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(54) ZERO-TWIST YARN FEEDING DEVICE

VERDREHUNGSFREIE FADENZUFÜHRVORRICHTUNG

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a yarn feeding arrangement. In particular, the present disclosure relates to a yarn feeding arrangement suitable for a rapier weaving machine weaving flat or tape yarns where the weft yarn shall be presented to the weaving machine without twist.

BACKGROUND

[0002] A general development trend in weaving is that the speed of the weaving machine is constantly being increased. Another trend is the increased use of flat or tape formed yarns, which shall be inserted without any twist. Examples of such yarns are polypropylene tape, carbon fiber tape, aramid and glass fiber tape. Presently the speed of a rapier weaving machines weaving flat or tape yarns without twist is limited by the low capacity of the zero twist yarn feeding devices that exist today.

[0003] Existing systems for feeding yarns without twist (zero-twist) typically have an un-wind motor that is controlled by measuring the length of a big loop buffer that is located between the bobbin and the weaving machine. The loop can be either free hanging or have a mechanical member that forms the loop by gravity, pressurized air or by under-pressure (aspirator). The existing systems can be considered as storage feeders, where the weaving machine can take the amount of yarn it needs, so called "negative yarn feed" or "feed on demand".

[0004] US 5150739 describes a yarn buffer unrolling the yarn tangentially from a bobbin and then feeding the yarn in loops into a container. A yarn buffer is an arrangement that can hold a bit of yarn that can be drawn with a small force during at least a part of the weaving cycle compared to the force required if the yarn would have been drawn directly from a yarn storage such as directly from the bobbin. The loop formation is not controlled but let free to depend on the yarn properties in the actual case, with the risk that the loops will form in an uneven way with entanglement or twisting as a consequence. Further, the yarn loops are advanced by gravity which limits the speed at which the loops can be made. As the yarn loops are let free and not controlled in any way there is a big risk that the yarn will entangle or twist. An entangled or twisted yarn will cause problems in the weft insertion, either by stopping the machine or by resulting in lower quality of the woven fabric.

[0005] US 3575217 also feeds the yarn in loops into a container, and in this case the loops are assisted to be formed by under-pressure obtained by an aspirator. Still, the loops are free and exposed to a big risk for twisting or entanglement.

[0006] In US 3825198 the loops are advanced by a moving wall on the rear and in one execution a moving wall both on the rear and front wall. Still the loops are not controlled and are exposed to a risk for entanglement or twisting.

[0007] DE 102 03 733 describes a linear measurement and magazine storage arrangement for threads which comprises thread feed elements and thread length-measuring elements together with magazines. The magazines are designed with retaining devices which retain thread parts in predetermined positions. The length-measuring elements comprise a pulse generator arranged in a load cell and designed to control the thread feed element in the form of an alternating current motor by means of pulses. An electric motor is provided to actuate reversing elements that displace parts of the threads into the magazines.

[0008] These above devices can potentially work when weaving at low speeds, but when increasing the weft insertion speed, they do not work anymore as the loops cannot be formed nor advanced at the necessary speed, or the loops will twist or entangle.

[0009] US 2015/0203999 introduces a movable loop roller to form a U-shaped loop by pulling the weft yarn. The movable loop roller gets its force to tension the yarn by either a spring or by under-pressure. However, the roller has a mass and when the yarn is accelerated during the weft insertion this mass of inertia will create a tension peak in the weft yarn. Also, this device works at low insertion speed, but when the speed of the weaving machine increases it causes a limitation in the whole system. Further, when the weaving machine speed is increased, the force from the movable yarn roller towards the yarn during the loop formation needs to be increased as there is less time to form a loop, and thus the movable loop roller will create an even higher yarn tension during insertion as not only the mass of inertia of the movable loop roller has to be overcome, but also an increased spring force or an increased under-pressure. This increased yarn tension at insertion limits the speed at which the weaving machine can be operated.

[0010] There is a constant desire to improve yarn feeding to textile machines. Hence, there is a need for an improved yarn feeding device.

SUMMARY

[0011] It is an object of the present invention to provide an improved yarn feeder arrangement.

[0012] This object and/or others are obtained by the weft yarn feeding device as set out in the appended claims.

[0013] Thus, to enable weaving of textile at high speed with zero-twist using a rapier weaving machine a weft yarn feeding arrangement is provided where the control of weft yarn feed is performed by at the same time controlling the speed of a motor driven bobbin and a motor driven loop buffer device. With this yarn feeding system the weft yarn will always be controlled and not be let free. Thus, the risk for the yarn to twist or entangle is eliminated. The motor driven loop buffer device is driven based on pre-stored information about the speed and position of the rapier(s) in relation to the weaving machine angle position. The motor driven bobbin is driven to supply the correct amount of weft yarn during each cycle of the weaving machine. The speed of the motor driven loop buffer device is adjusted based on the actual yarn tension. Also, the speed of the motor driven bobbin can be adjusted based on the actual yarn tension. The speed of the motor driven bobbin can be adjusted based on other parameters such as position of the loop buffer device. The weft yarn feeding arrangement can then supply the correct amount of weft yarn by driving the motor driven bobbin at a correct speed. The motor driven bobbin can change speed if required, but the speed changes are small, typically less than 5% over a weaving cycle. Compensation for the rapid speed changes of weft yarn insertion speed caused by the speed changes of the rapier(s) is made by the motor driven loop buffer device programmed to follow the weft yarn insertion speed changes. Finally, the control system is programmed to receive a weft yarn actual tension feedback signal. Fine tuning of the movement of the motor driven loop buffer device is then performed based on the fed-back actual yarn tension. The aim is to keep the yarn tension constant and to never have a slack in the yarn, or to let the yarn tension follow a pre-determined curve over a cycle of the weaving machine. Also, the speed of the motor driven bobbin can be controlled based on the weft yarn actual tension signal or a similar signal such as a signal representing the position of the loop buffer device.

[0014] In accordance with one embodiment a yarn feeding arrangement for feeding weft yarn to a weaving machine having at least one rapier wherein the weft yarn fed to the weaving machine continuously has a controlled yarn tension is provided. The yarn feeding arrangement comprises a motor driven bobbin and a motor driven loop buffer device. The yarn feeding arrangement further comprises a controller for controlling the motor of the motor driven bobbin and the motor driven loop buffer device. The controller is adapted to

- drive the motor of the motor driven bobbin at a speed to feed a determined essentially average amount of weft yarn for the weaving machine to consume wherein the determined essentially average amount of weft yarn deviates less than a pre-set amount from an actual average amount consumed by the weaving machine.
- drive the motor of the motor driven loop buffer device based on the difference between the output speed of yarn from the motor driven bobbin and a model of weft yarn insertion speed in the weaving machine, and
- adjust the drive of the motor of the motor driven loop buffer device based on a signal representing the actual weft yarn tension. Alternatively, or as a supplement the drive of the motor of the motor driven loop buffer device can be adjusted based on a signal representing the length of weft yarn inserted in the weaving machine.

[0015] Hereby a weft yarn feeding arrangement that can unroll weft yarn from a bobbin and feed it to a rapier weaving machine at high speed with zero-twist of the weft yarn can be obtained.

[0016] In accordance with one embodiment the motor driven loop buffer device is formed by an arm connected to the motor of the motor driven loop buffer device. The arm can be attached directly to an output shaft of the motor of the motor driven buffer device or connected to the output shaft via a gear arrangement. In accordance with an alternative embodiment the motor driven loop buffer device is formed by a member moving back and forth. Hereby an efficient yarn buffer that can easily be controlled is provided.

[0017] In accordance with one embodiment the model of weft yarn insertion speed is based on parameters comprising information about the rapier position or speed in relation to machine angle position of the weaving machine and information about the length of the pick. Information about momentary machine angle position of the weaving machine can also be transferred from the weaving machine to the yarn feeding arrangement. Further information about the weft pattern can be transferred to the yarn feeding arrangement before start of the weaving machine. Hereby a more accurate control can be achieved.

[0018] In accordance with one embodiment the controller is adapted to drive the motor of the motor driven loop buffer device based on information about the geometry of the loop buffer device and/or on information about dynamics of at least one moving part of the motor driven loop buffer device. This can further improve the control of the loop buffer.

[0019] In accordance with one embodiment the motor of the motor driven bobbin is adapted to unroll weft yarn from the bobbin using a center drive mechanism. In an alternative or supplemental configuration, the motor driven bobbin is adapted to unroll weft yarn from the bobbin using a tangential drive mechanism.

[0020] In accordance with one embodiment the speed of motor of the motor driven bobbin is adjusted based on a signal representing the actual weft yarn tension. Hereby the average amount of yarn fed from the bobbin can be accurately controlled. In an alternative or supplemental configuration, the speed of the motor of the motor driven bobbin is adjusted based on a signal representing the position of the motor driven loop buffer device.

In accordance with one embodiment when a difference between the actual average amount of yarn fed from the bobbin and the actual average amount of yarn consumed by the weaving machine is detected the controller is adapted to control the speed of motor of the motor driven bobbin to compensate for the difference. Hereby the average amount of yarn can be controlled to over time always be equal to the amount of yarn consumed by the weaving machine and there will be no residual errors that could accumulate over time to cause a malfunction in the yarn feeding system.

[0021] In accordance with one embodiment, the controller is adapted to have access to the circumference of the bobbin. This is particularly advantageous when the bobbin is driven using a center drive.

[0022] In accordance with one embodiment, the controller is adapted to control the motor of the motor driven buffer device to keep the buffered yarn length equal to, or within a predetermined range around the difference between the amount of yarn unrolled from the bobbin and the amount of yarn consumed by the weaving machine during the insertion to thereby control the yarn tension. The controller can in some embodiments be adapted to control the motor of the motor driven buffer device to keep the controlled yarn tension constant or to let the controlled yarn tension follow a predetermined yarn tension curve over a weaving machine cycle.

[0023] The invention also extends to methods for controlling a weft yarn feeding arrangement in accordance with the above and to a controller and computer program product for controlling the weft yarn feeding device in accordance with the above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present invention will now be described in more detail by way of non-limiting examples and with reference to the accompanying drawings, in which:

- Fig. 1 is a view illustrating a weft yarn feeding device,
- Figs. 2a - 2d illustrate different loop buffer configurations,
- Fig. 3 illustrates an alternative bobbin motor drive,
- Fig. 4 is a model illustrating control of a weft yarn feeding device,
- Fig. 5 is a flow chart illustrating different steps performed when forming a weft yarn buffer, and
- Fig. 6 is a view of a controller.

DETAILED DESCRIPTION

[0025] In the following a weft yarn feeding arrangement for a weaving machine will be described. In the Figures, the same reference numerals designate identical or corresponding elements throughout the several figures. It will be appreciated that these figures are for illustration only and are not in any way restricting the scope of the invention. Also, it is possible to combine features from different described embodiments to meet specific implementation needs.

[0026] For many types of yarns twist is not allowed to exist in the finished fabric. A known reliable way to achieve this is by providing a tangential unrolling of the bobbin. However, the possible maximum acceleration of the bobbin will be restricted due to inertia and limited stability of the bobbin and the wound material. Also, as has been realized an increased speed of the weaving machine will require a weft yarn buffer located between the bobbin and the weaving machine. Even with a buffer, the requirements on the weft yarn buffer will be high if the speed of the weaving machine is increased. This is due to high acceleration and retardation in the rapier motion cycle.

[0027] In Fig. 1 a weft yarn feeding arrangement 12 comprising a motor driven bobbin 13 in combination with a motor driven loop buffer device 16 is shown. In the arrangement 12, weft yarn 40 is tangentially un-rolled from the motor driven bobbin 13. The weft yarn passes the motor driven loop buffer device 16, which is adapted to form a weft yarn buffer. The weft yarn is supplied from the motor driven buffer device 16 to a weaving machine 10 comprising at least one rapier 11. The motor driven buffer device 16 comprises a yarn loop-forming arm 22. The arm 22 can be moved to form an adjustable buffer of weft yarn to be supplied to the weaving machine 10. The movements of the arm 22 are achieved by a motor 18 connected to the arm 22. The arm can be connected via a gear arrangement to the motor. In accordance with one embodiment the buffer arm is mounted directly on the output shaft of the motor 18. A force sensor 29 can also be provided to detect and output a signal representing the actual yarn tension. In the set-up in accordance with Fig. 1 the weft yarn inserted in to the weaving machine will always have a controlled yarn tension, i.e. there will be no loose yarn that can be drawn into the weaving machine. The motor 18 and also the motor 14 of the motor driven bobbin 13 can be controlled by a controller 32 as will described in more detail below.

[0028] In accordance with one embodiment the motor driven bobbin 13 is configured to unroll the bobbin by a center drive as is shown in Fig. 1.

[0029] In Fig. 1 the motor driven loop buffer device 16 comprises a single arm 22 having a weft yarn guide provided thereon 30. The yarn guide can be of a so called sliding type or the yarn guide can be of a so-called rolling type. In particular, the weft yarn guide 30 can be provided at one end of the arm 22 while the other end of the arm is attached to the motor 18. A configuration as in Fig. 1 with a single arm 22 gives a total weft yarn deflection angle of about 360°.

[0030] In Fig. 2a an alternative embodiment of a motor driven loop buffer device 16 is shown. The motor driven loop buffer device 16 in Fig. 2a comprises a double arm 24 having yarn guides 31, 32 provided at each end section of the double arm 24. In particular, the yarn guides 31, 32 are provided at each end of the double arm 24. A mid-section of the double arm 24 is attached to the motor 18. In particular, the mid-section can be attached directly to the shaft of the motor 18. A double arm 24 can be controlled with better dynamic properties compared to a single arm. A drawback of a double arm configuration is however that the total deflection angle of the weft yarn 40 is higher, about 720°.

[0031] Another alternative motor driven loop buffer device 16 is shown in Fig. 2b. The motor driven loop buffer device 16 in Fig. 2b comprises a two-way single arm 26. The two-way single arm 26 comprises a double weft yarn guide 34 that brings the weft yarn both ways, e.g. upwards and downwards, past a center line for the weft yarn 40. The center line constitutes a neutral position for the buffer formed by the motor driven loop buffer device 16. When moving through the neutral position the weft yarn buffer formed by the motor driven loop buffer device 16 changes from yarn let-out to yarn take-up with low power input.

[0032] In an alternative embodiment shown in Fig 2c the bobbin is placed so that the yarn going to the arm is first travelling in a direction away from the weaving machine resulting in a total deflection angle of much less than 360 degrees. It can be as low as approximately 180 degrees.

[0033] In yet one alternative embodiment the motor driven loop buffer is formed by a member driven back and forth along a path. In particular, the member can be driven back and forth along a path that is straight.

[0034] An alternative motor driven bobbin 13 is shown in Fig. 3. In Fig. 3, the bobbin 13 is unrolled using a tangential drive where drive member(s) 15 of the motor 14 are located outside the bobbin 13. A tangential drive has the benefit that the rotational speed is linear to the unrolling speed and that the diameter of the bobbin is not influencing the unrolling speed of the yarn.

[0035] When controlling a weft yarn feeding arrangement 12 as described above a controller 32 can be used. The controller can be provided with control data to control the speed of the motor drive and the movement of the motor driven loop buffer device 16. By controlling the motor driven bobbin 13 and motor driven loop buffer device 16, weft yarn can be supplied to the weaving machine correctly at high weaving speed.

[0036] The input to the controller can in accordance with one embodiment be:

- signals representing the state of the weaving machine. The signals can for example represent actual position (machine angle, machine encoder position), start in advance, speed ramp up, pattern or other signals representing events or motions in the weaving machine that could impact the insertion speed of the weft yarn.
- signals from the motor driving the bobbin. The signals can for example be a signal representing the position and/or speed of the motor, for example a signal from a rotation/angle sensor such as an encoder. Other signals representing the state of the motor could also be used.
- signals from the loop-forming arm motor. The signals can for example be a signal representing the position and/or speed of the motor, for example a signal from a rotation/angle sensor such as an encoder. Other signals representing the state of the motor could also be used.
- signals indicative of the present (actual) weft yarn tension, for example signals from a force sensor.
- a signal representing the momentary (actual) bobbin circumference.
- parameters P describing the particular set-up for, for example, loop-forming arm length, position of the weft yarn guides, settings of the weaving machine, position of the rapier(s) in relation to machine angle position etc. In particular, a look-up table for the position of the rapier(s) in relation to the weaving machine angle position can be provided. From such a look-up table the desired insertion speed of the weft yarn to the weaving machine can be deduced based on the actual weaving machine angle. Hereby the arm can be controlled to a position that allows for the correct amount of yarn to be fed to the weaving machine at a corresponding machine angle.

[0037] From the controller speed/position control signals to the loop-forming arm motor and bobbin un-wind motor can be output.

[0038] In Fig. 4 a representation of a control system as described above is shown.

[0039] The controller of the control system can in accordance with one embodiment be programmed with the angle-position curve of the rapier movement. Before machine start the controller can be provided with information about the weaving machine speed, ramp up and starting position. During running the controller gets information about the machine position by e.g. the machine angle sensor (encoder).

[0040] The controller is programmed to run the bobbin un-wind motor at a speed at which the average amount of weft yarn that the weaving machine consumes is unwound from the bobbin or close to such a speed. At the same time the controller is programmed to run the motor of the loop-forming arm so that the movement of the arm compensates for the difference of the essentially constant un-wind speed of the weft yarn from the bobbin and the intermittent consumption of weft yarn by the weaving machine. Generally, the motor of a motor driven buffer device is driven to keep the buffered yarn length equal to, or within a pre-determined range around, the difference between the amount of yarn unrolled from the bobbin and the amount of yarn consumed by the weaving machine during the insertion to thereby control the yarn tension. The target of the control system can in accordance with one embodiment be to have a constant yarn tension or to follow a varying yarn tension curve over a weaving machine cycle. In an alternative or supplemental configuration, the speed of the motor of the motor driven bobbin is adjusted based on another input signal than a signal representing the actual yarn tension. For example, a signal representing the position of the motor driven loop buffer device can be used or any other signal indicative of if the bobbin is unwound at a speed that matches the average yarn consumption of the weaving machine. Also, a signal indicative of accumulated errors in the amount of yarn fed to the weaving machine can be used. Hereby errors compensated for by the yarn buffer can be restored and the yarn buffer be returned to a neutral position.

[0041] A force sensor detecting the yarn tension can be used to give feedback to the control system in order to correct for the error between the expected consumption of the weaving machine and the real consumption, both in average and during the actual insertion. The control system can also be programmed to correct for the error between the expected amount of yarn unrolled from the bobbin and real amount based on a feedback signal from the force sensor.

[0042] In a set-up where the bobbin is driven on its center shaft, the control output signal can be rpm. However, it is unwound weft yarn length / time unit, e.g. m/s that is the parameter that is to be controlled. Thus, it is important to know the actual circumference of the bobbin. This is especially important at start-up of the system. To gain this information a sensor that measures the diameter of the bobbin can for example be used, or a manual input at start up can be entered to the control system as one of the parameters P or some other method can be used.

[0043] The motors of the weft yarn feeding arrangement can be controlled according to the following principles:

The controller for control of the motor running the loop-forming arm has a preset value for the required buffer position in relation to the weaving machine angle. The controller is also provided with information about the dynamics of the system. When the weaving machine is running the motor driven loop-forming arm will be controlled to act accordingly in order to always have the buffer arm in the proper position at all weaving machine angles and weaving machine speeds. The force sensor gives a feedback to the control system so it can correct deviations, such as external influence and also dynamic model preset values or actual running inaccuracy.

[0044] To weave flat tape yarns typically a one-sided rapier machine can be used. By this the problems with speed shift at transfer is avoided. Also, the start of the pick is much more gentle as the rapier has not reached a high speed before it takes the yarn.

[0045] In case a two-sided rapier machine is employed the speed shift at transfer can be mitigated using an additional yarn buffer. The additional buffer can comprise a mechanical element or a spring-loaded member. In Fig. 2d a set-up with an additional yarn buffer 36. The additional yarn buffer 36 is here formed in conjunction with the sensor 29 such that the sensor 29 is somewhat resilient and allows for yarn length deviations. Because the speed change at transfer has a short duration the buffered amount of yarn is typically very small. In accordance with one embodiment the length of the additional buffer is less than 10% of the maximal buffer of the motor driven loop buffer device 16, such as maximally 1 or 2 dm. Also for a one-sided rapier a small additional mechanical or spring loaded buffer might be advantageous. In this case, the additional buffer can have a very short stroke, for example less than one or two cm. This enables the system to cope with small errors. These errors can for example result from the machine speed not being constant, the rapier takes and leaves the yarn with some length variation from pick to pick or the binding between weft and warp might vary slightly from pick to pick etc.

[0046] In Fig. 5 a flow chart illustrating some steps when controlling a weft yarn feeding arrangement 12 feeding yarn 40 to a rapier weaving machine 10 is shown. First, in a step 501 the controller is provided with information relating to speed of the rapier(s) at different points in time during running of the rapier weaving machine. In step 501 a model of weft yarn insertion speed in the weaving machine during a machine cycle is formed. The actions in step 501 can be taken before start-up of the system and are not necessarily part of the control procedure. Typically, a look-up table of relevant control data can be pre-loaded to a controller. Next, in a step 503, the motor driven bobbin is controlled to supply weft yarn at an, essentially constant, speed such that the amount of weft yarn unrolled meets the amount of weft yarn consumed by the rapier weaving machine. Further, in a step 505, the motor of the motor driven loop buffer device is driven based on the difference between the output speed of yarn from the motor driven bobbin and the model of weft yarn insertion speed in the weaving machine. Finally, in a step 507, the drive the motor of the motor driven loop buffer device is adjusted based on a signal representing the actual weft yarn tension. Also, the speed of the motor of the motor driven bobbin can be adjusted based on a signal representing the actual weft yarn tension.

[0047] In Fig. 6 a controller 32 for controlling a weft yarn feeding arrangement 12 is depicted. The controller 32 can comprise an input/output 81 for receiving input signals for parameters used for controlling the yarn feeding device as set out above. For example, the input signals can be various sensor signals from sensors of the yarn feeding device. For example, sensor signals can be provided from any type of sensor, e.g. optical sensors, mechanical sensors or capacitive sensors. The yarn tension sensor(s) can for example be a piezo resistive type sensor, a strain gauge type sensor, or by sensing the position of a resilient or spring loaded yarn guide. Hereby the yarn length can be determined. The yarn length can be used as an alternative or in combination with a yarn tension signal as a feed-back signal to control the motor speed of the motor driven loop buffer device and in some embodiments as a feedback signal to control the motor speed of the motor driven bobbin. Other types of input signals can also be provided such as encoder signals and the like. Also signals from the rapier weaving machine can be input to the controller 32 and used to control the weft yarn feeding arrangement. In particular, the weaving machine angle can be provided. The input/output 81 outputs motor control signal(s) to the controlled motors of the weft yarn feeding arrangement. The controller 32 further comprises a micro-processor that also can be referred to as a processing unit 82. The processing unit 82 is connected to and can execute computer program instructions stored in a memory 83. The memory 83 can also store data that can be accessed by the processing unit 82. The data in the memory can comprise pre-stored data relating to the weaving machine 10. In particular, a model of the rapier movements can be stored to form a model of the weft yarn speed into the rapier weaving machine. The computer program instructions can be adapted to cause the controller to control the yarn feeding arrangement in accordance with the teachings herein. The controller 32 can be located at any suitable location. For example, the controller 32 can be integrated in a motor of the yarn feeding arrangement. The controller 32 can also be distributed at different locations.

[0048] To limit the load on the motor of the buffer arm, a light weight moving arm or other yarn loop forming member can be used. It can be of several types, for example using light and stiff materials like carbon fiber, or a light weight design in aluminum sheet.

[0049] The above examples are for illustration only. Numerous modifications can be envisaged and the different embodiments can be combined to meet specific implementation needs.

[0050] The yarn feeding arrangement as described herein is a so called positive feed system; it measures and outputs a pre-defined amount of yarn in synchronism with the weaving machine angle. In other words, the yarn feeding arrangement controls the amount of yarn available for the weaving machine in that the weaving machine cannot draw more yarn than the yarn feeding arrangement has fed. This in contrast to a so called negative feeding arrangement where the weaving machine draws an amount of yarn without being limited by how much yarn the yarn feeder can supply. Thus, in a negative feed system, the weaving machine has more or less free access to yarn, whereas in positive feed systems the yarn feed arrangement determines how much yarn can be fed to the weaving machine. The feedback to correct errors between the pre-defined amount of yarn and the real consumption in the positive feed system is obtained by a sensor, in particular a yarn tension sensor. In one embodiment, the yarn tension sensor is combined with a small mechanical or spring loaded yarn buffer.

Claims

1. A yarn feeding arrangement (12) suitable for feeding weft yarn (40) to a weaving machine (10) having at least one rapier (11) wherein the weft yarn fed to the weaving machine has a controlled yarn tension , the yarn feeding arrangement comprising a motor driven bobbin (13) and a motor driven loop buffer device (16), the yarn feeding arrangement further comprising a controller (32) for controlling the motor of the motor driven bobbin and the motor driven loop buffer device, wherein the controller is adapted to

   - drive the motor (14) of the motor driven bobbin at a speed to feed a determined essentially average amount of weft yarn to be consumed by the weaving machine wherein said determined essentially average amount of weft yarn deviates less than a pre-set amount from an actual average amount consumed by the weaving machine.
   - drive the motor of the motor driven loop buffer device based on the difference between the output speed of yarn (40) from the motor driven bobbin and a model of weft yarn insertion speed in the weaving machine, and
   - adjust the drive of the motor of the motor driven loop buffer device based on a signal representing the actual weft yarn tension or a signal representing the length of weft yarn actually inserted in the weaving machine.

2. The yarn feeding arrangement (12) according to claim 1, wherein the motor driven loop buffer device is formed by an arm (22, 24, 26) connected to the motor of the motor driven loop buffer device.

3. The yarn feeding arrangement (12) according to claim 2, wherein the motor driven loop buffer device is formed by an arm (22, 24, 26) attached directly to an output shaft of the motor of the motor driven loop buffer device (16) or connected to the output shaft via a gear arrangement.

4. The yarn feeding arrangement (12) according to claim 1, wherein the motor driven loop buffer device is formed by a member moving back and forth.

5. The yarn feeding arrangement (12) according to claim 1-4, wherein the model of weft yarn insertion speed is based on parameters comprising information about the rapier position or speed in relation to a machine angle position of the weaving machine and information about the length of the pick.

6. The yarn feeding arrangement (12) according to claim 1-5, wherein the controller (32) is adapted to receive information about momentary machine angle position of the weaving machine which is transferred from the weaving machine to the yarn feeding arrangement.

7. The yarn feeding arrangement (12) according to claim 1-6, wherein the controller (32) is adapted to receive information about the weft pattern which is transferred to the yarn feeding arrangement before start and/or during running of the weaving machine.

8. The yarn feeding arrangement (12) according to claim 1-7, wherein the controller is adapted to drive the motor of the motor driven loop buffer device

based on information about the geometry of the loop buffer device and/or on information about dynamics of at least one moving part of the motor driven loop buffer device.

9. The yarn feeding arrangement (12) according to any of claims 1 - 8, wherein the speed of motor (14) of the motor driven bobbin is adjusted based on a signal representing the actual weft yarn tension.

10. The yarn feeding arrangement (12) according to any of claims 1 - 9, wherein the speed of motor (14) of the motor driven bobbin is adjusted based on a signal representing the position of the motor driven loop buffer device.

11. The yarn feeding arrangement (12) according to any of claims 1 - 10, wherein the controller is adapted to, when a difference between the actual average amount of yarn fed from the bobbin and the actual average amount consumed by the weaving machine is detected controlling the speed of motor (14) of the motor driven bobbin to compensate for the difference.

12. The yarn feeding arrangement (12) according to any of claims 1 - 11, wherein the controller (32) is adapted to control the motor (14) of the motor driven loop buffer device (16) to keep the buffered yarn length equal to, or within a pre-determined range around, the difference between the amount of yarn unrolled from the bobbin and the amount of yarn consumed by the weaving machine during the insertion to thereby control the yarn tension.

13. The yarn feeding arrangement (12) according to claim 12, wherein the controller (32) is adapted to control the motor (14) of the motor driven loop buffer device (16) to keep the controlled yarn tension constant or to let the controlled yarn tension follow a predetermined yarn tension curve over a weaving machine cycle.

14. A method of controlling a yarn feeding arrangement (12) for feeding weft yarn (40) to a weaving machine (10) having at least one rapier (11) wherein the weft yarn fed to the weaving machine has a controlled yarn tension, the yarn feeding arrangement comprising a motor driven bobbin (13) and a motor driven loop buffer device (16), the yarn feeding arrangement further comprising a controller (32) for controlling the motor of the motor driven bobbin and the motor driven loop buffer device, the method comprising

- driving (503) the motor (14) of the motor driven bobbin at a speed to feed a determined essentially average amount of weft yarn for the weaving machine to consume wherein said determined essentially average amount of weft yarn deviates less than a pre-set amount from an actual average amount consumed by the weaving machine,
- driving (505) the motor of the motor driven loop buffer device based on the difference between the output speed of yarn (40) from the motor driven bobbin and a model of weft yarn insertion speed in the weaving machine, and
- adjusting (507) the drive of the motor of the motor driven loop buffer device based on a signal representing the actual weft yarn tension or a signal representing the length of weft yarn actually inserted in the weaving machine.

15. A computer program product comprising computer program code adapted to, when executed on a computer, cause the computer to control the yarn feeding arrangement (12) of claim 1 to execute the steps of the method according to claim 14.

Patentansprüche

1. Fadenzuführanordnung (12), die sich zum Zuführen eines Schussfadens (40) zu einer Webmaschine (10) eignet, die mindestens einen Greifer (11) aufweist, wobei der zur Webmaschine zugeführte Schussfaden eine gesteuerte Fadenspannung aufweist, wobei die Fadenzuführanordnung eine motorgetriebene Spule (13) und eine motorgetriebene Schleifenpuffervorrichtung (16) umfasst, wobei die Fadenzuführanordnung weiter eine Steuerung (32) zum Steuern des Motors der motorgetriebenen Spule und der motorgetriebenen Schleifenpuffervorrichtung umfasst, wobei die Steuerung angepasst ist, um

- den Motor (14) der motorgetriebenen Spule mit einer Geschwindigkeit anzutreiben, um eine bestimmte im Wesentlichen Durchschnittsmenge eines durch die Webmaschine zu verbrauchenden Schussfadens zuzuführen, wobei die bestimmte im Wesentlichen Durchschnittsmenge eines Schussfadens um weniger als eine voreingestellte Menge von der tatsächlichen, von Webmaschine verbrauchten Durchschnittsmenge abweicht;
- den Motor der motorgetriebenen Schleifenpuffervorrichtung basierend auf der Differenz zwischen der Ausgangsgeschwindigkeit eines Fadens (40) von der motorgetriebenen Spule und einem Modell einer Schussfadeneinführungsgeschwindigkeit in die Webmaschine anzutreiben, und
- den Antrieb des Motors der motorgetriebenen Schleifenpuffervorrichtung basierend auf einem Signal anzupassen, das die tatsächliche

Schussfadenspannung repräsentiert oder einem Signal, das die Länge des tatsächlich in die Webmaschine eingeführten Schussfadens repräsentiert.

2. Fadenzuführanordnung (12) nach Anspruch 1, wobei die motorgetriebene Schleifenpuffervorrichtung durch einen Arm (22, 24, 26) gebildet wird, der mit dem Motor der motorgetriebenen Schleifenpuffervorrichtung verbunden ist.

3. Fadenzuführanordnung (12) nach Anspruch 2, wobei die motorgetriebene Schleifenpuffervorrichtung durch einen Arm (22, 24, 26) gebildet wird, der direkt an einer Ausgangswelle des Motors der motorgetriebenen Schleifenpuffervorrichtung (16) befestigt, oder über eine Getriebeanordnung mit der Ausgangswelle verbunden ist.

4. Fadenzuführanordnung (12) nach Anspruch 1, wobei die motorgetriebene Schleifenpuffervorrichtung durch ein sich rückwärts und vorwärts bewegendes Element gebildet wird.

5. Fadenzuführanordnung (12) nach Anspruch 1 bis 4, wobei das Modell einer Schussfadeneinführungsgeschwindigkeit auf Parametern basiert, die Informationen über die Greiferposition oder Geschwindigkeit in Bezug auf eine Maschinenwinkelposition der Webmaschine und Informationen über die Länge des Hakens umfassen.

6. Fadenzuführanordnung (12) nach Anspruch 1 bis 5, wobei die Steuerung (32) angepasst ist, um Informationen über eine momentane Maschinenwinkelposition der Webmaschine zu empfangen, welche von der Webmaschine zu der Fadenzuführanordnung übertragen werden.

7. Fadenzuführanordnung (12) nach Anspruch 1 bis 6, wobei die Steuerung (32) angepasst ist, um Informationen über die Schussvorlage zu empfangen, die vor dem Start und/ oder währed des Laufens der Webmaschine an die Fadenzuführanordnung übertragen werden.

8. Fadenzuführanordnung (12) nach Anspruch 1 bis 7, wobei die Steuerung angepasst ist, um den Motor der motorgetriebenen Schleifenpuffervorrichtung basierend auf Informationen über die Geometrie der Schleifenpuffervorrichtung und/ oder auf Informationen über die Dynamik von mindestens einem beweglichen Teil der motorgetriebenen Schleifenpuffervorrichtung anzutreiben.

9. Fadenzuführanordnung (12) nach einem der Ansprüche 1 bis 8, wobei die Geschwindigkeit des Motors (14) der motorgetriebenen Spule basierend auf einem Signal angepasst wird, das die tatsächliche Schussfadenspannung repräsentiert.

10. Fadenzuführanordnung (12) nach einem der Ansprüche 1 bis 9, wobei die Geschwindigkeit eines Motors (14) der motorgetriebenen Spule basierend auf einem Signal angepasst wird, das die Position der motorgetriebenen Schleifenpuffervorrichtung repräsentiert.

11. Fadenzuführanordnung (12) nach einem der Ansprüche 1 bis 10, wobei die Steuerung angepasst ist, um, wenn eine Differenz zwischen der tatsächlichen Durchschnittsmenge eines von der Spule zugeführten Fadens und der tatsächlichen von der Webmaschine verbrauchten Durchschnittsmenge detektiert wird, die Geschwindigkeit des Motors (14) der motorgetriebenen Spule zu steuern, um die Differenz auszugleichen.

12. Fadenzuführanordnung (12) nach einem der Ansprüche 1 bis 11, wobei die Steuerung (32) angepasst ist, um den Motor (14) der motorgetriebenen Schleifenpuffervorrichtung (16) zu steuern, um während des Einführens die gepufferte Fadenlänge gleich oder innerhalb eines vorbestimmten Bereichs um die Differenz zwischen der Menge an von der Spule abgerolltem Faden und der Menge von durch die Webmaschine verbrauchten Faden zu halten, wodurch die Fadenspannung gesteuert wird.

13. Fadenzuführanordnung (12) nach Anspruch 12, wobei die Steuerung (32) angepasst ist, um den Motor (14) der motorgetriebenen Schleifenpuffervorrichtung (16) zu steuern, um die gesteuerte Fadenspannung konstant zu halten, oder um die gesteuerte Fadenspannung einer vorbestimmten Fadenspannungskurve über einen Webmaschinenzyklus folgen zu lassen.

14. Verfahren zur Steuerung einer Fadenzuführanordnung (12) zum Zuführen eines Schussfadens (40) zu einer Webmaschine (10), die mindestens einen Greifer (11) aufweist, wobei der zur Webmaschine zugeführte Schussfaden eine gesteuerte Fadenspannung aufweist, wobei die Fadenzuführanordnung eine motorgetriebene Spule (13) und eine motorgetriebene Schleifenpuffervorrichtung (16) umfasst, wobei die Fadenzuführanordnung weiter eine Steuerung (32) zum Steuern des Motors der motorgetriebenen Spule und der motorgetriebenen Schleifenpuffervorrichtung umfasst, wobei das Verfahren umfasst

- Antreiben (503) des Motors (14) der motorgetriebenen Spule mit einer Geschwindigkeit, um eine bestimmte im Wesentlichen Durchschnittsmenge eines durch die Webmaschine zu ver-

brauchenden Schussfadens zuzuführen, wobei die bestimmte im Wesentlichen Durchschnittsmenge eines Schussfadens um weniger als eine voreingestellte Menge von der tatsächlichen, von Webmaschine verbrauchten Durchschnittsmenge abweicht;
- Antreiben (505) des Motors der motorgetriebenen Schleifenpuffervorrichtung basierend auf der Differenz zwischen der Ausgangsgeschwindigkeit eines Fadens (40) von der motorgetriebenen Spule und einem Modell einer Schussfadeneinführungsgeschwindigkeit in die Webmaschine, und
- Anpassen (507) des Antriebs des Motors der motorgetriebenen Schleifenpuffervorrichtung basierend auf einem Signal, das die tatsächliche Schussfadenspannung repräsentiert oder einem Signal, das die Länge des tatsächlich in die Webmaschine eingeführten Schussfadens repräsentiert.

15. Computerprogrammprodukt, umfassend einen Computerprogrammcode, der angepasst ist, um, wenn er auf einem Computer ausgeführt wird, zu bewirken, dass der Computer die Fadenzuführanordnung (12) nach Anspruch 1 steuert, um die Schritte des Verfahrens nach Anspruch 14 auszuführen.

Revendications

1. Agencement d'amenée de fil (12) approprié pour amener du fil de trame (40) à une machine à tisser (10) présentant au moins une rapière (11) dans laquelle le fil de trame amené à la machine à tisser présente une tension de fil commandée, l'agencement d'amenée de fil comprenant une bobine entraînée par moteur (13) et un dispositif tampon à boucle entraîné par moteur (16), l'agencement d'amenée de fil comprenant en outre une unité de commande (32) pour commander le moteur de la bobine entraînée par moteur et le dispositif tampon à boucle entraîné par moteur, dans lequel l'unité de commande est conçue pour

- entraîner le moteur (14) de la bobine entraînée par moteur à une vitesse pour amener une quantité sensiblement moyenne déterminée de fil de trame à consommer par la machine à tisser dans laquelle ladite quantité sensiblement moyenne déterminée de fil de trame s'écarte de moins qu'une quantité définie à l'avance d'une quantité moyenne réelle consommée par la machine à tisser,
- entraîner le moteur du dispositif tampon à boucle entraîné par moteur sur la base de la différence entre la vitesse de sortie de fil (40) en provenance de la bobine entraînée par moteur et un modèle de vitesse d'insertion de fil de trame dans la machine à tisser, et
- ajuster l'entraînement du moteur du dispositif tampon à boucle entraîné par moteur sur la base d'un signal représentant la tension de fil de trame réelle ou d'un signal représentant la longueur de fil de trame insérée en réalité dans la machine à tisser.

2. Agencement d'amenée de fil (12) selon la revendication 1, dans lequel le dispositif tampon à boucle entraîné par moteur est formé par un bras (22, 24, 26) relié au moteur du dispositif tampon à boucle entraîné par moteur.

3. Agencement d'amenée de fil (12) selon la revendication 2, dans lequel le dispositif tampon à boucle entraîné par moteur est formé par un bras (22, 24, 26) directement attaché à un arbre de sortie du moteur du dispositif tampon à boucle entraîné par moteur (16) ou relié à l'arbre de sortie via un agencement d'engrenages.

4. Agencement d'amenée de fil (12) selon la revendication 1, dans lequel le dispositif tampon à boucle entraîné par moteur est formé par un élément se déplaçant dans les deux sens.

5. Agencement d'amenée de fil (12) selon la revendication 1-4, dans lequel le modèle de vitesse d'insertion de fil de trame est basé sur des paramètres comprenant des informations concernant la position ou la vitesse de rapière par rapport à une position d'angle de machine de la machine à tisser et des informations concernant la longueur de la duite.

6. Agencement d'amenée de fil (12) selon la revendication 1-5, dans lequel l'unité de commande (32) est conçue pour recevoir des informations concernant une position d'angle de machine momentanée de la machine à tisser qui est transférée depuis la machine à tisser jusqu'à l'agencement d'amenée de fil.

7. Agencement d'amenée de fil (12) selon la revendication 1-6, dans lequel l'unité de commande (32) est conçue pour recevoir des informations concernant le modèle de trame qui est transféré jusqu'à l'agencement d'amenée de fil avant le début et/ou pendant le fonctionnement de la machine à tisser.

8. Agencement d'amenée de fil (12) selon la revendication 1-7, dans lequel l'unité de commande est conçue pour entraîner le moteur du dispositif tampon à boucle entraîné par moteur sur la base d'informations concernant la géométrie du dispositif tampon à boucle et/ou d'informations concernant la dynamique d'au moins une partie mobile du dispositif tampon à boucle entraîné par moteur.

9. Agencement d'amenée de fil (12) selon l'une quelconque des revendications 1-8, dans lequel la vitesse de moteur (14) de la bobine entraînée par moteur est ajustée sur la base d'un signal représentant la tension de fil de trame réelle.

10. Agencement d'amenée de fil (12) selon l'une quelconque des revendications 1-9, dans lequel la vitesse de moteur (14) de la bobine entraînée par moteur est ajustée sur la base d'un signal représentant la position du dispositif tampon à boucle entraîné par moteur.

11. Agencement d'amenée de fil (12) selon l'une quelconque des revendications 1-10, dans lequel l'unité de commande est conçue pour, lorsqu'une différence entre la quantité moyenne réelle de fil amené en provenance de la bobine et la quantité moyenne réelle consommée par la machine à tisser est détectée, commander la vitesse de moteur (14) de la bobine entraînée par moteur pour compenser la différence.

12. Agencement d'amenée de fil (12) selon l'une quelconque des revendications 1-11, dans lequel l'unité de commande (32) est conçue pour commander le moteur (14) du dispositif tampon à boucle entraîné par moteur (16) pour conserver la longueur de fil mise en tampon égale à, ou à l'intérieur d'une plage prédéterminée autour de, la différence entre la quantité de fil déroulé de la bobine et la quantité de fil consommé par la machine à tisser pendant l'insertion pour commander de ce fait la tension de fil.

13. Agencement d'amenée de fil (12) selon la revendication 12, dans lequel l'unité de commande (32) est conçue pour commander le moteur (14) du dispositif tampon à boucle entraîné par moteur (16) pour conserver la tension de fil commandée constante ou pour laisser la tension de fil commandée suivre une courbe de tension de fil prédéterminée sur un cycle de machine à tisser.

14. Procédé de commande d'un agencement d'amenée de fil (12) pour amener du fil de trame (40) jusqu'à une machine à tisser (10) présentant au moins une rapière (11) dans laquelle le fil de trame amené jusqu'à la machine à tisser présente une tension de fil commandée, l'agencement d'amenée de fil comprenant une bobine entraînée par moteur (13) et un dispositif tampon à boucle entraîné par moteur (16), l'agencement d'amenée de fil comprenant en outre une unité de commande (32) pour commander le moteur de la bobine entraînée par moteur et le dispositif tampon à boucle entraîné par moteur, le procédé comprenant

- l'entraînement (503) du moteur (14) de la bobine entraînée par moteur à une vitesse pour amener une quantité sensiblement moyenne déterminée de fil de trame pour la machine à tisser pour consommation dans laquelle ladite quantité sensiblement moyenne déterminée de fil de trame s'écarte moins qu'une quantité définie à l'avance d'une quantité moyenne réelle consommée par la machine à tisser,
- l'entraînement (505) du moteur du dispositif tampon à boucle entraîné par moteur sur la base de la différence entre la vitesse de sortie de fil (40) en provenance de la bobine entraînée par moteur et un modèle de vitesse d'insertion de fil de trame dans la machine à tisser, et
- l'ajustement (507) de l'entraînement du moteur du dispositif tampon à boucle entraîné par moteur sur la base d'un signal représentant la tension de fil de trame réelle ou d'un signal représentant la longueur de fil de trame en réalité insérée dans la machine à tisser.

15. Produit formant programme informatique comprenant un code de programme informatique conçu pour, quand il est exécuté sur un ordinateur, amener l'ordinateur à commander l'agencement d'amenée de fil (12) de la revendication 1 pour exécuter les étapes du procédé selon la revendication 14.

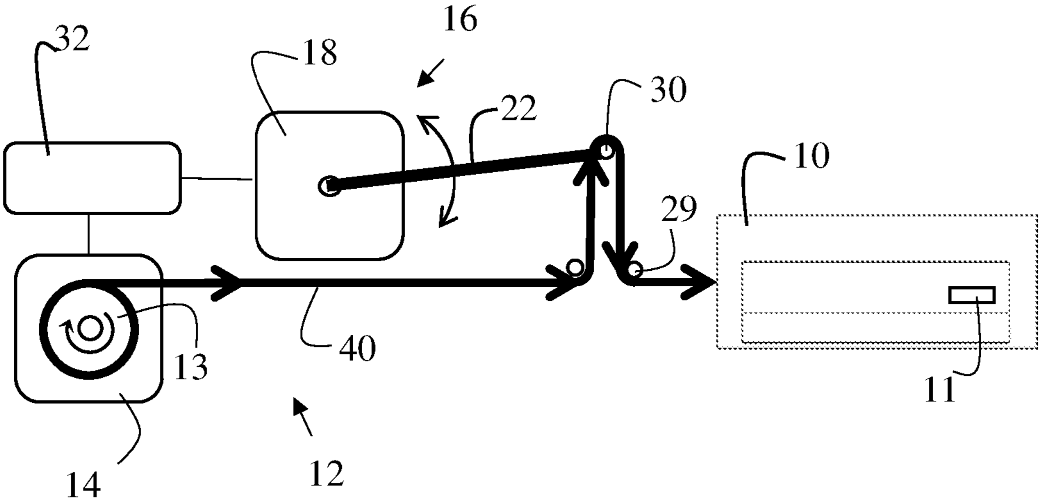

Fig. 1

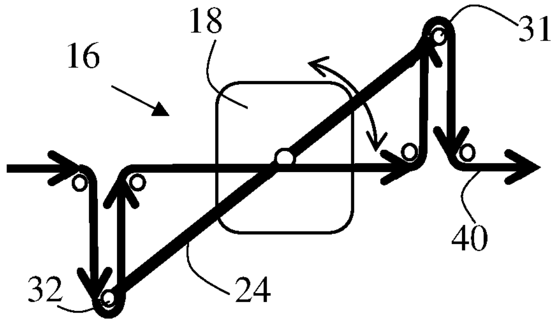

Fig. 2a

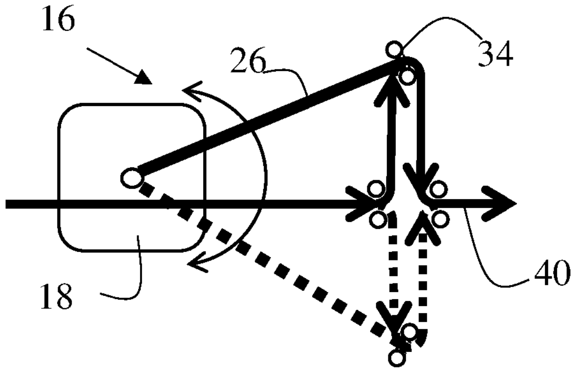

Fig. 2b

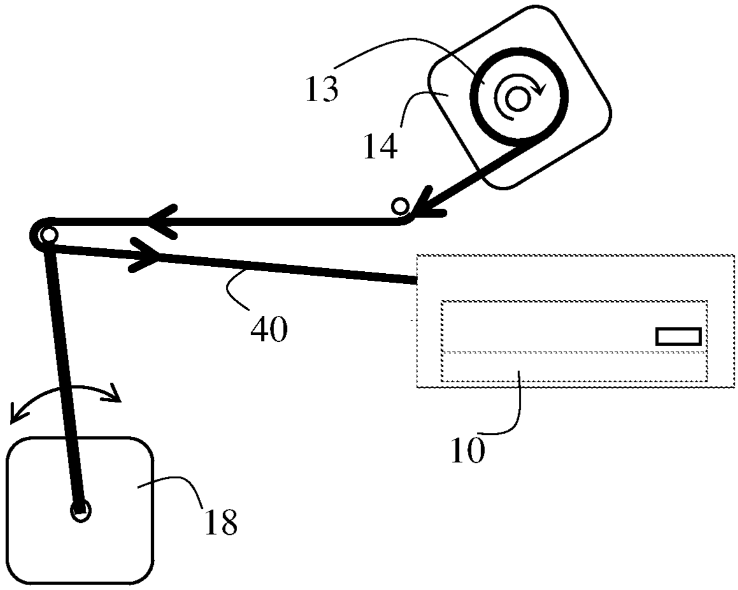

Fig. 2c

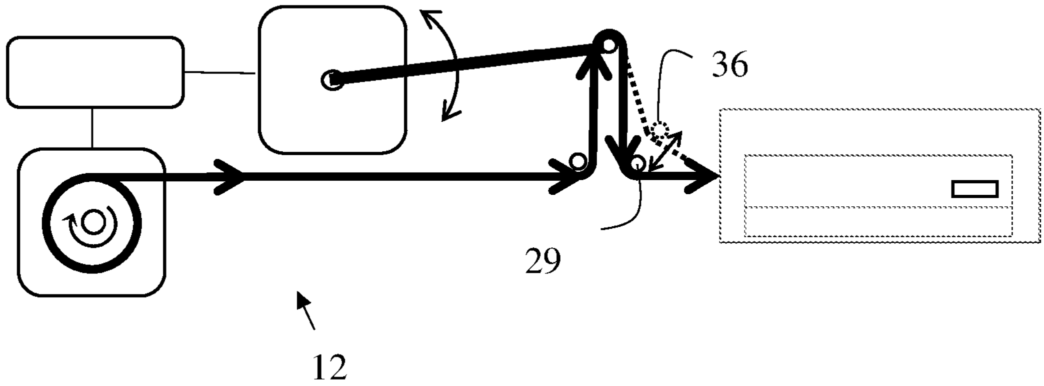

Fig. 2d

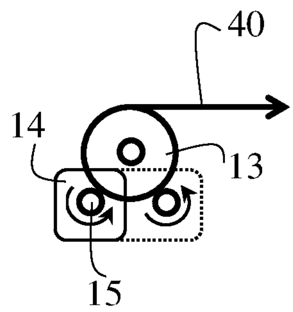

Fig. 3

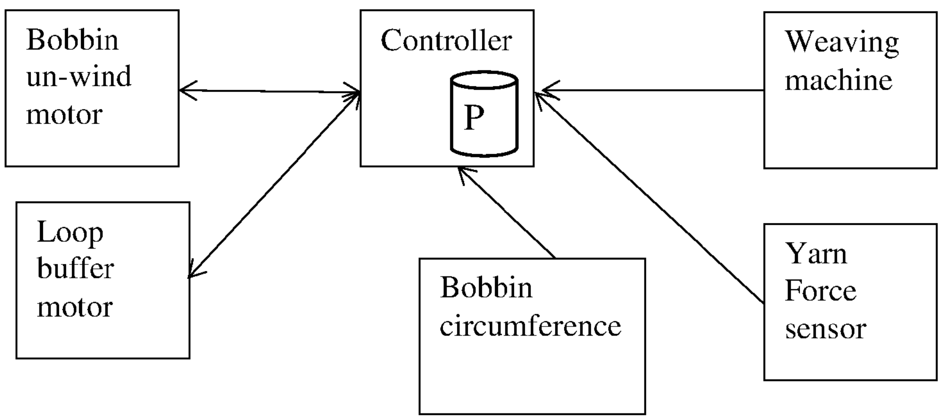

Fig. 4

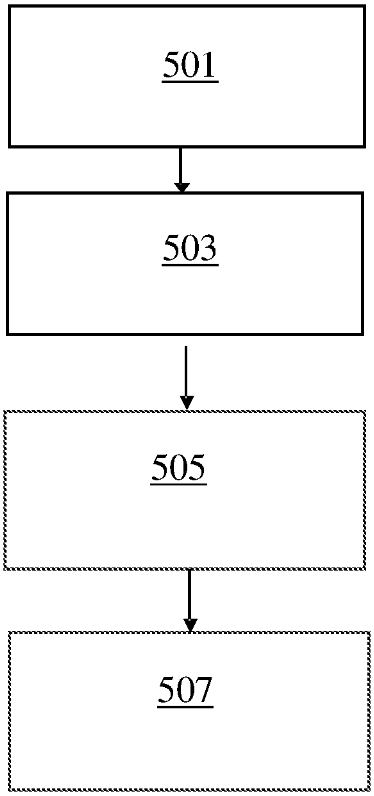

Fig. 5

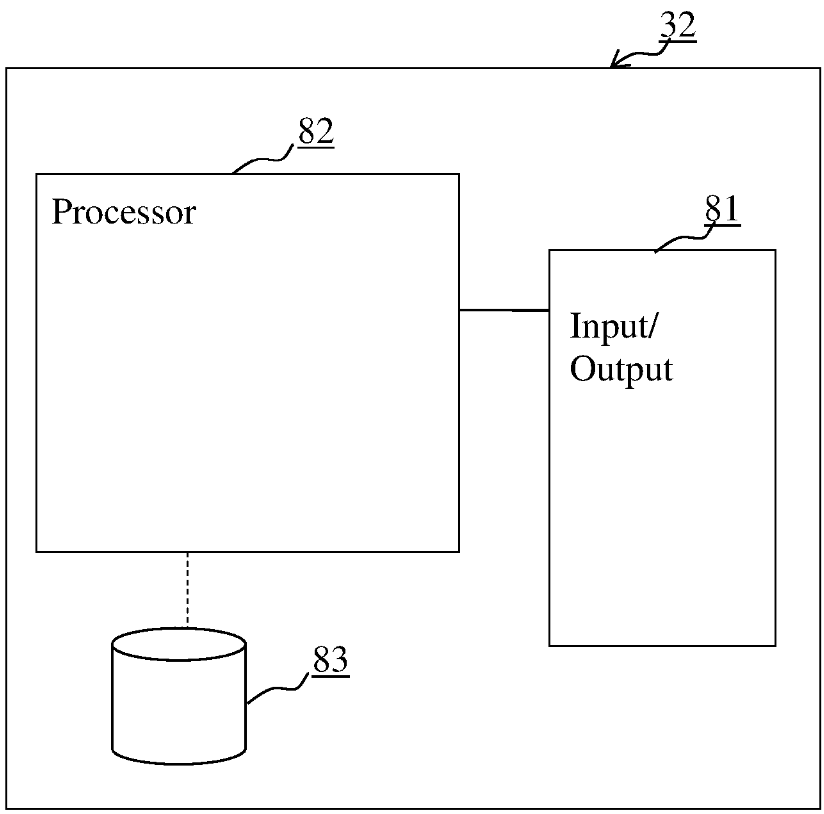

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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