



(11) **EP 2 166 136 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.03.2010 Bulletin 2010/12

(51) Int Cl.:
D01H 13/14 *(2006.01)* **B65H 63/06** *(2006.01)*
B65H 69/00 *(2006.01)*

(21) Application number: **09170493.2**

(22) Date of filing: **17.09.2009**

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

(30) Priority: **19.09.2008 IT UD20080201**

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(54) **Device and method to identify and eliminate impurities from textile fibers and textile machines provided with such device**

(57) Device to identify and eliminate impurities (27) from strips (12) of textile fibers, associated or able to be associated with a machine (11) for treating textile fibers, comprising members (15) to detect the impurities (27), and feed members (18, 19), able to feed the strips (12) of textile fibers to the machine (11) and/or to subsequent working steps. The device also comprises suction members (17), wherein the feed members (18, 19), as a function of information arriving from the detection members

(15) of the impurities (27), are also able to selectively break the strips (12) of textile fibers substantially around the point where the impurities (27) are present, and wherein the suction members (17) are able to suck in the segments of strip containing the impurities (27) broken from the strips (12) of textile fiber by the feed members (18, 19).

Description

FIELD OF THE INVENTION

[0001] The present invention concerns a device and the relative method to identify and eliminate impurities from substantially parallelized textile fibers, for example grouped in strips, such as wool and/or cotton and/or synthetic fibers and/or artificial fibers, even mixed with respect to each other. The impurities include for example residues of polypropylene coming from packaging, fragments of fabrics, residues of a vegetable and/or animal nature, and/or any other type of impurity which could spoil the quality of the textile fiber. The present invention also concerns the textile machine provided with this device.

BACKGROUND OF THE INVENTION

[0002] The presence in textile fibers used for the production of yarns such as wool and/or cotton, of impurities which are difficult to eliminate is known. Such impurities may be of a vegetable or animal origin, they may comprise residues from packaging, normally layers of polypropylene fiber, fragments of fabrics or other similar or comparable impurities which spoil the quality of the textile fibers and inevitably of the product deriving therefrom.

[0003] In particular, as far as concerns polypropylene, this, by its very nature, shape and size is difficult to identify and eliminate during carding, combing and spinning processes. During these processes, the polypropylene fibers are broken up even more, thus increasing in practice the degree of pollution of the textile fiber. Moreover polypropylene is a material which does not normally dye during the normal dyeing cycles of the fabrics.

[0004] To eliminate this defect it is necessary to treat the fabric obtained, for example with solvents at a high temperature, which inevitably spoil the quality of the fabric.

[0005] It is therefore known to use textile machines for processing such textile fibers, such as drawing frames, or downstream of the carding, combing or other similar apparatuses, optical detection devices to detect such impurities from the textile fibers so as to be able to subsequently eliminate them.

[0006] Typically the detection devices identify the impurity by means of beams of polarized light, and subsequently, once the presence of such impurities has been detected, they generate a signal and send it to a command and control unit which commands the textile machine on which such devices are installed to stop, allowing an operator to remove the portions of contaminated fibers and subsequently to re-start the textile machine.

[0007] One disadvantage of such devices is that the removal of the impurities is done manually, which entails a considerable waste of time, the need to have staff in charge of this activity, as well as the frequent stopping of the textile machine, which considerably slows down the production cycle and reduces productivity.

[0008] Purpose of the present invention is to achieve a device and to perfect the relative method to identify and eliminate impurities from textile fibers, which identifies and eliminates the impurities in an automatic and continuous way, that is, without needing to use operators in charge of the elimination of the polluted fibers and without needing to stop the textile machine.

[0009] 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

[0010] 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.

[0011] In accordance with said purpose, a device to identify and eliminate impurities from strips of textile fibers such as for example card slivers, according to the present invention, associated or able to be associated with a machine for processing said textile fibers, comprises means to detect the impurities and feed means, able to feed the strips of textile fibers to said machine and/or subsequent processing steps.

[0012] According to a characteristic feature of the present invention the device also comprises suction means associated with the feed means, in which the feed means, depending on the information coming from the impurity detection means, are able to selectively break up the strips of textile fibers substantially around the point in which the impurities are, and in which the suction means is able to suck up the segments of strip containing the impurities, separated from the strips of textile fibers by the feed means.

[0013] According to a variant of the present invention, the feed means comprise at least first and second feed means, in which the first feed means is able to be stopped when the optical detection means detect said impurities, while the second feed means continues to draw the strip, thus causing it to break.

[0014] In a variant of the invention, the breakage of the strip is caused by an acceleration of the second feed means with respect to the speed of the first means, or by a slowing of the first feed means with respect to the speed of the second means, so that the strip is stretched between the two feed means until it breaks.

[0015] According to another variant of the present invention the first feed means are disposed downstream of the detection means with respect to the direction of feed of the strip, so that the impurity possibly detected, following the stopping of the first feed means, finds itself between the detection means and the first feed means.

[0016] According to a variant of the present invention the suction means is disposed downstream from the second feed means with respect to the direction of feed of the strip, to allow the segment of strip containing the im-

purity to be sucked up and to keep the portion of interrupted strip between the first and the second feed means.

[0017] According to another variant of the present invention the feed means comprise at least a first and a second pair of superimposed cylinders, between which the strip of textile fiber which has been fed is able to pass, of which at least one cylinder is motorized.

[0018] Advantageously, the motorizations of said pairs of cylinders are independent with respect to each other and can be programmed to determine desired conditions on the segment of strip comprised between said pairs of cylinders, for example a light drawing in order to regularize the strips of fibers being processed, or the breakage of the strip after the impurity has been detected.

[0019] According to a further variant of the present invention the first and the second pairs of superimposed cylinders are disposed at a variable distance with respect to each other, depending on the length of the textile fibers that make up said strips.

[0020] In a preferential form of embodiment, the feed means also comprise a third pair of superimposed cylinders, disposed downstream from the second pair of cylinders and the suction means. The third pair of motorized cylinders cooperate with the second pair of superimposed cylinders in drawing the strip and, when necessary, in breaking it after the impurity has been identified, as well as facilitating the advance of the strip, after the interruption for it to be cleaned, and the subsequent placing of it adjacent with the other strips being processed on the textile machine, otherwise called the re-launch step.

[0021] The device according to the present invention therefore allows, through the use of the suction means, an automatic removal of the segment of strip containing the impurities. Moreover, since the machine for processing said textile fibers works by being fed by a plurality of belts, and each of said belts is provided with a device according to the present invention, if it happens that a belt is missing for the textile machine for the time needed for the suction of the segment of strip containing the impurity and the for the re-launch step of the strip, the machine can continue working fed by the remaining strips, without any need for interruption.

[0022] Moreover the control unit, following the detection of a plurality of impurities disposed on different strips, automatically commands the selective treatment of each strip.

[0023] The device according to the present invention, eliminating any type of impurity, therefore also allows to process textile fibers not particularly selected and therefore obtainable at a lower market cost. The device therefore allows a higher production, less waste of material limited only to the part of the strip containing the pollutant material and substantially no need of manpower, since the elimination operation is automatic.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- Fig. 1 is a schematic view from above of a textile machine provided with a device according to the present invention;
- Fig. 2 is a schematic representation of a first operative step of the device in fig. 1;
- Fig. 3 is a schematic representation of a second operative step of the device in fig. 1;
- Fig. 4 is a schematic representation of a third operative step of the device in fig. 1;
- Fig. 5 is a schematic representation of a fourth operative step of the device in fig. 1;
- Fig. 6 is a schematic representation of a fifth operative step of the device in fig. 1;
- Fig. 7 is a schematic representation of a sixth operative step of the device in fig. 1;
- Fig. 8 is a schematic representation of a seventh operative step of the device in fig. 1; and
- Fig. 9 is a schematic representation of a detail of a variant of the textile machine in fig. 1.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0025] With reference to fig. 1, a device 10 to identify and eliminate impurities 27 from textile fibers, according to the present invention, is able to be used, preferably, but not exclusively, in a regularization machine 11, such as for example a drawing frame with combs or discs, of the type for wool, or with cylinders, of the type for cotton, in which strips 12 of textile fibers are drawn to dispose the fibers parallel and to regularize them.

[0026] The regularization machine 11 comprises a feed table 13, in correspondence with which a plurality of strips 12 are able to be conveyed, in this case six, to undergo processing, coming from containers 29, to feed the strips 12 to a regularization head 14 of the machine 11.

[0027] In a first form of preferential embodiment the regularization machine 11 also comprises a pair of feed cylinders 22 able to feed continuously to the feed table 13 a strip 23 without any impurities 27, hereafter called neutral strip, substantially in a longitudinal and median direction with respect to the feed table 13.

[0028] The neutral strip 23 acts as a guide and support for the re-launch of the portions 12a of the strips 12 which have been subjected to processing. The strips 12a, overlapping/adjacent to the neutral strip 23, are able to be transported by the latter in correspondence with the regularization head 14, as will be described in more detail hereafter. To this purpose, the regularization machine 11

also comprises a plurality of lifting devices 24, disposed substantially in correspondence with the points where the strips 12a merge with the neutral strip 23. The lifting devices 24 are able to lift/lower the strips 12 and the strip 23 to allow them to overlap and/or be placed adjacent.

[0029] According to a variant of the present invention shown in fig. 9, to convey the strips 12a toward the regularization head 14, it is possible to provide, as a substitute for said neutral strip 23, a pair of overlapping sliding belts 25, their sliding speed being equal to the sliding speed of the strips 12.

[0030] In particular the lower sliding belt 25a is substantially coplanar to the feed table 13, while the upper belt 25b exerts a pressure on the lower belt 25a.

[0031] The upper belt 25b is also able to be raised/lowered, by means of levers 26 of the known type and commanded for example by means of pneumatic members substantially in correspondence with the insertion points of the strips 12a along the median axis of the feed table 13, to facilitate the insertion of the strips 12a under the strips 12 being processed.

[0032] The machine 11 also comprises, downstream of said points of insertion of the strips 12a, a binding unit 30 able to facilitate the weaving of the fibers of the strips 12a and those of the strips 12 and 23 overlapping/adjacent, and to facilitate and make more secure the re-launch step of the strips 12a in the continuation of the processing. The strips being processed and the clean strip to be re-launched can be bound, for example, by means of jets of compressed air opportunely directed on the strips to render them cohesive.

[0033] The machine 11 also comprises, upstream of the regularization head 14, an accompanying unit 28, able to facilitate the introduction of the overlapping/adjacent strips 12, 23 to the regularization head 14.

[0034] The machine 11 also comprises a command and control unit, of the known type and not shown in the drawings, able to command and control the elements which make up the machine 11. In particular the command and control unit is able to command the device 10 to identify and eliminate impurities according to parameters set or settable, relating to the type of the impurities which have to be detected and eliminated.

[0035] The regularization machine 11 also comprises, in correspondence with each strip 12, respective devices 10 to identify and eliminate impurities. In particular each device 10 comprises an optical/capacitive detection element 15, of the known type, and a feed-cleaning unit 16 disposed downstream from the optical/capacitive detection element 15.

[0036] The feed-cleaning unit 16 comprises a suction member 17 and, in this case, three pairs of superimposed cylinders 18, 19, 20, able to feed the respective strip 12 and/or 12a to the feed table 13.

[0037] The suction member 17 is provided with a movable suction inlet 17a, able to be disposed substantially near the cylinders 18, 19, 20, advantageously between the cylinders 19 and 20, to suck up the segments of strip

in which there are impurities, as will be described in more detail hereafter.

[0038] The pairs of cylinders 18, 19, 20 lie on the same plane and are able to be disposed at a variable distance from each other depending on the length of the fiber/strip being processed. Moreover, the relative speed of each pair of cylinders 18, 19, 20 is variable with respect to the speed of the other pairs. For each pair of cylinders 18, 19, 20, the lower cylinder 18a, 19a, 20a is the driver and has a fixed axis of rotation, whereas the upper cylinder 18b, 19b, 20b is able to be lifted and driven by the respective lower cylinder 18a, 19a, 20a on which it is also able to act at a variable pressure.

[0039] The device 10 according to the present invention as described heretofore functions as follows.

[0040] Each strip 12 is fed to the feed table 13 passing through the optical/capacitive detection element 15, to identify possible impurities present in the strip 12, and the feed-cleaning unit 16 (fig.2).

[0041] If the optical/capacitive detection element 15 does not identify any impurity in the strip 12, it follows its course, exits from the feed-cleaning unit 16 and moves adjacent to the neutral strip 23. Then each strip 12 follows its course toward the accompanying unit 28 and the regularization head 14, from which the adjacent strips 12 emerge drawn, regularized and cleaned, to be sent to subsequent storing and/or processing steps. Vice versa, if the optical/capacitive detection element 15 identifies an impurity 27 (fig. 3) which falls within the parameters set in the command and control unit 26, it generates a signal for the control and command unit 26, which, depending on the type of signal, intervenes on the feed-cleaning unit 16 relating to the appropriate device 10, while the regularization machine 11 continues to process all the other strips 12 on which no impurity 27 has been detected. The command and control unit 26 can be programmed to continue the processing of the other strips 12 even if the detection elements 15 have detected impurities 27 on other strips 12 during the time of a cleaning cycle. In this case the cleaning operation is carried out in sequence, that is, on one strip 12 at a time, keeping on stand-by, for the time of the cleaning cycle, the remaining strips 12 on which impurities 27 have been identified. This can happen for a pre-determined number of impurities detected, after which it is necessary to stop the regularization machine 11.

[0042] To carry out the cleaning operation, the command and control unit 26 initially commands the rotation of the pair of cylinders 18 to be stopped, leaving the pairs of cylinders 19, 20 to rotate. In this way the strip in the segment between the pairs of cylinders 18, 19 is broken. In this segment, given the different speeds of the pairs of cylinders, the strip tightens and stretches until it tears (fig. 4). This is possible since the distance between the release point of the pair of cylinders 18 and the gripping point of the pair of cylinders 19 is greater than the length of the longest fibers which make up the strip 12.

[0043] The segment of strip 12 which is torn, without

defects, then follows its course through the pairs of cylinders 19, 20 (fig. 5) and from these to the feed table 13, while the segment of strip 12 stopped by the pair of cylinders 18, on the other hand, has the impurity 27 localized substantially between the detection element 15 and the pair of cylinders 18.

[0044] Subsequently the pair of cylinders 18 is activated again, so as to feed the segment of the strip 12 having the impurity 27 under the pair of cylinders 19 which have remained in rotation (fig. 6).

[0045] During this step, the suction inlet 17a, is placed between the pairs of cylinders 19 and 20.

[0046] The pair of cylinders 19 then feeds the fibers of the segment of strip containing the defect to the suction inlet.

[0047] After a pre-determined time, depending on the length of the segment of strip to be eliminated, the pair of cylinders 18 is again stopped, while the pair of cylinders 19 remains in rotation for an interval of time sufficient to cause the breakage of the strip in the segment comprised between the pairs of cylinders 18 and 19.

[0048] In this way the strip stopped on the machine gripped between the pair of cylinders 18 is cleaned of the defect.

[0049] When the cleaning action has finished, with the suction of the segment of strip containing the impurity 27, the suction inlet 17a is then removed from the previous position, and the pair of cylinders 18 is re-started.

[0050] Subsequently, in the so-called re-launch step, the pair of cylinders 18 continues to feed the strip 12 under the pair of cylinders 19, and from these to the pair of cylinders 20 (fig. 8). The pairs of cylinders 18, 19, 20 in this step have substantially the same speed, and therefore they do not exert any drawing on the strip in transit. The segment 12a thus cleaned is then conveyed and thrust by the pair of cylinders 20 under the neutral strip 23 and also, possibly, under possible other strips 12 which are being processed at high speed upstream of the cleaned strip 12a.

[0051] The neutral strip 23 and the possible other strips 12 are lifted from the feed table 13 by means of a lifting device 24.

[0052] When the initial part of the cleaned strip 12 finds itself under the neutral strip 23, the lifting device lowers the strip 23 and the other possible strips 12, allowing the cleaned strip 12a to move under the strip 23. When the neutral strip 23 is lowered the cleaned strip 12a is moved, at the same working speed as the neutral strip 23 by increasing the speed of the whole feed-cleaning unit 16. At the same time the passage through the binding unit 30 and the flow of the jets of compressed air take place, which, weaving the strips of fiber 12a with those of the neutral strip 23 and possible adjacent strips 12, facilitates the re-launch of the strip 12a along the feed table 13.

[0053] In particular the re-launch step of the strip 12a, after the cleaning operation, takes place at a low speed while all the other strips 12 and 23 continue to be fed to the regularization head 14 at the normal working speed

of the machine 11.

[0054] To guarantee an efficient re-launch of the strip 12a, it is advantageously introduced under the other strips 12 and 23 substantially at a low speed, typically comprised between about 1/5 and about 1/10 of the normal working speed of the machine 11.

[0055] Again to guarantee the best re-launch conditions, the median axis Y of the device 10 is advantageously inclined by an angle α variable between about 15° and about 30° with respect to the median axis X of the feed table 13 on which the strips 12 being processed and the neutral strip 23 slide.

[0056] In this way, the strip 12a, which after the cleaning step has the leading fibers open and with a reduced consistency, does not meet any deflections, and consequently substantially no resistance, along its path. This facilitates the insertion of the strip 12a below the neutral strip 23 and the other possible strips 12 and/or its positioning adjacent to said strips 23, 12.

[0057] The pair of superimposed cylinders 20, which substantially have the same speed as the pair 19, control and guide the strip 12a substantially near the zone of intersection with the strip 23 and possibly with the other strips 12, always at a low speed so as to keep the leading fibers of the strip 12a parallel. The lifting of the neutral strip 23 and possibly of the adjacent strips 12, by means of the device 24, allows to introduce the initial part of the strip 12a at a low speed under the neutral strip 23 and the other strips 12, fed at the normal working speed of the machine 11, in a uniform and regular way without causing hooking and matting of the leading fibers of the strip 12a.

[0058] This allows the strip 12a to be positioned adjacent to the other strips being processed and to reach the working speed almost instantaneously without compromising the quality of the strip after the cleaning step, to carry out this operation automatically and without stopping the working of the machine 11.

[0059] The strips 12a, 12 and 23, overlapping and adjacent, then follow their course toward the accompanying unit 28 and the regularization head 14 and from this to the subsequent storing and/or processing steps.

[0060] According to a variant, in order to carry out the cleaning operation, the strip 12 with an impurity 27 is first fed forward so as to present the portion with the impurity 27 substantially in correspondence with the suction member 17. Subsequently the rotation of the pair of cylinders 18 is stopped, leaving the pairs of cylinders 19, 20 to rotate so as to break the segment of strip 12 containing the impurity 27, so that it is then sucked up.

[0061] According to another variant, in order to carry out the cleaning operation, the portion of strip 12 with an impurity 27 is subjected to de-felting, so as to allow the impurity 27 to be sucked up. At the end of the de-felting step, the strip 12 is not torn.

[0062] It is clear that modifications and/or additions of parts may be made to the device 10 to identify and eliminate impurities from textile fibers as described hereto-

fore, without departing from the field and scope of the present invention.

[0063] 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 device 10 to identify and eliminate impurities from textile fibers, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Device to identify and eliminate impurities (27) from strips (12) of textile fibers, associated or able to be associated with a machine (11) for treating said textile fibers, comprising means (15) to detect said impurities (27), and feed means (18, 19), able to feed said strips (12) of textile fibers to said machine (11) and/or to subsequent working steps, **characterized in that** said device also comprises suction means (17), wherein said feed means (18, 19) comprise at least first (18) and second (19) feed means disposed in sequence with respect to each other and interposed between said detection means (15) and said suction means (17) and, as a function of information arriving from said detection means (15) of said impurities (27), the first feed means (18) is able to assume a relative speed different with respect to the second feed means (19) in order to selectively break said strips (12) of textile fibers substantially around the point where said impurities (27) are present, and wherein said suction means (17) is able to suck in the segments of strip containing said impurities (27) broken from the strips (12) of textile fiber by said feed means (18, 19).
2. Device as in claim 1, **characterized in that** said first feed means (18) is able to be stopped when said detection means (15) detects said impurities (27), whereas said second feed means (19) continues to draw the strip thus causing it to break.
3. Device as in claim 2, **characterized in that** said first feed means (18) is disposed downstream of said detection means (15) with respect to the direction of feed of the strip (12), so that the impurity possibly detected, following the stoppage of the first feed means (18), finds itself between said detection means (15) and said first (18) feed means.
4. Device as in claim 3, **characterized in that** said suction means (17) is disposed downstream of said feed means (18, 19) with respect to the direction of feed of the strip (12), to allow the suction of said segments of strip (12) containing said impurities (27).
5. Device as in claim 1, **characterized in that** said feed means each comprises a pair of superimposed cylinders, wherein at least a first and a second pair of superimposed cylinders (18, 19) are disposed at a variable distance with respect to each other depending on the length of the textile fiber making up said strips (12).
6. Device as in claim 5, **characterized in that** said feed means also comprise a third pair of superimposed cylinders (20) able to facilitate the advance of the strip (12a) and the positioning of said strip (12a) adjacent to other strips being processed on said machine (11).
7. Method to identify and eliminate impurities (27) from strips (12) of textile fibers performed using a device (10) to identify and eliminate said impurities (27), associated or able to be associated with a machine (11) for treating said textile fibers, comprising means (15) to detect said impurities (27), and feed means (18, 19), able to feed said strips (12) of textile fibers to said machine (11) and/or to subsequent working steps, **characterized in that** it comprises at least a first step in which said feed means (18, 19), as a function of information arriving from said means (15) to detect said impurities (27), are driven at relatively different speeds with respect to each other in order to selectively break said strips (12) of textile fibers substantially around the point where said impurities (27) are present, and suction means (17), associated with said feed means (18, 19), suck in the segments of strip containing said impurities (27) broken from the strips (12) of textile fiber by said feed means (18, 19).
8. Method as in claim 7, **characterized in that** said first step comprises at least a sub-step in which the first (18) of said feed means is stopped when said detection means (15) detects said impurities (27), whereas the second (19) of said feed means continues to draw the strip, causing it to break.
9. Method as in claim 7, **characterized in that** said first step comprises at least a sub-step in which after the suction of said impurities (27) by means of said suction means (17), said first feed means (18) feeds the clean strip (12a) to said second feed means (19) and said second feed means (19) feeds said cleaned strip (12a) to said machine (11) in order to treat said textile fibers, and/or to subsequent working steps.
10. Method as in any claim from 7 to 9, **characterized in that** it also comprises a second step in which said clean strip (12a) is conveyed by third feed means (20) in correspondence with conveyor means (23, 25) able to guide and support said clean strips (12a) in correspondence with at least a work unit (14) of

said machine (11).

11. Method as in claim 10, **characterized in that** said second step comprises at least a sub-step in which a binding unit (30) facilitates the association between said clean strips (12a) and said conveyor means (23). 5
12. Method as in claim 10, **characterized in that** said second step comprises at least a sub-step in which lifting means (24, 26) lift said conveyor means (23, 25) to facilitate the association and conveyance of said clean strips (12a). 10
13. Textile machine comprising at least a device (10) to identify and eliminate impurities (27) from strips (12) of textile fibers as in any claim from 1 to 6. 15
14. Textile machine as in claim 13, **characterized in that** it comprises conveyor means (23, 25) able to guide and support clean strips (12a) arriving from said device (10) in order to convey said clean strips (12a) in correspondence with at least a work unit (14) of said machine (11) in which said conveyor means comprise a strip (23) of textile fiber without impurities with which said clean strips (12a) are able to be associated. 20 25
15. Textile machine as in claim 14, **characterized in that** said conveyor means comprise at least a pair of belt means (25) superimposed one on the other, between which said clean strips (12a) are able to be disposed. 30
16. Textile machine as in any claim from 13 to 15, **characterized in that** it comprises lifting means (24, 26) to lift said conveyor means (23, 25), able to facilitate the association and conveyance of said clean strips (12a). 35

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 0493

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Place of search Munich		Date of completion of the search 19 November 2009	Examiner Dreyer, Claude
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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