



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.11.2018 Bulletin 2018/46

(51) Int Cl.:
D04B 15/50 (2006.01)

(21) Application number: **18171107.8**

(22) Date of filing: **07.05.2018**

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

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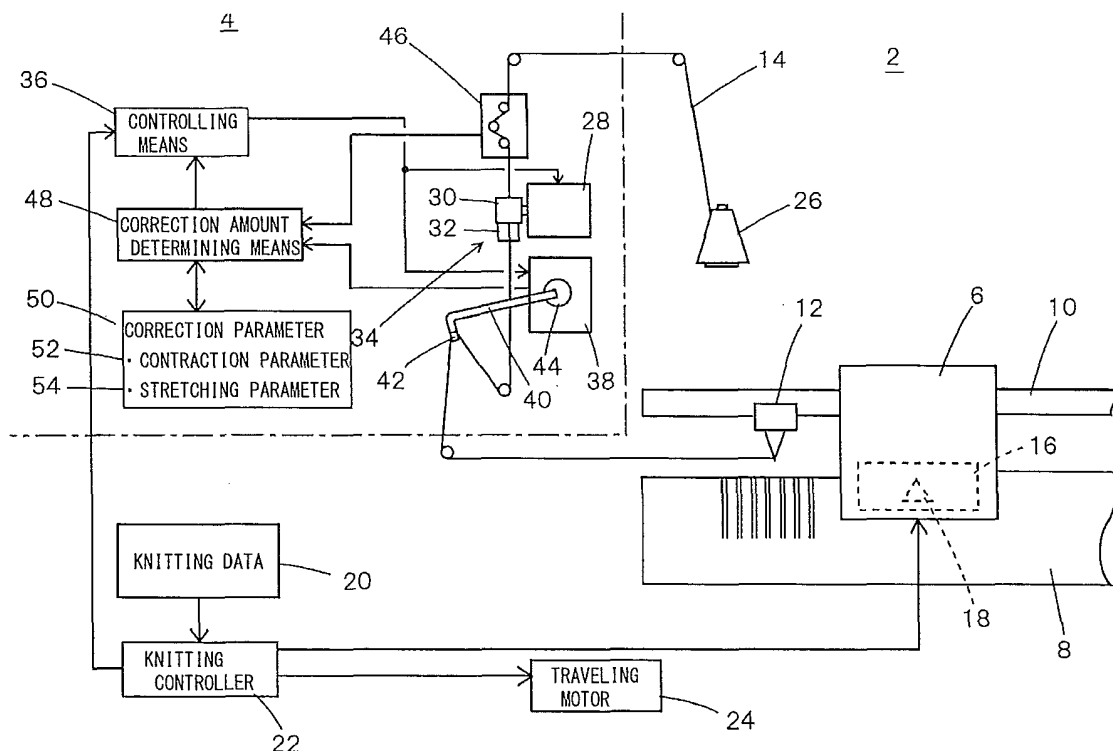
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(30) Priority: **08.05.2017 JP 2017092655**

(54) **YARN FEEDING DEVICE FOR ELASTIC YARN FOR FLAT KNITTING MACHINE**

(57) The magnitude of an entering tension of an elastic yarn to a sending-out mechanism (34) of a flat knitting machine and the magnitude of a knitting tension provided by a buffer arm (40) are compared with each other, and, based on a result of comparison, an appropriate correction amount is determined from a correction parameter (50) to control the sending-out mechanism (34). The correction parameter (50) includes a correction amount for increasing an amount of elastic yarn when the entering

tension is larger than the knitting tension, and a correction amount for decreasing the amount of elastic yarn when the entering tension is smaller than the knitting tension. Correction amount determining means (48) determines an appropriate correction amount from the correction parameter (50). Controlling means (36) controls the sending-out mechanism (34) by using the correction amount determined by the correction amount determining means (48).



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn feeding device for an elastic yarn when a knitting operation is performed at a flat knitting machine by using elastic yarns having high elasticity as knitting yarns.

2. Description of the Related Art

[0002] Hitherto, elastic yarns using fibers that have high stretchability and that stretch and contract have been used in knitting, for example, underwear, socks, supporters, clothing for sports, and medical elastic clothing. In flat knitting machines for knitting such knit products, it is desired that a loop length of a stitch of a knitted fabric that is knitted be stabilized, and the knitting operation be performed with a predetermined amount of yarn. When each knit course is not knitted with a determined amount of yarn, differences in, for example, lengths, texture, and tension occur among the knit products.

[0003] As prior arts for yarn feeding devices for elastic yarns for knitting machines, for example, the following publications are available. According to Japanese Patent No. 4016030, on the basis of knitting data, a required loop length of a stitch for each knitting needle is determined, knitting yarns are actively fed in synchronism with the movement of a carrier, and, due to angular displacement of a buffer arm before and after knitting a course, density is corrected.

[0004] However, in this invention, when the tension of an elastic yarn that enters the yarn feeding device is not constant, since the elastic yarn sent out by the active feeding may contract or stretch, a difference occurs between a yarn length of the elastic yarn that has been fed for a knit course and a theoretical value. Therefore, in the next and subsequent courses, the density is corrected to try to cause the yarn length in the knit course to become a determined yarn length. However, the density is erroneously corrected, as a result of which it is difficult to bring the amount of elastic yarn closer to the theoretical value.

[0005] According to Japanese Patent No. 2541574, tension is applied to a knitting yarn by a guide arm and preliminary storage is performed to make it possible to deal with sudden changes in tension, to suppress changes in the tension of the yarn while actively sending out the knitting yarn. During the knitting operation, the guide arm detects the tension of the knitting yarn, and a motor that drives a spinning wheel, where the preliminary storage is performed, is controlled.

[0006] However, in the invention, since the preliminary storage is performed at the spinning wheel, the device becomes large. Since a difference occurs between the tension of the elastic yarn that is wound around the spin-

ning wheel and the tension that occurs at the guide arm, the elastic yarn contracts or stretches in a yarn feed path. Therefore, it is not possible to supply a required amount of elastic yarn. In addition, the characteristics of the elastic yarn change depending upon at which tension the elastic yarn is wound around the spinning wheel, as a result of which it is difficult to supply a required amount of elastic yarn.

10 SUMMARY OF THE INVENTION

[0007] Accordingly, it is an object of the invention to provide a yarn feeding device for an elastic yarn for a flat knitting machine, which makes it possible to, in a knitting operation performed at the flat knitting machine by using the elastic yarn, perform a required yarn feeding operation in which the stretching and contraction of the elastic yarn are considered without increasing the size of the device.

[0008] According to the present invention, there is provided a yarn feeding device for an elastic yarn for a flat knitting machine. The yarn feeding device includes a sending-out mechanism that sends out the elastic yarn to a yarn feeding member by a roller based on knitting data that is used in a knitting machine body; a buffer arm that is swingable and that intermediately stores the yarn sent out from the sending-out mechanism; a torque generator that applies a torque to the buffer arm for causing a knitting tension of the elastic yarn from the sending-out mechanism to the yarn feeding member to become a predetermined value; and controlling means that calculates a theoretical value of a loop length of a stitch that is knitted for each knitting needle, and controls the sending-out mechanism such that a required yarn feeding operation of the elastic yarn is performed in synchronism with a movement of the yarn feeding member. The yarn feeding device includes a tension sensor that is disposed on an upstream side of the roller, and that measures a tension of the elastic yarn as an entering tension of the elastic yarn to the roller; a correction parameter that is used for correction for bringing the loop length of the stitch closer to the theoretical value from characteristics of the elastic yarn; and correction amount determining means that compares a magnitude of the entering tension of the elastic yarn measured by the tension sensor and a magnitude of a knitting tension provided by the buffer arm, and, from a result of comparison, determines a correction amount with respect to the sending-out mechanism from the correction parameter. The correction parameter includes a correction amount for increasing an amount of elastic yarn when the entering tension is larger than the knitting tension, and a correction amount for decreasing the amount of elastic yarn when the entering tension is smaller than the knitting tension. The correction amount determining means determines an appropriate correction amount from the correction parameter. The controlling means controls the sending-out mechanism by using the correction amount determined by the correction amount

determining means.

[0009] According to the present invention, the correction parameter may include a contraction parameter and a stretching parameter, which are determined from the characteristics of the elastic yarn, and the correction amount determining means may determine the correction amount by using the contraction parameter when the entering tension is larger than the knitting tension, or by using the stretching parameter when the entering tension is smaller than the knitting tension.

[0010] According to the present invention, the entering tension of the elastic yarn that is measured by the tension sensor may be used by calculating an average value of entering tensions measured within a predetermined zone.

[0011] According to the present invention, in order to absorb an error with respect to the theoretical value in knitting one course, the controlling means may perform a density correction in a next course, the error being determined from an angular displacement of the buffer arm after knitting one course.

[0012] According to the present invention, the correction amount determining means may determine a difference between the entering tension of the elastic yarn measured by the tension sensor and the knitting tension provided by the buffer arm, determine a correction amount with respect to the torque of the buffer arm such that the difference is small, and compare the magnitude of the entering tension and the magnitude of the knitting tension of the elastic yarn and, from a result of comparison, determine the correction amount with respect to the sending-out mechanism from the correction parameter. The controlling means may adjust the torque of the buffer arm by the correction amount with respect to the torque of the buffer arm determined by the correction amount determining means, and control the sending-out mechanism by using the correction amount with respect to the sending-out mechanism.

[0013] Accordingly, in the invention, in a knitting operation that is performed at the flat knitting machine by using an elastic yarn, the magnitude of the entering tension of the elastic yarn to the sending-out mechanism of the flat knitting machine and the magnitude of the knitting tension provided by the buffer arm are compared with each other, and, on the basis of the result of comparison, an appropriate correction amount is determined from the correction parameter to control the sending-out mechanism. The correction parameter includes the correction amount for increasing the amount of elastic yarn when the entering tension is larger than the knitting tension, and the correction amount for decreasing the amount of elastic yarn when the entering tension is smaller than the knitting tension. From the result of comparison between the entering tension and the knitting tension, the correction amount determining means determines the appropriate correction value for the sending-out mechanism, and the controlling means controls the sending-out mechanism in accordance with the determined correc-

tion amount. Therefore, it is possible to bring the amount of elastic yarn that is supplied closer to the theoretical value.

[0014] In the present invention, the correction parameter may include the contraction parameter and the stretching parameter, which are determined from the characteristics of the elastic yarn. When the entering tension is larger than the knitting tension, the contraction parameter is used to perform correction, and, when the entering tension is smaller than the knitting tension, the stretching tension is used to perform the correction. Therefore, it is possible to bring the amount of elastic yarn that is supplied more precisely closer to the theoretical value.

[0015] In the present invention, since the measurement of the entering tension by the tension sensor may involve calculating the average value of the tension values measured within a predetermined zone, it is possible to stabilize the tension value.

[0016] In the present invention, after a knitting operation of one course, on the basis of a change in the angle of the buffer arm before the knitting operation of one course and after the knitting operation of one course, density may be corrected in the next course such that an error with respect to the theoretical value in the knitting of one course is absorbed. Since the error of the actual amount of yarn is determined to correct the density such that this error is absorbed in the next course, it is possible to bring the amount of elastic yarn that is supplied closer to the theoretical value without being influenced by changes in the knitting environment.

[0017] In this invention, when a difference occurs between the entering tension and the knitting tension, the correction amount determining means may determine the correction amount of control of the torque of the buffer arm and the correction amount for controlling the sending-out mechanism, and the controlling means may control both the torque of the buffer arm and the sending-out mechanism. Therefore, it is possible to reduce the correction amount of the control of the torque of the buffer arm and the correction amount of the control of the feeding by the sending-out mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 illustrates a yarn feeding device and a flat knitting machine of an embodiment;

Fig. 2 shows a graph of the characteristics of an elastic yarn;

Figs. 3(1) and 3(2) show graphs of a contraction parameter and a stretching parameter in the embodiment; and

Fig. 4 shows a flowchart of a feeding process of the elastic yarn of the embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Embodiments for carrying out the invention are described below.

Embodiments

First Embodiment

[0020] Fig. 1 illustrates a yarn feeding device for an elastic yarn for a flat knitting machine of an embodiment. Although an embodiment in which yarn is fed from the left side of the flat knitting machine is described, the yarn may be fed from the upper side or from the right side. In Fig. 1, reference numeral 2 denotes a flat knitting machine body, and reference numeral 4 denotes a yarn feeding device. Although, in the embodiment, the yarn feeding device 4 and the flat knitting machine body 2 are integrated with each other, the yarn feeding device 4 may be independent from the flat knitting machine body 2. The flat knitting machine body 2 is hereunder simply called the flat knitting machine 2. The flat knitting machine 2 includes, for example, a carriage 6 and a pair of front and back needle beds 8. A carrier 12, which is a yarn feeding member that is movable along a carrier rail 10, is conveyed by, for example, the carriage 6 to feed an elastic yarn 14 with respect to knitting needles of the needle beds 8.

[0021] The carriage 6 is such that which knitting needle of the needle beds 8 is to be driven is selected by a needle selecting device 16, and the selected knitting needle is driven by a cam 18 to perform knitting. Reference numeral 20 denotes knitting data that is supplied to the flat knitting machine 2 from, for example, LAN or a USB memory (which are not shown). The knitting data 20 also includes, for example, data regarding patterns of knit products and data regarding control of the carriage 6, etc. A knitting controller 22 takes out, from the knitting data 20, data regarding control of a traveling motor 24 of the carriage 6, data regarding the selection of knitting needles, density values, or data regarding the conveyance of the carrier 12 to control the flat knitting machine 2 and perform a knitting operation.

[0022] The yarn feeding device 4 takes out the elastic yarn 14 from a cone 26 disposed at an upper portion of the flat knitting machine 2, drives a driving roller 30 by using a servo motor 28, and places the elastic yarn 14 between the driving roller 30 and a driven roller 32 to draw out and wind back the elastic yarn 14. The servo motor 28, the driving roller 30, and the driven roller 32 form a sending-out mechanism 34.

[0023] The servo motor 28 is controlled by controlling means 36. Reference numeral 38 denotes a torque generator that is capable of generating a desired torque and that is controlled by the controlling means 36. The controlling means 36 controls the torque generator 38 such that the elastic yarn 14 that has been drawn out by the driving roller 30 and the driven roller 32 has a desired

tension (hereunder referred to as "knitting tension") during the knitting operation.

[0024] Reference numeral 40 denotes a buffer arm. The buffer arm 40 includes a yarn guide 42 at an end portion thereof. The elastic yarn 14 that is supplied from a location between the driving roller 30 and the driven roller 32 is drawn out from a supply path. The buffer arm 40 swings due to the torque from the torque generator 38. The angular displacement of the buffer arm 40 can be detected by an angle sensor 44 provided at, for example, an output shaft of the torque generator 38.

[0025] Reference numeral 46 denotes a tension sensor that is disposed on an upstream side of the driving roller 30 and the driven roller 32 of the sending-out mechanism 34 in a yarn path of the elastic yarn 14 and that measures the tension of the elastic yarn 14. In the embodiment, this measured tension is called an entering tension. Reference numeral 48 denotes correction amount determining means that compares the entering tension measured by the tension sensor 46 and the knitting tension provided at the buffer arm 40 by the torque generator 38, and determines the feeding amount of the elastic yarn 14 based on the sending-out mechanism 34 such that the amount of elastic yarn 14 that is supplied to the carrier 12 is brought closer to a theoretical value.

[0026] Reference numeral 50 denotes a correction parameter. On the basis of the characteristics of the elastic yarn 14 that is used, correction amounts are stored. There are two types of correction parameter 50. They are a contraction parameter 52 and a stretching parameter 54.

[0027] Here, the characteristics of the elastic yarn 14 are described.

[0028] In the present invention, in order to bring the amount of elastic yarn 14 that is supplied closer to a theoretical value, an appropriate correction amount (correction parameter) is determined to control the sending-out mechanism 34. In order to determine the correction parameter 50, the characteristics of the elastic yarn 14 that is used are required. The characteristics of the elastic yarn 14 differ depending upon the type of elastic yarn 14 that is used. The characteristics of the elastic yarn 14 may also differ due to, for example, differences in the lot or color, even if the type of elastic yarn 14 is the same. In order to bring the amount of elastic yarn 14 that is supplied closer to a theoretical value, it is desirable to, first, acquire the characteristics of the elastic yarn that is actually used.

[0029] As a method of determining the characteristics of the elastic yarn 14, for example, an automatic tension testing machine for yarn is used to measure the yarn characteristics. Here, the required yarn characteristics are the stretching characteristics. After gradually pulling the elastic yarn 14 having a prescribed length (such as 10 cm or 20 cm) up to a prescribed pull tension from a state in which the tension is 0, the pull tension on the elastic yarn 14 is gradually relaxed until the pull tension becomes 0, and the relationship between the tension with

respect to both the stretching and contraction of the elastic yarn 14 and the length of the elastic yarn 14 at this time is determined.

[0030] The table shown in Fig. 2 shows an example of the characteristics of the elastic yarn 14. The pull tensions are those after extracting portions of the tensions in the range of 20 gf to 30 gf. However, actually, a wider range is measured. A characteristic of the elastic yarn 14 is that, due to the effects of hysteresis, the elastic yarn 14 that is stretched once is not restored to its original length. Therefore, as can be understood from Fig. 2, even if the pull tension is the same, the stretching percentage when the elastic yarn 14 stretches and the contraction percentage when the elastic yarn 14 contracts differ from each other.

[0031] In order to acquire the yarn characteristics, manual operations may be performed without using an automatic tension testing machine. Alternatively, in Fig. 1, it is possible to acquire the yarn characteristics at the knitting machine by providing a jig to which the elastic yarn 14 is fixed at a location upstream from the tension sensor 46, fixing the elastic yarn 14 to the jig, driving the driving roller 30 of the sending-out mechanism 34 in this state, measuring the tension while drawing out the elastic yarn 14, and then measuring the tension while winding back the elastic yarn 14.

[0032] Next, the contraction parameter 52 and the stretching parameter 54 of the correction parameter 50 are described.

[0033] Fig. 3(1) shows a table showing an example of the contraction parameter 52. The table shows correction amounts of the sending-out mechanism 34 for corresponding ranges of entering tensions considering the contraction percentages when the elastic yarn 14 contracts from the characteristics of the elastic yarn 14 shown in Fig. 2. The contraction parameter 52 is used when the entering tension of the elastic yarn 14 that is detected by the tension sensor 46 is larger than the knitting tension provided by the buffer arm 40. That is, after the elastic yarn 14 has been sent out by the sending-out mechanism 34, the tension that is applied to the elastic yarn 14 is reduced and the elastic yarn 14 contracts. Therefore, in order to bring the amount of elastic yarn 14 closer to a theoretical value, the contraction parameter 52 is used to perform correction such that the sending-out mechanism 34 acts on a plus side, so that the sending-out amount of the elastic yarn 14 is increased. For example, when it has been determined that the theoretical value of the elastic yarn 14 at a needle pitch is 8 mm, and the correction amount is +2%, the sending-out mechanism 34 is controlled so as to send out an elastic yarn 14 having a length of 8.16 mm.

[0034] Fig. 3(2) shows a table showing an example of the stretching parameter 54. This table shows correction amounts of the sending-out mechanism 34 for corresponding ranges of entering tensions considering the stretching percentages when the elastic yarn 14 stretches from the characteristics of the elastic yarn 14 shown

in Fig. 2. The stretching parameter 54 is used when the entering tension of the elastic yarn 14 that is detected by the tension sensor 46 is smaller than the knitting tension provided by the buffer arm 40. That is, after the elastic yarn 14 has been sent out by the sending-out mechanism 34, the tension that is applied to the elastic yarn 14 is increased and the elastic yarn 14 stretches. Therefore, in order to bring the amount of elastic yarn 14 closer to a theoretical value, the stretching parameter 54 is used to perform correction such that the sending-out mechanism 34 acts on a negative side, so that the sending-out amount of the elastic yarn 14 is decreased. For example, when it has been determined that the theoretical value of the elastic yarn 14 at a needle pitch is 8 mm, and the correction amount is -2%, the sending-out mechanism 34 is controlled so as to send out an elastic yarn 14 having a length of 7.84 mm.

[0035] Fig. 4 shows a flowchart of a feeding process of the elastic yarn 14 during a knitting operation.

[0036] First, the feeding process is started in Step S1. In Step S2, an entering tension before the elastic yarn 14 enters the sending-out mechanism 34 is measured by using the tension sensor 46. The tension sensor 46 measures the tension of the elastic yarn 14 for, for example, every 1 ms in a predetermined zone of a knit course. When the measurement of the tension in the predetermined zone is completed, the average tension in this zone is calculated. This makes it possible to acquire an entering tension with high precision.

[0037] A predetermined zone of knit course may be for one course. However, since the tension of the elastic yarn 14 in a knitting-in zone and a knitting-out zone is not stable, it is desirable that, for example, a location excluding the knitting-in zone and the knitting-out zone be the predetermined zone. It is possible to more stably perform a knitting operation by determining the average value of tensions determined in such a predetermined zone for, for example, two to three courses, and averaging these tension values.

[0038] For example, the measurement of the entering tension and the determination of the correction amount by the correction amount determining means 48 are performed when a knit product is actually knitted. However, when, for example, the measurement of the entering tension and the determination of the correction amount by the correction amount determining means 48 are also performed when a loop length routine is executed in order to perform stitch cam adjustment before the actual knitting operation, it is possible to correct the feeding amount from a first course during the actual knitting operation.

[0039] Next, in Step S3, the knitting tension is acquired. The knitting tension is determined by the torque that is applied to the buffer arm 40 by the torque generator 38. In the embodiment, the torque that is applied to the buffer arm 40 is set such that the knitting tension is fixed at, for example, 20 gf or 25 gf. The knitting tension may be determined in accordance with the characteristics of the elastic yarn 14 that is used and the knit product to be

knitted. Instead of being fixed, the knitting tension may be variable in accordance with, for example, a knitting-in location, a knitting-out location, or a knitting location.

[0040] In Step S4, the magnitude of the entering tension in Step S2 and the magnitude of the knitting tension in Step S3 are compared with each other. In Step S5, if the entering tension is larger than the knitting tension, the process proceeds to Step S6. In Step S6, when the elastic yarn 14 moves past the sending-out mechanism 34, the tension is decreased and, thus, the elastic yarn 14 contracts. Therefore, the correction amount determining means 48 uses the contraction parameter 52 of the correction parameter 50, and determines the correction amount of the sending-out mechanism 34 that is appropriate for the entering tension. Then, the process proceeds to Step S7 and the controlling means 36 controls the sending-out mechanism 34 by the determined correction amount.

[0041] In Step S9, if the entering tension is smaller than the knitting tension, the process proceeds to Step S10. In Step S10, when the elastic yarn 14 moves past the sending-out mechanism 34, the tension is increased and, thus, the elastic yarn 14 stretches. Therefore, the correction amount determining means 48 uses the stretching parameter 54 of the correction parameter 50, and determines the correction amount of the sending-out mechanism 34 that is appropriate for the entering tension. Then, the process proceeds to Step S7 and the controlling means 36 controls the sending-out mechanism 34 by the determined correction amount.

[0042] In Step S11, when the entering tension and the knitting tension are the same, the correction parameter 50 does not need to be particularly used. Then, the process proceeds to Step S7, and the sending-out mechanism 34 is controlled without any correction. Lastly, the process proceeds to Step S8 and the process ends.

[0043] The angular displacement of the buffer arm 40 can be detected by the angle sensor 44. On the basis of the difference between the angle of the buffer arm 40 before the knitting of one course and the angle of the buffer arm 40 after the knitting of one course, it is possible to determine an error between a theoretical value of the amount of elastic yarn 14 that is used for the one course and the actual amount of elastic yarn 14 that is used. The angle of the buffer arm 40 before the knitting of one course can match a predetermined angle by drawing out or winding back the elastic yarn 14 by the sending-out mechanism 34.

[0044] After the knitting of one course, the error of the yarn amount with respect to the theoretical value is calculated, and the density is corrected such that this error can be absorbed in the next course. This makes it possible to bring the length of the elastic yarn 14 even closer to the theoretical value.

Second Embodiment

[0045] In the embodiment, a case in which, when the

difference between the entering tension and the knitting tension is large, control of the torque of a buffer arm 40 and control of a sending-out mechanism 34 are both performed is described.

[0046] First, correction amount determining means 48 compares an entering tension of an elastic yarn 14 measured by a tension sensor 46 and a knitting tension provided by the buffer arm 40, and determines a correction amount of the control of the torque of the buffer arm 40 such that the difference between the entering tension and the knitting tension is small. In accordance with this correction amount, the controlling means 36 controls the torque generator 38 to control the torque of the buffer arm 40. However, since, when the torque of the buffer arm 40 is considerably changed, the knitting tension changes for each course, it is not desirable that the torque of the buffer arm 40 be considerably changed. Therefore, not only is the torque of the buffer arm 40 controlled, but also, as in the first embodiment, the correction amount determining means 48 compares the entering tension and the knitting tension with each other, and determines the correction amount for controlling the sending-out mechanism 34. In this case, it is possible to decrease the correction amounts of both the control of the torque of the buffer arm 40 and the control of the feeding of the sending-out mechanism 34.

[0047] Although, in the above-described embodiments, it is described that it is desirable to determine the characteristics of the elastic yarn 14 that is actually used, it is possible to use already acquired characteristics of the elastic yarn 14 for several purposes when the lot of the elastic yarn 14 is the same, or when small variations in the amount of yarn is allowed.

Claims

1. A yarn feeding device (4) for an elastic yarn for a flat knitting machine, comprising:

a sending-out mechanism (34) that sends out the elastic yarn to a yarn feeding member by a roller based on knitting data that is used in a knitting machine body;

a buffer arm (40) that is swingable and that intermediately stores the yarn sent out from the sending-out mechanism (34);

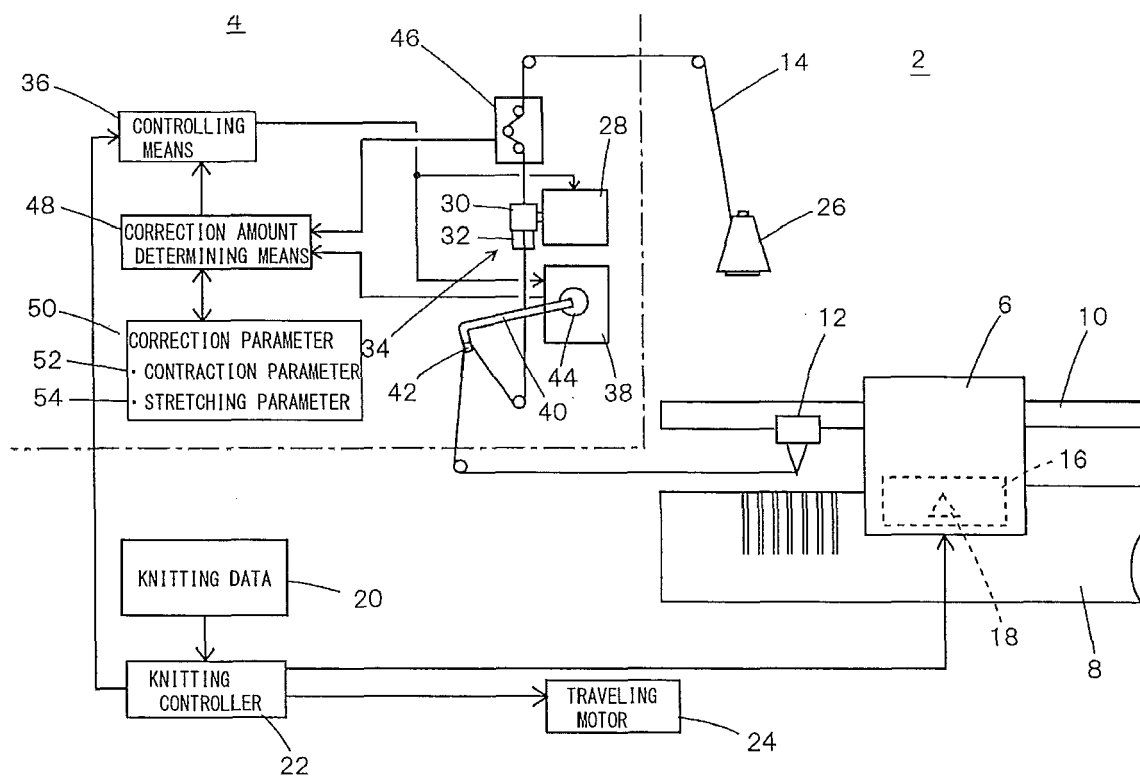
a torque generator (38) that applies a torque to the buffer arm (40) for causing a knitting tension of the elastic yarn from the sending-out mechanism (34) to the yarn feeding member to become a predetermined value; and

controlling means (36) that calculates a theoretical value of a loop length of a stitch that is knitted for each knitting needle, and controls the sending-out mechanism (34) such that a required yarn feeding operation of the elastic yarn is performed in synchronism with a movement of the

- yarn feeding member,
 wherein the yarn feeding device (4) includes
 a tension sensor (46) that is disposed on an up-
 stream side of the roller, and that measures a
 tension of the elastic yarn as an entering tension
 of the elastic yarn to the roller,
 a correction parameter (50) that is used for cor-
 rection for bringing the loop length of the stitch
 closer to the theoretical value from characteris-
 tics of the elastic yarn, and
 correction amount determining means (48) that
 compares a magnitude of the entering tension
 of the elastic yarn measured by the tension sen-
 sor (46) and a magnitude of a knitting tension
 provided by the buffer arm (40), and, from a re-
 sult of comparison, determines a correction
 amount with respect to the sending-out mecha-
 nism (34) from the correction parameter (50),
 wherein the correction parameter (50) includes
 a correction amount for increasing an amount
 of elastic yarn when the entering tension is larger
 than the knitting tension, and a correction
 amount for decreasing the amount of elastic
 yarn when the entering tension is smaller than
 the knitting tension,
 wherein the correction amount determining
 means (48) determines an appropriate correc-
 tion amount from the correction parameter (50),
 and
 wherein the controlling means (36) controls the
 sending-out mechanism (34) by using the cor-
 rection amount determined by the correction
 amount determining means (48).
2. The yarn feeding device (4) for the elastic yarn for
 the flat knitting machine according to Claim 1, where-
 in the correction parameter (50) includes a contrac-
 tion parameter and a stretching parameter, which
 are determined from the characteristics of the elastic
 yarn, and
 wherein the correction amount determining means
 (48) determines the correction amount by using the
 contraction parameter when the entering tension is
 larger than the knitting tension, or by using the
 stretching parameter when the entering tension is
 smaller than the knitting tension.
3. The yarn feeding device (4) for the elastic yarn for
 the flat knitting machine according to either Claim 1
 or Claim 2, wherein the entering tension of the elastic
 yarn that is measured by the tension sensor (46) is
 used by calculating an average value of entering ten-
 sions measured within a predetermined zone.
4. The yarn feeding device (4) for the elastic yarn for
 the flat knitting machine according to any one of
 Claims 1 to 3, wherein, in order to absorb an error
 with respect to the theoretical value in knitting one

course, the controlling means (36) performs a den-
 sity correction in a next course, the error being de-
 termined from an angular displacement of the buffer
 arm (40) after knitting one course.

5. The yarn feeding device (4) for the elastic yarn for
 the flat knitting machine according to any one of
 Claims 1 to 4, wherein the correction amount deter-
 mining means (48) determines a difference between
 the entering tension of the elastic yarn measured by
 the tension sensor (46) and the knitting tension pro-
 vided by the buffer arm (40), determines a correction
 amount with respect to the torque of the buffer arm
 (40) such that the difference is small, and compares
 the magnitude of the entering tension and the mag-
 nitude of the knitting tension of the elastic yarn and,
 from a result of comparison, determines the correc-
 tion amount with respect to the sending-out mecha-
 nism (34) from the correction parameter (50), and
 wherein the controlling means (36) adjusts the
 torque of the buffer arm (40) by the correction amount
 with respect to the torque of the buffer arm (40) de-
 termined by the correction amount determining
 means (48), and controls the sending-out mecha-
 nism (34) by using the correction amount with re-
 spect to the sending-out mechanism (34).



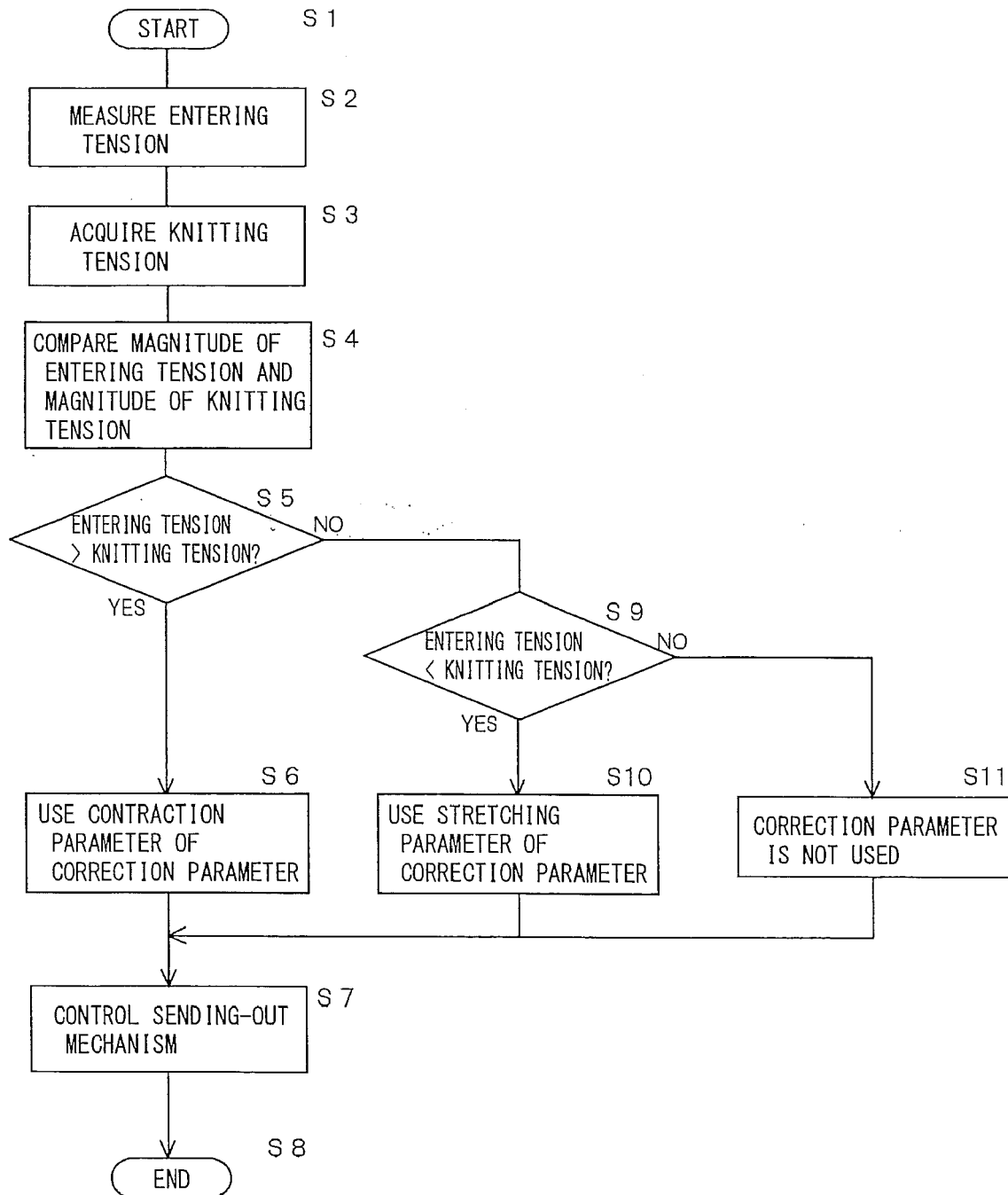
PULL TENSION (gf)	STRETCHING PERCENTAGE (%)	CONTRACTION PERCENTAGE (%)
20gf	230%	236%
25gf	233%	238%
30gf	236%	240%

(1)

ENTERING TENSION(gf)	CORRECTION AMOUNT (%)
20.00 gf OR LARGER	+1%
22.50 gf OR LARGER	+2%
25.00 gf OR LARGER	+3%
27.50 gf OR LARGER	+4%

(2)

ENTERING TENSION(gf)	CORRECTION AMOUNT (%)
LESS THAN 20.00 gf	0%
LESS THAN 18.00 gf	-1%
LESS THAN 16.00 gf	-2%
LESS THAN 14.00 gf	-3%





EUROPEAN SEARCH REPORT

 Application Number
 EP 18 17 1107

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 548 163 A1 (SHIMA SEIKI MFG [JP]) 29 June 2005 (2005-06-29) * paragraphs [0002], [0022] - [0026]; figure 1 *	1-5	INV. D04B15/50
A	EP 2 251 470 A1 (SHIMA SEIKI MFG [JP]) 17 November 2010 (2010-11-17) * paragraphs [0006], [0007], [0009], [0010] - [0018], [0021] - [0045]; figures 1-5 *	1-5	
A	EP 1 626 113 A1 (SHIMA SEIKI MFG [JP]) 15 February 2006 (2006-02-15) * paragraphs [0006], [0014] - [0033]; figures 1-3 *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 September 2018	Examiner Wendl, Helen
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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