated to the support frame 11 with respect to a longitudinal axis (e.g. central).

- The first roller 21, for example, exhibits a cladding made of sandpaper or other material with a high coefficient of friction, such as rubber or the like, in
15 relation to the fabric that it will support and draw in rotation.

The first roller 21 exhibits for example a first end 211 rotatably constrained to a first platform 210 in turn associated to the support frame 11, for example to the support plate 110.

- The first end, for example, exhibits an end pin, for example coaxial to the first
20 roller 21, which is inserted in a cylindrical seating fashioned in the first platform 210, so as to enable rotation of the first roller 21 about the central axis thereof.

- The first platform 210 is slidingly associated for example to the support plate 110 with respect to a perpendicular direction to the rotation axis of the first
25 roller 21.

The first roller 21 exhibits, for example, a second free end 212, so that a tubular fabric T can be pulled over the first roller 21, starting from the above-described part of the free end and be inserted on the rotatable roller.

- The first roller 21 has a substantially comparable length to the length of the
30 tubular fabric T (for example between 1 and 10 times the length of the tubular fabric T).

In practice the tubular fabric T can be of a length of less than or equal to the

length of the first roller 21.

For example, the rotatable roller 20 comprises a second roller 22 provided with at least a portion, for example with a lower coefficient of friction compared to the first roller 21 (although still sufficient to draw a tubular fabric
5 inserted thereon in rotation), and also rotatably associated to the support frame 11 with respect to a longitudinal axis (e.g. central).

The second roller 22, for example, exhibits a cladding made of sandpaper (less coarse than the sandpaper cladding the first roller 21), or another material, such as rubber or the like, so as to support and draw in rotation the
10 tubular fabric T inserted thereon.

The second roller 22 exhibits for example a first end 221 rotatably constrained to a second platform 220 in turn associated to the support frame 11, for example to the support plate 110.

The first end 221, for example, exhibits an end pin, for example coaxial to the
15 second roller 22, which end pin is inserted in a cylindrical seating formed in the second platform 220, such as to enable rotation of the second roller 22 around the central axis thereof.

The second platform 220 is for example slidingly associated to the support plate 110 with respect to a perpendicular direction to the rotation axis of the
20 second roller 22 and, for example, parallel (and aligned) to the sliding direction of the first platform 210.

The second roller 22 exhibits, for example, a second free end 222, so that a tubular fabric T can be pulled over the second roller 22, starting from the above-described part of the free end and be inserted on the rotatable roller.

25 The second roller 21 has a substantially comparable length (identical in the illustrated example) to the length of the first roller 21.

The rotatable roller 20, in practice, is constituted by the first roller 21 and second roller 22, parallel to one another and associated so as to vary the reciprocal distance thereof, for example by means of the first and the second
30 platform, respectively 210 and 220.

The rotatable roller 20 comprises transforming means of the rotary motion of the first roller 21 into the rotary motion of the second roller 22.

The transforming means, in particular, comprise: a first pulley 213 associated to one from between the first end 211 and second end 212 of the first roller 21 (in the example the first end 211, inserted on the end pin); a second pulley 223 associated to one between the first end 221 and second end 222 of the second roller 22, (in the example the first end 221, inserted on the end pin); and a flexible organ for transferring motion, such as a belt 200 loop-wound around the first pulley 213 and the second pulley 223, equipped with a suitable belt tensioner (not shown) able to compensate for the variation of the distance between the first roller 21 and second roller 22.

- 10 The respective second ends 212 and 222 of the first roller 21 and second roller 22 have respective axially accessible seatings, for example, grooved and/or conical.

The first roller 21 defines, in essence, a portion having a high coefficient of friction of the rotatable roller 20.

- 15 In practice, the term high coefficient of friction, in the present description, is intended to mean a friction sufficient to prevent the tubular fabric T, when subjected to the usual stresses in play caused by the moving organs of the machine 10, to slide and be rubbed axially and/or circumferentially on the rotatable roller 20 (i.e. on the first roller 21).

- 20 In practice, the material, the roughness and the physical characteristics of the first roller 21 are configured, according to the fabric to be treated, in such a way as to attain this result.

The machine 10 comprises cladding means configured so as at least partially to removably cover the portion having a high coefficient of friction of the rotatable roller 20.

- 25 In practice, the cladding means are configured to removably clad at least one of the first roller 21 and second roller 22, in the example the first roller 21.

The cladding means include, in the example, an elongate cladding body 23 (e.g. tubular) equipped with a longitudinal groove 230 configured so as to accommodate at least one of the first roller 21 and second roller 22 (in the example the first roller 21).

- 30 In practice, the cladding body 23 is located with the longitudinal axis thereof

parallel to the axis of the first roller (and vertical).

The cladding body 23 exhibits for example a first end 231 constrained to the support frame 11, for example to the support plate 110 in a fixing zone interposed (and aligned) between the hinge points of the first roller 21 to the first platform 210 and of the second roller 22 to the second platform 220.

The cladding body 23 exhibits, for example, a second free end 232, so that a tubular fabric T can be inserted over the cladding body 23 from the part of the free end and inserted on the cladding body.

The cladding body 23 has a length substantially comparable (slightly greater) than the length of the first roller 21.

The cladding body 23 exhibits a substantially smooth external surface, or having a low coefficient of friction (lower than the coefficient of friction of the first roller 21 with respect to the tubular fabric T), so that the tubular fabric T inserted thereon can easily slide axially along it.

Further, the groove 230 of the cladding body 23 exhibits a substantially cylindrical shape with a diameter and height slightly greater than the first roller 21.

The cladding body 23 is fixed to the support plate 110 by the first end 231 thereof.

The cladding body 23 comprises at least a pair of semi-cylindrical shells 234 hinged along a generatrix, in which the hinging axis is substantially parallel to the longitudinal axis of the first roller 21.

The shells 234 are mutually and alternately mobile between a closed position, in which the free ends distal from the pivot axis are substantially reciprocally close or in contact, and an open position, in which the distance between the free ends is at least equal to the diameter of the first roller 21.

In the example, the shells 234 are mutually movable from the closed position to the open position in contrast with return means, for example elastic means; it is however possible for the opening and/or closing movements to be controlled by means of lever or automatic activating means.

The groove 230 is peripherally delimited by the shells 234 when the shells 234 are in the closed position, being accessible from the outside when the

shells are in the open position.

The first roller 21 is movable on the support plate 110 (by means of the first platform 210) with respect to the cladding body 23, alternately between a retracted position, in which the first roller 21 is placed inside the groove 230
5 (figure 3), and at least an extended position, in which the first roller 21 is located at least partially outside the groove 23 (figure 4).

In practice, the first roller 21 can be moved with the rotation axis remaining parallel to itself and in a vertical position between the retracted position, in which it enters between the shells 234 of the cladding body 23, becoming
10 substantially coaxial with the groove 230, and the extracted position in which it is positioned externally of the groove 230 and is thus parallel to (and distant from) the cladding body 23.

With the first roller 21 in the retracted position the coefficient of friction between the rotatable roller 20 (which is in this step is primarily constituted by
15 the cladding body 23 and the second roller 22) on the tubular fabric T is very limited and the tubular fabric T can easily slide along the axis of the rotatable roller 20.

Further, with the first roller 21 in the retracted position the radial dimension of the rotatable roller 20 is also limited (less with respect to when the first roller
20 21 is located in the extracted position, given a same positioning of the second roller 22) also facilitating the detachment of the tubular fabric from the rotatable roller 20 and therefore the sliding thereof along the axis of the rotatable roller.

Vice versa when the first roller 21 is brought into the extracted position, the
25 greater coefficient of friction and/or the greater radial dimensions of the rotatable roller 20 (which in this step is constituted by the first roller 21 and second roller 22) prevent and/or strongly limit the axial sliding of the tubular fabric T on the rotatable roller 20, enabling the stable positioning of the tubular fabric thereof on the rotatable roller 20.

30 The support plate 110 is slidably associated to the support frame 11, for example by means of a guide 112 that guides the movement imposed by an actuator group (not shown) having for example an independent motor and

chain means able to draw the support plate 110 in translation along the guide 112.

The guide 112 can define a substantially closed annular or otherwise-configured path.

- 5 In the example the machine 10 comprises a plurality of support plates 110, each supporting a rotatable roller 20 as described above and movable along the guide 112.

For example, the support plates 110 of the machine 10 are distanced from one another (e.g. equidistant) along the guide 112.

- 10 In practice, the machine 10 comprises at least a loading and/or unloading station, where the items of tubular fabric T are loaded and/or unloaded, for example manually, on the rotatable roller 20 and a work station, for example, separate from the loading and/or unloading station, where the tubular fabric T are napped, as will be more fully illustrated in the following.

- 15 In the loading and/or unloading station, the rotatable roller 20 is located with the free end thereof facing upwards and is accessible from the outside so as to be inserted (and vice versa removed) in/from a tubular fabric T which, entering from the free end, slides axially along the rotatable roller 20 so as to be positioned about it, for example at an axially central portion thereof.

- 20 In practice, for the loading of the tubular fabric T on the first roller 21 in the retracted position, the tubular fabric T is inserted on the cladding body 23 and on the second roller 22 (figures 1 and 3).

Once the tubular fabric T is positioned substantially inserted onto an axially central area of the cladding body 23 and the second roller 22, the first roller

- 25 21 is brought into an extracted position, so as to come into contact with the internal surface of the tubular fabric T and fabric T.

The first platform 210, for example, pawl-engages a cogged guide (not illustrated located in the support plate 110, so as to guide the translation of the first roller 21 from the retracted position to an extracted position and prevent the automatic return thereof (which can be activated only by means of a mechanical or electromechanical release).

- 30 As it passes from the retracted position to an extended position the first roller

21 distances from the second roller 22 (along the alignment direction between the first and second rollers) in practice stretching the tubular fabric T inserted thereon.

5 The friction between the first roller 21 (and the second roller 22) and the tubular fabric T is such as to prevent the sliding (downwards) of the tubular fabric itself, so that it remains in the position in which it was positioned (substantially central with respect to the length of the first roller 21).

To unload the tubular fabric T from the rotatable roller 20 the above-described steps are carried out in reverse order.

10 In the work station the machine 10 comprises a rotation group of the rotatable roller 20.

The rotation activating group comprises a first motor 24 associated to a drive shaft 240 which can be inserted in the free end of the rotatable roller 20, so as to draw it in rotation.

15 In practice, the first motor 24 is movably associated to an upper cross-member 241 parallel to the support frame 11 and located at a higher altitude than the altitude at which the free end of the rotatable roller 20 is located.

The upper cross-member 241 exhibits at least a section parallel (and substantially aligned in plan view) to a portion of the underlying guide 112.

20 The first motor 24 (and/or the drive shaft 240) is slidably associated to the upper cross-member 241 with respect to a sliding axis that is substantially parallel to the rotation axis of the rotatable roller 20 (vertical), so as to be able to align with the rotatable roller 20 which is movable along the guide 112 and/or on the support plate 110.

25 In practice, the first motor 24 (and/or the drive shaft 240 thereof) is vertically movable between a raised position of non-interference with the rotatable roller 20 and a lowered position of engagement, in which the motor shaft 240 engages the rotatable roller 20.

30 The drive shaft 240 of the first motor 24 is aligned in plan view with the rotatable roller 20 when the rotatable roller 20 is located in the work station.

In practice, the drive shaft 240 of the first motor 24 is aligned in plan view with the first roller 21 when the first roller 21 is located in the work station.

The first motor 24 is slidably associated to the upper cross-member 241 also along a direction that is substantially parallel to the guide 112 lying below it, so that it can be moved horizontally and aligned with the rotatable roller 20 or with the first roller 21.

- 5 At the free end thereof, the drive shaft 240 of the first motor 24 exhibits a rapid coupling 242 able to be inserted in a seating formed in the second end 212 of the first roller 21, when the first motor 24 is in the lowered position, so as to draw the first roller 21 in rotation.

The drive shaft 240 is moved alternately between the raised position and the
10 lowered position by a first jack 243.

The rotation activating group further comprises a centring organ 245.

The centring organ 245 comprises a revolving element, for example a bearing (conical) movable with respect to a sliding axis that is substantially parallel to the rotation axis of the rotatable roller (vertical).

- 15 In practice, the centring organ 245 is vertically movable between a raised position of non-interference with the rotatable roller 20 and a lowered position of contact therewith, in which the centring organ 245 comes into contact with the rotatable roller 20.

The centring organ 245 is aligned in plan view with the second roller 22 when
20 the second roller is located in the work station.

The centring organ 245 is slidably associated to the upper cross-member 241 also along a direction that is substantially parallel to the underlying guide 112, so that the centring organ 245 can be moved horizontally and aligned with the rotatable roller 20 or the second roller 22.

- 25 The centring organ 245 is moved alternately between the raised position and the lowered position thereof by a second jack 246.

The centring organ 245 (for example, the conical bearing) is insertable in a conical seating fashioned in the second end 222 of the second roller 22, when the centring organ 245 is in the lowered position, in such a way as to
30 support and guide the rotation of the second roller 22, imposed by the first motor 24 via the first roller 21 and the transforming means (i.e. the first pulley 213, second pulley 223 and belt 200).

In the work station the machine 10 comprises an abrasive group 30 that can come into contact with the external surface of the tubular fabric T inserted on the rotatable roller 20, in order to nap the fabric T.

5 The abrasive group 30 comprises an abrasive band 300, which is driven in rotation about a rotation axis parallel to the rotation axis of the rotatable roller 20, for example in a counter-rotating direction thereto.

The counter-rotation, in practice, defines a gentle napping (which does not damage the fabric) of the tubular fabric, which at most is done without large-scale circumferential rubbing and is gentler with respect to a case in which
10 the abrasive band were activated in rotation in a same direction with respect to the rotatable roller 20 (and therefore to the tubular fabric T drawn in rotation thereby).

In particular, the abrasive band 300 comprises a sheet of abrasive material, such as diamond abrasive papers or silicon of appropriate grain size, loop-wound on at least a drive roller 31.
15

In the example the abrasive band 300 is wound about one or more drive rollers 31, 32 of which one drive roller 31 and at least a driven roller 32 (in the example two driven rollers 32).

In particular, the abrasive band 300 is able to come into contact with the
20 tubular fabric T in the free portion thereof interposed between one support roller 31, 32 and another, in particular between the drive roller 31 and a driven roller 32.

In practice, the free portion interposed between one support roller 31, 32 and the other (or in any case the portion of the abrasive band 300 destined to go
25 into contact with the tubular fabric T) is substantially facing the rotatable roller 20, for example the first roller 21, so that the tubular fabric T can be interposed between the abrasive band 300 and the first roller 21 when the abrasive band 300 is in contact with the tubular fabric T.

The abrasive group 30 comprises actuating means for moving the abrasive
30 band 300 between a position of no contact with the tubular fabric T inserted on the rotatable roller 20 in the work station and a position of contact therewith

In practice, the abrasive band 300 is moved by the actuator means along a perpendicular direction to the rotation axis of the abrasive band, in the approach to and/or expulsion from the rotatable roller 20.

In practice, the drive roller 31 is rotatably supported by a support platform 34 that is substantially parallel to the support frame 11 and fixed thereto by means of an upright 35, substantially parallel to the rotatable roller 20, i.e. substantially vertical.

The drive roller 31 is activated in rotation by a second motor 310, for example supported by the floor support 35, by means of appropriate motion transmission organs, such as a pair of pulleys and a belt.

The driven rollers 32 are supported by an intermediate body 36 in turn hinged to the platform support 34 coaxially to the drive roller 31.

The actuator means advantageously comprise a third jack 33 hinged to the support platform 34 and the intermediate body 36, so as to control the oscillation of the intermediate body 36 with respect to the rotation axis of the drive roller 31 and the displacement of the abrasive band 300 between the no contact position (figure 2) and the contact position.

The abrasive band 300 in the example exhibits an axial length (parallel to the rotation or vertical axis) much smaller than the length of the rotatable roller 20.

The abrasive band 300 is, therefore, slidably associated to the support frame 11 with respect to a sliding direction parallel to the rotation axis of the rotatable roller 20, for example when in the contact position thereof.

In practice, the support platform 34 is slidably associated to the upright 35 with respect to the longitudinal axis thereof, and is moved along it by means of an independent third motor 37 that controls translation and vertical positioning thereof.

In practice, the abrasive band 300, once in the contact position with the tubular fabric T (i.e. a portion of the tubular fabric T is stretched between the abrasive band 300 and the first roller 21 of the rotatable roller 20, for example counter-rotating), is moved vertically so as to be in contact with a larger surface (for example all) of the tubular fabric T and so nap the external

surface thereof (which external will later be turned inside-out to become the inside of the garment realized with the tubular fabric T).

In the illustrated embodiment in which the guide 112 is substantially annular, in the machine 10 the tubular fabric T is loaded on a rotatable roller 20 located in the loading and/or unloading station, and is moved towards the work station where it is napped and unloaded when it reaches the loading and/or unloading station.

However, the configuration of the machine 10 could be different and for example exhibit a loading station separate from the unloading station and/or exhibit more than one work station or like particulars known to a person skilled in the sector.

The machine 10 comprises a control and command unit, not illustrated, as it is a usual electronic processor, operatively connected to the first motor 24, the second motor 310, the third motor 37, the first jack 243, the second jack 246 and the third cylinder 33, so as to control movement and activation thereof independently, for carrying out programmable work and rest cycles.

Further, the control and command unit is operatively connected to the actuator assembly which commands the advancement and the stationing of the support plate(s) 110 along the guide 112.

Lastly, the machine 10 comprises one or more groups of photocells (and/or sensors), for example in the work station, able to detect the presence and position of the rotatable roller 20 (first roller 21 and/or second roller 22) along the guide 112, as well as the position and extension of the tubular fabric T along the axis of the rotatable roller 20, so as to enable an exact positioning of the first motor 24, the centring organ 245 and the abrasive band 300 for the carrying-out of the napping steps in the work station.

In the light of the above, the operation of the machine 10 is as follows.

The machine 10 is operated by the command and control unit which controls the operating steps as illustrated below.

When the rotatable roller 20 is placed in a loading and/or unloading position an operator can load a tubular fabric T on the rotatable roller as follows.

First, the first roller 21 should be moved into or be in the retracted position

thereof internally of the groove 230 of the cladding body 23.

With the first roller 21 in this position, the tubular fabric T can be inserted on the second roller 22 and the cladding body 23 so that it surrounds both.

The tubular fabric T is then made to slide along the longitudinal axis of the
5 second roller 22 and the cladding body 20 that, as it exhibits a low coefficient of friction, enables the sliding of the tubular fabric T without great resistance and the correct positioning of the tubular fabric T, for example without folds and creases; thus the tubular fabric T can be positioned so that when it is placed on the second roller 22 and the cladding body 23 it presents its
10 maximum elongation.

Following the positioning of the tubular fabric T at a central area of the rotatable roller 20 (in this step constituted by the second roller 22 and the cladding body 23), the operator can operate (for example by acting on a suitable grippable lever, the translation of the first roller 21 so that it moves
15 from from the retracted position to the extracted position and exits from the cladding body 23.

In practice, by means of the translation the first roller 21 comes into contact with the internal surface of the tubular fabric T and moves away from the first roller 21 (therefore widening the distance between the first roller 21 and the
20 second roller 22), stretching the tubular fabric T so that it remains firmly fixed in the central position of the rotatable roller 20 (which at this stage is constituted by the first roller 21 and second roller 22) so as to remove any slack therefrom.

Once the tubular fabric T is loaded on the rotatable roller 20, the machine
25 advances the support plate 110 along the guide 112, so that the rotatable roller 20 with the tubular fabric T loaded thereon reaches the work station. When a rotatable roller 20 with the tubular fabric T thereon is loaded in the work station the support plate 110 is, for example, halted.

As the support plates 110 are all kinematically connected the machine 10 is
30 configured so that when a rotatable roller 20 is halted at the work station for the working of the tubular fabric T loaded thereon, a further rotatable roller 20 is halted in the loading and/or unloading station so that a tubular fabric T can

be loaded onto and/or off it.

With the rotatable roller 20 (which at this stage is constituted by the first roller 21 and second roller 22) located in the work station, the machine 10 commands the positioning of the abrasive band 300, by actuating the third motor 37 and the third jack 33, so that it moves into the contact position with the tubular fabric T.

For example, the first zone of contact between the abrasive band 300 and the tubular fabric T is positioned at an axial end of the tubular fabric T, for example the lower end thereof.

10 The machine 10, for example simultaneously with the activation in approach to the abrasive band 300 to the tubular fabric T, commands the rotation of the rotatable roller 20 and the counter-rotation of the abrasive band 300, which latter is driven by the rotational activating of the second motor 310.

15 In practice, the machine 10 commands the activating of the first jack 243 so that the motor shaft 240 engages, by means of the quick coupling 242, in the groove fashioned in the second end 212 of the first roller 21 and simultaneously commands the activating of the second cylinder 246, so that the centring organ 245 inserts into the conical seating fashioned in the second end 222 of the second roller 22.

20 In this configuration, the machine 10 commands the activating of the first motor 24 so as to rotate the first roller 21 and second roller 22 (the rotatable roller 20) that draw the tubular fabric T loaded thereon in rotation.

In practice, the reciprocal motion between the rotatable roller 20 and the abrasive band 300, for example, counter-rotating at different velocities, enables napping the tubular fabric T in the contact zone (annular) of the abrasive band 300 with the tubular fabric T, i.e. the external surface of the tubular fabric T inserted on the rotatable roller 20.

To perform this processing on the entire external surface of the tubular fabric T inserted on the rotatable roller 20, it is sufficient for the machine 10 to command vertical translation of the abrasive band 300 by activating the third motor 37, for example through a simple translation in a direction (up) or with a plurality of translations, depending on requirements.

In addition, the axial stroke (vertical) of the napping belt 300 can be configured so that it works on only one axial portion of the tubular fabric T, for example smaller than the whole.

During the vertical translation of the abrasive band 300 and the rotatable roller, the two are maintained in rotation (reciprocal counter-rotation), so that the entire external surface of the tubular fabric T inserted on the rotatable roller 20 (in the circumferential direction) is napped by entering into contact with the abrasive band 300.

In practice, the rotation (and counter-rotation) velocity of the rotating roller 20 and the abrasive band 300 and the axial (vertical) translation velocity of the abrasive band 300 are suitably dimensioned and calibrated so that the abrasive band 300 is in contact with the entire circumferential surface of the tubular fabric T along the entire axial (vertical) run thereof.

When the tubular fabric T has been worked, the machine 10 commands the abrasive band 300 so that it returns to its position of no-contact (it moves away from the rotating roller 20).

Simultaneously, the machine 10 commands the disengagement of the motor shaft 240 from the first roller 21 and the centering organ 245 from the second roller 22, releasing the free end of the rotating roller.

From this position the rotating roller 20 with the processed tubular fabric T loaded thereon is translated into the loading and/or unloading station of the machine 10, so that the tubular tissue T cannot be de-inserted (from above) from the rotatable roller 20 on the side of the free end thereof.

In practice, the operator simply has to bring the first roller 21 into the retracted position thereof, and the tubular fabric T, sliding axially on the cladding body 23 and the second roller 22 (which define in this stage the rotating roller 20) can easily be removed from the rotating roller 20, leaving the rotating roller 20 free to receive a new tubular fabric to be loaded and worked.

The invention as it is conceived is susceptible to numerous modifications and variants, all falling within the scope of the inventive concept.

Further, all the details can be replaced by other technically-equivalent

elements.

In practice, the materials used, as well as the contingent shapes and dimensions, can be any according to requirements, without forsaking the scope of protection of the following claims.

CLAIMS

1. A napping machine (10) for tubular fabrics (T) characterised in that it comprises a support frame (11) of at least a rotatable roller (20) insertable internally of a tubular fabric (T) to be napped and configured such as to draw
5 the tubular fabric (T) inserted on the rotatable roller (20) in rotation, and at least an abrasive band (300) in relative motion to the rotatable roller (20) and able to go into contact, on an opposite side with respect to the rotatable roller (20), with the tubular fabric (T) when the tubular fabric (T) is in rotation.
2. The machine (10) of claim 1, wherein the abrasive band (300) is
10 supported and drawn in rotation by at least a support roller (31, 32) that is parallel to the rotatable roller (20).
3. The machine (10) of claim 2, wherein the abrasive band (300) is substantially loop-wound about at least a pair of support rollers (31, 32), the abrasive band (300) contacting the tubular fabric (T) at a free portion of the
15 abrasive band (300) interposed between the pair of support rollers (31, 32).
4. The machine (10) of claim 3, wherein the pair of support rollers comprises at least a first drive roller (31) and at least a second driven roller (32).
5. The machine of any one of the preceding claims from 2 to 4, wherein
20 each support roller (31, 32) is counter-rotating with respect to the rotatable roller (20).
6. The machine (10) of any one of the preceding claims, wherein the abrasive band (300) is slidably associated to the support frame (11) with respect to a sliding direction parallel to the rotation axis of the rotatable roller
25 (20).
7. The machine (10) of any one of the preceding claims, wherein the rotation axis of the rotatable roller (20) is substantially vertical.
8. The machine (10) of any one of the preceding claims, characterised in that the rotatable roller (20) exhibits at least a portion (21) having a high
30 coefficient of friction, the machine (109) comprising cladding means (23) configured such as to at least partially removably clad the portion (21) having a high coefficient of friction of the rotatable roller (20).

9. The machine (10) of claim 8, wherein the cladding means comprise a cladding body (23) provided with a longitudinal groove (230) configured such as to house at least the portion (21) having a high coefficient of friction of the rotatable roller (20), at least one from between the rotatable roller (20) and the cladding body (23) being movably associated to the support frame (11) in a perpendicular direction to the rotation axis of the rotatable roller (20) between a retracted position, in which the portion (21) having a high coefficient of friction of the rotatable roller is located internally of the groove (230) of the cladding body (23), and at least an extracted position, in which the portion (21) having a high coefficient of friction of the rotatable roller (20) is located at least partially externally of the groove (230).

10. The machine (10) of claim 9, wherein the cladding body (23) comprises at least a pair of hinged shells (234) having a hinge axis parallel to the longitudinal axis of the rotatable roller (20) and movable from a closed position to an open position in contrast with return means, the groove (230) being delimited by the pair of shells (234) in a closed position thereof.

11. A napping method for tubular fabric, comprising steps of:

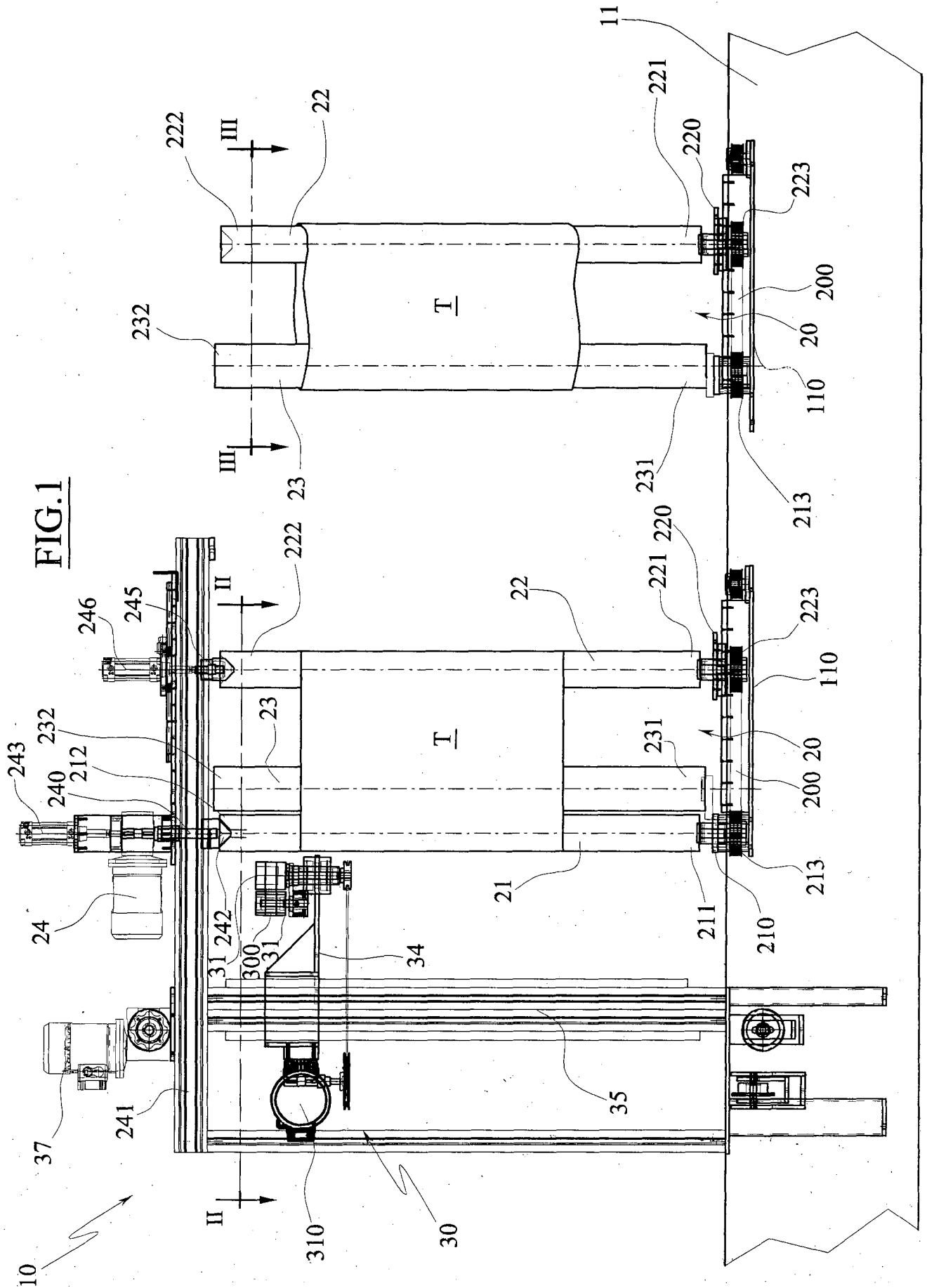
- arranging a tubular fabric (T) with a surface to be napped located externally thereof;
- arranging a rotatable abrasive band (300);
- rotating the tubular fabric (T) with respect to an axis thereof;
- rotating the abrasive band (300) with respect to a rotation axis parallel to the rotation axis of the tubular fabric (T) and
- placing in contact an external surface to be napped of the tubular fabric (T) in rotation with the rotating abrasive band (300).

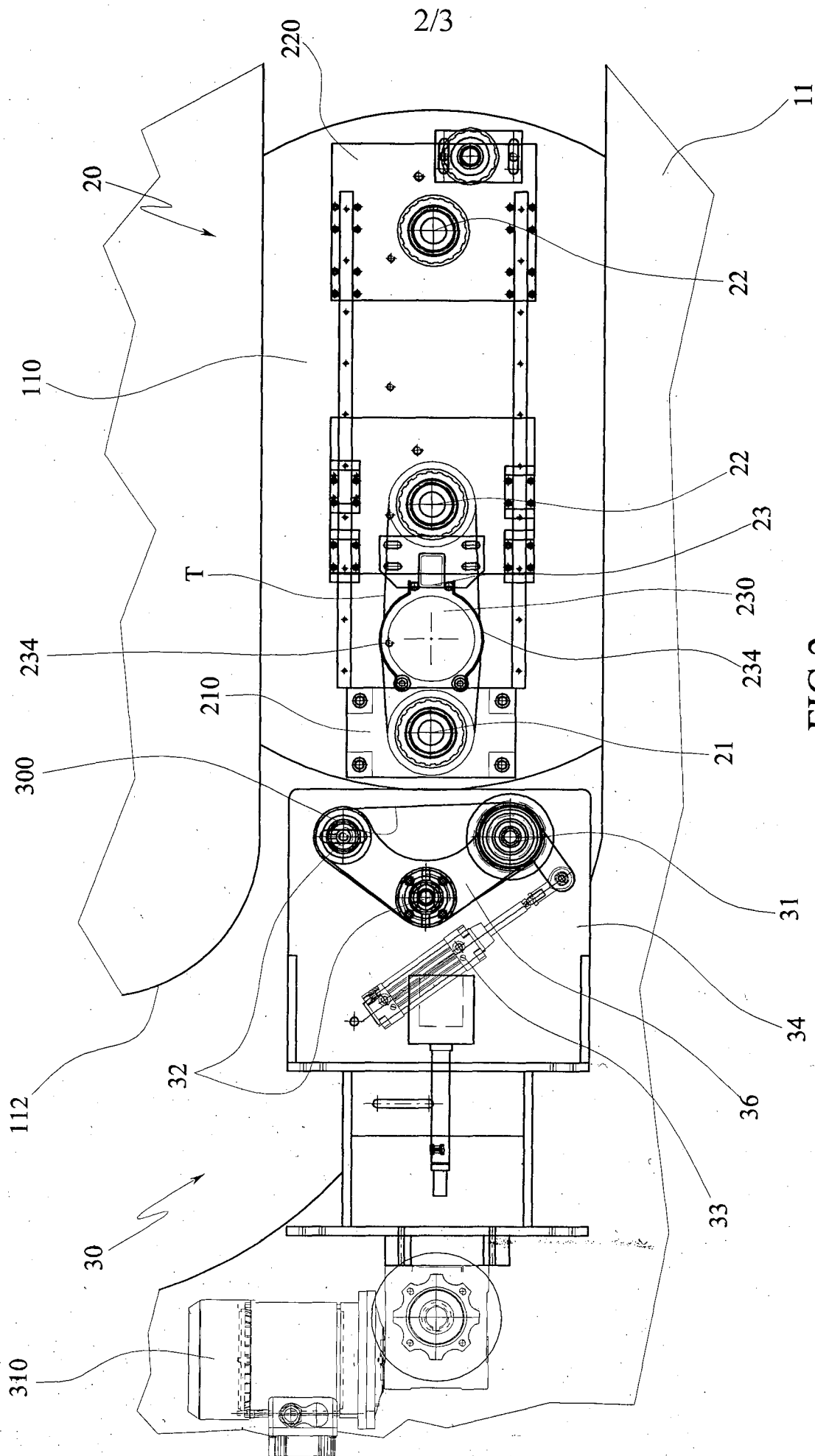
12. The method of claim 10, characterised in that it comprises a step of translating the rotating abrasive band (300) in contact with the external surface of the tubular fabric (T) along a parallel direction to the rotation axis of the tubular fabric (T).

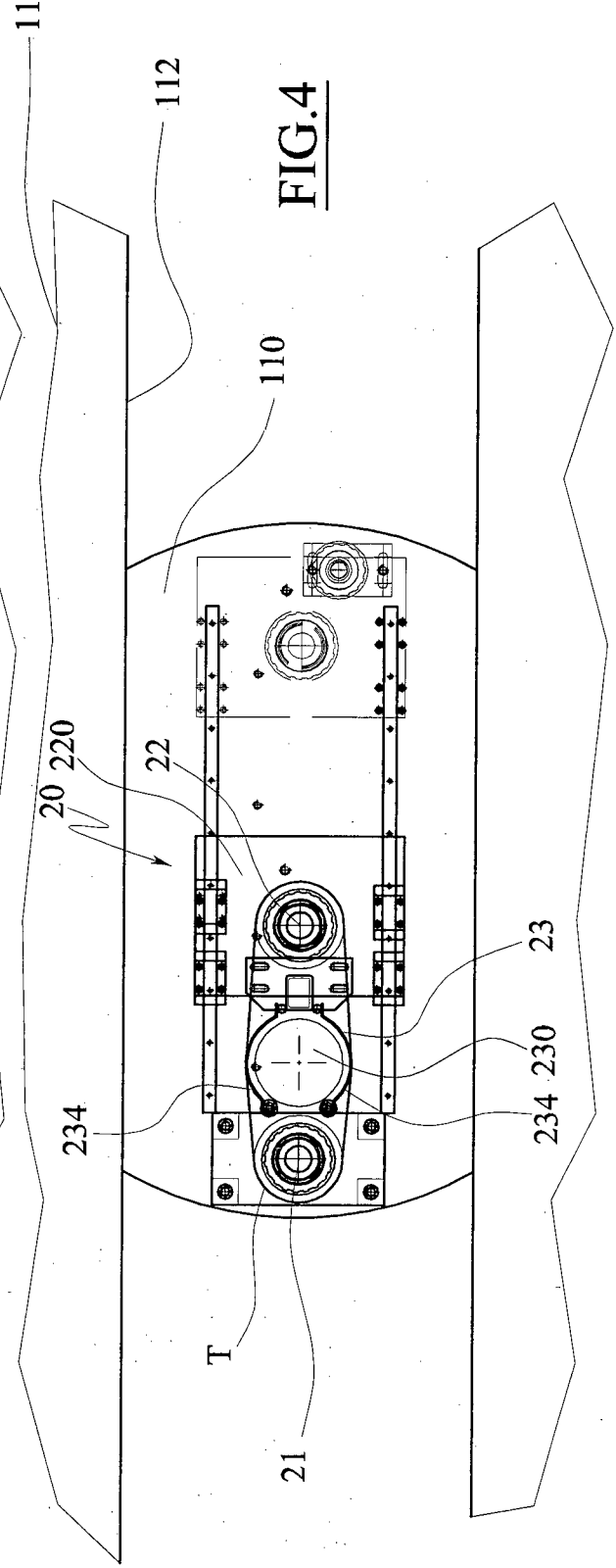
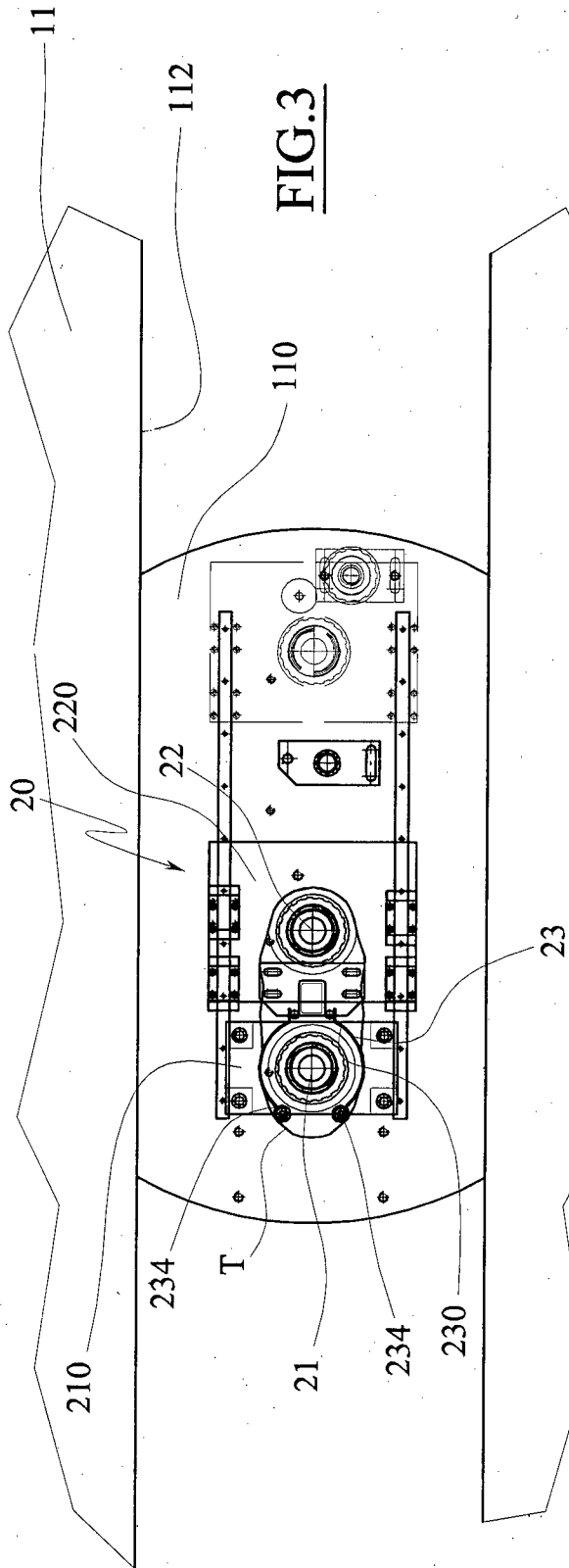
13. The method of claim 11 or 12, wherein the abrasive band (300) is set in counter-rotation with respect to the tubular fabric (T).

14. A fabric (T) in tubular form and without longitudinal seams obtained by

the method of one or more of claims from 11 to 13, characterised in that it comprises at least an axial portion of brushed wall along a whole circumference thereof.







INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/002890

A. CLASSIFICATION OF SUBJECT MATTER
INV. D06B23/04 D06C5/00 D06C11/00 D06C23/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D06B D06C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

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A	paragraphs [0032], [0067], [0068]; claim 1; figures 5,7	1-13
X	WO 2004/048672 A1 (CROSTA MARIO SRL [IT]; CROSTA EMANUELE [IT]) 10 June 2004 (2004-06-10)	14
A	page 4, line 13 - page 6, line 4	1-13
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

16 February 2015

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INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2014/002890

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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