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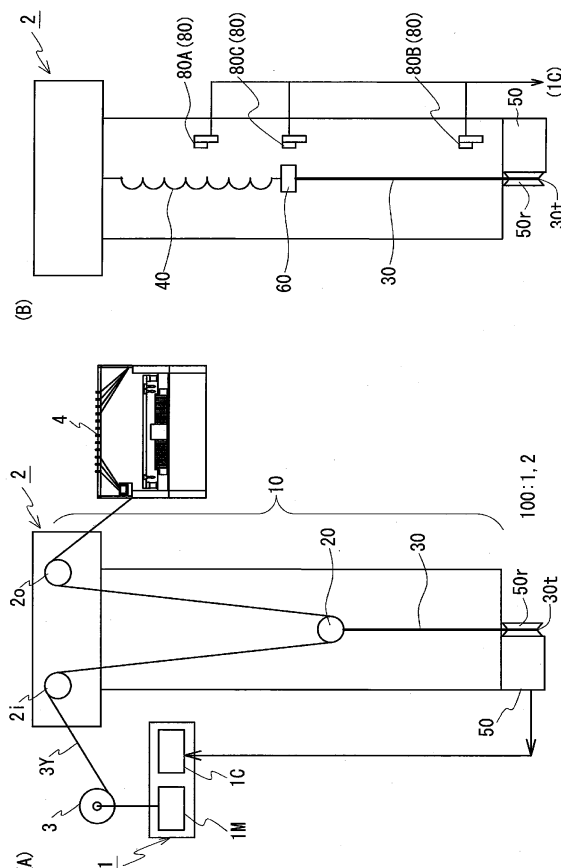
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(54) **Yarn supplying system**

(57) There is provided a yarn supplying system capable of maintaining the tensile force of the yarn in a yarn supply path in an appropriate range, and supplying the yarn from the bobbin without slackening of the yarn with a simple configuration.

The yarn supplying system includes a yarn storing device (2) and a control means (1C). The yarn storing device (2) includes a storing unit (10) that stores a yarn (3Y) reeled out from a bobbin (3) in the middle of a yarn supply path, a pull-in piece (20), a filament (30), an elastic body (40), and a displacement detector (50). The pull-in piece (20) pulls in the yarn (3Y) toward the storing unit (10) and linearly reciprocates along a pull-in direction. The filament (30) is connected to the pull-in piece (20) and includes a turn back portion (30t) at the middle, and reciprocates by interlocking with the reciprocate movement of the pull-in piece (20) without substantially stretching or contracting. The elastic body (40) is connected to the filament (30). The displacement detector (50) detects displacement of the filament (30) from an origin position. The control means (1C) controls a supply amount of the yarn (3Y) from the bobbin (3) based on the displacement of the filament (30) from the origin position.

Fig. 1



Description**PRIOR ART DOCUMENT****BACKGROUND OF THE INVENTION****PATENT DOCUMENT****Field of the Invention**5 **[0005]**

[0001] The present invention relates to a yarn supplying system for supplying yarn to a receiving device of a yarn that receives the supply of the yarn such as a knitting machine, a weaving machine, and the like.

[Patent Document 1] Japanese Laid-Open Patent Publication No. 2006-299426

Description of the Related Art10 **SUMMARY OF THE INVENTION**

[0002] A yarn supplying system for supplying yarn from a bobbin, around which the yarn is wound, to a receiving device of the yarn such as a flat knitting machine and a warp knitting machine that automatically knit a fabric, a weaving machine that weaves a fabric, a yarn twisting device that twists a plurality of yarns, and the like, has been known. The yarn supplying system includes a yarn supplying device that reels out the yarn from the bobbin, and a yarn storing device that temporarily stores the reeled out yarn and then feeds the yarn to the receiving device.

[0006] A plurality of proximity sensors arranged with a predetermined interval in a pull-in direction, and a magneto-strictive linear sensor arranged along the pull-in direction are conventionally used for the measurement of the position of the pull-in piece described above. However, such measuring of the position of the pull-in piece has the following problems.

[0003] The yarn storing device temporarily stores the yarn that is reeled out from the bobbin and then feeds the yarn to the receiving device to reduce a fluctuation of a tensile force acting on the yarn resulting from the difference between a supplying amount of the yarn from the yarn supplying device and a usage amount of the yarn in the receiving device. For example, in Figs. 7 and 8 of the patent document, the yarn is temporarily stored by being pulled in a vertical direction with a dancer roller (pull-in piece) that is hooked to the yarn. With such configuration, the pull-in piece moves vertically downward so that the yarn does not slack and is in a stretched state when the supply amount of the yarn is greater than the usage amount, and the pull-in piece moves vertically upward so that the stored yarn can be fed to the receiving device when the usage amount of the yarn is greater than the supply amount. Normally, the yarn storing device is configured such that when the dancer roller is balanced at a substantially middle position of the movement range of the pull-in piece, the yarn does not slack and an excessively large tensile force does not act on the yarn.

15 **[0007]** First, when using the proximity sensors, the position of the pull-in piece can only be discontinuously grasped regardless of how much the number of proximity sensors is increased. As a result, the behavior (to which way in the pull-in direction the pull-in piece is moving, etc.) of the pull-in piece at the positions where the proximity sensors are not arranged cannot be grasped, and hence the control of the yarn supplying device tends to be delayed.

[0004] In the yarn supplying system including the yarn storing device, a position of the pull-in piece in the vertical direction, which acts as an index of a storage amount of the temporarily stored yarn, is measured, and the supply amount of the yarn from the bobbin in the yarn supplying device is controlled based on the measurement result. According to such control, the tensile force acting on the yarn in a yarn supply path is prevented from becoming too low thus slackening the yarn due to excess of the storage amount, and the tensile force acting on the yarn in the yarn supply path is prevented from becoming too high thus breaking the yarn due to deficiency of the storage amount.

20 **[0008]** When using the magneto-strictive linear sensor, the position of the pull-in piece can be continuously grasped, but the configuration of the sensor is extensive and the cost is high. In addition, the pull-in piece to be measured needs to be configured with a magnet when using the magneto-strictive linear sensor, which increases the mass of the pull-in piece. In this case, when the usage amount of the yarn is rapidly reduced, the movement of the pull-in piece with respect to such change may be delayed, and when the usage amount of the yarn is rapidly increased, a large tensile force may act on the yarn.

25 **[0009]** In light of the foregoing, it is an object of the present invention to provide a yarn supplying system capable of maintaining the tensile force of the yarn in the yarn supply path in an appropriate range, and supplying the yarn from the bobbin without slackening of the yarn with a simple configuration.

30 **[0010]** A yarn supplying system of the present invention is a yarn supplying system including a yarn supplying device that reels out a yarn from a bobbin, and a yarn storing device that temporarily stores the yarn reeled out from the bobbin in the middle of a yarn supply path extending from the yarn supplying device to a receiving device of the yarn and feeds the yarn to the receiving device. The yarn storing device includes a storing unit for storing the yarn, a pull-in piece, a filament, an elastic body, and a displacement detector. The pull-in piece is a member that is hooked to the yarn to pull in the yarn toward the storing unit, and that linearly reciprocates along the pull-in direction. The filament includes one end

side, to which the pull-in piece is connected, and a turn back portion extending in the pull-in direction from the one end side and being turned back to an opposite direction, the filament being a member that reciprocates by interlocking with the reciprocate movement of the pull-in piece without substantially stretching or contracting. The elastic body is a member that is connected to the filament at a predetermined position on the other end side of the filament. The displacement detector is a member that detects the displacement of the filament from an origin position determined in advance. Furthermore, the yarn supplying system of the present invention further includes a control means that controls a supply amount of the yarn from the bobbin based on the displacement of the filament from the origin position.

[0011] According to one aspect of the yarn supplying system of the present invention, the yarn supplying system further includes an immobile fixing member that fixes the other end of the filament, and a moving pulley around which the filament between the turn back portion and the fixing member is wound, the moving pulley reciprocating by interlocking with the reciprocate movement of the filament. The elastic body is connected to the filament through the moving pulley.

[0012] According to another aspect of the yarn supplying system of the present invention, the yarn supplying system further includes a detection sensor that detects a position of a joint of the filament and the elastic body in at least one area of a range in which the joint reciprocates. A position of the filament of when the joint is detected by the detection sensor is the origin position.

[0013] According to the yarn supplying system of the present invention, the displacement (movement amount) from the origin position of the filament coupled to the pull-in piece, which pulls in the yarn toward the storing unit, is continuously measured in real time by the displacement detector. The pull-in piece linearly reciprocates along the pull-in direction to reach a position where a tensile force acting on the yarn and a tensile force by the filament (elastic body) are balanced. The storage amount of the yarn in the storing unit can be controlled by the reciprocate movement of the pull-in piece, and the storage amount of the yarn can be grasped by the position of the pull-in piece. Since the movement amount of the filament changes according to the position of the pull-in piece, the movement amount of the filament can be used to grasp the storage amount of the yarn. As the movement amount of the filament can be continuously measured in real time, a predetermined amount of yarn can be stored in the storing unit by controlling the supply amount of the yarn from the yarn supplying device based on the measurement result, so that the yarn can be supplied without slackening to the receiving device of the yarn while maintaining the tensile force acting on the yarn in the yarn supply path within a constant range. Therefore, the yarn can be supplied in correspondence with the fluctuation of the usage amount of the yarn on the receiving device side. As a result, the quality of the re-

sultant object (knitted fabric and woven fabric) obtained by the receiving device can be enhanced.

[0014] In particular, the filament substantially does not stretch or contract with the reciprocate movement of the pull-in piece, and thus measuring the movement amount of the filament is equivalent to measuring the movement amount of the pull-in piece, whereby the accurate position of the pull-in piece can be obtained. Furthermore, through the use of the filament that substantially does not stretch or contract, the degree of freedom in the arrangement mode of the filament is high and the degree of freedom in the arrangement location of the displacement detector for measuring the movement amount of the filament is high. For example, when pulling the pull-in piece with only the elastic body without arranging the filament, if the spring is used for the elastic body, the spring can only be arranged linearly along the pull-in direction. In this case, the yarn storing device needs to be large linearly if the movement amount of the pull-in piece is large. In contrast, the filament can be easily turned back along the pull-in direction of the yarn by arranging the filament that substantially does not stretch or contract between the pull-in piece and the spring, and a small yarn storing device can be built.

[0015] If the supply amount of the yarn greatly fluctuates, the movement amount of the pull-in piece becomes large and the stretching (tensile force) of the elastic body also greatly fluctuates therewith. The position of the pull-in piece changes so that the force acting on the yarn and the force by the filament (elastic body) are balanced, and thus if the stretching of the elastic body greatly fluctuates, the fluctuation by the stretching of the elastic body easily influences the force acting on the yarn. If the filament and the elastic body are connected through the moving pulley, the stretching amount of the elastic body becomes half the movement amount of the filament (pull-in piece). Thus, the force acted by the filament can be made to half the force acted by the elastic body. Therefore, even if the supply amount of the yarn greatly fluctuates and the stretching of the elastic body greatly fluctuates with such fluctuation, the influence of the fluctuation in the stretching of the elastic body with respect to the yarn can be reduced and the yarn can be stably supplied to the receiving device. Furthermore, since the stretching amount of the elastic body can be reduced, the load on the elastic body can be reduced thus enhancing the lifespan of the elastic body itself, and the supply amount of the yarn can be stably adjusted over a long period of time.

[0016] With the arrangement of the detection sensor, the origin position of the filament can be easily reset even if the origin position of the filament is shifted due to a slip or the like at the turn back portion. The displacement of the displacement detector is assumed as zero in the reset origin position, so that the error in the displacement of the displacement detector caused by the shift of the filament can be removed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Fig. 1A shows a schematic configuration front view of a yarn supplying system according to a first embodiment, and Fig. 1B is a rear view of a yarn storing device of Fig. 1A; and

Fig. 2 is a schematic configuration rear view of a yarn storing device of a yarn supplying system according to a second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Embodiments of the present invention will be hereinafter described based on the drawings. The embodiments of the present invention are not limited to the following embodiments, and the embodiments can be appropriately changed within a scope not deviating from the gist of the invention. In the figures, the same reference numerals are denoted on the components having the same name.

<First Embodiment>

[0019] As shown in Fig. 1A, a yarn supplying system according to a first embodiment is a system that supplies a yarn 3Y to a flat knitting machine (receiving device of yarn) 4 for knitting a fabric, and includes a yarn supplying device 1 that reels out the yarn 3Y from a bobbin 3, around which the yarn 3Y is wound; and a yarn storing device 2 that temporarily stores the yarn 3Y reeled out from the bobbin 3 in the middle of a yarn supply path extending from the yarn supplying device 1 to the flat knitting machine 4 and feeds the yarn 3Y to the receiving device 4. One of the characteristics of this yarn supplying system 100 is that a configuration of controlling a supply amount of the yarn 3Y from the bobbin 3 is arranged so that a storage amount of the yarn in a storing unit is adjusted to be an appropriate amount to maintain a tensile force acting on the yarn 3Y in the yarn supply path in an appropriate range.

[Yarn supplying device]

[0020] The yarn supplying device 1 of the first embodiment includes a pair of supporting members for sandwiching and fixing both end faces of the bobbin 3, a motor 1M for rotating the supporting units, and a control means 1C for controlling the rotation of the motor 1M. The supporting units have a tapered shape toward a shaft hole of the bobbin 3, which tapered portion is inserted to the shaft hole so that a rotation axis of the supporting units and a shaft center of the bobbin 3 are fixed in a matching state. When the supporting units are rotated by the motor 1M, the bobbin 3 is rotated and the yarn 3Y is reeled out from the bobbin 3. A reel-out amount (supply amount) of

the yarn 3Y is adjusted by the rotation speed of the bobbin 3, that is, the rotation speed of the supporting units. Besides the yarn supplying device 1, a yarn supplying device that mounts a bobbin on a pair of rollers, and rotates the rollers with a motor to reel out the yarn may be used.

[0021] The yarn supplying device 1 that supplies the yarn 3Y from the bobbin 3 that is rotated is suitable when, for example, supplying the yarn 3Y such as a metal yarn that is hard and is less likely to stretch, a tape yarn that has a flat cross-section, and the like. This is because when the bobbin 3 itself is rotated, the yarn 3Y is twisted thus preventing kink from occurring in the yarn 3Y. In the yarn supplying device 1 that rotates the bobbin 3 itself, it is difficult to make the supply amount of the yarn 3Y quickly respond to the rapid increase or decrease of the usage amount of the yarn 3Y. The yarn supplying system 100 including such yarn supplying device 1 thus requires the yarn storing device 2, to be described later.

[Yarn storing device]

[0022] The yarn storing device 2 is a device that temporarily stores the yarn 3Y reeled out from the bobbin 3 and then feeds the yarn to the flat knitting machine 4 to reduce the rapid fluctuation of the tensile force acting on the yarn 3Y resulting from the difference between the supply amount of the yarn 3Y from the yarn supplying device 1 and the usage amount of the yarn 3Y in the flat knitting machine 4. The yarn storing device 2 is configured mainly by a storing unit 10, a pull-in piece 20, a filament 30, an elastic body 40, and a displacement detector 50.

[0023] The storing unit 10 is a portion that pulls in the yarn 3Y vertically downward and stores the yarn in the middle of the yarn supply path. The pull-in direction of the yarn 3Y is not limited to the vertically downward direction, and can be any direction that intersects the yarn supply path of when the yarn storing device 2 is not arranged. For example, the yarn 3Y may be pulled in vertically upward, in the horizontal direction, and the like. In this case, the storing unit 10 extends vertically upward or in the horizontal direction. In addition, the yarn 3Y extending from the yarn supplying device 1 toward the flat knitting machine 4 may be turned back toward the yarn supplying device 1, and then turned back again to extend toward the flat knitting machine 4. That is, the yarn supply path may be configured to an S-shape so that the yarn 3Y is pulled in toward the yarn supplying device 1. A pair of rollers is arranged in a direction parallel to the yarn supply path on the upper side of the yarn storing device 2. The yarn 3Y pulled out from the yarn supplying device 1 is pulled into the storing unit 10 through a pull-in roller 2i arranged on the yarn supplying device 1 side, and the yarn 3Y pulled out from the storing unit 10 is supplied to the flat knitting machine 4 through a feed roller 2o arranged on the flat knitting machine 4 side.

[0024] The pull-in piece 20 is a member hooked to the yarn 3Y to pull in the yarn 3Y toward the storing unit 10

side, and linearly reciprocates along the pull-in direction according to the change in the supply amount and the usage amount of the yarn 3Y. The filament 30, to be described later, is connected to the pull-in piece 20. Furthermore, the elastic body 40, to be described later, is connected to the filament 30. The pull-in piece 20 moves along the vertical direction to a position where the force of being pulled vertically upward by the yarn 3Y and a force of being pulled vertically downward by the filament 30 and the elastic body 40, respectively, are balanced. Specifically, the force which pulls the pull-in piece 20 vertically downward also includes the weight of the pull-in piece 20 and the yarn 3Y. The pull-in piece 20 moves vertically upward when the usage amount of the yarn 3Y by the receiving device 4 is greater than the supply amount of the yarn 3Y from the yarn supplying device 1, and the pull-in piece 20 moves vertically downward when the supply amount is greater than the usage amount of the yarn 3Y. In this case, the filament 30 displaces from an origin position, to be described later, according to the position of the pull-in piece 20, and the stretching amount of the elastic body 40 changes.

[0025] The pull-in piece 20 in the first embodiment is a pulley made of plastic. The yarn 3Y is wound around a circumferential groove of the pulley and turned back vertically upward, and the filament 30 is connected to the pulley in a direction of pulling the pulley vertically downward. If the yarn 3Y is a metal yarn, and the like that is hard and is less likely to stretch, a pulley having a diameter such that the yarn 3Y does not curl when it is turned back is preferably adopted. The pull-in piece 20 may be made light weight by being made of plastic or by being locally perforated, so that the acceleration of the movement of the pull-in piece 20 corresponding to the fluctuation of the usage amount of the yarn 3Y can be enhanced. As a result, an excessive tensile force can be prevented from being applied on the yarn 3Y when the storage amount of the yarn 3Y is reduced, and a tensile force may be rapidly applied on the yarn 3Y to remove the slack of the yarn 3Y when the storage amount of the yarn 3Y is increased. The pulley may be rotatably supported by a slider for example. The slider is fitted to a rail (not shown) arranged along the pull-in direction, and moves along the rail.

[0026] The pull-in piece 20 merely needs to be able to hook the yarn, and a ring may be used other than the pulley. In the case of the ring-like pull-in piece, the yarn is to be inserted through the ring. An S-shaped hook may also be used. The yarn may be hooked to one end of the S-shaped hook, and the filament may be attached to the other end.

[0027] The filament 30 has one end connected to the pull-in piece 20, and the other end connected to the elastic body 40 through a joint 60, to be described later. In the middle of the filament 30, there is arranged a turn back portion 30t extending from one end side in the pull-in direction and being turned back in the opposite direction. The filament 30 is wound around a rotating body 50r

arranged on the lower side of the storing unit 10 to obtain the turn back portion 30t. The filament 30 is turned back in the direction (vertically upward) opposite to the pull-in direction (vertically downward herein) at the turn back portion 30t. The rotating body 50r may be made of aluminum to have lighter weight, and may be made of resin such as polyamideimide to have lighter weight and so that the filament 30 is less likely to slide. As shown in Fig. 1, the rotating body 50r is arranged in a direction the axis becomes parallel to the yarn supply path, where the turned back filament 30 is arranged on the rear surface side (far side in the figure) of the filament 30 of before being turned back. As shown in Fig. 1B, the turned back filament 30 is fixed to the joint 60, and is connected to the elastic body 40 through the joint 60.

[0028] The material of the filament 30 is suitably a material that substantially does not stretch or contract with the reciprocate movement of the pull-in piece 20. The filament 30 may be, for example, made of nylon fiber (Young's modulus: 3 to 7 GPa), aramid fiber (Young's modulus: 60 to 144 GPa), and the like.

[0029] The elastic body 40 has one end connected to the other end side of the filament 30 through the joint 60, and other end fixed to the vertically upper side of the yarn storing device 2. A tension spring is used for the elastic body 40. The filament 30 displaces from the origin position, to be described later, according to the position of the pull-in piece 20, and the stretching amount of the elastic body 40 changes. The joint 60 of the filament 30 and the elastic body 40 is the slider fitted to the rail (not shown) arranged along the pull-in direction, and moves along the rail. Since the filament 30 is arranged in a state of being turned back, the joint 60 moves in the opposite direction from the pull-in piece 20. For example, when the pull-in piece 20 moves vertically upward, the joint 60 moves vertically downward, and the stretching of the elastic body 40 becomes greater than before the movement of the pull-in piece 20. On the contrary, when the pull-in piece 20 moves vertically downward, the joint 60 moves vertically upward, and the stretching of the elastic body 40 becomes smaller than before the movement of the pull-in piece 20. The filament 30 and the elastic body 40 are connected to the joint 60 serving as the slider herein, but the filament 30 and the elastic body 40 may be directly joined.

[0030] The displacement detector 50 detects the displacement (movement amount) from the origin position of the filament 30 that reciprocates by interlocking with the reciprocate movement of the pull-in piece 20. The displacement detector 50 includes, for example, a rotary encoder. The displacement detector 50 may be arranged at any location as long as the movement amount of the filament 30 can be measured. The displacement detector 50 is arranged next to the rotating body 50r at the position of the turn back portion 30t of the filament 30 herein. The rotary encoder detects the rotation number of the rotating body 50r. The movement amount of the filament 30 is based on [rotation number of rotating body 50r x circum-

ferential length of rotating body 50r]. While the yarn supplying device 1 is operating, the movement amount of the filament 30 continues to be detected by the encoder.

[0031] The origin position of the filament 30 can be set to an arbitrary position beforehand. The details of the origin position will be described later. The movement amount of the filament 30 is substantially the same as the movement amount of the pull-in piece 20, and thus the movement amount of the pull-in piece 20 with respect to the origin position can be found from the movement amount of the filament 30 detected and obtained by the displacement detector 50, whereby the storage amount of the yarn 3Y can be grasped.

[0032] With the yarn storing device 2 having the above configuration, the amount of the yarn 3Y fed out from the storing unit 10 changes according to the change in the usage amount of the yarn 3Y in the flat knitting machine 4, and the fluctuation of the tensile force acting on the yarn 3Y can be reduced. For example, when the usage amount of the yarn 3Y is increased, the pull-in piece 20 moves vertically upward, and the amount of the yarn 3Y fed out from the storing unit 10 is increased. When the usage amount of the yarn 3Y is reduced, the pull-in piece 20 moves vertically downward, and the amount of the yarn 3Y fed out from the storing unit 10 is reduced so that the yarn 3Y does not slacken.

[0033] The information on the movement amount (displacement from the origin position) of the filament 30 detected by the displacement detector 50 is output to the control means 1C of the yarn supplying device 1. The control means 1C controls the motor 1M based on such information, and fine-tunes the reel-out amount (supply amount) of the yarn 3Y from the bobbin 3 so that the pull-in piece 20 is balanced in the vicinity of a predetermined position (e.g., passing point where the pull-in piece 20 frequently passes) in the pull-in direction. For example, if the position of the pull-in piece 20 is high, this means that the supply amount of the yarn 3Y from the bobbin 3 has not caught up with the usage amount of the yarn 3Y in the flat knitting machine 4, and thus the control means 1C raises the rotation speed of the motor 1M. If the position of the pull-in piece 20 is low, the control means 1C reduces the rotation speed of the motor 1M to suppress the supply amount of the yarn 3Y from the bobbin 3.

[0034] As shown in Fig. 1B, the yarn storing device 2 of the first embodiment includes proximity sensors (detection sensors) 80A, 80B, 80C arranged spaced apart in the moving direction of the joint 60 of the filament 30 and the elastic body 40, and a position detection means 80 including a control means (not shown) for controlling the proximity sensors 80A to 80C. The information detected by the proximity sensors 80A to 80C is output to the control means 1C of the yarn supplying device 1. The proximity sensor 80A is arranged at an upper end position in a movement range of the joint 60, the proximity sensor 80B is arranged at a lower end position in the movement range of the joint 60, and the proximity sensor 80C is arranged in the vicinity of the passing point where the

pull-in piece 20 frequently passes in the movement range. For example, if the position of the filament 30 of when the joint 60 is at the position of the proximity sensor 80A is assumed as the origin position, the position of the pull-in piece 20 at that time is assumed as the initial setting. When the yarn storing device 2 is continuously used, the filament 30 may slide with respect to the rotating body 50r thus causing the origin position to shift. According to the position detection means 80, the origin position of the filament 30 can be calibrated with respect to the shift. The information detected by the proximity sensor 80A and the information detected by the displacement detector 50 are both transmitted to the control means 1C of the yarn supplying device 1, and the origin position of the filament 30 is calibrated based on both information. Specifically, the control means 1C first controls the motor 1M and moves the joint 60 to the proximity sensor 80A. The control means 1C then sets the displacement amount obtained by the displacement detector 50 to zero when receiving the information that the joint 60 is detected by the proximity sensor 80A, and resets the position of the filament 30 at that time as the origin position. According to this resetting of the origin position, the influence of sliding, and the like of the filament 30 with respect to the rotating body 50r can be eliminated. The influence can be eliminated by simply resetting the origin position because the displacement amount of the filament 30 obtained by the displacement detector 50 represents the displacement amount of the pull-in piece 20 as is. That is, the displacement amount merely needs to be deducted to the position of the pull-in piece 20 at the origin position. The proximity sensor 80A is used herein, but the proximity sensors 80B, 80C may be used.

[0035] The proximity sensors 80A, 80B may be used to monitor so that the joint 60 does not go beyond the upper and lower limits of the movement range during the operation of the yarn supplying system 100. The joint 60 moves in the opposite direction from the pull-in piece 20, and thus the monitoring of the upper limit and the lower limit of the joint 60 means the monitoring of the lower limit and the upper limit of the pull-in piece 20. The yarn supplying device 1 and the flat knitting machine 4 may be urgently stopped based on the detection results of the proximity sensors 80A, 80B.

[0036] Furthermore, the origin position can be reset even during the operation of the yarn supplying device 1 by using the proximity sensor 80C arranged at the passing point (e.g., middle point in the pull-in direction) frequently passed in the reciprocate movement of the pull-in piece 20 as a calibration sensor of the origin position of the filament 30. If the proximity sensors 80A to 80C are used only for the resetting of the origin position, the positions of the proximity sensors 80A to 80C do not need to be set at the upper and lower end positions of the movement range of the joint 60, and may be set to any position in the movement range.

[0037] According to the yarn supplying system 100 having the configuration described above, the storage

amount of the yarn 3Y in the storing unit 10 can be maintained in a constant range, and the yarn 3Y can be supplied to the flat knitting machine 4 with the tensile force acting on the yarn 3Y maintained in the constant range. As a result, a fabric with stable quality can be knitted. Furthermore, drawbacks such as the yarn 3Y breaking and the supply of the yarn 3Y to the flat knitting machine 4 stopping, and the like are less likely to occur, whereby the fabric can be knitted with satisfactory productivity.

<Second Embodiment>

[0038] In the first embodiment, the yarn supplying system 100 in which each one end of the filament 30 and the elastic body 40 are connected to the joint 60 has been described. According to another embodiment, a moving pulley 60p can be used as the joint 60, as shown in Fig. 2. The yarn supplying system 100 of the second embodiment merely differs from the first embodiment in the configuration of the joint 60, and other configurations are similar to the first embodiment, and hence the following description will be made focusing on the difference.

[0039] The filament 30, which has one end connected to the pull-in piece 20, is extended vertically downward, and turned back at the turn back portion 30t, and then wound around the circumferential groove of the moving pulley 60p and further turned back vertically downward. The other end of the filament 30 is fixed to a fixing member 30f on the vertically lower side of the storing unit 10 after being turned back at the moving pulley 60p. The fixing member 30f is an immobile member arranged on the rail, and is a fastening clasp integrally attached to the rail in the present embodiment. The elastic body 40 is connected to the moving pulley 60p in the direction of pulling the pulley 60p vertically upward. The moving pulley 60p is axially supported by a slider (not shown), which slider is fitted to a rail (not shown) arranged along the vertical direction to move along the rail. As shown in Fig. 2, the moving pulley 60p has a rotation axis arranged along a perpendicular direction in the plane of drawing herein, but the rotation axis may be arranged along the left and right direction in the plane of drawing. If the rotation axis is arranged along the left and right direction in the plane of drawing, the filament 30 having the moving pulley 60p sandwiched in between is arranged on the near side and the far side in the plane of drawing. In this case, the turn back direction at the turn back portion 30t and the turn back direction at the moving pulley 60p are the same in the handling of the filament 30, so that the filament 30 is less likely to be twisted, and the mechanical load acting on the filament 30 is small.

[0040] The moving pulley 60p reciprocates by interlocking with the reciprocate movement of the pull-in piece 20 (Fig. 1A). In this case, the moving pulley 60p moves along the vertical direction to a position where the force of being pulled vertically downward by the filament 30 and the force of being pulled vertically upward by the elastic body 40 are balanced. The filament 30 is wound

around and turned back at the moving pulley 60p, so that a force F of being pulled vertically upward by the elastic body 40 and a force of being pulled vertically downward by the two filaments 30 are balanced. Therefore, if the own weight of the moving pulley 60p is not taken into account, the force acted by one filament 30 is $F/2$, whereby the force acting vertically downward at the pull-in piece 20 is also $F/2$.

[0041] When using the flat knitting machine 4 as the receiving device of the yarn 3Y, the yarn is greatly consumed at the beginning of knitting and the time of inversion of yarn feeding. If the supply amount of the yarn greatly fluctuates, the movement amount of the pull-in piece 20 (filament 30) becomes large and the stretching of the elastic body 40 also greatly fluctuates therewith. If the stretching of the elastic body 40 greatly fluctuates, the fluctuation by the stretching of the elastic body 40 easily influences the force acting on the yarn 3Y. In the second embodiment, the force acted by the filament 30 can be reduced to half the force acted by the elastic body 40, and thus the force acting on the yarn 3Y from the elastic body 40 can be reduced. Therefore, even if the supply amount of the yarn 3Y greatly fluctuates and the stretching of the elastic body 40 greatly fluctuates by interlocking with the fluctuation of the supply amount, the force acting on the yarn 3Y from the elastic body 40 can be reduced, whereby the yarn 3Y can be stably supplied to the flat knitting machine 4.

[0042] The movement amount of the moving pulley 60p becomes $L/2$ with respect to the movement amount L of the pull-in piece 20 (Fig. 1A) by using the moving pulley 60p, and thus the yarn storing device 2 can be miniaturized. The stretching/contracting amount of the elastic body 40 also can be reduced compared to the first embodiment, so that the load on the elastic body 40 becomes small, chronologic flattening on the elastic body 40 can be suppressed and the stable control of the supply amount of the yarn can be carried out over a long period of time. When aiming to miniaturize the yarn storing device 2, another moving pulley may be arranged, so that the filament 30 turned back at the moving pulley 60p can be further turned back by such moving pulley. Accordingly, the yarn storing device 2 can be miniaturized in the vertical direction, and the load on the elastic body 40 can be further reduced.

[0043] The receiving device of the yarn 3Y in the first and second embodiments merely needs to be able to produce some kind of product by receiving the supply of the yarn 3Y, and is not limited to the flat knitting machine 4. For example, the warp knitting machine, weaving machine, yarn twisting machine, and the like may be adopted.

[0044] Furthermore, the joint 60 (moving pulley 60p) in the first and second embodiments is arranged on the rear side (far side in the plane of drawing of Fig. 1A) of the pull-in piece 20, but may be arranged in parallel on either left or right of the pull-in piece 20. In such case, the rotating body 50r is to be arranged so that its rotation

axis becomes parallel to the rotation axis of the pull-in piece 20 (pulley).

[0045] In the first and second embodiments, the supply amount of the yarn 3Y from the bobbin 3 is adjusted by controlling the motor 1M with the control means 1C so that the pull-in piece 20 is maintained around the middle of the range in which the pull-in piece 20 reciprocates. In contrast, if the usage amount of the yarn 3Y in the flat knitting machine 4 is large, the control means 1C may reduce the supply amount of the yarn 3Y to balance the pull-in piece 20 at the position upper than the middle of the movement range thereof to prepare for the rapid reduction in the usage amount of the yarn 3Y. This can prevent the yarn 3Y from slackening due to the rapid reduction in the usage amount of the yarn 3Y which causes the pull-in piece 20 to lower too much. If the usage amount of the yarn 3Y in the flat knitting machine 4 is small, the control means 1C may increase the supply amount of the yarn 3Y to balance the pull-in piece 20 at the position lower than the middle of the movement range thereof to prepare for the rapid increase in the usage amount of the yarn 3Y. This can prevent an excessively large tensile force from acting on the yarn 3Y due to the rapid increase in the usage amount of the yarn 3Y which causes the pull-in piece 20 to rise too much.

(3Y) from the bobbin (3) based on the displacement of the filament (30) from the origin position.

2. The yarn supplying system according to claim 1, further including an immobile fixing member (30f) that fixes the other end of the filament (30), and a moving pulley (60p) around which the filament (30) between the turn back portion (30t) and the fixing member (30f) is wound, the moving pulley (60p) reciprocating by interlocking with the reciprocate movement of the filament (30); wherein that the elastic body (40) is connected to the filament (30) through the moving pulley (60p).
3. The yarn supplying system according to claim 1 or 2, further including a detection sensor (80A) that detects a position of a joint (60) of the filament (30) and the elastic body (40) in at least one area of a range in which the joint (60) reciprocates; wherein a position of the filament (30) of when the joint (60) is detected by the detection sensor (80A) is the origin position.

Claims

1. A yarn supplying system (100) including a yarn supplying device (1) that reels out a yarn (3Y) from a bobbin (3); and a yarn storing device (2) that temporarily stores the yarn (3Y) reeled out from the bobbin (3) in a middle of a yarn supply path extending from the yarn supplying device (1) to a receiving device (4) of the yarn and feeds the yarn (3Y) to the receiving device (4); **characterized in that** the yarn storing device (2) includes a storing unit (10) that stores the yarn (3Y), a pull-in piece (20) that is hooked to the yarn (3Y) to pull in the yarn (3Y) toward the storing unit (10) and that linearly reciprocates along a pull-in direction, a filament (30) that includes one end side, to which the pull-in piece (20) is connected, and a turn back portion (30t) extending in the pull-in direction from the one end side and being turned back to an opposite direction, the filament (30) reciprocating by interlocking with the reciprocate movement of the pull-in piece (20) without substantially stretching or contracting, an elastic body (40) that is connected to the filament (30) at a predetermined position on other end side of the filament (30), and a displacement detector (50) that detects displacement of the filament (30) from an origin position determined in advance; and the yarn supplying system (100) includes a control means (1C) that controls a supply amount of the yarn

Fig. 1

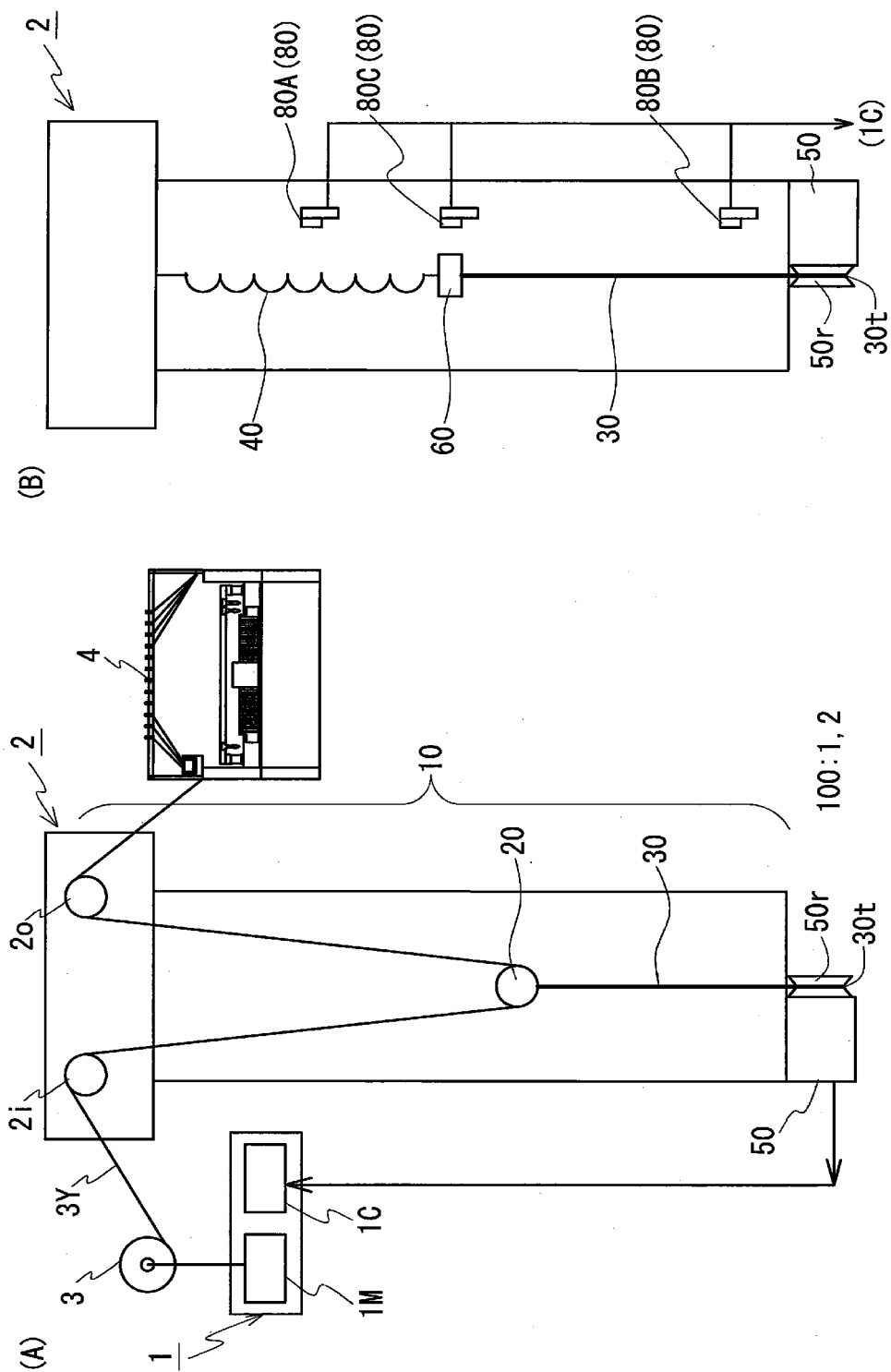
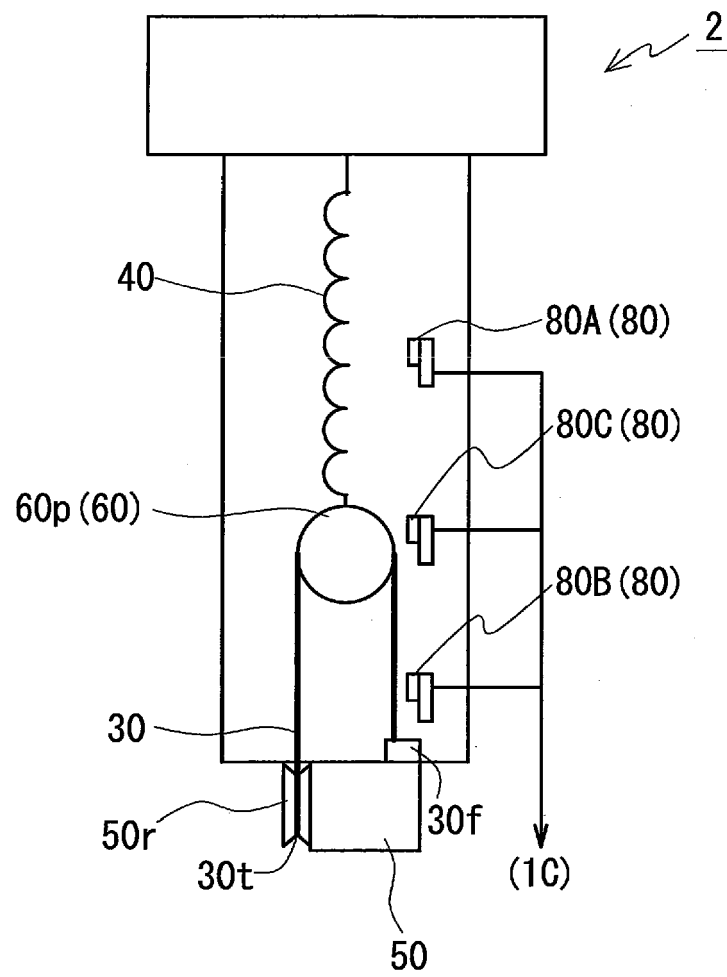


Fig. 2





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