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(54) **DEVICE AND METHOD FOR PRODUCING KNITTED FABRIC**

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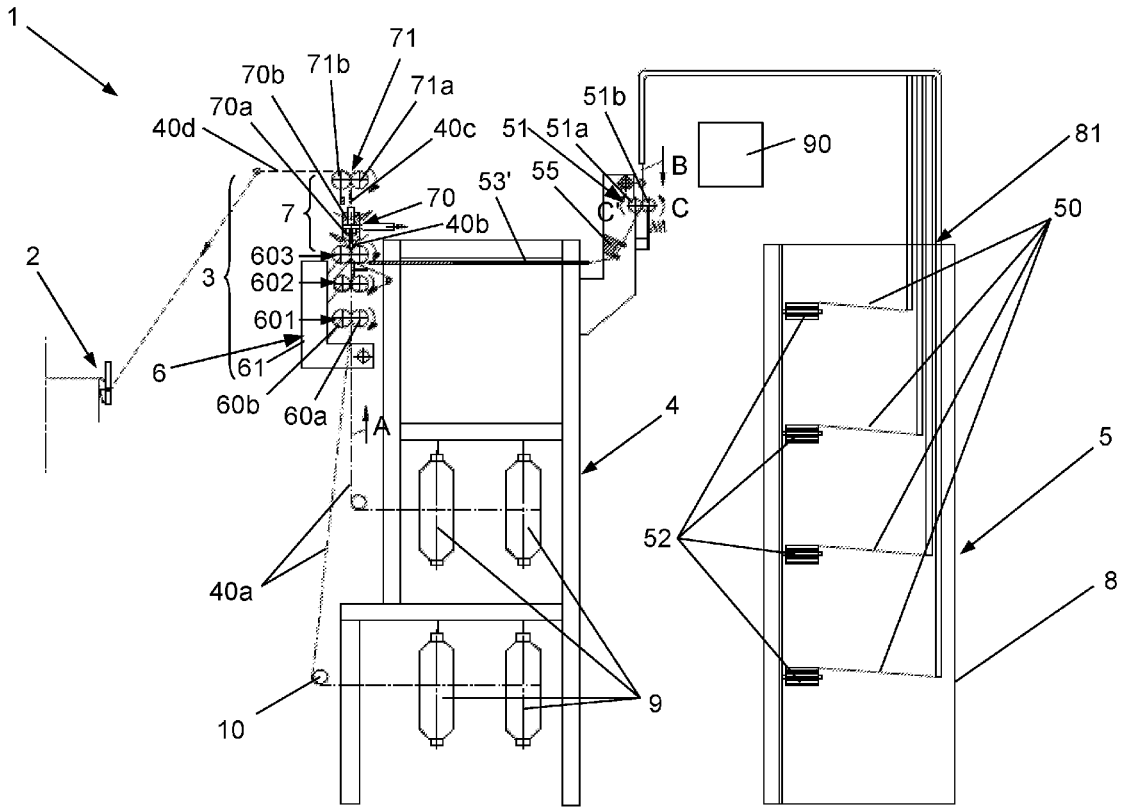
(57) **ABSTRACT**

Knitted fabric is produced with a knitting machine and a roving drawing and strengthening unit. A roving supply unit provides a roving and an auxiliary thread supply unit provides an auxiliary thread. A stretching unit receives the roving and the auxiliary thread. A spinning nozzle following the stretching unit in a roving conveying direction forms a fiber strengthening segment by applying compressed air and an end thread gripping roller pair rotatable in opposite directions provided downstream from the spinning nozzle device in the roving conveying direction delimiting the fiber strengthening segment. A soft knitted fabric is formed by guiding an auxiliary thread through an auxiliary thread gripping roller pair with an adjustable rotational speed before the roving and auxiliary thread enter the stretching unit. The gripping roller pair holds the auxiliary thread so that the auxiliary thread is subjected to tension of no more than 2 cN.



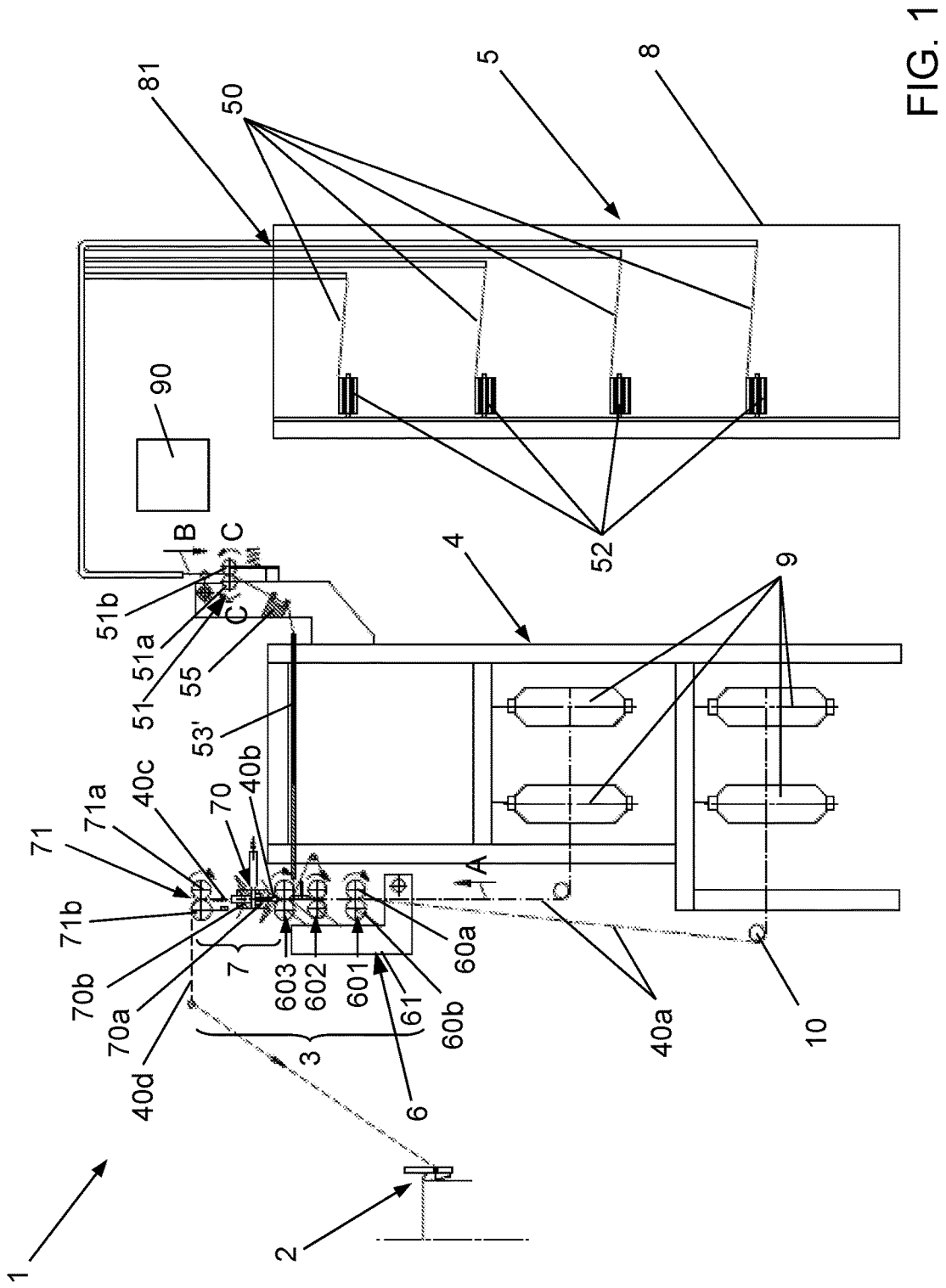

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FIG. 1

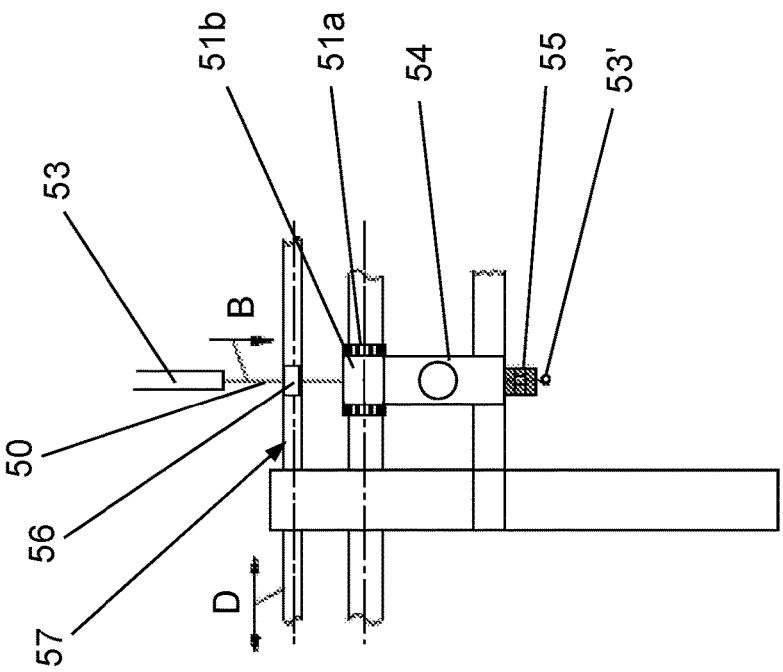

FIG. 3

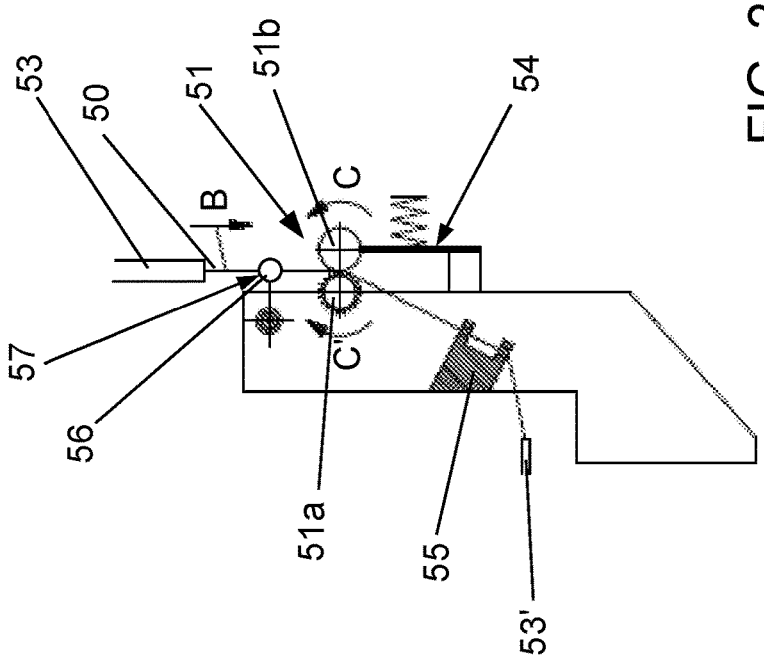

FIG. 2

DEVICE AND METHOD FOR PRODUCING KNITTED FABRIC

[0001] The present invention relates firstly to a device for producing knitted fabric with a knitting machine and a roving drawing and strengthening unit which comprises a roving supply unit with at least one roving, an auxiliary thread supply unit with at least one auxiliary thread, a stretching unit linked to the roving supply unit for supplying the roving and the auxiliary thread supply unit for supplying the auxiliary thread, a spinning nozzle provided downstream from the stretching unit in a roving conveying direction of the device forming a fiber strengthening segment by applying compressed air and an end thread gripping roller pair rotatable in opposite directions provided downstream from the spinning nozzle device in the roving conveying direction delimiting the fiber strengthening segment. The invention further relates to a method for producing knitted fabric, wherein at least one roving by means of a roving supply unit and at least one auxiliary thread by means of an auxiliary thread supply unit are supplied to a stretching unit, compressed air being applied to a drawn roving exiting the stretching unit comprising the auxiliary thread by a spinning nozzle device in a fiber strengthening segment, said roving being thus strengthened, wherein the fiber strengthening segment is delimited by an end thread gripping roller pair rotating in opposite directions through which the drawn, strengthened roving comprising the auxiliary thread is led in clamped fashion and an end thread exiting the end thread gripping roller pair is fed to a knitting machine.

[0002] In order to be able to produce knitted fabric, which is characterized by a particularly soft feel and fullness, various approaches are known from the prior art. It is proposed in particular not to use conventional, durably strengthened thread provided on bobbins for the production of knitted fabric, but instead to form an only temporarily strengthened thread bundle which is supplied directly to the knitting needles of a knitting machine by means of corresponding guiding tools and is there used for knitting knitted fabric.

[0003] Such a temporarily strengthened thread bundle is also referred to as false strand. A false strand is typically twisted in itself, whereby the twist is released by pulling on both ends of the false strand.

[0004] A device and method for producing such knitted fabric are suggested inter alia in the document WO 2009/043187 A1. In this document, a fiber assembly is drawn to a desired fineness in a stretching unit and is strengthened by means of pneumatically operating spinning nozzles in a section between the stretching unit and the knitting needles and is transported to knitting needles of a knitting machine. By means of the spinning nozzles, a permanently strengthened false strand is formed comprising a core of fibers that are primarily without twisting and mostly aligned parallel to each other and which are surrounded by overlapping, interlocked entwining fibers. Depending of the length of a transport section between the spinning nozzles and the knitting needles, the twisting of the entwining fibers can dissolve more or less. A final strengthening of the fiber assembly only takes place by means of the knitting needles within the manufactured knitted fabric. Due to this, it is mandatory to position the knitting needles of the knitting machine as close as possible to the spinning nozzles or to provide guiding tubes in case of longer transport distances between the spinning nozzles and the knitting needles in order to ensure a safe and interruption-free transport of the fiber assembly moderately strengthened by the spinning nozzles.

[0005] A similar approach for manufacturing soft knit fabrics without the detour of classical yarn manufacturing is disclosed in the document DE 10 2006 037714 A1. In this document, a drawn fiber assembly is produced in a stretching unit and is supplied to the knitting needles of a knitting machine by means of one or several swirl devices and at least one active transport element. Spinning tubes, each with a pneumatically operating swirl nozzle, are suggested as swirl devices, by which a false swirl is given to the drawn fiber assembly which dissolves again at the knitting point. A supplier comprising a roller pair can be used as an active transport element.

[0006] Problematic when manufacturing knitted fabrics by means of such drawn and only temporarily strengthened rovings is, that their strengthening can dissolve especially on longer transport distances between the swirl device and spinning nozzle device and the knitting needles of the knitting machine, whereby the production process is interrupted in an unwanted manner.

[0007] Another approach for manufacturing soft knitted fabric is disclosed in the document WO 2009/059438 A1. This document suggests the use of a roving treatment device comprising a dissolving device for dissolving the roving into single fibers and a friction spinning device formed as a friction spinning reel for processing the single fibers into a stable yarn of the desired fineness ready for transport. In the friction spinning reel, the individual fibers of the roving are twisted to a real, stable yarn ready for transport which is transported to a collector nozzle by means of a withdrawing roll pair and further to the knitting needles, which knit a knitted fabric out of it. By withdrawing the formed yarn in prolongation of the extension of the friction spinning reel, yarn breakages due to changes of direction are prevented.

[0008] The document DE 10 2011 053 396 B3 furthermore suggests a device according to type and a method according to type for increasing a drawn, strengthened roving supplied to a knitting machine, in which an auxiliary thread respectively core thread is supplied to a roving during its drawing in the stretching unit, whereby a so-called core-coat-yarn with a high stability is formed. The auxiliary thread applied to a supply spool, is picked up by means of an outlet roller pair of the stretching unit and bound into the drawn roving. In the document DE 10 2011 053 396 B3, the auxiliary thread is supplied to the stretching unit by means of a tube in order to enable a draw-free and thus unscathed supply of the auxiliary thread to the stretching unit.

[0009] In order to produce an even knitted fabric, it is necessary to not only supply the drawn, strengthened roving, but also used auxiliary threads with a constant thread tension to the production process. The thread tension of the roving can be easily adjusted by means of the rotation speed of the stretching unit rollers and the air pressure on the swirl nozzles or spinning nozzles. In order to be able to supply auxiliary threads or core threads with a constant thread tension to a stretching unit, thread supply devices in form of feeders are used in the auxiliary thread supply in the prior art. A feeder typically comprises a thread winding reel on which the thread coming from a supply reel can be wound up on. Thereby, the thread windings are wound up on a thread winding reel transversely to the actual thread conveying direction. The feeder is operated electrically by

means of a control device so that by correspondingly turning the feeder by means of the control device, if necessary, an excessive thread can be wound up or a thread supply stored in the feeder can be unrolled for supplying a knitting point with thread material.

[0010] However, due to its operating mode, a feeder has the disadvantage that the thread supplied by it, is continuously under a certain, not inconsiderable tension. In contrast, the insertion of the auxiliary thread, which is for example disclosed in the document DE 10 2011 053 396 B3, into the drawn roving works reliably only then, if the auxiliary thread supplied to the stretching unit comprises only a small thread tension, which cannot be realized or not permanently realized by means of a feeder.

[0011] The object of the present invention is therefore to further develop a device and a method of the initially mentioned type in such a way that soft knitted fabric can be reliably produced, using at least one auxiliary thread for forming the roving.

[0012] The object is firstly solved according to the invention by a device of the above-mentioned type, in which an auxiliary thread gripping roller pair rotatable in opposite directions, comprising an adjustable rotational speed is provided between the auxiliary thread supply unit and the stretching unit, between whose auxiliary thread gripping rollers the auxiliary thread is being led.

[0013] The auxiliary thread gripping roller pair forms a clamping lead through for the at least one auxiliary thread supplied by the auxiliary thread supply unit. By providing the auxiliary thread gripping roller pair comprising adjustable rotational speed between the auxiliary thread supply unit and the stretching unit, the auxiliary thread, which serves especially for increasing the stability of the end thread and for increasing the reliability of the process carried out on the device according to the invention, can be supplied to the stretching unit with differing tensions and can be bound into the drawn roving. Due to the adjustability of the rotational speed respectively the difference of the rotational speed between the auxiliary thread gripping rollers, the thread tension of the auxiliary thread can be adjusted extremely small compared to the thread tension which can be adjusted with known feeders. This has the advantage that the auxiliary thread running through the auxiliary thread gripping roller pair, supplied to the stretching unit is not tightly stretched but slightly lurches or flaps. Surprisingly, due to the flapping of the auxiliary thread, the fibers of the roving accumulate particularly well to the spinning nozzle device arranged successively to the stretching unit. As it turned out, the tension of the auxiliary thread actually has a vital impact in how many fibers of the roving wind themselves around the auxiliary thread. Corresponding to this, the softness of the yarn and thus the soft touch of the produced knitted fabric can be significantly influenced with the device according to the invention by adjusting the rotation speed of the auxiliary thread gripping rollers of the auxiliary thread gripping roller pair and thus by adjusting the tension of the auxiliary thread with which it is supplied to the spinning nozzle device. The more stretched the auxiliary thread is, when being led through the spinning nozzle device and thus during the actual connection of the auxiliary thread and the roving, the less fibers of the roving can wind around the auxiliary thread and the harder the formed yarn and thus the subsequent knitted fabric become. In accordance with this, it is desired to supply the auxiliary thread with as little thread tension as possible to the roving stretched in the stretching unit.

[0014] In contrast to a feeder, the auxiliary thread passes through the clamping point between the auxiliary thread gripping roller pair and does not wrap itself around them. The rotation axis of the auxiliary thread gripping roller pair is aligned perpendicular to the auxiliary thread conveying direction. Due to this, the auxiliary thread is only clamped, wherein the clamping force can be precisely adjusted by means of the rotational speed of the auxiliary thread gripping roller pair.

[0015] The transport of the auxiliary thread via the auxiliary thread gripping roller pair holds the advantage that the auxiliary thread can be supplied to the stretching unit with a constant thread tension, which positively affects the evenness of the formation of the drawn, strengthened roving reinforced by the auxiliary thread and thus a knit fabric formed from this roving.

[0016] According to the invention, the auxiliary thread gripping roller pair comprises two auxiliary thread gripping rollers pressed to each other or pressable whose size, dimension, shape and condition can be chosen application-specific. One or both auxiliary thread gripping roller(s) can be driven with the device according to the invention. If only one of the auxiliary thread gripping rollers is driven, a rotation of n the non-driven auxiliary thread gripping roller is achieved by pressing it against the driven auxiliary thread gripping roller. If both auxiliary thread gripping rollers are driven, they can either be moved independently of each other or comprise connected or connectable drives.

[0017] The auxiliary thread gripping rollers can be permanently pressed against each other. However, it is also possible that the auxiliary thread gripping rollers do not permanently touch each other, but can be brought into positions that are spaced apart from each other so that an insertion of the auxiliary thread between the auxiliary thread gripping rollers is eased and repair and maintenance works on the other auxiliary thread gripping roller pair is simplified.

[0018] It has also turned out to be advantageous if the auxiliary thread gripping roller(s) is/are provided suchlike in the device according to the invention that it/they or at least its/their roller surface can be replaced. Hereby, the auxiliary thread gripping rollers can either be replaced by identical auxiliary thread gripping rollers or by auxiliary thread gripping rollers comprising different dimensions and/or different characteristics. Thus, the auxiliary thread gripping rollers can for example be adjusted ideally to the used material of the auxiliary thread and/or the auxiliary thread gripping rollers can be quickly and easily replaced by new ones in case of abrasion or damage.

[0019] In order to be able to gently supply the auxiliary thread to the roving even over long distances, in the desired quantity and with the desired tension, the device according to the invention can also comprise several, in conveying direction of the auxiliary thread successively arranged, spaced apart auxiliary thread gripping roller pairs. The number, form and arrangement of the individual auxiliary thread gripping roller pairs can hereby be chosen application-specific.

[0020] With the device according to the invention, it is generally possible to supply the auxiliary thread to the roving before traversing the stretching unit, during the

stretching process or directly after finishing the stretching process, that is, between the stretching unit and the spinning nozzle device.

[0021] Insofar the stretching unit is formed of individual roller pairs, successively arranged in conveying direction of the roving, which are preferably operated with a speed that is increasing in conveying direction, the auxiliary thread can be supplied to the roving between two successive, preferably between a penultimate and an outlet roller pair of the stretching unit. Preferably, the auxiliary thread can hereby be ideally received by the outlet roller pair and conveyed alongside the roving towards the spinning nozzle device. Furthermore, the rotation speed of the auxiliary thread gripping roller pair can be ideally bided to the rotation speed of the outlet roller pair. It has proven to be especially advantageous if the auxiliary thread coming from the back of the stretching unit is pulled off tangentially from the outlet gripping roller pair of the stretching unit. By supplying the auxiliary thread only during the main drawing, it traverses only through one clamping point on the stretching unit and can thus be bound into the roving draw-free and unscathed.

[0022] In the present invention, the auxiliary thread is supplied by means of a supply spool in an auxiliary thread supply unit which is preferably a spool rack. The auxiliary thread gripping roller pair to which the auxiliary thread is supplied, is preferably provided near the stretching unit, however, it can also be arranged on any other spot between the stretching unit and the auxiliary thread supply unit.

[0023] The auxiliary thread can be an inelastic thread or an elastic thread, wherein the arrangement and/or the number and/or the size of the at least one auxiliary thread gripping roller pair can vary depending on the elasticity of the auxiliary thread.

[0024] The roving to be drawn by the stretching unit is preferably provided on a so-called flyer spool in form of non-strengthened fiber assembly and is pulled off from it by means of the stretching unit. After the stretching of the roving in the stretching unit and the supply of the auxiliary thread, the drawn roving is strengthened to a drawn, strengthened roving by means of the spinning nozzle device provided downstream from the stretching unit in a roving conveying direction and is connected with the auxiliary thread. The auxiliary thread is thereby preferably bound approximately centric into the drawn, strengthened roving; however, it can also lie in a peripheral area of the drawn, strengthened roving.

[0025] Hereby, it is particularly preferable to form the device according to the invention in such a way that the spinning nozzle device comprises two successively arranged, pneumatically operating spinning nozzles in roving conveying direction with opposing rotation directions. The spinning nozzle device is thereby preferably comprised of two air vortex nozzles, whose generated air flows comprise opposing rotation directions. The spinning nozzle arranged as second in conveying direction, is preferably a swirl nozzle which creates a so-called false strand from the supplied fiber material including the auxiliary thread. The spinning nozzle arranged prior to the swirl nozzle, the injector nozzle, causes an untwisting of the fiber material due to the opposing rotation direction, whereby a bracing of the edge fibers ensues, which in turn are wound around the fiber core and the auxiliary thread due to the rotation generation of the swirl nozzle.

[0026] According to the invention, rotation intensity and/or pressure of the air exiting the spinning nozzles are independently adjustable, whereby the characteristics of the drawn, strengthened roving with the integrated auxiliary thread can be ideally influenced and the spinning speed of the spinning nozzles can be adjusted to the knitting speed of the knitting machine provided downstream from the roving drawing and strengthening unit.

[0027] In order to further enhance the strength of the drawn, strengthened roving in which the auxiliary thread is bound in and to prevent a disintegration of the drawn, strengthened roving with the bound in auxiliary thread during the transport to the knitting machine, the device according to the invention comprises an end thread gripping roller pair rotatable in opposite directions provided downstream from the spinning nozzle device in the roving conveying direction delimiting the fiber strengthening segment. The end thread gripping roller pair forms a clamping feedthrough for the drawn, strengthened roving exiting the spinning nozzle device comprising the auxiliary thread. Following the end thread gripping roller pair, a supply to the knitting machine is provided for the drawn, strengthened roving comprising the auxiliary thread.

[0028] The end thread gripping roller pair forms a clamping point for the drawn, strengthened roving comprising the auxiliary thread which delimits the fiber strengthening segment of the spinning nozzle device. The end thread gripping roller pair can thereby be arranged with a relatively small distance to the spinning nozzle device in the device according to the invention, whereas the distance of the end thread gripping roller pair to the knitting needles of the knitting machine can comprise a larger distance and thus a practical useful measure.

[0029] By means of the end thread gripping roller pair, a speed decoupling of the technical system of the roving drawing and the roving strengthening from the technical system of the thread supply of the knitting machine is enabled, wherein the clamping point formed by means of the end thread gripping roller pair blocks the formation of the false strand realized by the upstream spinning nozzle device. This means that the end thread gripping roller pair determines one end of the rotation generated by the spinning nozzle device and thus one end of the false strand, whereby the drawn, strengthened end thread comprising the auxiliary thread exiting the end thread gripping roller pair maintains its strength and a disintegration of the end thread can be prevented. Accordingly, transport ways of the end thread can be realized over relatively long distances.

[0030] The arrangement of the end thread gripping roller pair can happen application-specific. However, it has proven to be particularly suitable, if at least one of the two end thread gripping rollers is driven, wherein the second end thread gripping roller does not comprise a separate drive and is set in motion by pressing it against the driven end thread gripping roller.

[0031] In a particularly preferable embodiment of the device according to the invention, the rotational speed of at least one of the auxiliary thread gripping rollers is adjustable by means of a device control, with which the rotational speed of the stretching rollers of the stretching unit is adjustable as well. A shared device control enables a continuous and coordinated transport of the roving and the auxiliary thread through the device according to the invention and thus ensures a consistent product quality of the end

thread. Furthermore, the programming and controlling effort of the device according to the invention is reduced due to such a shared device control, wherein the costs of the device can be kept low.

[0032] With the device according to the invention, at least one of the two auxiliary thread gripping rollers is drivable, wherein the rotational speed of the at least one auxiliary thread gripping roller can be regulated and controlled by means of the device control according to the operation conditions. Hereby, the second auxiliary thread gripping roller of the auxiliary thread griping roller pair is preferably driven by pressing it against the driven auxiliary thread gripping roller, however, in alternative embodiments of the invention, it can also be driven by the device control, which also drives at least one other auxiliary thread gripping roller and the stretching rollers.

[0033] In further embodiments of the invention, also at least one roller of the end thread gripping roller pair can be driven speed-controlled by the device control apart from the auxiliary thread gripping roller pair and the stretching rollers, whereby the operating effort as well as the costs of the device according to the invention can be further reduced.

[0034] In another preferred embodiment of the device according to the invention, the auxiliary thread gripping rollers comprise a first, profiled auxiliary thread gripping roller and a second, rubberized auxiliary thread gripping roller, whereby the auxiliary thread can be reliably transported without slipping out of the auxiliary thread gripping roller pair or jamming or halting between the auxiliary thread gripping rollers.

[0035] It is especially preferable if an auxiliary thread oscillation device is provided in roving conveying direction of the device prior to the at least one auxiliary thread gripping roller pair through which a thread progression between the auxiliary thread gripping rollers that is temporally variable can be realized. Since the components of the device according to the invention, especially also the auxiliary thread gripping rollers, are exposed to high strain during the roving processing due to the high production speeds, the efficiency of the device can be increased by means of such an auxiliary thread oscillation device. By means of the auxiliary thread oscillation device it can hereby be ensured that the auxiliary thread does not constantly come into contact with the same contact surface on the auxiliary thread gripping rollers. A shrinkage of the used auxiliary thread gripping rollers can thus be prevented. Preferably, a defined oscillation path is provided for this purpose in order to ensure a safe guidance of the auxiliary thread. The oscillation path should especially be chosen and adjusted depending on the axial length of the auxiliary thread gripping rollers.

[0036] In order to ensure that the auxiliary thread is supplied to the stretching unit and not to increase the thread tension set by the auxiliary thread gripping roller pair, at least one optical thread sensor is provided downstream from the auxiliary thread gripping roller pair in auxiliary thread conveying direction in an appropriate embodiment of the device according to the invention, through which the auxiliary thread can be optically recorded.

[0037] In a preferable embodiment example of the present invention, the auxiliary thread supply unit comprises a closed housing with an opening for exiting the auxiliary thread. The housing protects especially the auxiliary thread, the spool carrying the auxiliary thread and elements of the auxiliary thread supply unit necessary for auxiliary thread conveying from fiber fly, which is especially generated through the processing of the roving in the stretching unit and the spinning nozzle device. The housing thus ensures a safe process flow. The constructive form and material selection of the housing can be chosen application-specific.

[0038] The object of the present invention is furthermore solved by means of a method of the above-mentioned type in which the auxiliary thread is led between the auxiliary thread supply unit and the stretching unit through a rotational speed-variable auxiliary thread gripping roller pair rotatable in opposite directions.

[0039] The method according to the invention enables a particularly preferable integration of the at least one auxiliary thread into the roving, in order to be able to generate an end thread, which on the one hand serves for forming a knit fabric with a very soft feel and is on the other hand very strong itself.

[0040] With the method according to the invention the auxiliary thread increasing the strength of the end thread is led between the at least one rotational speed-variable auxiliary thread gripping roller pairs rotatable in opposite directions towards the stretching unit. Especially by adjusting the rotational speed of at least one of the auxiliary thread gripping rollers, the speed and the tension of the auxiliary thread with which it is transported to the roving, can be controlled, whereby the characteristics of the end thread and the process conditions can be influenced. Furthermore, the auxiliary thread can be supplied to the stretching unit according to demand and with a constant thread tension by transporting the auxiliary thread from the auxiliary thread supply unit to the stretching unit by means of the auxiliary thread gripping roller pair, whereby a treated roving with constant quality is produced, which in turn leads to a constantly good knitting result on the knitting machine. By means of the used auxiliary thread gripping roller pair, a relatively small thread tension of the auxiliary thread supplied to the stretching unit can be generated, which is not possible in the dimension according to the invention when using a feeder. A tearing of the auxiliary thread for example due to the gravitation or too high tension can also be prevented due to the used auxiliary thread gripping roller pair.

[0041] The auxiliary thread gripping roller pair thus forms an auxiliary thread supply axis to the stretching unit, through which the tension of the supplied auxiliary thread respectively core thread is adjusted. The thread tension of the auxiliary thread is adjusted as small as possible by means of a suitable rotational speed setting of the auxiliary thread gripping rollers especially because the auxiliary thread does not stretch during the supply to the stretching unit and fibers of the roving accumulated around the auxiliary thread later do not compress during a "relaxing" of the auxiliary thread.

[0042] Thereby it is possible that the auxiliary thread is led by more than one auxiliary thread gripping roller pair on very long transport ways in order to be able to regulate the tension of the auxiliary thread better and to prevent a tearing of the auxiliary thread during the transport.

[0043] According to the invention, the auxiliary thread is for example removed from the auxiliary thread supply unit by means of a spool and is supplied to the roving drawn in the stretching unit. Herein, the auxiliary thread can be supplied to the roving before the stretching process, during the stretching process or directly after finishing the stretch-

ing process. Especially if the auxiliary thread is supplied to the roving only towards the end of the stretching process, it can be ensured that the auxiliary thread is supplied to the spinning process following the stretching process with the desired tension. Especially by means of the tension with which the auxiliary thread traverses the spinning process, the quality and softness of the end thread can be significantly influenced, since it is determined by the auxiliary thread tension, how many fibers of the roving entwine the auxiliary thread and how the fibers of the roving hold on the auxiliary thread. Thus, the auxiliary thread should comprise a thread tension as small as possible when traversing the spinning process in order to produce a soft end thread.

[0044] In a particularly preferable embodiment of the method according to the invention, two spinning nozzles of the spinning nozzle device strengthening the roving with the auxiliary thread, work pneumatic and apply compressed air to the drawn roving exiting the stretching unit with respectively opposing rotation directions. The tension condition of the drawn, strengthened roving is adjusted in the area between the spinning nozzle device and the in roving conveying direction succesively arranged end thread gripping roller pair by adjusting the rotation intensity and/or the pressure of the compressed air exiting the spinning nozzles of the spinning nozzle device. The quality and especially the strength of the drawn, strengthened end thread exiting the gripping roller pair comprising the auxiliary thread can thus be ideally adjusted, whereby a smooth process sequence can be ensured and a high-quality knitted fabric can be produced on the knitting machine.

[0045] According to the invention, a clamping of the end thread is provided downstream the strengthening process with the spinning nozzle device, with which the drawn, strengthened roving comprising the end thread is led clamped through the end thread gripping roller pair rotating in opposite directions and the end thread exiting the end thread gripping roller pair is supplied to the knitting machine. By clamping the roving comprising the auxiliary thread exiting the spinning nozzle device through the end thread gripping roller pair, the formation of the false strand caused by the spinning nozzle device is ended, whereby a subsequent twisting of the end thread can be prevented. Accordingly, the end thread can also be transported to the knitting needles of the knitting machine over long distances with a constant quality.

[0046] In order to ensure an effortless transport of the end thread to the knitting needles of the knitting machine, it has proven to be particularly preferable if at least one of the two end thread gripping rollers is driven. Herein the other, non-driven end thread gripping roller is preferably set in rotation by pressing it against the driven gripping roller. In alternative embodiments, however, also both end thread gripping rollers can be driven, wherein they are either driven independently of each other or driven coupled together.

[0047] It is particularly appropriate to form the method according to the invention in such a way that the rotational speed of the auxiliary thread gripping rollers of the auxiliary thread gripping roller pair is adjusted in such a way that a thread tension of the auxiliary thread exiting the auxiliary thread gripping roller pair is smaller than 2 cN. If the auxiliary thread is supplied to the spinning nozzle device, through which the entwining of the auxiliary thread with the fibers of the roving happens, with such a small tension, especially many fibers can entwine the auxiliary thread, whereby a very soft end thread and thus a knitted fabric that is very soft to the touch can be produced on the knitting machine.

[0048] In alternative embodiments of the method according to the invention, thread tensions larger than 2 cN when exiting the auxiliary thread from the auxiliary thread gripping roller pair can of course also be realized, wherein here, however, no such soft thread can be produced any more, since considerably less fibers of the roving entwine the auxiliary thread than is the case with a thread tension smaller than 2 cN. Preferably, the auxiliary thread is supplied to the stretching unit with a thread tension smaller than 2 cN, preferred with a thread tension less than 1 cN and particularly preferred with a thread tension less than 0.5 cN.

[0049] In a particularly suitable version of the method according to the invention, the auxiliary thread is supplied to the auxiliary thread gripping roller pair, oscillating in axis direction of the auxiliary thread gripping rollers, whereby a shrinkage of the auxiliary thread gripping rollers due to the constant contact that is happening under high strains between the auxiliary thread and the auxiliary thread gripping rollers can be prevented. It is especially preferable if the auxiliary thread can be oscillated over the entire axial length of the auxiliary thread gripping rollers, however, only so far that a secure course of the auxiliary thread over the auxiliary thread gripping rollers can be realized.

[0050] Furthermore, it has proven to be favorable for a safe auxiliary thread supply with a tension as small as possible, if the auxiliary thread tension between the auxiliary thread gripping roller pair and the stretching unit is optically recorded.

[0051] Preferred embodiments of the present invention, including their structure, function and advantages are explained in more detail in the following using figures, wherein

[0052] FIG. **1** schematically shows an embodiment of the device according to the invention in a side view;

[0053] FIG. **2** schematically shows auxiliary thread gripping roller pair of an embodiment of a device according to the invention in a side view; and

[0054] FIG. **3** schematically shows the auxiliary thread gripping roller pair of FIG. **2** in a frontal view.

[0055] FIG. **1** schematically shows an embodiment of the device **1** according to the invention in a side view. Except for the auxiliary thread supply, the shown device corresponds to the device which is described in the document DE 10 2011 053 396 B3 and to whose content it is herewith fully referred.

[0056] The device **1** comprises a roving drawing and strengthening unit **3** for treating a roving **40***a* under formation of an end thread **40***d*. The roving drawing and strengthening unit **3** is coupled with a knitting machine **2** for forming a knitted fabric from the end thread **40***d* on the knitting machine **2**. Despite the description end "thread" it should be noted that the end thread **40***d* is no conventional yarn, but a drawn, temporarily strengthened roving comprising at least one auxiliary thread **50**, as described in detail in the following.

[0057] The roving drawing and strengthening unit **3** comprises a roving supply unit **4** with at least one roving **40***a* and an auxiliary thread supply unit **5** with at least one auxiliary thread **50**.

[0058] The roving supply unit **4** supplies the non-strengthened roving **40***a* for the roving drawing and strengthening

unit **3**, which is provided on flyer spools **9** encompassed by the roving supply unit **4**. As FIG. **1** shows, the roving **40***a* is preferably supplied via a transportation shaft **10** to the roving drawing and strengthening unit **3** in a roving conveying direction A. In alternative embodiments of the device **1** according to the invention, the roving **40***a* can also be supplied to the roving drawing and strengthening unit **3** by means of several or without a transportation shaft **10** situated between the roving drawing and strengthening unit **3** and the roving supply unit **4**.

[0059] The roving drawing and strengthening unit **3** further comprises a stretching unit **6** and a spinning nozzle device **70** provided downstream from the stretching unit **6** in roving conveying direction A. The stretching unit **6** illustrated in FIG. **1** comprises stretching roller pairs **601**, **602**, **603** arranged successively in roving conveying direction A of the roving **40***a*, especially an inlet roller pair **601**, an intermediate roller pair **602** and an outlet roller pair **603**. In other embodiments of the device **1** according to the invention, the stretching unit **6** can also comprise more than one intermediate roller pair **602** or no intermediate roller pair **602** at all.

[0060] For drawing and thus for homogenizing the roving **40***a*, the roving **40***a* is led through between stretching rollers **60***a* and **60***b* of the individual stretching roller pairs **601**, **602**, **603**. By driving the stretching roller pairs **601**, **602**, **603** with varying speeds that are increasing in the roving conveying direction A, a drawing of the roving **40***a* to a drawn roving **40***b* is achieved. The stretching roller pairs **601**, **602**, **603** are therein driven with such speeds that the outlet roller pair **603** comprises a higher speed than the intermediate roller pair **602** and the intermediate roller pair **602** in turn comprises a higher speed than the inlet roller pair **601**. Thus a pre-drawing happens between the inlet roller pair **601** and the intermediate roller pair **602**, whereas a subsequent main drawing of the roving **40***a* is realized between the intermediate roller pair **602** and the outlet roller pair **603**.

[0061] For generating the drawing of the roving **40***a*, the roving **40***a* has to be transported in clamped fashion between the stretching rollers of the stretching roller pairs **601**, **602**, **603**. This happens preferably by pressing a non-driven stretching roller respectively upper roller **60***b* to a driven stretching roller respectively lower roller **60***a* respectively. For pressing the upper rollers **60***b* to the lower rollers **60***a*, the upper rollers **60***b* are connected to an L-shaped stretching unit pressure arm **61**. Accordingly, the non-driven stretching rollers **60***b* can be easily collectively pressed against the driven stretching rollers **60***a* or removed from them by swinging the stretching unit pressure arm **61**. The stretching unit pressure arm **61** can be moved mechanically, pneumatically or hydraulically.

[0062] In order to increase the strength of the drawn roving **40***b* and to increase the reliability of the process carried out on the device **1**, at least one auxiliary thread **50** is supplied according to the invention to the roving **40***a*. The auxiliary thread **50** is provided by means of an auxiliary thread supply unit **5** typically comprising several supply spools **52**.

[0063] In the shown embodiment, the auxiliary thread supply unit **5** comprises a housing **8**, which surrounds the supply spools **52** stocking the at least one auxiliary thread **50**. The housing **8** of the auxiliary thread supply **5** comprises at least one opening **81**, through which the auxiliary thread **50** can be supplied to at least one auxiliary thread gripping roller pair **51** provided downstream from the auxiliary thread supply unit **5** in an auxiliary thread conveying direction B of the auxiliary thread **50**. In alternative embodiments of the device **1** according to the invention, the housing **8** can also comprise several openings **81**, through which several auxiliary threads **50** can be led out of the housing without tangeling.

[0064] The auxiliary thread **50** removed from the spool **52** and led through the opening **81** of the housing **8** of the auxiliary thread supply unit **5**, is supplied carefully and with a desired thread tension to the drawn respectively partly drawn roving **40***b* by means of the auxiliary thread gripping roller pair **51**.

[0065] In the embodiment depicted in FIG. **1**, the supply of the auxiliary thread **50** to the drawn roving **40***b* happens during the drawing of the roving **40***a* in the stretching unit **6**. In the process, the auxiliary thread **50** is supplied particularly preferred between the intermediate roller pair **602** and the outlet roller pair **603** to the stretching unit **6** and thus the roving **40***b*. Preferably, the auxiliary thread **50** is hereby removed by the outlet roller pair **603** and is, along with the drawn respectively partly drawn roving **40***b*, conveyed towards a spinning nozzle device **70** provided downstream from the stretching unit in a roving conveying direction A. The rotation speed of the auxiliary thread gripping roller pair **51** can thus be adjusted ideally to the rotation speed of the outlet roller pair **603**.

[0066] In other, not shown embodiments of the device **1** according to the invention, the auxiliary thread **50** can be supplied to the not yet drawn roving **4***a* before traversing the stretching unit **6** or to the drawn roving **40***b* only after leaving the stretching unit **6**.

[0067] By adjusting the tension of the auxiliary thread **50** by means of the auxiliary thread gripping roller pair **51**, with which it is supplied to the stretching unit **6**, it is possible to significantly influence the softness of the produced end thread **40***d* and the thereof produced knitted fabric, since the thread tension of the auxiliary thread **50** is inter alia responsible for how many fibers of the drawn roving **40***b* entwine the auxiliary thread **50** and stick to it in and after the spinning nozzle device **70**. In the embodiment of FIG. **1**, the auxiliary thread **50** is supplied to the stretching unit **6** with a thread tension smaller than 2 cN, since especially many fibers of the drawn roving **40***b* wind themselves around the auxiliary thread **50** with such a small thread tension and a particularly high softness of the end thread **40***d* and thus also of the knitted fabric is generated.

[0068] Furthermore, a tearing of the auxiliary thread **50** and thus an unwanted process interruption can be prevented due to the transport of the auxiliary thread **50** with small tension by means of the auxiliary thread gripping roller pair **51**.

[0069] In the embodiment illustrated in FIG. **1**, the device according to the invention only comprises one auxiliary thread roller pair **51**, however, in further embodiments it can also comprise several auxiliary thread roller pairs **51** arranged successively in auxiliary thread conveying direction B. The use of several auxiliary thread gripping roller pairs **51** in a device **1** has proven to be preferable especially with long transport distances of the auxiliary thread **50** from the auxiliary thread supply unit **5** to the stretching unit **6**.

[0070] The drawn roving **40***a* exiting the stretching unit **6** is, alongside the at least one supplied auxiliary thread **50**, supplied to a spinning nozzle device **70** provided down-

stream from the stretching unit **6** in a roving conveying direction A. In the spinning nozzle device **70**, a rotation of the drawn roving **40***b* comprising the auxiliary thread **50** takes place by means of air jets exiting the spinning nozzle device **70** so that a formation of a so-called false strand ensues.

[0071] In the embodiment of FIG. **1**, the spinning nozzle device **70** comprises two air twirling nozzles **70***a*, **70***b* arranged successively in roving conveying direction A. The air flow generated in the two air twirling nozzles **70***a*, **70***b* comprise opposing rotation directions. The first air twirling nozzle **70***a* provided downstream from the stretching unit **6**, a so-called injector nozzle, causes an untwisting of fiber material of the drawn roving **40***b*, whereby the peripheral fibers on the drawn roving **40***b* spread apart. The spread apart peripheral fibers are wound around a fiber core of the roving **40***a* and/or the auxiliary thread **50** by means of a rotation generation of the second air twirling nozzle **70***b* provided downstream from the first air twirling nozzle **70***a*, a so-called swirl nozzle, whereby the false strand is formed. The rotation speeds of the air twirling nozzles **70***a*, **70***b* as well as an air flow generated by the respective air twirling nozzle **70***a*, **70***b* can be chosen depending on the knitting speed adjustable on the knitting machine **2** and a respective roving conveying speed. Furthermore, the distance of the spinning nozzle device **70** from the stretching unit **6** as well as the distance of the air twirling nozzles **70***a*, **70***b* to each other can be chosen application-specific.

[0072] The roving **40***b* drawn by the stretching unit **6**, comprising the at least one auxiliary thread **50** and strengthened in the spinning nozzle device **70** is removed by an end thread gripping roller pair **71** provided downstream from the spinning nozzle device **70** in transport direction A of the roving **40***a*. The end thread gripping roller pair **71** typically has a driven gripping roller **71***a* and a non-driven gripping roller **71***b* pressed against the driven gripping roller **71***a*. The end thread gripping roller pair **71** can also comprise two driven gripping rollers **71***a* pressed against each other in alternative embodiments of the device **1** according to the invention. The end thread gripping roller pair **71** enables a speed decoupling of the technical system of the roving drawing and strengthening unit **3** from the technical system of the thread supply to the knitting machine **2**. Furthermore, the clamping point realized by the end thread gripping roller pair **71** enables a diversion of the drawn, strengthened roving **40***c* exiting the end thread gripping roller pair **71** comprising the auxiliary thread **50** to the operational level of the knitting machine **2**.

[0073] FIG. **2** schematically shows an auxiliary thread gripping roller pair **51** in an embodiment of the device **1** according to the invention in a side view. The elements in FIG. **2** indicated with the same reference signs as in FIG. **1** correspond to those of FIG. **1**, which is why here it is being referred to the above description of these elements.

[0074] In the embodiment shown in FIG. **2**, the auxiliary thread **50** stored in the auxiliary thread supply unit **5** is supplied to the auxiliary thread gripping roller pair **51** by means of an auxiliary thread conveying tube **53**, whereby a destruction of the auxiliary thread **50** during the transport can be largely excluded. Form, position and dimensions of the auxiliary thread conveying tube **53** can hereby be chosen application-specific.

[0075] The auxiliary thread **50** exiting the auxiliary thread conveying the tube **53** is, before it is supplied to the auxiliary thread gripping roller pair **51** provided downstream in auxiliary conveying direction B, led through an auxiliary thread guiding device **56** arranged between the auxiliary thread conveying tubes **53** and the auxiliary thread gripping roller pair **51**. The auxiliary thread guiding device **56** is part of an auxiliary thread oscillation device **57** through which the auxiliary thread **50** is moved sideways back and forth vertically to the auxiliary thread transport direction B, causing that the auxiliary thread **50** does not constantly come into contact with the same contact surfaces of the auxiliary thread gripping rollers **51***a*, **51***b* of the auxiliary thread gripping roller pair **51**. A shrinkage of the used auxiliary gripping rollers **51***a*, **51***b* can thus be prevented.

[0076] The auxiliary thread gripping roller pair **51** preferably comprises, as shown in FIG. **2**, two opposing auxiliary thread gripping rollers **51***a*, **51***b* working in opposite directions, pressable against each other. In the shown embodiment, the first of the two auxiliary thread gripping rollers **51***a* is fixed in the device **1**, whereas the second auxiliary thread gripping roller **51***b* is provided in such a way in the device **1** according to the invention that it can be pressed against and detached from the fixedly placed first auxiliary thread gripping roller **51***a*. According to the embodiment of FIG. **2**, for example a spring activated pressing device **54** can be used for this purpose, with which the second auxiliary thread gripping roller **51***b* can be pressed against the first auxiliary thread gripping roller **51***a*. In alternative embodiments of the device **1** according to the invention, the pressure device **54** can, however, also be formed differently and can, apart from a mechanical operation, also be positioned hydraulically and pneumatically.

[0077] Size, dimensions, form and texture of the auxiliary thread gripping rollers **51***a*, **51***b* can be chosen application-specific. In the shown embodiment, the first auxiliary thread gripping roller is profiled and the second auxiliary thread gripping roller **51***b* is rubberized. Such a form of the auxiliary thread gripping rollers **51***a*, **51***b* prevents a slipping out of the auxiliary thread **50** from the space between the auxiliary thread gripping rollers **51***a*, **51***b* and furthermore enables a gentle transport of the auxiliary thread **50**. The second auxiliary thread gripping roller **51***b* can either be formed completely of rubber or only comprise a rubber coating. The profile and material of the profiled auxiliary thread gripping roller **51***a* can be chosen freely depending on the operation conditions of this auxiliary thread gripping roller **51***a*. Thus it is for example possible that the profiled auxiliary thread gripping roller **51***a* comprises a serrated pattern or grooves provided contrary to the auxiliary thread transport direction B.

[0078] In the embodiment shown in FIG. **2**, the first auxiliary thread gripping roller **51***a* is driven, wherein its rotation transmits to the non-driven second auxiliary thread gripping roller **51***b*. Accordingly, the auxiliary thread gripping rollers **51***a*, **51***b* execute opposing rotation movements C, C'. In further embodiments of the device **1** according to the invention, however, both auxiliary thread gripping rollers **51***a*, **51***b* can be driven, wherein they can either be driven independently of each other or linked to each other or can be linked to each other. What is important here is only that the two auxiliary thread gripping rollers **51***a*, **51***b* are driven with opposing rotation directions.

[0079] In the embodiment of FIG. **2**, a diversion device **55** is provided downstream the auxiliary thread gripping roller pair **51**, which guides the auxiliary thread **50** towards the

stretching unit **6**. The diversion device **55** prevents a too abrupt diversion and thus a damage of the auxiliary thread **50**, whereby the process safety of the device **1** according to the invention can be increased. The diversion device **55** is furthermore formed as an optical fiber sensor in the shown embodiment, which serves for guaranteeing the presence of the auxiliary thread **50** after the auxiliary thread gripping roller pair **51**. The detection of the auxiliary thread happens optically and not mechanically at this point in order not to increase the tension level of the thread tension of the auxiliary thread **50** again after the traversing of the auxiliary thread **50** through the auxiliary thread gripping roller pair **51**.

[0080] In the shown embodiment, the auxiliary thread **50** exiting the auxiliary thread gripping roller pair **51** and diverted by the diversion device **55** is thereupon transported to the stretching unit **6** or the spinning nozzle device **70** through another auxiliary thread conveying tube **53'**, whereby a particularly gentle and process-stable transport of the auxiliary thread **50** is enabled.

[0081] FIG. **3** schematically shows the auxiliary thread gripping roller pair **51** depicted in FIG. **2** in a frontal view, wherein here the same reference signs as in the previous figures also indicate the same elements, which is why it is being referred to their previous embodiments at this point.

[0082] FIG. **3** shows the auxiliary thread **50** led through the auxiliary thread conveying tube **53**, the auxiliary thread gripping rollers **51***a*, **51***b* and the diversion device **55** into the auxiliary thread conveying tube **53'**.

[0083] Furthermore, it is also apparent from FIG. **3**, how the auxiliary thread **50** passes through the auxiliary thread oscillation device **57** comprising the auxiliary thread guiding device **56**. By moving the auxiliary thread oscillation device **57** in an oscillation direction D, transverse to the auxiliary thread transport direction B, the contact surface of the auxiliary thread **50** with the surfaces of the auxiliary thread gripping rollers **51***a*, **51***b* can be varied, whereby a shrinkage of the auxiliary thread gripping rollers **51***a*, **51***b* and their increased wear can be prevented. Especially the guidance of the auxiliary thread **50** by means of the auxiliary thread guiding device **56** of the auxiliary thread oscillation device **57** has proven to be especially preferable with regard to the movement of the auxiliary thread **50** along the surface of the auxiliary thread gripping rollers **51***a*, **51***b*, since the auxiliary thread **50** can thus be moved controllably, without shifting, by means of the auxiliary thread oscillation device **57**.

[0084] The rotational speed of the auxiliary thread gripping rollers **51***a*, **51***b* and/or the movement of the auxiliary thread **50** by means of the auxiliary thread oscillation device **57** can be adjusted by means of a device control **90**. By means of this device control **90**, the rotational speed of the end thread gripping roller pair **71** and/or the pressure of the compressed air exiting the spinning nozzles **70***a*, **70***b* and/or the rotational speed of the rollers of the stretching unit **6** and/or the knitting speed of the knitting machine **2** can be adjusted.

[0085] In the simplest embodiment, the auxiliary thread guiding device **56** is formed as a drill in the auxiliary thread oscillation device **57**, which is for example formed as a shaft, however, in other embodiments of the device **1** according to the invention, it can also be formed differently.

1-10. (canceled)

11. A device for producing knitted fabric with a knitting machine and a roving drawing and strengthening unit, the device comprising:

a roving supply unit with at least one roving;

an auxiliary thread supply unit with at least one auxiliary thread;

a stretching unit coupled to said roving supply unit for supplying the roving and said auxiliary thread supply unit for supplying the auxiliary thread, said stretching unit including stretching roller pairs arranged one after another in a roving conveying direction;

a spinning nozzle device following said stretching unit in the roving conveying direction and forming a fiber strengthening segment by applying compressed air; and

an end thread gripping roller pair rotatable in opposite directions and disposed following said spinning nozzle device in the roving conveying direction delimiting said fiber strengthening segment;

at least one auxiliary thread gripping roller pair disposed between said auxiliary thread supply unit and said stretching unit, said at least one auxiliary thread gripping roller pair having two auxiliary thread gripping rollers that are rotatable in opposite directions and adjustable with regard to a rotational speed, said auxiliary thread gripping rollers being pressed or capable of being pressed to one another and guiding the auxiliary thread towards said stretching unit, said auxiliary thread gripping roller pair forming a clamping lead-through for the at least one auxiliary thread, and wherein a rotational speed of said auxiliary thread gripping rollers of said auxiliary thread gripping roller pair is adjustable such that a thread tension of the auxiliary thread exiting said auxiliary thread gripping roller pair is smaller than 2 centinewtons.

12. The device according to claim **11**, which comprises a device control configured to adjust the rotational speed of at least one of said auxiliary thread gripping rollers and to adjust a rotational speed of said stretching rollers of said stretching unit.

13. The device according to claim **11**, wherein said auxiliary thread gripping rollers include a first, profiled auxiliary thread gripping roller and a second, rubberized auxiliary thread gripping roller.

14. The device according to claim **11**, further comprising an auxiliary thread oscillation device before said at least one auxiliary thread gripping roller pair in the roving conveying direction of the device.

15. The device according to claim **11**, further comprising at least one optical thread sensor following the auxiliary thread gripping roller pair in an auxiliary thread conveying direction.

16. The device according to claim **11**, wherein said auxiliary thread supply unit comprises a closed housing formed with at least one opening for exiting the auxiliary thread.

17. A method for producing knitted fabric, the method comprising:

supplying at least one roving from a roving supply unit;

supplying at least one auxiliary thread from an auxiliary thread supply unit;

clamping the auxiliary thread between rollers of at least one auxiliary thread gripping roller pair that rotate in opposite directions, the rollers of the auxiliary thread

gripping roller pair having two auxiliary thread gripping rollers that are pressed or capable of being pressed to one another;

adjusting the rotational speed of the auxiliary thread gripping rollers such that a thread tension of the auxiliary thread exiting the auxiliary thread gripping roller pair is less than 2 centinewton;

guiding the roving and the auxiliary thread to a stretching unit, the stretching unit having stretching roller pairs arranged one after another in a roving conveying direction;

subjecting a drawn roving with the auxiliary thread exiting the stretching unit to pressurized air by a spinning nozzle device in a fiber strengthening segment, to thereby strengthen the drawn roving, wherein the fiber strengthening segment is delimited by an end thread gripping roller pair rotating in opposite directions through which the drawn and strengthened roving with the auxiliary thread is led in clamped fashion and an end thread exiting the end thread gripping roller pair is supplied to a knitting machine.

18. The method according claim **17**, which comprises supplying the auxiliary thread to the auxiliary thread gripping roller pair oscillating in axis direction of the auxiliary thread gripping rollers.

19. The method according to claim **17**, which comprises optically recording a thread tension of the auxiliary thread between the auxiliary thread gripping roller pair and the stretching unit.

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