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(54) **COMBINED COMPACTING MACHINE FOR FABRICS AND CORRESPONDING COMPACTING METHOD**

(57) A compacting machine for compacting a fabric (12) comprises at least a first mechanical compacting module (14) suitable to perform a compacting treatment of the mechanical type, and at least a second rubber compacting module (16), disposed in direct connection with and directly downstream of the first compacting module (14) in a direction of feed (D) of the fabric (12), suitable to perform a compacting treatment of the rubber type.

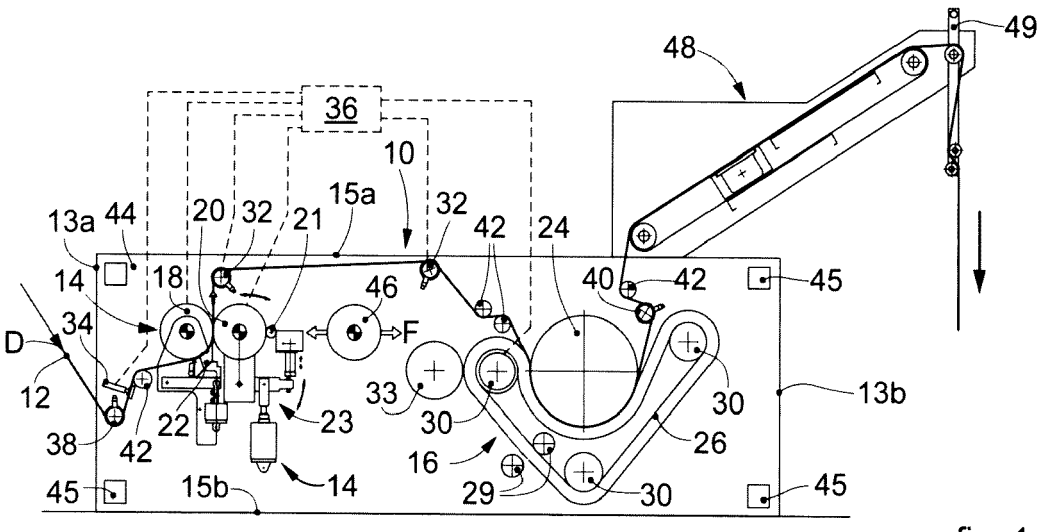

fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a combined compacting machine for fabrics, which can be used to confer a desired dimensional stability and desired qualitative characteristics to the fabrics, before they are sent for tailoring.

[0002] The invention also concerns the corresponding compacting method.

BACKGROUND OF THE INVENTION

[0003] In the field of fabric finishing, it is known to subject a fabric to a compacting treatment which mainly serves to stabilize the fabric in its dimensions, avoiding subsequent unforeseen shrinkages and/or size variations as well as conferring qualitative characteristics to it, such as for example a certain softness or a particular surface finish.

[0004] In order to perform this treatment, different types of compacting machines are known in the state of the art, which are normally chosen on the basis of the quality of the fabric to be treated, as well as the final quality sought, the desired productivity, and partly also the type of market for which the fabric is intended.

[0005] In particular, compacting machines for knitted fabrics are substantially divided into three categories, namely felt compacting machines, rubber compacting machines and mechanical compacting machines.

[0006] Mechanical compacting machines are used by fabric manufacturers who need to treat large quantities of fabrics, to the detriment of the quality thereof mainly in terms of the touch they are given.

[0007] On the other hand, felt compacting machines are generally used to obtain high quality fabrics, generally destined for markets that require fabrics with a soft and fluffy touch, and are therefore used by manufacturers who mainly focus on the quality of fabrics obtained, often to the detriment of production speed.

[0008] Rubber compacting machines are generally used to compact fabrics, giving them a shiny and flattened effect.

[0009] It is known that mechanical compacting machines generally comprise, as main elements, an introduction cylinder and a rubberized cylinder, generally called "retarder cylinder", which rotates at a lower speed than the introduction cylinder. The fabric is guided to the mouth between the two cylinders by a shaped blade element.

[0010] The compacting of the fabric is determined by the combined effect of the shaped blade element that guides the fabric between the introduction cylinder and the rubberized cylinder, and of the rubberized cylinder that "slows down" the fabric and therefore compacts it in the direction of feed.

[0011] Rubber compacting machines comprise, as main elements, a heated cylinder around which the fabric to be compacted is wound, and a rubber belt which rotates externally to the fabric and presses it against the surface of the cylinder.

[0012] Felt compacting machines comprise, as main elements, a heated cylinder around which the fabric to be compacted is wound, and a felt belt which rotates externally to the fabric and presses the fabric against the surface of the cylinder. The fabric to be compacted is guided to the mouth between the cylinder and the felt belt by an introduction element generally called "shoe".

[0013] The compacting machines above give different characteristics and qualities to the outgoing fabric.

[0014] Mechanical machines perform treatments whose quality, in particular in terms of touch, is sacrificed in favor of the high volumes of fabric that can be processed in a short period of time. In fact, mechanical compacting machines allow to reach working speeds much higher than those of the felt-type, or rubber-type machines, up to 60-80 m/min, and allow to obtain high compacting values, but give a low quality touch to the fabric, therefore it is stiff and not very soft.

[0015] A further disadvantage of mechanical compacting machines is, moreover, that they do not guarantee a high dimensional stability of the fabrics, since only a part of the compacting applied stabilizes and persists over time.

[0016] Felt- or rubber-type machines, on the contrary, produce a soft and fluffy effect on the treated fabrics, intended for high quality garments.

[0017] One disadvantage of rubber compacting machines is that they only allow to reach low working speeds, of the order of 25-40 m/min, and are therefore not very efficient in terms of productivity, while still providing a high quality final effect.

[0018] For these reasons, in the state of the art, mechanical compacting machines are mainly used when there is the need to process large quantities of fabrics, generally of medium-low quality, in a short time, while felt or rubber compacting machines are used when, respectively, it is necessary to process fabrics that require a particular and high quality surface finish.

[0019] For example, compacting machines of the combined type are known which comprise a rubber compacting module, which is followed by one or more felt compacting modules, so as to combine the shiny and flattened effect provided by the first module with the dimensional stability provided by the felt module, confirming that these compacting machines are chosen by the same type of fabric producers.

[0020] In particular, there is a deep-rooted practice amongst operators in the sector of considering the treatment methods and the respective machines as intended for different reference markets, for example low quality and high productions for mechanical compacting machines, and low quality and high productions for the remaining rubber or felt compacting machines.

[0021] The treatment methods, and the corresponding

types of machines, are generally selected based on the requests of the tailors, the market segments, the garments to be obtained, the productivity and quality sought, etc.

[0022] In order to meet the growing demand by tailors for fabrics with new characteristics, to meet the needs of the markets and win new ones, it is necessary to develop new methods to treat fabrics.

[0023] The purpose of the invention is to overcome the limitations of the current methods and machines, providing a compacting machine with high flexibility and the ability to satisfy requirements that have so far been considered as conflicting and incompatible, in a solution that is efficient, versatile, compact and configurable based on needs.

[0024] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0025] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0026] In accordance with the above purposes, a combined compacting machine for fabrics, in accordance with the present invention, comprises at least a first mechanical compacting module suitable to perform a compacting treatment of the mechanical type, and at least a second rubber compacting module, disposed downstream of said first compacting module in a direction of feed of the fabric, and suitable to perform a compacting treatment of the rubber type.

[0027] The mechanical compacting module comprises an introduction cylinder, also known as the feeder cylinder, a rubberized cylinder, also called retarder cylinder, and a shaped blade configured to introduce the fabric to be treated between the feeder cylinder and the rubberized cylinder.

[0028] The fabric passes directly in contact with the introduction cylinder and the rubberized cylinder and is compacted due to the different rotation speed of the two cylinders.

[0029] The rubber compacting module, also known in the textile sector as the "sanfor" compacting machine, comprises a heated cylinder around which the fabric to be treated is at least partly wound and a rubber belt that rotates externally to the fabric and presses it against the surface of the cylinder.

[0030] The rubber belt has elastic properties that make it suitable to deform from a concave position to a convex position, extending and contracting so as to shrink and compact the fabric with which it is in contact.

[0031] According to some embodiments, the second rubber compacting module can be disposed in direct connection with the first mechanical compacting module.

[0032] The Applicant has found that, subjecting the fabric to be worked to a first pass of mechanical compacting then, in direct continuity - both spatial and also temporal - to a second pass of rubber compacting, it is possible to combine the advantages deriving from the particular surface finish of the rubber treatment with the high productivity of the mechanical treatment.

[0033] In addition to greater productivity, the combination of the mechanical treatment followed by the rubber treatment allows to obtain a fabric with unique characteristics not yet present in the textile market.

[0034] Through a suitable regulation of the reciprocal operative parameters of the mechanical and rubber compacting modules, it is possible to select and modulate the contribution of each of them on the fabric to be treated.

[0035] For example, it is possible to assign a high percentage of the compacting to be obtained to the first pass of mechanical compacting, with a treatment speed high enough to guarantee a sufficient productivity.

[0036] The remaining and residual portion of the compacting to be performed is then assigned to the second pass of rubber compacting, which, precisely because of the residual portion of compacting to be achieved, can perform its operation at a speed that is compatible with the first mechanical pass, therefore guaranteeing the production needs are met.

[0037] The rubber compacting treatment performed immediately downstream of the mechanical compacting treatment, in addition to providing the desired shiny and flattened final effect, also allows to remedy possible defects made to the fabric by the mechanical compacting module.

[0038] In the event the mechanical compacting module exceeds in the compacting, for example due to an excessive difference in speed between the feeder cylinder and the retarder cylinder, or to a reduced minimum distance between them, creases or wrinkles can be generated on the fabric, which create an effect known as "elephant skin".

[0039] The rubber compacting module located downstream allows to smooth out the fabric, and therefore eliminate these defects.

[0040] According to some embodiments, the combined compacting machine can comprise at least one felt compacting module located downstream of the rubber compacting module.

[0041] The felt compacting module comprises a heated cylinder around which the fabric to be treated is at least partly wound, a felt belt that rotates externally to the fabric and presses the fabric against the surface of the heated cylinder, and an introduction element, generally referred to as "shoe", which guides the fabric between the felt belt and the heated cylinder.

[0042] The felt compacting module allows to provide dimensional stability to the treated fabric, as well as creating a soft, high quality touch.

[0043] In fact, the heated cylinder of the felt compacting module performs a stabilization and/or a thermal fixing

of the degree of compacting obtained with the compacting modules upstream, improving the overall compacting effect.

[0044] The presence of at least one felt compacting module, associated with the mechanical and the rubber compacting modules, increases the capacity of the compacting machine to confer and combine different treatments to the fabric, and in different proportions. Consequently, a machine of this type can allow to produce a range of fabrics so far not obtainable with known compacting machines.

[0045] Thanks to the presence of mechanical and rubber compacting modules, a very low compacting percentage can be attributed to the third felt compacting module, which can therefore be performed at higher speeds than those provided in the state of the art, allowing to keep the overall productivity of the machine high.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] These and other characteristics of the present invention will become apparent from the following description of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic lateral view of a combined compacting machine in accordance with embodiments described here;
- fig. 2 is a schematic lateral view of a combined compacting machine in accordance with variant embodiments;
- fig. 3 a schematic lateral view of a combined compacting machine according to further variant embodiments;

[0047] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can conveniently be incorporated into other embodiments without further clarifications.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0048] We will now refer in detail to the various embodiments of the present invention, of which one or more examples are shown in the attached drawings. Each example is supplied by way of illustration of the invention and shall not be understood as a limitation thereof. For example, the characteristics shown or described insomuch as they are part of one embodiment can be adopted on, or in association with, other embodiments to produce another embodiment. It is understood that the present invention shall include all such modifications and variants.

[0049] In accordance with the present description, embodiments described here concern a combined compacting machine 10, that is, of the hybrid type, configured to work fabrics 12, such as, by way of a non-limiting example only of the present invention, natural wool or cotton fabrics, or synthetic, or cotton-lycra, or 100% lycra, or viscose fabrics or suchlike.

[0050] The fabric 12 is preferably a fabric of the open type, but it is not excluded that it may also be a fabric 12 of the tubular type, or folded on itself longitudinally and sewn, providing suitable modifications and adaptations of the compacting machine 10.

[0051] The compacting machine 10 comprises at least a first mechanical compacting module 14 and at least a second rubber compacting module 16 disposed downstream of the first mechanical compacting module 14 along a direction of feed D of the fabric 12.

[0052] The at least one second rubber compacting module 16 is located downstream, and in direct connection, both temporal and also spatial, with the at least one first mechanical compacting module 14.

[0053] It is understood that the term "at least' refers to the fact that there can be both two or more mechanical compacting modules 14, and also two or more rubber compacting modules 16, without prejudice to the fact that at least one rubber compacting module 16 is located downstream of the last mechanical compacting module 14.

[0054] The first mechanical compacting module 14 can be configured to perform the greater portion of the overall amount of compacting to be applied to the fabric 12. The second rubber compacting module 16 can be assigned a small residual portion of the overall compacting, and in particular, advantageously although not limitedly, the amount necessary to provide the desired effect to the fabric 12.

[0055] For example, the first roughing compacting of the mechanical type can correspond to about 70-85% of the total amount of compacting to be applied to the fabric 12, while the second finishing compacting of the rubber type can correspond to about 15-30% of the total amount of compacting.

[0056] Since it has to perform only a minimal and residual part of the compacting work, the second rubber compacting module 16 can work at speeds greater than those generally used by solely rubber compacting machines of the state of the art; according to the invention, for example, the compacting machine 10 can achieve working speeds up to 50-60 m/min.

[0057] With the configuration according to the present invention it is therefore possible to obtain a fabric 12 with a flattened and shiny effect comparable to that of a solely rubber compacting machine, at the same time working with working speeds that approach those of a solely mechanical compacting machine.

[0058] The rubber module 16 also allows to iron and smooth out possible creases or wrinkles that can be generated on the fabric following the mechanical treatment.

[0059] In accordance with some embodiments, the first mechanical compacting module 14 comprises an intro-

duction cylinder 18, also known as a "feeder cylinder", a rubberized cylinder 20, also called "retarder cylinder", and a shaped blade 22 to introduce the fabric between the two cylinders 18, 20.

[0060] In accordance with some embodiments, an introduction element, or shoe, can be associated with the shaped blade 22 in order to facilitate the introduction of the fabric 12 between the introduction cylinder 18 and the rubberized cylinder 20 and/or protect the shaped blade 22 against wear.

[0061] In accordance with some embodiments, the introduction cylinder 18 is lined with gripping material in order to facilitate the gripping on the fabric 12 which is wound around it, while the rubberized cylinder 20 is lined with rubber or similar material, in order to brake the fabric 12 and compact it thanks to the speed differential between the two cylinders 18 and 20.

[0062] According to possible solutions, the rubberized cylinder 20 rotates at a speed lower than that of the introduction cylinder 18, for example equal to about half the speed of rotation of the introduction cylinder 18.

[0063] In accordance with some embodiments, the introduction cylinder 18 can be heated, in order to partly heat the fabric 12 which is wound around it in order to make the compacting action more effective.

[0064] The rubberized cylinder 20 generally cannot be heated. In order to prevent drops of condensation from forming on the external surface of the rubberized cylinder 20, which could cause defects if they came into contact with the fabric 12, the first mechanical compacting module 14 can comprise a dryer cylinder 21.

[0065] According to some solutions, the dryer cylinder 21 is lined with permeable material and is located adjacent to and in contact with the rubberized cylinder 20 so as to absorb the possible drops of condensation on the surface thereof.

[0066] In accordance with some embodiments, the first mechanical compacting module 14 further comprises a positioning device 23, configured to regulate and adjust the position of the rubberized cylinder 20, for example to regulate the distance from the feeder cylinder 18 as a function of the thickness of the fabric 12.

[0067] In accordance with some embodiments, the second rubber compacting module 16 can comprise a heated cylinder 24, around which the fabric 12 to be compacted is wound, and a rubber belt 26 which presses the fabric against the heated cylinder 24.

[0068] The rubber belt 26 is normally mounted on a plurality of cylinders 30, so as to partly wind around the heated cylinder 24, following a profile having at least one concave portion and one convex portion, in correspondence with which it deforms, respectively contracting and extending thanks to its elastic characteristics.

[0069] At least one cylinder 30 can be motorized and/or provided with means to adjust the contact pressure of the rubber belt 26 against the heated cylinder 24.

[0070] According to some embodiments, the rubber compacting module 16 can comprise at least a pair of squeezer rollers 29 between which the rubber belt 26 passes. The pair of squeezer rollers 29 can be useful to remove from the rubber belt 26 the water used to cool the belt itself.

[0071] According to some embodiments, the rubber compacting module 16 can also comprise a roller, or grinding cylinder 33, configured to grind, that is, to treat the surface of the rubber belt 26, maintaining a smooth surface thereof, suitable to provide the desired aesthetic effect on the fabric 12.

[0072] According to some embodiments, the compacting machine 10 can comprise at least one load cell 32 disposed between the first mechanical compacting module 14 and the second rubber compacting module 16, configured to regulate the tension of the fabric 12 between the exit from the first mechanical compacting module 14 and the entry into the second rubber compacting module 16.

[0073] The compacting machine 10, according to some embodiments, can also comprise a control and command unit 36, connected at least to the first mechanical compacting module 14 and to the second rubber compacting module 16 and configured to regulate their respective work speeds, for example as a function of the type of fabric 12 to be treated and of the type or quality of compacting required.

[0074] The control and command unit 36 can be, for example, connected to drive members (not shown) of the introduction cylinder 18, of the rubberized cylinder 20 and of the heated cylinder 24 of the rubber belt 26 so as to regulate their respective speeds of rotation as a function of the fabric 12 to be processed.

[0075] The control and command unit 36 can also be connected to the at least one load cell 32, so as to regulate the functioning of the second rubber compacting module 16 as a function of the tension of the fabric 12 exiting from the mechanical compacting module 14.

[0076] According to variant embodiments, for example described with reference to fig. 2, the compacting machine 10 can comprise at least one third felt compacting module 17 disposed downstream of the second rubber compacting module 16 in the direction of feed D.

[0077] Advantageously, the at least one third felt module 17 allows to obtain a better dimensional stability of the fabric 12 after the compacting with one or both of the modules 14, 16 positioned upstream.

[0078] In the rubber compacting module 16, in fact, the contact surface of the fabric 12 with the heated cylinder 24 is smaller than that of a felt compacting module 17, since the rubber belt 26 is wound on about half of its lateral surface, and, moreover, the temperature of the heated cylinder 24 is not particularly high, so as not to prematurely deteriorate the rubber.

[0079] In further embodiments, for example described with reference to fig. 3, the compacting machine 10 can comprise two felt compacting modules 17 located in succession one after the other.

[0080] The two felt compacting modules 17 can be con-

figured to both act on a same side of the fabric 12, or to each act on two opposite sides thereof.

[0081] In the event the compacting machine 10 provides one or more felt compacting modules 17, the amount of compacting assigned to the rubber compacting module 16 can also be distributed between them.

[0082] It can also be provided to distribute the overall amount of compacting between the three or more modules 14, 16, 17 in a different way, in any case assigning the greater compacting percentage to the mechanical compacting module 14, so as to maintain productivity high.

[0083] In accordance with some embodiments, the at least one felt compacting module 17 is located in correspondence of an exit side 13b of the machine 10, so as to provide the final touch to the fabric 12.

[0084] According to some embodiments, the compacting machine 10 can be configurable to achieve different workings of the fabric 12.

[0085] According to some embodiments, the compacting machine 10 can be configured so that the fabric 12 bypasses one or more modules provided by the compacting machine 10 according to, for example, the type of treatment to be obtained or the productivity to be achieved.

[0086] Further embodiments can provide that the compacting machine 10 allows to bypass all the modules, for example in the event the machine is positioned downstream of a stenter or a setter and the processed fabric 12 does not require compacting.

[0087] The compacting machine 10 is therefore very versatile and allows to perform different types of working of a fabric 12 simply modifying the travel of the fabric 12 through the compacting modules 14, 16, 17.

[0088] The versatility offered by the possible different configurations allows to be able to install the compacting machine 10 in any fabric finishing line whatsoever, without having to dedicate specific working lines for one or the other type of compacting, being able to choose on each occasion the optimal configuration to use.

[0089] In accordance with some embodiments, the or each felt compacting module 17 can comprise a heated cylinder 25, around which the fabric 12 to be compacted is at least partly wound, a felt belt 27 which presses the fabric against the heated cylinder 25, and an introduction element, or shoe 28, configured to introduce the fabric 12 between the heated cylinder 25 and the felt belt 27.

[0090] The heated cylinders 24, 25 can have a controllable and selectable temperature.

[0091] According to some embodiments, the felt belt 27 is wound around a plurality of return cylinders 31, at least one of which is motorized in order to command the motion of the felt belt 27.

[0092] According to some embodiments, the compacting machine 10 can comprise a load cell 32 located between the exit from the second rubber compacting module 16 and the entrance of the third felt module 17 and/or between two felt modules 17 configured to regulate the tension of the fabric 12 between the exit from one compacting module and the entrance into the next module.

[0093] In the case of one or more felt compacting modules 17, the control and command unit 36 can also be connected to the respective drive members, to the load cells 32 or to the respective heated cylinders 25 in order to regulate their functioning.

[0094] According to some embodiments, the compacting machine 10 can comprise a thickness measuring device 34, configured to measure the thickness of the fabric 12 to be compacted.

[0095] According to possible solutions, the thickness measuring device 34 can be disposed in correspondence with the entry side 13a, for example upstream of the first mechanical compacting module 14.

[0096] In accordance with some embodiments, the control and command unit 36 can also be connected to the possible thickness measuring device 34, so as to regulate the functioning of the compacting modules 14, 16, 17 also as a function of the thickness of the fabric 12.

[0097] In accordance with some embodiments, the compacting machine 10 can comprise an entry load cell 38, positioned upstream of the first mechanical compacting module 14, and configured to regulate the tension of the fabric 12 at entry.

[0098] According to possible solutions, the compacting machine 10 can comprise an exit load cell 40, positioned downstream of the second rubber compacting module 16, or downstream of the possible felt compacting module 17, and configured to regulate the tension of the fabric 12 at exit.

[0099] According to some embodiments, the compacting machine 10 can comprise return rollers or spiral expander rollers 42 located downstream and/or upstream of the first mechanical compacting module 14 and/or of the second rubber compacting module 16 and/or of the at least one third felt compacting module 17, in order to impose a desired travel to the fabric 12 and keep it laid down correctly.

[0100] In accordance with embodiments described using figs. 1-3, the compacting machine 10 comprises one or more lateral structures 44, defining as a whole an entry side 13a and an exit side 13b of the compacting machine 10, on which one or more compacting modules 14, 16, 17 can be installed.

[0101] According to embodiments described with reference to fig. 1, a lateral structure 44 can be provided, defined by the entry side 13a, by the exit side 13b and by respective upper 15a and lower 15b sides, on which at least one first mechanical compacting module 14 and at least one second rubber compacting module 16 can be simultaneously installed.

[0102] In this case, the at least one first mechanical compacting module 14 is disposed in correspondence with the entry side 13a and the at least one second rubber compacting module 16 is disposed in correspondence with the exit side 13b.

[0103] According to variant embodiments, for example

described with reference to fig. 2, a mechanical compacting module 14, a rubber compacting module 16 and a felt compacting module 17 can be installed on a same lateral structure 44, one in succession to the other.

[0104] According to some embodiments, the compacting machine 10 comprises two lateral structures 44 facing each other and having facing walls, equipped in a specular manner for the installation of the at least one first mechanical compacting module 14, of the at least one second rubber compacting module 16 and of the at least one felt compacting module 17.

[0105] In accordance with some embodiments, the lateral structures 44 can be joined together and maintained in position by means of suitable elements, called beams or tie rods 45.

[0106] According to other variant embodiments, it can also be provided that the mechanical compacting module 14 is provided on a first lateral structure 44a and that the rubber 16 and felt 17 compacting modules share a same second lateral structure 44b.

[0107] According to further embodiments, it can also be provided that each compacting module 14, 16, 17 or at least each type of module is provided with its own structure 44a, 44b, 44c.

[0108] The drawings show, by way of example, embodiments in which the first mechanical compacting module 14 and the rubber compacting module 16 are positioned horizontally aligned (fig. 1), while the felt compacting module 17 is positioned either above (fig. 2) or laterally to (fig. 3) the module 16.

[0109] Naturally, variant embodiments can be provided in which the second rubber compacting module 16 can be positioned in the upper part of the lateral structure 44.

[0110] In accordance with some embodiments, the compacting machine 10, within its overall bulk, can comprise a grinding cylinder 46, configured to allow the grinding of the rubberized cylinder 20 of the first mechanical compacting module 14, without having to disassemble it. The rubberized cylinder 20, in fact, being made of rubber material, can wear, for example due to friction with the fabric 12, or if located in contact with the introduction cylinder 18 lined with gripping material.

[0111] The grinding cylinder 46 allows to reduce both the number of maintenance operations and also the duration of the machine down time required for grinding, and therefore the overall operating costs.

[0112] In accordance with some embodiments, the grinding cylinder 46 is configured to be able to translate in a direction F toward/away from the rubberized cylinder 20. The rubberized cylinder 20 can also be moved in proximity to the grinding cylinder 46 for the grinding operation by means of the positioning device 23.

[0113] Embodiments described here also concern a method for compacting a fabric 12.

[0114] The compacting method provides to perform a first roughing compacting, of the mechanical type, on the fabric 12 in a first mechanical compacting module 14, a second finishing compacting, of the rubber type, on the fabric 12 in a second rubber compacting module 16 in direct spatial and temporal connection with respect to the first compacting of the mechanical type.

[0115] In particular, the second finishing compacting of the rubber type is performed immediately downstream and in continuity with respect to the first roughing compacting of the mechanical type.

[0116] In accordance with the configuration of fig. 1, the fabric 12 can be fed to the compacting machine 10 in the direction D, made to pass between the introduction cylinder 18 and the rubberized cylinder 20 guided by the shaped blade 22, in order to undergo a first roughing compacting of the mechanical type, then wound around at least one load cell 32 and finally made to pass between the rubber belt 26 and the heated cylinder 24, in order to undergo a second finishing compacting of the rubber type.

[0117] According to some embodiments, the distance between the exit of the fabric from the first mechanical compacting module 14 and the heated cylinder 24 is minimal, sufficient to guarantee that the fabric 12 arrives in correspondence with the heated cylinder 24 before part of the compacting performed on the fabric 12 disappears.

[0118] According to some embodiments, the first roughing compacting of the mechanical type can correspond to about 70-85% of the total amount of compacting to be applied to the fabric 12, while the second finishing compacting of the rubber type can correspond to about 15-30% of the total amount of compacting.

[0119] According to further embodiments, the method can provide to perform a third finishing compacting of the felt type on the fabric 12, in at least one third felt compacting module 17, in direct spatial and temporal connection with respect to the first mechanical compacting.

[0120] In particular, the third finishing compacting of the felt type is performed immediately downstream and in continuity with respect to the second finishing compacting of the rubber type, so as to stabilize the compacting effect obtained on the fabric 12.

[0121] In accordance with the configuration of fig. 2, the fabric 12 exiting the rubber compacting module 16 can be wound around a load cell 32 and be made to pass between the felt belt 27 and the heated cylinder 25 guided by two return rollers or spiral expander rollers 42 and the introduction element 28.

[0122] The passage of the fabric 12, already almost completely compacted in the first mechanical compacting module 14 and in the second rubber compacting module 16, around the heated cylinder 25 allows to stabilize and thermally fix the compacting performed on the fabric 12, preventing part of the first roughing compacting and the first finishing compacting from vanishing.

[0123] According to some embodiments, the distance between the exit of the fabric 12 from the rubber compacting module 16 and the heated cylinder 25 is minimal, sufficient to guarantee that the fabric 12 arrives in correspondence of the heated cylinder 25 before part of the

compacting performed on the fabric 12 vanishes.

[0124] In accordance with the configuration of fig. 3, the fabric 12, after exiting from the rubber compacting module 16 can be made to pass through two felt compacting modules 17. The fabric 12, exiting from the felt compacting module 17, can be wound to a load cell 32 and made to pass between the felt belt 27 and the cylinder 25 of a subsequent felt compacting module 17.

[0125] The compacting method can provide to perform the felt finishing compacting on each side of the fabric 12, changing the direction of insertion thereof between the first and the second felt compacting module 17.

[0126] According to some embodiments, the compacting machine 10 can comprise movement means 48 suitable to receive the fabric 12 exiting from the compacting machine 10 in order to dispose it in a suitable container C.

[0127] According to some embodiments, the movement means 48 can comprise an arm 49 that pivots around a horizontal axis of rotation, suitable to deposit the fabric 12 in the container C in layers.

[0128] This allows to obtain a better and more effective compacting, and therefore greater dimensional stability of the fabric 12.

[0129] It is clear that modifications and/or additions of parts may be made to the compacting machine 10 as described heretofore, without departing from the field and scope of the present invention.

[0130] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of hybrid compacting machine, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Compacting machine for compacting a fabric (12), **characterized in that** it comprises:

   at least a first mechanical compacting module (14) suitable to perform a compacting treatment of the mechanical type, and
   at least a second rubber compacting module (16), disposed in direct connection with and directly downstream of said first mechanical compacting module (14) in a direction of feed (D) of the fabric (12), suitable to perform a compacting treatment of the rubber type,
   wherein said first mechanical compacting module (14) comprises an introduction cylinder (18), a rubberized retarder cylinder (20), and a shaped blade (22) configured to introduce the fabric (12) between the two cylinders (18, 20), and said rubber compacting module (16) comprises a heated cylinder (24) around which the fabric (12) to be compacted is wound, and a rubber belt (26) configured to press the fabric (12) against the heated cylinder (24).

2. Compacting machine as in claim 1, **characterized in that** it comprises at least one load cell (32) disposed between said mechanical compacting module (14) and said rubber compacting module (16) and configured to regulate the tension of the fabric (12) between the exit from the first mechanical compacting module (14) and the entry into the second rubber compacting module (16).

3. Compacting machine as in any claim hereinbefore, **characterized in that** it comprises a control and command unit (36), connected at least to said first mechanical compacting module (14) and to said second rubber compacting module (16) and configured to regulate their respective working speeds as a function of the type of fabric (12) and/or the type of compacting required.

4. Compacting machine as in claims 2 and 3, **characterized in that** said control and command unit (36) is connected to said at least one load cell (32), so as to regulate the functioning of said second rubber compacting module (16) as a function of the tension of the fabric (12) exiting from said mechanical compacting module (14).

5. Compacting machine as in any claim hereinbefore, **characterized in that** it comprises at least a third felt compacting module (17) disposed downstream of said second compacting module (16) in said direction of feed D, and suitable to perform a compacting treatment of the felt type, wherein said third felt compacting module (17) comprises a heated cylinder (25) around which the fabric (12) to be compacted is at least partly wound, a felt belt (27) mounted on return cylinders (31) which presses the fabric (12) against the heated cylinder (25), and an introduction element (28) to introduce the fabric between the surface of the heated cylinder (25) and the felt belt (27).

6. Compacting machine as in claims 3 and 5, **characterized in that** it comprises at least one load cell (32) disposed between the exit of said second rubber compacting module (16) and the entry of said third felt module (17), and connected to said control and command unit (36).

7. Machine as in any claim hereinbefore, **characterized in that** it comprises a grinding cylinder (46) configured to allow the grinding of the rubberized cylinder (20) of the first mechanical compacting module (14), without having to disassemble it.

8. Method to compact a fabric (12), **characterized in that** it provides to:

- perform a first roughing compacting of the mechanical type on said fabric (12) introducing said fabric (12) by means of a shaped blade (22) between an introduction cylinder (18) and a rubberized retarder cylinder (20);
- perform a second finishing compacting of the rubber type on said fabric (12), introducing said fabric (12) between a heated cylinder (25) around which said fabric (12) is partly wound, and a rubber belt (26) which presses the fabric (12) against the heated cylinder (24),

wherein said second finishing compacting of the rubber type is performed immediately downstream of, and in direct continuity, both spatial and also temporal, with said first roughing compacting of the mechanical type.

9. Compacting method as in claim 8, **characterized in that** said first roughing compacting of the mechanical type corresponds to about 70-85% of an overall amount of compacting to be applied to the fabric (12) and said second finishing compacting of the rubber type corresponds to about 15-30% of said overall amount of compacting.

10. Compacting method as in claim 8, **characterized in that** it provides to perform a third finishing compacting of the felt type on said fabric (12) immediately downstream of, and in direct continuity, both spatial and also temporal, with said second finishing compacting of the rubber type introducing said fabric (12) by means of an introduction element (28) between a heated cylinder (25) and a felt belt (27) of a felt compacting module (17).

11. Method as in claim 10, **characterized in that** said first roughing compacting of the mechanical type corresponds to about 70-85% of an overall amount of compacting to be applied to the fabric (12), and said second finishing compacting of the rubber type and third compacting of the felt type, together, correspond to about 15-30% of said overall amount of compacting.

12. Method as in claim 10, **characterized in that** it provides to follow said third finishing compacting of the felt type on the two sides of said fabric (12), causing it to pass in alternate directions in at least two felt compacting modules (17) located in series one to the other.

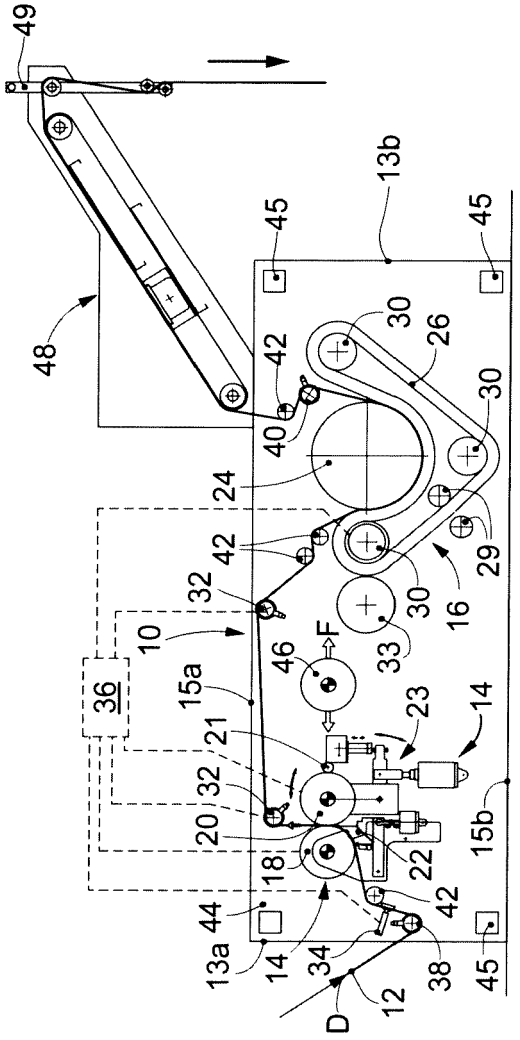
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fig. 1

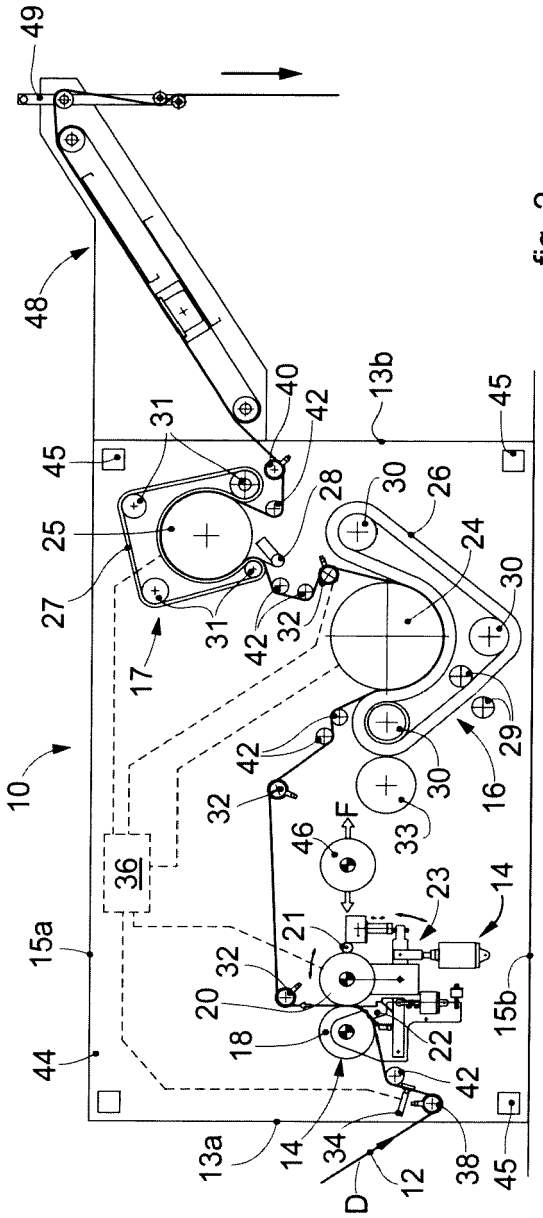
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fig. 2

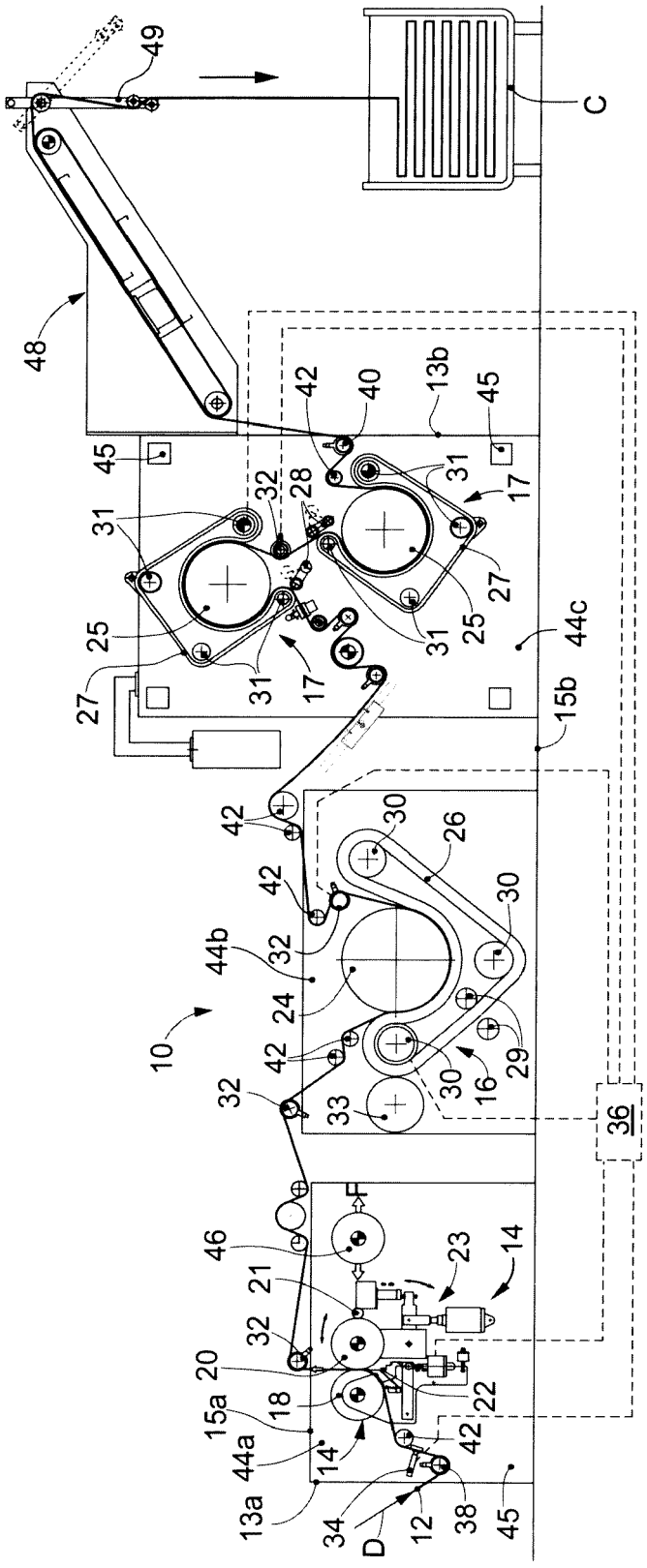
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fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 19 42 5062

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	26 February 2020	Uhlig, Robert

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