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(54) A SETUP METHOD OF TENSION DEVICES ON A FLAT KNITTING MACHINE AND A SETUP SYSTEM

(57) A top tension device, provided on a flat knitting machine, having an adjusting member for adjusting tension to a yarn, according to an electrical input, is set. An input value to the adjusting member for applying a desired tension to a yarn is measured. The input value is corrected and transformed to a setup value on the basis of elements in the yarn feeding route from the top tension device to the carrier of the yarn. The controller of the flat knitting machine applies the setup value to the adjusting member.

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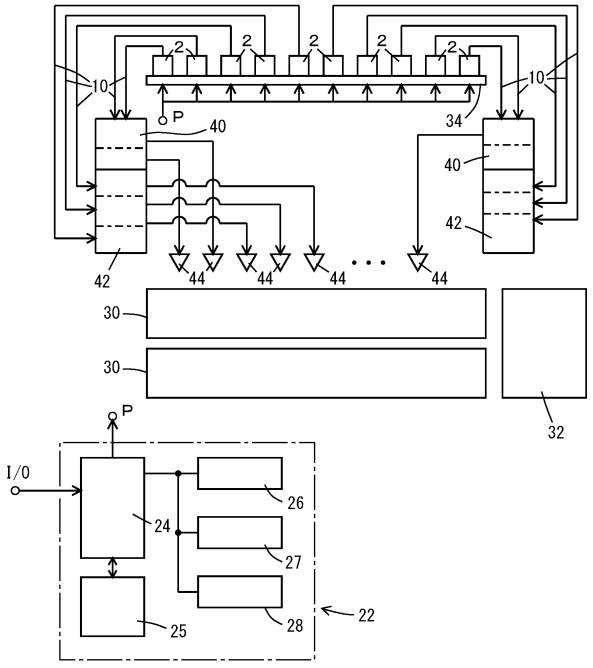

EP 3 754 078 A1

Description

Field of the Invention

[0001] The invention relates to the setup of top tension devices on a flat knitting machine.

Background Art

[0002] In flat knitting machines, a large number of top tension devices (upper tensioning biasing devices) are equipped to apply tension to yarns from yarn packages and to supply the yarns to side tension devices, to positive yarn feeding devices, or directly to carriers (see Patent document 1: JP H08-3844A). A flat knitting machine has, for example, about twenty top tension devices, and therefore, a knitting shop having a large number of flat knitting machines has a considerably large number of top tension devices.

[0003] When an electrically controllable disc, rollers, or the like is provided in a top tension device, tension can be applied to a yarn controllably. For example, when a disc cramps a yarn and when the pressure from the disc to the yarn is controlled, the tension is controlled. Similarly, when rollers of a yarn are driven by a motor and when the torque applied to the rollers is controlled, the tension can be controlled. However, even if the pressure from the disc or the torque to the rollers is made constant, different yarns make the applied tension change.

[0004] The suitable tension to be applied by a top tension device is dependent upon and changes according to a yarn feeding route to a carrier for the yarn. Further, the yarn feeding routes change according to respective top tension devices. Therefore, it is troublesome to set tension for a large number of top tension devices.

Prior Document

Patent Document

[0005] Patent Document 1: JP H08-3844A

Summary of the Invention

Object of the Invention

[0006] The object of the invention is to set tension automatically for top tension devices that apply electrically controllably tension to yarns.

Means for Achieving the Object

[0007] A setup method according to the invention of a top tension device provided on a flat knitting machine, has an adjusting member for applying electrically controllable tension to a yarn, and is characterized by
a measuring step for measuring an input value for each yarn to the adjusting member for applying a desired tension to said each yarn and
a setup step for correcting said input value on the basis of elements in a yarn feeding route from the top tension device to a carrier of said each yarn in order to transform said input value to a setup value for the adjusting member and applying the setup value to the adjusting member by a controller in the flat knitting machine.

[0008] A setup system according to the invention of a top tension device, provided on a flat knitting machine, has an adjusting member for adjusting tension to a yarn, according to an electrical input, and is characterized in that
the setup system comprises: a measuring means for measuring an input value for each yarn to the adjusting member for applying a desired tension to said each yarn; and a controller of the flat knitting machine and that
the controller of the flat knitting machine is configured to correct said input value on the basis of elements in a yarn feeding route from the top tension device to a carrier of said each yarn in order to transform said input value to a setup value for the adjusting member and to apply the setup value to the adjusting member.

[0009] According to the invention, when the species of yarn is changed, for the top tension devices that apply electrically adjustable tension to yarns, the setup of the torque is automatically changed. The invention is particularly efficient when a large number of the top tension devices are used. In addition, yarns of the same species may be regarded as the same yarn, however, there are cases where the same species of yarns have different characteristics due to changes in the temperature, humidity, and the production lot. In such cases, when temperature, humidity, or the production lot changes, it is preferable to measure the input value to the adjusting member once more.

[0010] Preferably, in said setup step, said input value is corrected based on a species of a yarn feeding object to which said each yarn is fed by the top tension device at an upper stream position of the carrier along a direction of yarn feeding, the number of eyelets (yarn guide) which said each yarn passes through in said each yarn feeding route, and the degree of bending of said each yarn in said each yarn feeding route. The tension to be applied by the top tension device is dependent upon the yarn feeding route. However, according to the above construction, the input value is corrected according to the elements in the yarn feeding route and may be transformed to the setup value.

[0011] Preferably, said input value is measured for each of plural yarn feeding speeds, and the controller of the flat knitting machine corrects the setup value during knitting, based upon the yarn feeding speed from the top tension device. As a result, adequate tension is applied according to the knitting speed, and disturbance in the fabric sizes is prevented.

[0012] Preferably, in the measuring step, said each yarn is fed through the adjusting member and a tension sensor to a drawing member, the adjusting member ap-

plies tension to said each yarn, the drawing member draws said each yarn, and the input value to the adjusting member is measured when the tension applied to said each yarn, measured by the tension sensor, is a desired value. If a dedicated measuring device having the above construction is used, the input value can be measured without using a flat knitting machine. And therefore, knitting machines have not to be halted during the measurement. Therefore, knitted fabrics are produced more efficiently. If without using the dedicated measuring device, the tension sensor is provided between the top tension device and a side tension device, a positive yarn feeding device, or the like, the drawing member is provided at a downstream position of the carrier, and then, the input value to the adjusting member can be measured on a flat knitting machine and without actual knitting.

[0013] According to an embodiment, a correction amount for each element in the yarn feeding route is retrieved and added. However, a correction amount for the entire yarn feeding route may be measured. This correction is also a correction corresponding to elements in the yarn feeding route. For example, the drawing speed of the yarn and the tension in the vicinity of the outlet of the top tension device are made constant, and the necessary input value to the adjusting member is measured for each yarn feeding route. Then, the difference from an input value to a standard top tension device is stored as a correction amount for each yarn feeding route. Even when the species of the yarn is changed, this correction amount for each yarn feeding route is usable, for example, without alteration.

Brief Description of the Drawings

[0014]

[Fig. 1] A block diagram of a top tension device used in an embodiment.
[Fig. 2] A schematic view of a measuring step according to the embodiment.
[Fig. 3] A schematic view of an input value table for top tension devices according to the embodiment.
[Fig. 4] A schematic view indicating the setup of top tension devices on a flat knitting machine according to the embodiment.
[Fig. 5] A flowchart indicating the setup algorithm of top tension devices according to the embodiment.

Features for carrying out the Invention

[0015] The best embodiment for carrying out the invention will be described.

Embodiment

[0016] Figs. 1 to 5 indicate an embodiment. Fig. 1 indicates an example of the top tension device 2; indicated by 4 are a pair of dies that cramp a yarn and apply pressure. Indicated by 6 is a driver for driving the dies 4 so as to adjust the pressure, and indicated by 7 is an input port for inputting an electrical input to the driver 6. The whole from the dies 4 to the port 7 are referred to as an adjusting member 8. Instead of the dies 4, the yarn 10 may be braked by rollers in contact with the yarn, and the mechanism for the tension adjustment is arbitrary. Further, indicated by 11 is an eyelet for guiding the yarn. In addition, when a tension sensor 12 is provided in the top tension device 2, input values to an adjusting member shown in Fig. 2 can be measured. However, if all top tension devices 2 are provided with the tension sensors 12, the present invention reduces practical utility. Therefore, the tension sensors may be provided in a part of the top tension devices 2, when the sensors are provided. When a top tension device 2 is used to measure the tension on a flat knitting machine 20, the correction amounts corresponding to elements in the yarn feeding route used in the measurement are subtracted, and correction amounts corresponding to the elements in the yarn feeding route for each top tension device 20 are added.

[0017] Fig. 2 indicates the measurement of input values to the adjusting member. A yarn 10 is supplied from a yarn source such as an yarn package 16 or the like, to a drawing member 14, through an adjusting member 9 and the tension sensor 12. The adjusting member 9 may be the same as the adjusting member 8 in the top tension device 2 or a similar one, such as a version having a higher precision. The tension sensor 12 measures the tension applied to the yarn 10. The drawing member 14 has a pair of rollers for cramping the yarn and draws the yarn by driving the rollers. The adjusting member 9, the tension sensor 12, and the drawing member 14 are an example of a dedicated measuring means. Further, the top tension device 2 in Fig. 1 in combination with the tension sensor 12 is an example of the measuring means that functions as a top tension device on a flat knitting machine. For each drawing speed of the yarn by the drawing member 14, an input value to the adjusting device 9 is measured when the tension measured by the tension sensor 12 becomes a desired value, and the measured value is stored in a memory not shown. As a result, data for tables 26 shown in Fig. 3 are obtained. One table is provided for one drawing speed of a yarn, and preferably, input values for respective desired tensions are stored for respective drawing speeds. Instead of tables 26 for respective drawing speeds, the yarn may be drawn with a slight speed and the input value to the adjusting member 9 is measured when a desired tension is achieved.

[0018] Fig. 4 indicates setup of the top tension devices 2 on the flat knitting machine 20 according to the embodiment. Indicated by 30 are, for example, a pair of needle beds, and 32 is a carriage manipulating needles on the needle beds 30. Indicated by 34 is a stand over the needle beds 30 and supports the top tension devices 2 and yarn packages not shown. At both side ends of the needle beds 30, for example, there are provided positive yarn

feeding devices 40 and side tension devices 42. The top tension devices 2 draw yarns from the yarn packages, apply tension to the yarns, and supply them to the positive yarn feeding devices 40 or the side tension devices 42. Further, the positive yarn feeding devices 40 and the side tension devices 42 supply the yarns to carriers 44, and the carriers 44 supply the yarns to needles on the needle beds 30. In the yarn feeding routes, there are eyelets for changing the directions of the yarns, and therefore, the eyelets apply friction to the yarns.

[0019] The flat knitting machine 20 is provided with a controller 22. Indicated by 24 is the main controller, 25 is a carriage controller, and 26 to 28 are tables. The table 26 stores data shown in Fig. 3, the table 27 stores elements in the yarn feeding route for each top tension device 2. In addition, the data with respect to the elements in the yarn feeding routes may be generated based upon the knitting data or may be inputted by a user from the controller 22.

[0020] The table 28 stores a correction amount for each element in the yarn feeding routes. For example, it stores an additional tension amount for an eyelet in the yarn feeding routes, correction amounts on the basis of intermediate yarn feeding objects between the carriers 44 and the top tension devices 2, and correction amounts on the basis of bending angles of the yarns in the yarn feeding routes.

[0021] As upstream side yarn feeding objects, Fig. 4 indicates the positive yarn feeding devices 40 and the side tension devices 42. The positive yarn feeding devices 40 feed yarns through a gap between a pair of rollers and control the rotation number of the rollers so as to feed desired lengths of yarns. The side tension devices 42 apply tension to the yarns and further work as buffers of yarns. In addition, the positive yarn feeding devices 40 and the side tension devices 42 are different in the suitable yarn tension to be applied from the top tension devices 2. Without the positive yarn feeding devices 40 nor the side tension devices 42, yarns may be directly supplied to the carriers 44 from the top tension devices 2. In this case, the correction amount with respect to the direct yarn feeding is stored in the table 28.

[0022] While not shown in the drawings, there are plural eyelets between a top tension device 2 and a carrier 44, and the yarn is bent by the eyelets. Since the eyelets apply friction to a yarn, an additional amount of tension per eyelet is stored in the table 28. Further, when a yarn is bent at an eyelet, additional tension is necessary. Since the bending angle of a yarn at an eyelet can be considered from 180 degrees (no bending) to 90 degrees, additional amounts of tension on the basis of the bending angle are stored. For example, the additional amount is stored at 9 stages and increases by 0.4 g per 10 degrees when approaching 90 degrees. Further, since thick yarns increase tension loss by the eyelets and so on, it is preferable to store correction amounts on the basis of the thickness of the yarns (for example, three stages in the thickness of under 0.2 mm, down to 0.2 mm and up to 0.8 mm, and over 0.8 mm) are further stored.

[0023] The main controller 24 calculates yarn feeding speed from the top tension devices 2 on the basis of knitting information, such as the speed of the carriage, the species of push knitting or pull knitting, and consumed loop length. The main controller 24 performs the following processing for each top tension device 2 in use. Retrieving elements in the yarn feeding routes from the table 27, and calculates the basic tension with reference to the table 28, according to the species of the yarn feeding object of the positive yarn feeding devices 40 or the side tension devices 42. Further with reference to the table 28, retrieving a correction amount for tension for each element, and corrects the basic tension. In addition, with reference to the table 26 according to the yarn feeding speed, the main controller retrieves the setup value for the top tension device 2 with respect to the desired tension and sets the adjustment member 8 for the top tension device 2.

[0024] The setup algorithm of the top tension devices according to the embodiment is shown in Fig. 5. As a preparation, correction amounts for elements in the yarn feeding routes are determined and are stored in the table 28. Yarns for knitted fabrics change from a season to another season, and a large number of new species of yarns are used in one season. Therefore, data necessary for the table 26 for one species of yarn are measured by once and they are implemented to the tables 26 in plural flat knitting machines 20. In step S1, the input values to the adjusting member for applying desired tension to a yarn are measured for respective yarn feeding speeds and are stored. Here, the ambient temperatures and humidities may change the characteristics of yarns and thus, may change the suitable input values. Therefore, it is preferable to coincide the environment where the input values to the adjusting member are measured and the environment where the flat knitting machines work. In addition, the characteristics of a yarn may change according to the production lot of the yarn, it is preferable to measure once more the data in the table 26 when the production lot is changed, if necessary.

[0025] In step S2, the yarn feeding routes for respective top tension devices 2 are stored in the table 27. The order to carry out the steps S1 and S2 is arbitrary. In step S3, with reference to the correction amounts stored in the table 28 and the yarn feeding routes stored in the table 27, the setup values for the adjusting members 8 in respective top tension devices 2 are determined. In addition, it is not necessary to perform the step S3 repeatedly during knitting. Changing amounts corresponding to yarn feeding speeds may be stored in the main controller 24 or in a table not shown, and the setup values may be changed on the basis of the changing amount corresponding to yarn feeding speeds.

[0026] The detailed process in step S3 is indicated by steps S3a to S3d. In step S3a, the elements in the yarn feeding route are retrieved from the table 27. The elements in the yarn feeding route are, for example, the

eyelets and the bending angle of the yarn therein, the species of the first yarn feeding object from the top tension device, such as a positive yarn feeding device or a side tension device, the direction of knitting of push knitting or pull knitting, and so on. In step S3b, correction amounts for respective elements in the yarn feeding route are retrieved from the table 28 and are added to a total correction amount. In step S3c, a subtable corresponding to the yarn feeding speed in the table 26 for each yarn is referred to, and a setup value for a desired tension is retrieved. For example, the table 26 in Fig. 3 includes three subtables corresponding to three yarn feeding speeds. Here it is preferable to store the retrieved setup value. In step S3d, the setup value retrieved in step S3c and the total correction amount gotten in step S3b are added to the setup value of the top tension device.

[0027] Knitting speed is frequently changed during knitting. In this case, steps S3a to S3d may be re-executed. However, it is preferable to re-execute only step S3c to calculate the change in the setup value from that at an old yarn feeding speed before the speed change. And, when the change is added to the old setup value before the change, a new setup value for the new yarn feeding speed is resultant. During knitting, the direction of knitting of push knitting or pull knitting may be changed. In this case, the change in the correction amounts according to the direction of knitting is calculated from the table 28, and the calculated change is added to the setup value before the change in order to get a new setup value after the change.

[0028] When using a new species of yarn, the data for the table 26 are enough to be measured by once for a large number of top tension devices 2, and therefore, the embodiment is very efficient. By the way, when every top tension device 2 is provided with a tension sensor 12, the invention is not needed to be carried out. However, this needs a large number of tension sensors.

[0029] The embodiment has the following advantageous effects, in addition to the above:

[0030] All top tension devices are uniformly set for a yarn to be used. Therefore, stitch sizes in knitted fabrics are made uniform between different carriers 44. Further, the stitch sizes are made uniform between flat knitting machines 2.

[0031] Knitted fabrics with higher quality can be knitted when the setup values for tension are corrected not only on yarn feeding speeds but also on knitting start, knitting stitches at edges of a knitted fabric, the species of push knitting or pull knitting, and so on. These corrections are made by feedforward control based upon the knitting information, and the tension is kept constant without a delay resulting in feedback control.

[0032] When the setup values to the adjusting members 8 of the top tension devices 2 are made not uniform and changed according to carriers 44, the stitch sizes can be positively controlled.

List of Symbols

[0033]

2	top tension device
4	die
6	driver
7	input port
8,9	adjusting member
10	yarn
11	eyelet
12	tension sensor
14	drawing member
16	yarn package
20	flat knitting machine
22	controller
24	main controller
25	carriage controller
26-28	table
30	needle bed
32	carriage
34	stand
40	positive yarn feeding device
42	side tension device
44	carrier

Claims

1. A setup method of a top tension device (2) provided on a flat knitting machine (20), having an adjusting member (8) for applying electrically controllable tension to a yarn (10), being **characterized by**
a measuring step (S1) for measuring an input value for each yarn (10) to the adjusting member (8) for applying a desired tension to said each yarn (10) and a setup step (S3) for correcting said input value on the basis of elements in a yarn feeding route (11,40,42) from the top tension device (2) to a carrier (44) of said each yarn (10) in order to transform said input value to a setup value for the adjusting member (8) and applying the setup value to the adjusting member (8) by a controller (22) in the flat knitting machine (20).

2. The setup method of the top tension device (2) provided on a flat knitting machine (20) according to claim 1, being **characterized in that**, in said setup step (S3), said input value is corrected based on a species of a yarn feeding object (40,42), at an upper stream position of the carrier (44) along a direction of yarn feeding, to which said each yarn (10) is fed by the top tension device (2); the number of eyelets (11) which said each yarn (10) passes through in said each yarn feeding route; and degree of bending of said each yarn (10) in said each yarn feeding route.

3. The setup method of the top tension device (2) pro-

vided on a flat knitting machine (20) according to claim 1 or 2, being **characterized in that**, in said setup step (S1), said input value is measured for each of plural yarn feeding speeds, and **characterized by** a speed compensation step (S3c) where the controller (22) of the flat knitting machine (20) corrects the setup value during knitting, based upon yarn feeding speed from the top tension device (2) .

4. The setup method of the top tension device (2) provided on a flat knitting machine (20) according to one of claims 1 to 3, being **characterized in that**, in said measuring step (S1), said each yarn (10) is fed to a drawing member (14) through both the adjusting member (8,9) and a tension sensor (12), that the adjusting member (8,9) applies tension to said each yarn (10), that the drawing member (14) draws said each yarn (10), and that an input value to the adjusting member (8,9) is measured when the tension to said each yarn (10), measured by the tension sensor (12), is a desired value.

5. A setup system of a top tension device (2), provided on a flat knitting machine (20), having an adjusting member (8) for adjusting tension to a yarn (10) according to an electrical input, being **characterized in that**
the setup system comprises: a measuring means (9b) for measuring an input value for each yarn (10) to the adjusting member (8) for applying a desired tension to said each yarn (10); and a controller (22) of the flat knitting machine (20) and that
the controller (22) of the flat knitting machine (20) is configured to correct said input value on the basis of elements (11,40,42) in a yarn feeding route from the top tension device (2) to a carrier (44) of said each yarn (10) in order to transform said input value to a setup value for the adjusting member (8) and to apply the setup value to the adjusting member (8).

FIG. 1

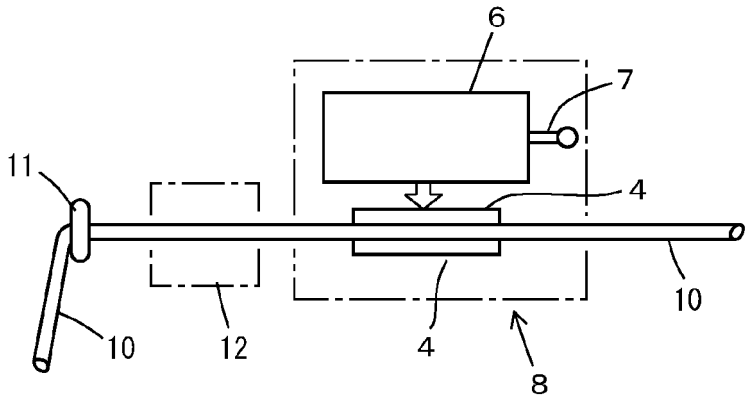

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FIG. 2

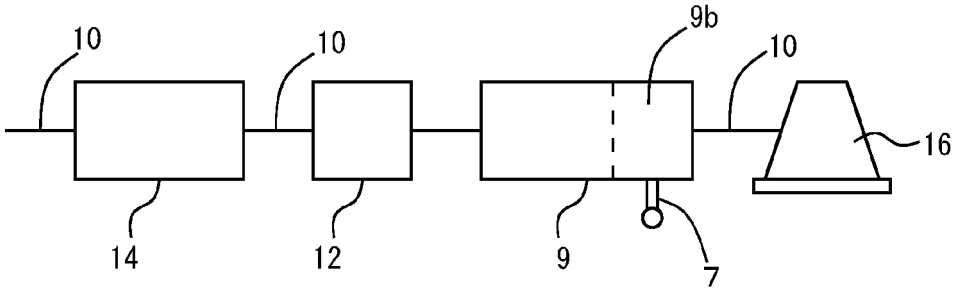

FIG. 3

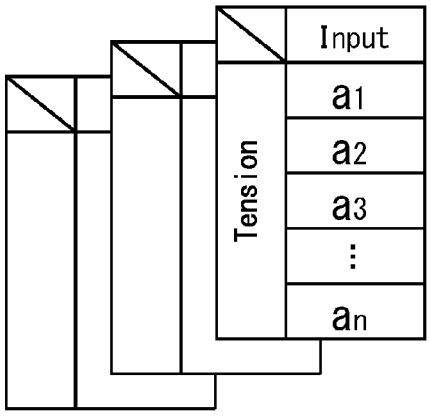

FIG. 4

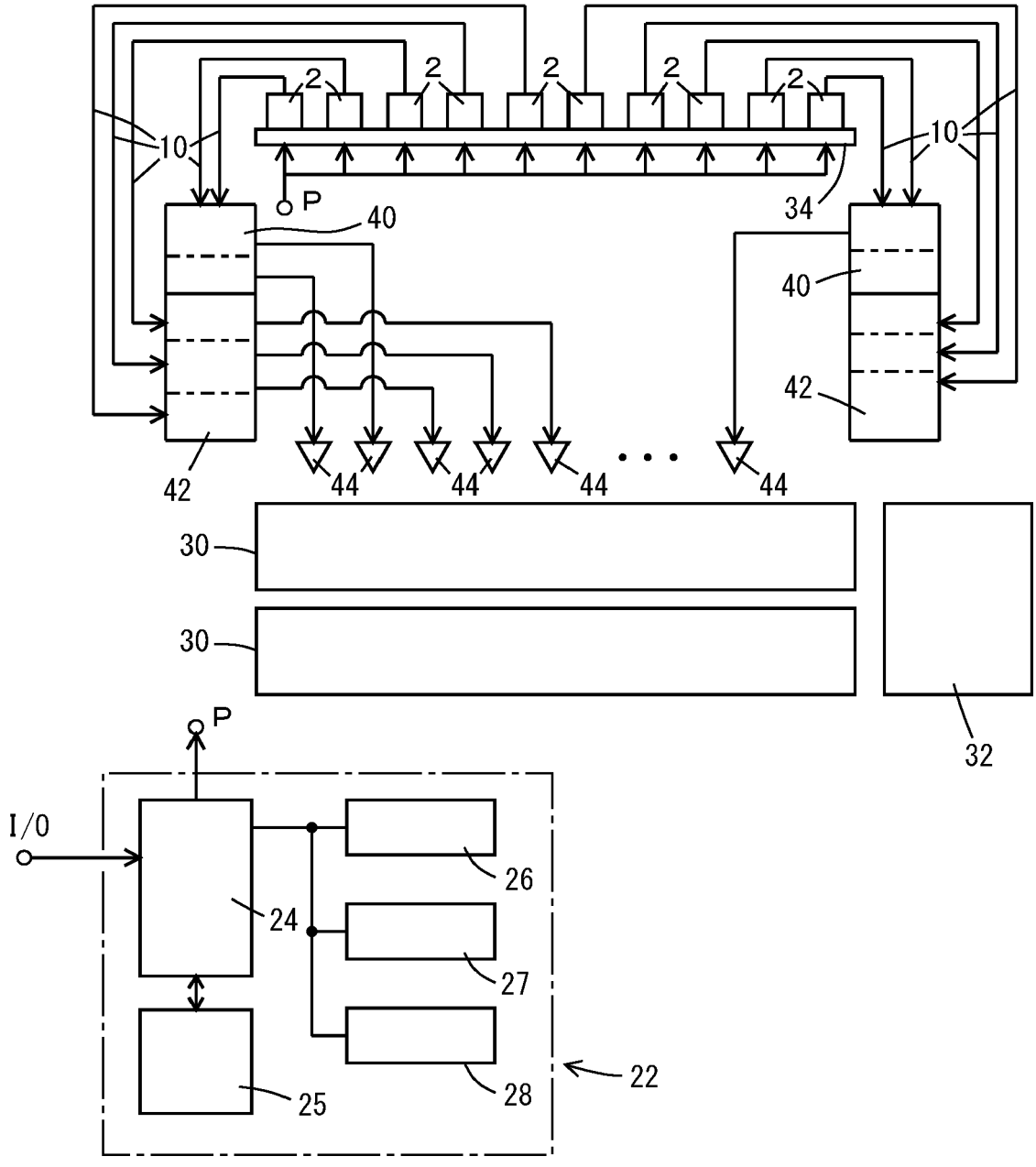
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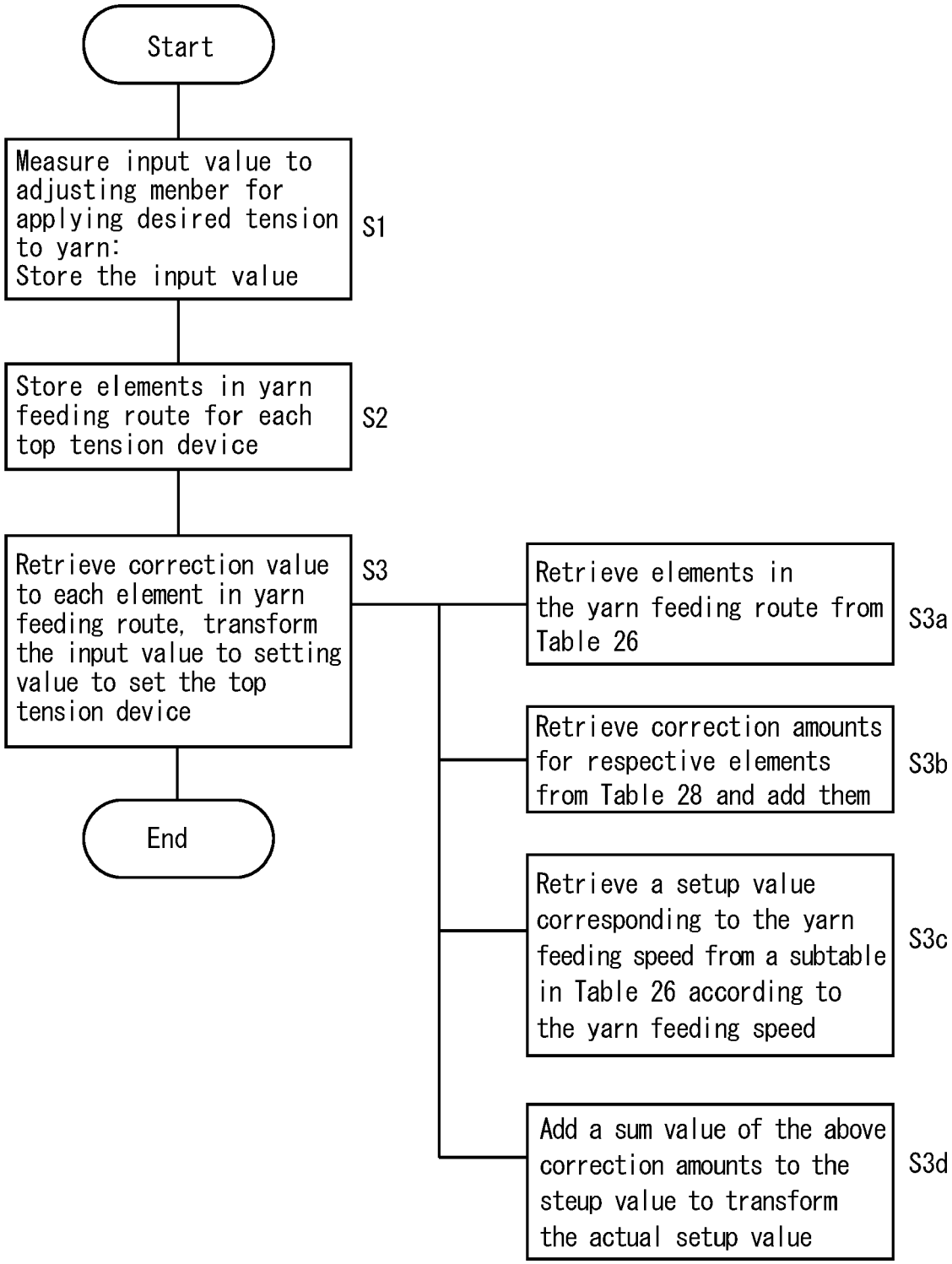
FIG. 5


Start
Measure input value to adjusting menber for applying desired tension to yarn: Store the input value
S1
Store elements in yarn feeding route for each top tension device
S2
Retrieve correction value to each element in yarn feeding route, transform the input value to setting value to set the top tension device
S3
End
Retrieve elements in the yarn feeding route from Table 26
S3a
Retrieve correction amounts for respective elements from Table 28 and add them
S3b
Retrieve a setup value corresponding to the yarn feeding speed from a subtable in Table 26 according to the yarn feeding speed
S3c
Add a sum value of the above correction amounts to the steup value to transform the actual setup value
S3d

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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 0428

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TECHNICAL FIELDS SEARCHED (IPC)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 November 2020	Messai, Sonia

CATEGORY OF CITED DOCUMENTS

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