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(54) Yarn tensioner

(57) In a yarn tensioner T comprising a series of rigid yarn deflecting elements 1 commonly defining a yarn path P, the yarn deflecting elements being distributed with interspaces in-between on both opposite sides of the yarn path such that a respective yarn deflecting element is located at one side with an offset in yarn run direction D relative to a yarn deflecting element 1 located at the opposite side, at least one yarn deflecting element 2a, 2b being adjustable substantially perpendicularly to the yarn path in order to vary the tensioning effect in an operative condition of the yarn tensioner, the yarn path P is lined between the yarn deflecting elements 1, 2 by at least one thin walled flexible spring leaf 8a, 8b per side of the yarn path P, the spring leaves being biased towards each other by the deflecting elements, such that one respective spring leaf 8a, 8b is supported at one location of the yarn path P at a deflecting element while the other respective and parallelly arranged spring leaf is free at the same location of yield perpendicularly to the yarn run direction D away from the one spring leaf, the spring leaf 8a, 8b being markedly longer in yarn run direction D than the distance occupied by the series of yarn deflecting elements 1, 2 with the longitudinal free end of the spring leaves being distant in yarn run direction from the respective first yarn deflecting element.

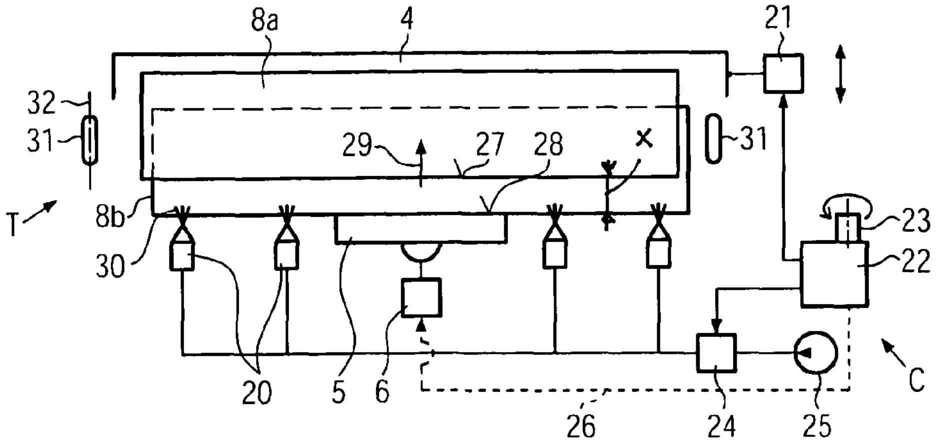

FIG. 4

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Description

[0001] The invention relates to a yarn tensioner according to the preamble part of claim 1.

[0002] In the yarn tensioner known from US 5,738,295 A the yarn path is defined by four stationary rigid deflecting elements on one side of the yarn path and three rigid deflecting elements on the other side of the yarn path, such that the yarn path has a zigzag configuration. The three deflecting elements at the other side of the yarn path commonly are adjustable perpendicular to the yarn run direction in order to vary the tensioning effect by changing the deflection angles around the deflecting elements. The running yarn exclusively is braked by friction force depending on the total angle of deflection and the friction coefficient between the yarn and the deflecting elements. The yarn tensioner has to generate a tension in the yarn which can be finely adjusted and which will be kept relatively constant at the set value. However, as soon as the running yarn contains a knot, a snarl or an irregularity, the yarn tension changes drastically seven times while the knot passes the yarn tensioner and jumps over the deflecting elements. This effect might cause a yarn breakage or results in a long time duration until the originally set yarn tension value can be regained.

[0003] EP 1 072 707 A discloses a similar yarn tensioner with seven deflecting elements in total and a linear motor for modulating the tensioning effect in order to achieve a predetermined variable tension course during an insertion cycle into a weaving machine. The tensioning effect depends on the wrapping angles of the yarn around the deflecting elements and varies with an exponential function of the magnitudes of the wrapping angles. This allows to achieve relatively high yarn tension as is needed for heavy yarn qualities like e.g. synthetic yarns or ribbons for producing airbag fabrics. However, a relatively high yarn tension with strong deflections of the yarn unavoidably results in drastic tension variations as soon as a knot, a snarl or an irregularity in the yarn passes the yarn tensioner. Then the yarn tensioner cannot regain the initial yarn tension setting rapidly enough, meaning that either a yarn breakage occurs or that the set yarn tension is lost for a long period of time.

[0004] US 5,363,883 A and US 4,641688 A each discloses a yarn tensioner commonly called leaf tensioner. The yarn tensioner has a pair of spring leaves each pivotally supported at an open inlet end of the yarn tensioner, both spring leaves being pressed resiliently against each other. The yarn runs straight through the leaf tensioner and is clamped between the spring leaves. However, as the resulting tensioning effect depends on the pressing force between the spring leaves and the friction coefficient only, the maximum yarn tension is relatively low and not sufficient for heavy yarn qualities. In case that, with a view to a maximum tensioning effect, the spring leafs are pressed against each other strongly, the yarn tensioner does not tolerate a passing knot, a snarl or an irregularity easily but tends to cause a yarn breakage as the hard impact of a knot cannot spread the spring leafs apart rapidly enough.

[0005] EP 0 622 485 A discloses a leaf tensioner having a pair of spring leaves which are bent such that their convex sides abut each other. Both longitudinal ends of each spring leaf are captured in a socket. In case of heavy yarn qualities needing a relatively high but constant yarn tension the spring leaves have to be pressed against each other very firmly, resulting in a tendency of the yarn tensioner to cause a yarn breakage upon occurrence of a knot, a snarl, or an irregularity in the yarn, because then the yarn tensioner does not yield.

[0006] US 2001/0022201 A discloses a yarn tensioner of a leaf tensioner type. Two spring leaves are pressed against each other with convexly bent clamping surfaces for the yarn passing the yarn tensioner. Although at least one longitudinal end of one spring leaf is free to flex, the yarn tensioner, in case of a setting for high tension, is unable to yield sufficiently easily in case of a passing knot.

[0007] EP 1 811 068 A discloses a yarn tensioner of a hybrid type operating with a flexible spring leaf fixed at both longitudinal ends and a rigid deflection element pressed with a flat braking surface against one side of the spring leaf. In case of a setting of the yarn tensioner for a strong tensioning effect the yarn tensioner is unable to yield upon passage of a knot.

[0008] EP 1 786 715 A, finally, discloses an e.g. controlled yarn tensioner either containing a pair of spring leaves which are locally pressed against each other or one spring leaf and a fixed stationary planar braking surface against which the spring leaf is pressed locally. In the embodiment having a pair of spring leaves a stationary spring leaf is loaded perpendicular to the yarn run direction by a spring while the opposite spring leaf is resting locally on a stationary stop. The yarn tensioner is designed, in particular, for heavy yarn qualities needing relatively high yarn tension when being processed, e.g. in weaving machines or other yarn processing machines, and additionally is designed to let pass unavoidable knots, snarls or regularities in the yarn, both without causing a yarn breakage and re-establishing the set yarn tension very rapidly after the passage of a knot. However, setting and gradually varying high yarn tension is a difficult task for this yarn tensioner type.

[0009] It is an object of the invention to provide a structurally simple yarn tensioner allowing to precisely set and gradually vary the tension in a running yarn, to tolerate the passage of a knot, a snarl or an irregularity in the yarn with minimum danger of a yarn breakage but at the same time to re-establish the set yarn tension very rapidly after the passage of a knot or like, and, in particular, to reliably process heavy yarn qualities in different types of machines like projectile weaving machines, rapier weaving machines and other yarn processing machines like spooling machines or winding machines even operating with relatively constant yarn speed. In other words, it is intended to provide a heavy duty yarn tensioner for heavy yarn qualities unavoidably containing occasional knots or the like, the yarn tensioner operating even with a setting for high yarn tension such that a knot passage occurs smoothly and with a relatively low tension peak caused by the knot passage.

[0010] This object is achieved by the features of claim 1.

[0011] The yarn tensioner is a combination of a deflection tensioner and leaf tensioner, meaning that the running yarn becomes deflected several times along the yarn path through the yarn tensioner and is clamped between spring leaves over a significant long extension of the yarn path. The yarn tensioner allows to build up a relatively high resulting yarn tension although the specific tensioning load on a length unit of the yarn in the yarn path of the yarn tensioner remains relatively low. In the case that a knot, a snarl, or a marked irregularity of the yarn is passing the yarn tensioner, the yarn tensioner is opened by the knot at the instant location of the knot only while the remaining part of the yarn tensioner is still tensioning the yarn. The resistance for pulling the knot through the yarn tensioner remains desirably low, i.e., the knot passage occurs relatively smoothly and with a low tension peak in the yarn only. The knot can displace either both leaves from each other except at the locations of the deflecting elements backing up the spring leaves, but also can displace one spring leaf away from the other at the locations of the deflecting elements. The resulting yarn tension depends on several deflections of the spring leaves plus the clamping friction along the long clamping zone between the spring leaves. As both longitudinal ends of the spring leaves extend relatively far beyond the respective first deflecting element of the series of deflecting elements, a knot more easily enters and leaves the yarn tensioner, because there it has to deform the spring leaves against their elasticity only, while the additional tensioning effect of the deflecting elements will come into action first later or has ceased already. This leads to a gradual rise and drop of the yarn tension when a knot is passing the yarn tensioner with minimum danger of a yarn breakage and the positive side effect that the yarn tension will never drop totally. As such, the yarn tensioner according to the invention is particularly suitable for processing heavy yarn qualities which need relatively high yarn tension. This may be, for example, synthetic yarns or ribbons for producing airbag fabric or e.g. a cotton yarn of the specification Ne16 running with a speed 500 m/min needing a maximum yarn tension of about 100 cN. Although an already perfect performance of the yarn tensioner can be achieved with one pair of spring leaves, in alternative embodiments more than one spring leaf could be provided per side of the yarn path, with the spring leaves having equal length or with each outer spring leaf being shorter than the innermost spring leaf at that side of the yarn path.

[0012] In a preferred embodiment the spring leaves at least in one of the inlet and outlet regions are left loose to facilitate flexing of portions of the spring leaves between the longitudinal free ends and the respective first deflection element towards and away from each other. This arrangement assures that a knot enters and leaves the yarn tensioner with a smooth rise and smooth drop of the yarn tension. Preferably, the portions of the spring leaves easily flex in the outlet region of the yarn tensioner while a knot is leaving the yarn tensioner and while the yarn remains tensioned along the remaining part of the yarn tensioner.

[0013] Preferably, the spring leaves are held against movement in yarn run direction relative to the yarn deflecting elements such that the spring leaves do not change their relative position in yarn run direction at the deflecting elements, not even during a knot passage. The yarn tensioner has, preferably, stationary holding elements co-acting with the longitudinal ends in the inlet region or the outlet region, more preferably, in the inlet region of the yarn tensioner. Finally, the spring leaves should form funnel-shaped upstream and downstream inlet and outlet regions for easy entry and exit of knots.

[0014] Although the deflecting elements can be distributed arbitrarily along the extension of the part of the yarn path occupied by the deflecting elements, the deflecting elements preferably are arranged alternatingly on both sides of the yarn path, preferably even regularly, such that both spring leaves are deformed into a regular serpentine-like configuration or wavy profile. In order to achieve relatively high and constant yarn tension by combining a clamping tensioning effect and a deflection tensioning effect, in a preferred embodiment, and in the operative condition of the yarn tensioner, the deflecting elements are deforming the spring leaves into a serpentine-line-shaped configuration. An arrangement of the deflecting elements such that they deform the spring leaves results in a relatively long clamping zone formed between both spring leaves, meaning that during a knot passage other parts of the yarn will still be clamped and tensioned while the knot only locally spreads apart the spring leaves.

[0015] In a preferred embodiment the series of deflecting elements comprises at least two deflecting elements at each side of the yarn path, preferably two at one side and three at the other side, all deflecting elements commonly supporting one pair of equally dimensioned spring leaves in-between them.

[0016] In order to achieve a "gentle" response behaviour in the inlet and outlet regions, in an alternative embodiment the distance in yarn run direction between the longitudinal free ends of the spring leaves and the respective first deflecting element is larger than the interspaces between the deflecting elements.

[0017] In a structurally simple embodiment the deflecting elements are arranged in sockets of tensioner base parts. In order to facilitate variation of the yarn tensioner performance it is even expedient that at least one tensioner base part has a number of sockets larger than the number of deflecting elements provided at that side of the yarn path, the sockets being distributed in the tensioner base part in yarn run direction either regularly or irregularly. The sockets allow to change the relative arrangement between the deflecting elements at both sides, to change the interspaces between the deflection elements, and/or to vary the number of deflecting elements per side of the yarn path, upon demand.

[0018] In an expedient embodiment at least one tensioner base part has mounts for stationarily mounting the longitudinal free ends of the spring leaves. The mounts, preferably, are situated at the inlet region of the yarn tensioner and are spaced apart perpendicular to the yarn run direction further than the deflecting elements at both sides of the yarn path. The mounts hold the spring leaves stationary in yarn run direction and relative to the deflecting elements such that the spring leaves may easily move on the deflecting elements during operation of the yarn tensioner. Furthermore, the mounts keep the longitudinal free ends of the spring leaves spread apart for easy entry of a knot into the yarn tensioner.

[0019] In another embodiment an elastic spring leaf damper may be arranged at least in the vicinity of the outlet region, preferably at one tensioner base part. The spring leaf damper may come into action with one spring leaf in order to suppress vibrations of the longitudinal free end of the spring leaf, particularly of the spring leaf which is supported on the respective second of the series of deflecting elements. The elastic spring leaf damper is an option but not necessary.

[0020] In order to set a tensioning effect either manually or motorised or even to vary the tensioning effect remotely controlled (active yarn tensioner, passive yarn tensioner, uncontrolled yarn tensioner, controlled yarn tensioner), one tensioner base part may be arranged adjustably substantially perpendicular to the yarn run direction in relation to the other tensioner base part. The adjustably arranged tensioner base part may be connected to a manual and/or motorised setting drive or setting mechanism.

[0021] In a structurally simple embodiment the series of deflecting elements may be defined by, preferably equally dimensioned, pins or tube sections each having a convex round spring leaf contact periphery. The convex round periphery may be at least partly cylindrical such that theoretically each deflecting element is only in line contact with the spring leaf along a line which extends crosswise to the longitudinal direction of the spring leaf. The deflecting element may be just snapped into the sockets or may be removably secured therein by fastening elements or may be glued in.

[0022] To facilitate easy cleaning of the yarn tensioner from unavoidably collected lint at at least one side of the yarn tensioner the spring leave longitudinal side edges may be laterally offset in relation to one another.

[0023] In another embodiment of particular importance the yarn tensioner may be equipped with a cleaning device comprising at least one blowing nozzle for pressurised air directed substantially parallel to the spring leaf contact area against longitudinal side edges of the spring leaves for blowing in cleaning air, particularly after first the deflecting elements on both sides of the yarn path have been moved away from each other to open the yarn tensioner.

[0024] Part of the cleaning device may be a displacement drive or displacement mechanism for moving one spring leaf or one tensioner base part with the spring leaf sidewardly in relation to the yarn run direction and in relation to the other spring leaf into a temporary cleaning position.

[0025] In the cleaning position the lateral offset between the spring leaves or the longitudinal side edges facilitates that air jets of the blowing nozzles impinging perpendicular to the yarn run direction on the longitudinal leaf edges spread the spring leaves apart, resulting in an efficient cleaning effect removing lint and other contamination immediately.

[0026] In view to an automatic cleaning operation of the yarn tensioner it might be expedient that the blowing nozzle and optionally the displacement drive, if provided, are connected with a cleaning control system, which, preferably, also is connected to the setting drive of the yarn tensioner for temporarily opening the yarn tensioner and displacing the spring leaves into the cleaning position for a cleaning cycle. Cleaning cycles, preferably, may be executed mainly while the yarn tensioner is not in operative condition, i.e. when the deflecting elements are spread apart to a certain extent.

[0027] Expediently, the spring leaves are made of metal or plastics and extend over more than 200 mm in yarn run direction. Compared to conventional yarn tensioners this means of course an extreme longitudinal extension of the yarn tensioner. However, normally there is sufficient space in yarn run direction to install such a long yarn tensioner.

[0028] As, in particular, with heavy yarn qualities and relatively high yarn tension settings mechanical wear on the spring leaves may become an issue, it may be advantageous to provide yarn eyelets upstream and/or downstream of the yarn tensioner, the yarn eyelets defining the yarn path during operation of the yarn tensioner. If those yarn eyelets are oval or oblong hole-like with a long oval main axis or hole main axis oriented substantially parallel to the contact plane between the spring leaves, the running yarn oscillates sidewardly in the yarn path which distributes wear evenly on the spring leaves.

[0029] Embodiments of the invention will be explained with the help of the drawing. In the drawing is:

Fig. 1 a schematic side view of a yarn tensioner, in particular for heavy yarn qualities,

Fig. 2 a detail illustration of the function of the yarn tensioner in the case of a knot passage,

Fig. 3 another part of the yarn tensioner in operation during a knot passage, and

Fig. 4 a schematic top view of another embodiment of the yarn tensioner having a pneumatic cleaning equipment, and in a cleaning position.

[0030] Fig. 1 illustrates schematically an embodiment of a yarn tensioner T, particularly designed for processing heavy yarn qualities. The yarn tensioner T is a sc-called heavy duty yarn tensioner intended for use e.g. in rapier weaving machines, projectile weaving machines, but also in other yarn processing machines e.g. operating with relatively constant yarn speed like winding machines or spooling machines, i.e. a yarn tensioner for applications where the running yarn needs relatively high yarn tension which remains as set relatively constant even in cases where unavoidably a knot, a snarl or a marked irregularity of the yarn passes the yarn tensioner T, and such that e.g. a knot passes smoothly without a harsh tension peak, without danger of a yarn breakage, and that the set yarn tension does not vary significantly during a knot passage and is regained immediately after the knot passage.

[0031] The yarn tensioner T in Fig. 1 is a combination of a deflection tensioner and a clamping or leaf tensioner and comprises a series of deflecting elements 1, 2 at both sides of a yarn path P of a yarn Y running in yarn run direction D. In the shown embodiment in total five deflecting elements 1, 2 are provided, namely three deflecting elements 1, 1 a to 1 c at one side and 2a, 2b at the other side of the yarn path P. The deflecting elements 1, 2 e.g. are cylindrical or have at least convexly rounded contact peripheries with a generatrice extending perpendicular to the yarn run direction D. The yarn path P is lined in the yarn tensioner T at both sides by a pair of planar, substantially parallel and flexible thin-walled spring leaves 8a, 8b. The spring leaves 8a, 8b may have equal dimensions or different widths in width direction perpendicular to the yarn run direction D, such that even in operative condition of the yarn tensioner T longitudinal side edges (27, 28 in Fig. 4) of the spring leaves 8a, 8b are positioned at least at one side with a lateral offset between the longitudinal spring leave edges 27, 28 (Fig. 4). In the case of equal widths of the spring leaves (8a, 8b) the spring leaves (8a, 8b) and/or even the base parts 4, 5 could be positioned with a lateral offset.

[0032] In operative condition, e.g. indicated in Fig. 1, the deflecting elements 1, 2 are arranged such at both sides of the yarn path P and in relation to each other that the spring leaves 8a, 8b are deformed into a serpentine-like configuration. The deflecting elements 1 may be distributed regularly with interspaces in-between. The deflecting elements 2a, 2b are arranged with an interspace in-between and such that each is located about midway in the interspace of the deflecting elements 1 a to 1c. Each deflecting element 1, 2 may be mounted in a socket 3 of one tensioner base part 4, 5. The tensioner base part 4, 5 may have a larger number of regularly or irregularly distributed sockets 3 than the number of actually mounted deflecting elements 1, 2, allowing to change the position and interspacings of and between the deflecting elements in order to vary the tensioning performance of the yarn tensioner. As a minimum, there may be provided two deflecting elements 1 at one side and only a single deflecting element 2 at the other side of the yarn path P, or there may be provided more deflecting elements than shown and in another arrangement as shown. The tensioner base part 4 may be arranged stationarily and fixed to a setting drive 6. The tensioner base part 5 may be connected with the setting drive 6 such that it is movable substantially perpendicular to the yarn run direction D in the directions of a double arrow 5a, in order to vary the tensioning effect, by both the serpentine-like configuration of and the contact pressure between the spring leaves 8a, 8b. The setting drive 6 may be a manually actuated setting drive mechanism for setting and varying a permanent tensioning value. The setting can also be executed by a motorised setting drive 6. Finally, in an actively controlled version of the yarn tensioner T the tensioning performance can be varied remotely controlled upon demand e.g. during an insertion cycle into a weaving machine in order to achieve a certain tension course during the insertion cycle, as is conventional in the case of projectile weaving machines or rapier weaving machines. In case of an electric setting drive 6, the setting drive 6 may be connected via cables 7 to a control unit (not shown).

[0033] The spring leaves 8a, 8b e.g. have equal dimensions, as mentioned above, and may be rectangular strips from spring steel or plastic material, and may thus have a longitudinal extension L longer than their width. The longitudinal extension L may amount to more than 200 mm in yarn run direction D. Although Fig. illustrates only a pair of spring leaves 8a, 8b, there may be provided instead more than two spring leaves, i.e. more than one spring leaf 8a, 8b per each side of the yarn path P. In the latter case the respective spring leaf placed at a respective outer side may be as long as the respective innermost spring leaf or even may be shorter. Even spring leaves 8a, 8b of differing widths may be combined.

[0034] In the embodiment in Fig. 1 the longitudinal extension L of the spring leaves 8a, 8b is markedly longer than the length occupied by the series of deflecting elements 1, 2. Longitudinal free ends 11, 13 of the spring leaves 8a, 8b are bent outwardly in order to form funnel-shaped upstream and downstream inlet and outlet regions 9, 14. The spring leaves 8a, 8b are secured stationary in yarn run direction D, e.g. on mounts 10, 12 of the tensioner base part 4, preferably at the inlet region 9, while the longitudinal free ends 13 in the outlet region 14 are left free to flex away from and towards each other. Unsupported portions 17 of the spring leaves 8a, 8b, between the longitudinal free ends 11, 13 and the respective first deflecting element 1 a, 1 c are longer in yarn run direction D than the interspaces between the deflecting elements or, alternatively, are almost as long as the interspaces. Optionally, there may be provided a spring leaf damper 18 adjacent to the longitudinal free end 13 of the spring leaf 8b which is first supported by the second deflecting element 2a, in order to suppress oscillations or vibrations of the longitudinal free end 13 of the lower spring 8b in the outlet region, e.g. during a knot passage.

[0035] The yarn path P of the yarn Y in the yarn tensioner, additionally, may be defined by yarn eyelets 31 placed upstream and/or downstream. In a preferred embodiment those yarn eyelets 31 (Fig. 4) may be oval or oblong hole-shaped with an oval main axis or hole main axis 32 extending parallel to the contact plane between both spring leaves 8a, 8b, that the running yarn Y oscillates laterally and distributes wear laterally over the spring leaves 8a, 8b.

[0036] The deflecting elements 1, 2 may be mainly cylindrical pins or tube sections made from metal and/or plastic material, or are fixedly provided at or even integrated in the tensioner base parts 4, 5.

[0037] Fig. 2 indicates an operation condition of the yarn tensioner of Fig. 1 during a passage of a knot K contained in the yarn Y running in run direction D. When the knot K enters the inlet region 9 it easily spreads apart the unsupported portions of the spring leaves 8a, 8b until it reaches the location of the respective first deflecting element 1c. In this location the spring leaf 8a is backed-up by the deflecting element 1c. The knot K, however, then yieldably displaces the other spring leaf 8b in the direction of the arrow 15 so that the knot K easily and smoothly passes the deflecting element 1 c without a drastic tension peak. At the same time, the remaining part of the yarn Y is tensioned upstream and downstream of the location at the knot K between the spring leaves 8a, 8b which are pressed against each other by the deflecting elements 1, 2, and is also tensioned at the deflections at the other deflecting elements. As soon as the knot K will then reach the location of the next deflecting element 2b, the knot K will yieldably displace the upper spring leaf 8a in the direction of the dotted arrow 16, with the same positive effects as mentioned above.

[0038] Fig. 3 illustrates an operation phase of the yarn tensioner of Figs 1 and 2 when a knot K is on the way to leave the yarn tensioner T. The knot K has already passed the last deflecting element 1a and now spreads apart both spring leaves 8a, 8b in the portions 17 before the knot K easily will leave the yarn tensioner through the outlet region 13. Downstream of the current location of the knot K the yarn Y will remain tensioned by the clamping effect of the spring leaves 8a, 8b and the deflections around the deflecting elements 1, 2. In this final phase of a knot passage the spring leaf damper 18, which may be a pin having a rubber coating, may come into action in order to suppress undesired oscillations of the longitudinal free end 13 of the lower spring leaf 8b. The leaf spring damper 18, however, is an optional equipment of the yarn tensioner only.

[0039] Fig. 4 illustrates the yarn tensioner T in a further embodiment where the yarn tensioner T is equipped with a cleaning device C for removing collected lint and other contamination, e.g. while the yarn tensioner is in a non-operative condition, i.e., when the deflecting elements 1, 2 have been moved away from each other by means of the setting drive 6 or another yarn tensioner opening mechanism (not shown).

[0040] The cleaning device C has at least one blowing nozzle 20 positioned, at least during a cleaning cycle, close to longitudinal side edges 27, 28 of the spring leaves 8a, 8b with blowing directions of jets 30 of pressurised air substantially parallel to the contact plane between both spring leaves 8a, 8b and against the longitudinal edges 27, 28. Blowing nozzles 20 may even be placed at both longitudinal sides of the spring leaves 8a, 8b. The blowing direction may be even be somewhat oblique in relation to the run direction D. A displacement drive 21 as part of the cleaning device C may be used to sidewardly displace e.g. the upper spring leaf 8a in relation to the lower spring leaf 8b such that the longitudinal edges 27, 28 are laterally offset in relation to each other while the blowing nozzles 20 blow. The displacing movement of the e.g. upper spring leaf 8a is indicated by an arrow 29.

[0041] Alternatively, as mentioned above, the longitudinal spring leaf side edges 27, 28 may be laterally offset (measure X) also in the operative condition of the yarn tensioner T.

[0042] The offset facilitates that the jets 30 efficiently spread apart the spring leaves 8a, 8b and remove lint and other debris. There may be provided a cleaning control 22, e.g. with an actuator 23 for initiating a cleaning cycle (or a pre-programmed cleaning control system 22 for regularly or upon demand carrying out cleaning cycles). The blowing nozzles 20 may be connected to a valve mechanism 24 and a pressure source 25 for pressurised air. The valve mechanism 24 may be connected, as well as the displacement drive 21, if provided, to the cleaning control system 22 which, preferably, also could be connected (line 26) with the setting drive 6 such that for a cleaning cycle first the yarn tensioner T is opened by use of the setting drive 6, before or while the displacement drive 21 displaces the spring leaves 8a, 8b laterally in relation to each other and before or while the valve mechanism 24 supplies the blowing nozzles 20 with pressurised air. The cleaning device C, with or without a displacement drive 21, however, is an optional equipment of the yarn tensioner T. When the edges 27, 28 permanently are laterally offset to one another, cleaning as well may be possible by use of a handheld air nozzloe.

[0043] As an example, if a cotton yarn of the specification Ne16 is processed by the yarn tensioner T, a high yarn tension of about 100 cN is set, which also has to be kept substantially constant for a yarn speed up to about 500 m/min. The set yarn tension will also be maintained substantially constant during a knot passage. Even the set yarn tension is relatively high, the mechanical tensioning load on the yarn Y per length unit remains relatively moderate, as the yarn tensioner T is acting on the yarn over an extremely long distance and by combined clamping and deflecting effects.

Claims

1. Yarn tensioner (T) for a running yarn (Y), in particular of a robust, heavy yarn quality, comprising a series of at least three rigid yarn deflecting elements (1, 2), commonly defining a yarn path (P) through the yarn tensioner (T), the yarn deflecting elements being distributed in yarn run direction (D) with interspaces inbetween and on both opposites sides of the yarn path (P) such that a respective yarn deflecting element is located at one side with an offset in yarn run direction (T) relative to an adjacent yarn deflecting element located at the opposite side of the yarn path (P), at least one yarn deflecting element being adjustable in manual and/or motorised fashion substantially perpendicularly to the yarn path relative to another located at the opposite side of the yarn path in order to vary the tensioning effect in an operative condition of the yarn tensioner, **characterised in that** the yarn path (P) is lined between the yarn deflecting elements (1) by at least one pair of thin walled flexible, planar and parallel spring leaves (8a, 8b), that the spring leaves (8a, 8b) are biased towards each other by the deflecting element (1) such that one respective spring leaf (8a) is supported at one location of the yarn path (P) at a deflection element (1) while the other spring leaf (8b) is free at the same location to yield substantially perpendicularly to the yarn run direction (D) and away from the one spring leaf, and that the spring leaves (8a, 8b) are markedly longer in yarn run direction (D) than the distance occupied by the series of yarn deflecting elements (1, 2) with longitudinal free ends (11, 13) of the spring leaves (8a, 8b) being distant in yarn run direction (D) from the respective first yarn deflecting element (1 a, 1 c) of the series of yarn deflecting elements (1,2).

2. Yarn tensioner according to claim 1, **characterised in that** the spring leaves (8a, 8b) at least in one of an inlet and an outlet region (9, 14) are left loose to facilitate flexing of portions (17) of the spring leaves (8a, 8b) towards and away from each other, the portions (17) extending between the longitudinal free ends (11, 13) and the respective first deflecting element (1 a) of the series of deflecting elements (1, 2).

3. Yarn tensioner according to claim 1, **characterised in that** the spring leaves (8a, 8b) are held against movements in yarn run direction (D) relative to the series of yarn deflecting elements (1), preferably by stationary mounts co-acting with the longitudinal free ends at the inlet region (9) of the yarn tensioner (T).

4. Yarn tensioner according to claim 1, **characterised in that** the deflecting elements (1, 2) are alternatingly arranged at both sides of the yarn path (P), preferably in regular fashion.

5. Yarn tensioner according to claim 1, **characterised in that** in the operative condition of the yarn tensioner (T) the deflecting elements (1) deform the spring leaves (8a, 8b) into a serpentine-lined shaped configuration.

6. Yarn tensioner according to claim 1, **characterised in that** the series of deflecting elements (1) comprises at least two deflecting elements (1 a to 1 c, 2a, 2b) at each side of the yarn path (P), preferably two at one side and three at the other side for supporting one pair of substantially equally sized spring leaves (8a, 8b) lining the yarn path (P) at the inner side of the yarn deflecting elements.

7. Yarn tensioner according to claim 1, **characterised in that** in yarn run direction (D) the distance between the longitudinal free ends (13, 11) of the spring leaves (8a, 8b) and the respective first deflecting element (1 a, 1 c) is larger than the interspaces between the deflecting elements (1, 2).

8. Yarn tensioner according to at least one of the preceding claims, **characterised in that** the deflecting elements (1, 2) respectively are arranged in sockets (3) of two tensioner base parts (4, 5), and that at least one tensioner base part (4, 5) has a number of sockets (3) larger than the number of deflecting elements (1, 2) provided at the respective side of the yarn path (P), the sockets (3) being distributed in yarn run direction (D) regularly or irregularly in the tensioner base part (4, 5).

9. Yarn tensioner according to claim 8, **characterised in that** at least one tensioner base part (4) has the mounts (10, 12) for stationarily mounting the respective longitudinal free end (11) of one of the spring leaves (8a, 8b), preferably at the inlet region (9), the mounts being further spaced apart perpendicular to the yarn path (P) than the deflecting elements (1, 2) are at both sides of the yarn path (P).

10. Yarn tensioner according to at least one of the preceding claims, **characterised in that** an elastic spring leaf damper (18) is arranged in the outlet region (14) in functional co-operation with at least one spring leaf (8b), the spring leaf damper (18), preferably, being arranged at one tensioner base part (4).

11. Yarn tensioner according to claim 8, **characterised in that** one tensioner base part (5) is arranged adjustably substantially perpendicularly to the yarn run direction (D) in relation to the other tensioner base part (4), and that the one tensioner base part (5) is connected to a manual and/or motorised setting drive (6).

12. Yarn tensioner according to at least one of the pre-

ceding claims, **characterised in that** the series of deflecting elements (1) is defined by, preferably equally dimensioned, pins or tube sections each having a convex, round spring leaf contact periphery.

13. Yarn tensioner according to claim 1, **characterised in that** the spring leaves (8a, 8b) are formed with different widths in a width direction perpendicular to the yarn run direction (D) or are formed with essentially equal widths but are arranged with a relative offset in relation to each other in a width direction perpendicular to the yarn run direction (D), respectively, such that in an operative condition of the yarn tensioner (T) at least at one side of the yarn tensioner (T) longitudinal side edges (27, 28) of the spring leaves (8a, 8b) are laterally offset in relation to one another.

14. Yarn tensioner according to at lest one of claims 1 to 12, **characterised in that** at least one spring leaf (8a) or one tensioner base part (4) is arranged such that it at least partly can be displaced sidewardly into a cleaning position and in relation to the yarn run direction (D) to form a lateral offset between longitudinal side edges (27, 28) of the spring leaves (8a, 8b), preferably manually or by a displacement drive (21) being part of the cleaning device (C).

15. Yarn tensioner according to claim 13 or 14, **characterised in that** the yarn tensioner (T) is equipped with a cleaning device C) comprising at least one blowing nozzle (20) aiming substantially parallel to the spring leaves (8a, 8b) against the laterally offset longitudinal side edges (27, 28) of the spring leaves (8a, 8b).

16. Yarn tensioner according to claim 15, **characterised in that** at least the blowing nozzle (20) is connected with a cleaning control system (22), which cleaning control system (22), preferably, is also connected with the setting drive (6) of the yarn tensioner (T) for temporarily opening the yarn tensioner during a cleaning cycle.

17. Yarn tensioner according to claim 1, **characterised in that** the spring leaves (8a, 8b) are made of metal and/or plastics and extend over more than 200 mm in yarn run direction (D).

18. Yarn tensioner according to at least one of the preceding claims, **characterised in that** at least one oval or oblong hole-shaped yarn eyelet (31) is arranged upstream and/or downstream of the yarn tensioner (T), with a long oval or hole main axis (32) oriented substantially parallel to the contact area between the spring leaves (8a, 8b).

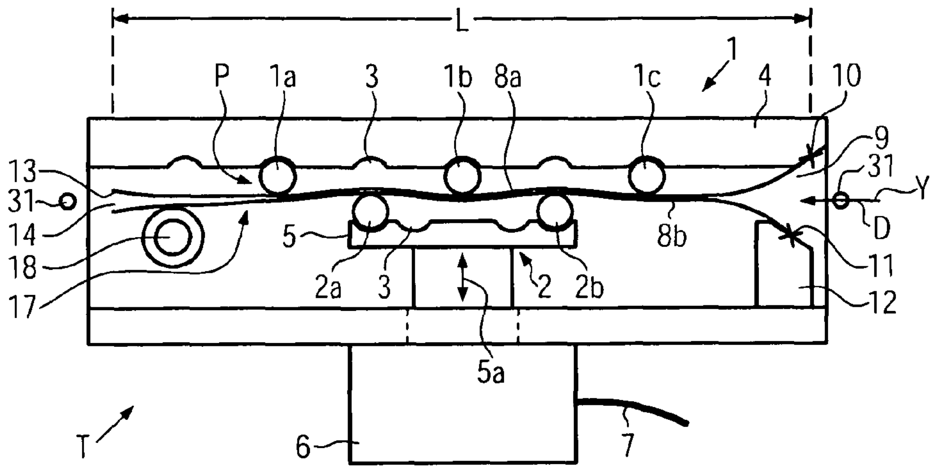

FIG. 1

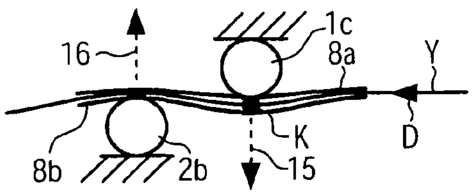

FIG. 2

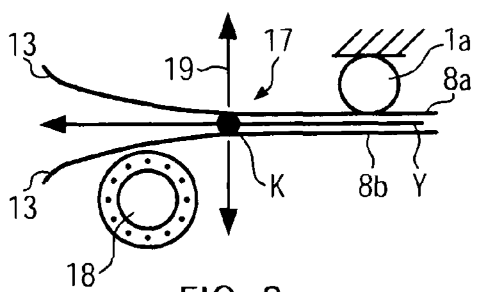

FIG. 3

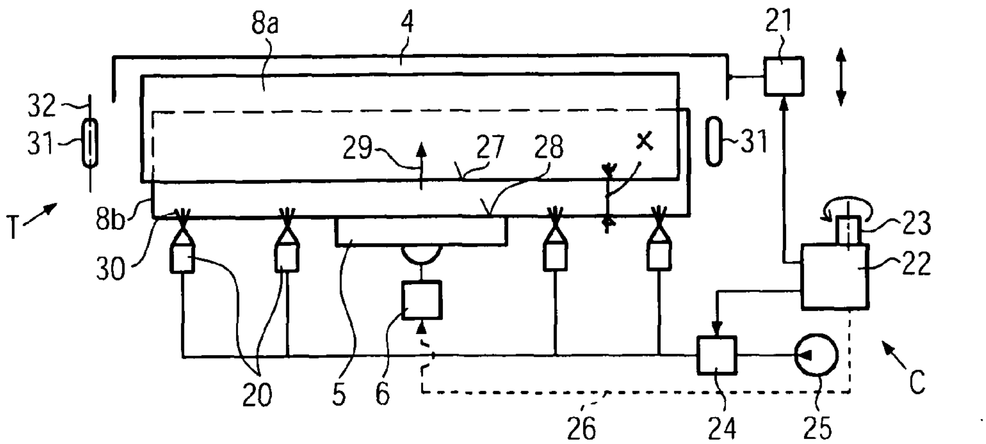

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 00 0995

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Place of search	Date of completion of the search	Examiner
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