



(11) **EP 2 573 026 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
27.03.2013 Bulletin 2013/13

(51) Int Cl.:
B65H 59/38 (2006.01)

(21) Application number: **11783352.5**

(86) International application number:
PCT/JP2011/059300

(22) Date of filing: **14.04.2011**

(87) International publication number:
WO 2011/145415 (24.11.2011 Gazette 2011/47)

(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**

(30) Priority: **21.05.2010 JP 2010117815**

(71) Applicant: **Shima Seiki Manufacturing., Ltd.
Wakayama 641-8511 (JP)**

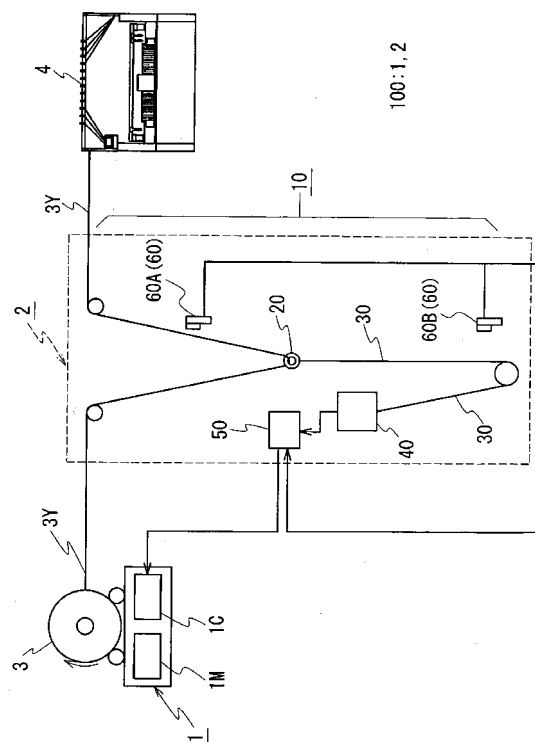
(72) Inventor: **NAKAHATA, Sadamu
Wakayama-shi
Wakayama 641-8511 (JP)**

(74) Representative: **Wagner, Karl H.
Wagner & Geyer Partnerschaft
Patent- und Rechtsanwälte
Gewürzmühlstrasse 5
80538 München (DE)**

(54) **THREAD SUPPLY SYSTEM**

(57) Provided is a yarn supplying system in which a tension of a yarn in a yarn supplying path is maintained in an appropriate range and the yarn can be supplied from a bobbin without slackening with a simple configuration. Tension measuring means 40 measures the tension of an elastic body 30 that pulls a pulling piece 20 hooked to a yarn 3Y reeled out from a bobbin 3 to a storage unit 10. Deriving means 50 uses a correlative relationship between the tension of the elastic body 30 and the position of the pulling piece 20 (physical amount for controlling a supply amount of the yarn 3Y from the bobbin 3) along the pulling direction determined in advance in order to determine the relevant position from the actually measured tension. Control means 1C controls the supply amount of the yarn 3Y from the bobbin 3 by the yarn supplying device 1 based on the determined position.

Fig. 1



EP 2 573 026 A1

Description

TECHNICAL FIELD

5 **[0001]** The present invention relates to a yarn supplying system for supplying a yarn to a receiving device of the yarn such as a knitting machine, a weaving machine, or the like that receives the supply of yarn.

BACKGROUND ART

10 **[0002]** There is known a yarn supplying system for supplying a yarn from a bobbin, around which the yarn is wound, to a receiving device of a yarn such as a flat knitting machine or a warp knitting machine for automatically knitting a knitted fabric, a weaving machine for weaving a woven fabric, and a yarn twisting device for twisting a plurality of yarns. The yarn supplying system includes a yarn supplying device for reeling out the yarn from the bobbin, and a yarn storage device for temporarily storing the yarn reeled out and then feeding the yarn to the receiving device.

15 **[0003]** The yarn storage device moderates the fluctuation in tension that acts on the yarn resulting from a difference between the supply amount of yarn from the yarn supplying device and the usage amount of yarn of the receiving device by temporarily storing the yarn reeled out from the bobbin and then feeding the yarn to the receiving device. For example, in Figs. 7 and 8 of the patent document, the yarn is temporarily stored by pulling the yarn into a tubular body (storage unit) that extends in a vertical direction with a dancer roller (pulling piece) to be hooked to the yarn. According to such
20 a configuration, the pulling piece moves vertically downward so that the yarn is stretched without slackening when the supply amount of the yarn is greater than the usage amount, and the pulling 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 storage device is configured such that the yarn does not slack and an excessively large tension does not act on the yarn when the dancer roller is balanced at substantially an intermediate position of a moving range of the
25 pulling piece.

[0004] In the yarn supplying system including the yarn storage device, the position in the vertical direction of the pulling piece, which acts as an index of the tension acting on the yarn in a yarn supplying path, is measured, and the supply amount of the yarn from the bobbin is controlled by the yarn supplying device based on the measurement result. This control prevents the tension from becoming too low thus slackening the yarn, or the tension from becoming too high
30 thus breaking the yarn.

PRIOR ART DOCUMENT

PATENT DOCUMENT

35 **[0005]**

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

40 SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

45 **[0006]** A plurality of proximity sensors arranged with a predetermined spacing in a pulling direction or a magnetostrictive linear sensor arranged along the pulling direction is conventionally used to measure the position of the pulling piece described above. However, the following problems arise when measuring the position of the pulling piece.

[0007] First, when using the proximity sensors, the position of the pulling piece can only be grasped intermittently even if the number of the proximity sensors is increased. As a result, the behavior of the pulling piece (which way the pulling piece is moving in the pulling direction, or the like) at the positions where the proximity sensors are not arranged cannot
50 be grasped, and hence the control of the yarn supplying device tends to be delayed.

[0008] When using the magnetostrictive linear sensor, the position of the pulling piece can be grasped continuously, but the configuration of the sensor is large scale and the cost is high. In addition, the mass of the pulling piece increases since the pulling piece to be measured needs to be made of magnet when using the magnetostrictive linear sensor. In this case, when the usage amount of the yarn is rapidly reduced, the movement of the pulling piece with respect to such
55 a change may be delayed, and when the usage amount of the yarn is rapidly increased, a large tension may act on the yarn.

[0009] The present invention has been made in view of such situations, and an object thereof is to provide a yarn supplying system in which the tension of the yarn in the yarn supplying path is maintained in an appropriate range and the yarn can be supplied from the bobbin without slackening with a simple configuration.

MEANS FOR SOLVING THE PROBLEMS

[0010] A yarn supplying system of the present invention is a yarn supplying system including a yarn supplying device for reeling out a yarn from a bobbin, and a yarn storage device for temporarily storing the yarn reeled out from the bobbin and then feeding the yarn to a receiving device in a middle of a yarn supplying path, which extends from the yarn supplying device to the receiving device of the yarn. The yarn storage device includes a storage unit, to which the yarn is pulled in, a pulling piece, and an elastic body. The pulling piece is a member which is hooked to the yarn and which linearly reciprocates along a pulling direction of the yarn. The elastic body is a member for pulling the pulling piece in the pulling direction. The yarn supplying system of the present invention further includes tension measuring means for measuring a tension of the elastic body hooked to the yarn, deriving means for deriving a physical amount from a measurement result of the tension measuring means using a correlative relationship between the tension of the elastic body and the physical amount for controlling a supply amount of the yarn from the bobbin determined in advance, and control means for controlling the supply amount of the yarn from the bobbin based on the derived physical amount.

[0011] In one aspect of the yarn supplying system of the present invention, a detection sensor for detecting a position of the pulling piece is arranged in at least two areas in a range in which the pulling piece reciprocates, and when the pulling piece is detected at the position of each detection sensor, the tension of the elastic body is detected with the tension measuring means, and the correlative relationship is calibrated based on the result.

[0012] In another aspect of the yarn supplying system of the present invention, the control means controls the supply amount of the yarn such that a position at which the pulling piece is balanced changes within the range in which the pulling piece reciprocates in accordance with a usage amount of the yarn in the receiving device.

EFFECTS OF THE INVENTION

[0013] According to the yarn supplying system of the present invention, the tension of the elastic body coupled to the pulling piece for pulling in the yarn to the storage unit is continuously measured in real time, and the supply amount of the yarn by the yarn supplying device is controlled with the measurement result, so that the yarn can be supplied without slackening to the receiving device of the yarn while maintaining the tension acting on the yarn in the yarn supplying path in a constant range. As a result, quality of the resultant article (knitted fabric and woven fabric) obtained in the receiving device can be improved. The tension of the elastic body can be used to maintain the tension acting on the yarn in a constant range because the tension of the elastic body changes in accordance with the position of the pulling piece in the storage unit, and the position of the pulling piece acts as an index of the tension acting on the yarn in the yarn supplying path.

[0014] According to the yarn supplying device including the detection sensors, the tension of the elastic body at the position of each detection sensor is detected, and the correlative relationship between the tension of the elastic body and the physical amount for controlling the supply amount of the yarn from the bobbin can be calibrated. As a result, the influences of temperature change in the environment, degradation over years of the elastic body, and the like that affect the supply state of the yarn from the yarn supplying device to the receiving device can be removed.

[0015] Furthermore, the slackening of the yarn and the yarn breakage involved in the rapid change in the usage amount of the yarn in the receiving device can be prevented by changing the position at which the pulling piece is balanced in accordance with the usage amount of the yarn in the receiving device. The details thereof will be described in the end of the embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a schematic configuration diagram of a yarn supplying system shown in an embodiment.

Fig. 2 is a schematic diagram of a lookup table showing a correlative relationship between a position of a pulling piece and a tension of an elastic yarn in the yarn supplying system.

MODE FOR CARRYING OUT THE INVENTION

[0017] An embodiment of the present invention will be hereinafter described based on the drawings. The embodiment of the present invention is not limited to the embodiment described below, and the embodiment can be appropriately changed within a range not deviating from the gist of the invention.

<Overall configuration>

[0018] A yarn supplying system 100 shown in Fig. 1 is a system for supplying a yarn 3Y to a flat knitting machine (receiving device of a yarn) 4 for knitting a knitted fabric, and includes a yarn supplying device 1 for reeling out the yarn 3Y from a bobbin 3, around which the yarn 3Y is wound, and a yarn storage device 2 for temporarily storing the yarn 3Y reeled out from the bobbin 3 and then feeding the yarn to the flat knitting machine 4 in the middle of a yarn supplying path extending from the yarn supplying device 1 to the flat knitting machine 4. The main characteristic of the yarn supplying system 100 lies in having the configuration of controlling the supply amount of the yarn 3Y from the bobbin 3 so as to maintain the tension that acts on the yarn 3Y in the yarn supplying path in an appropriate range.

[Yarn supplying device]

[0019] The yarn supplying device 1 of the present embodiment includes a pair of rollers arranged in parallel, a motor 1M for rotating the rollers, and control means 1C for controlling the rotation of the motor 1M. In order to reel out the yarn 3Y from the bobbin 3 with the yarn supplying device 1, the bobbin 3 is mounted on the pair of rollers, and the rollers are rotated with the motor 1M. The reeling amount (supply amount) of the yarn 3Y is adjusted by the rotation speed of the bobbin 3, that is, the rotation speed of the rollers.

[0020] Other than the yarn supplying device 1, a yarn supplying device for reeling out the yarn 3Y by directly rotating the drum of the bobbin 3 may be used, or a yarn supplying device for sandwiching the yarn 3Y with a pair of feeding rollers and reeling out the yarn 3Y by the rotation of the rollers may be used. In the latter configuration, there may be adopted a configuration of axially supporting the bobbin 3 in a rotatable manner with some kind of member thus enabling the bobbin 3 to rotate following the reeling of the yarn 3Y.

[0021] The yarn supplying device 1 for supplying the yarn 3Y from the rotating bobbin 3 is suited for supplying the yarn 3Y such as a metal yarn, which is hard and does not easily stretch, or a tape yarn, which has a flat cross-section, for example. This is because kink is prevented from occurring in the yarn 3Y when the yarn 3Y is twisted as the bobbin 3 itself is rotated. The yarn supplying device 1 for rotating the bobbin 3 itself is difficult to have the supply amount of the yarn 3Y immediately respond to the rapid increase and decrease of the usage amount of the yarn 3Y. Thus, the yarn supplying system 100 including the yarn supplying device 1 as described above requires the yarn storage device 2 to be described later.

[Yarn storage device]

[0022] The yarn storage device 2 is a device for temporarily storing the yarn 3Y reeled out from the bobbin 3 and then feeding the yarn to the flat knitting machine 4 to moderate the rapid fluctuation in the tension 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 storage device 2 is mainly configured by a storage unit 10, a pulling piece 20, and an elastic yarn (elastic body) 30.

[0023] The storage unit 10 is a portion for pulling the yarn 3Y vertically downward and storing the yarn in the middle of the yarn supplying path. The pulling direction of the yarn 3Y is not limited to vertically downward, and can be any direction that would intersect the yarn supplying path when the yarn storage device 2 was not arranged. For example, the yarn 3Y may be pulled vertically upward, in a horizontal direction, or the like. In this case, the storage unit 10 extends vertically upward or in the horizontal direction. Furthermore, the yarn 3Y extending from the yarn supplying device 1 to the flat knitting machine 4 may be once turned back towards the yarn supplying device 1, and then turned back again to be directed toward the flat knitting machine 4. That is, the yarn supplying path may be configured to an S-shape so that the yarn 3Y is drawn toward the yarn supplying device 1 side.

[0024] The pulling piece 20 is a member for pulling the yarn 3Y into the storage unit 10 by being hooked to the yarn 3Y, and reciprocates along the pulling direction in accordance with the change in the supply amount and the usage amount of the yarn 3Y. The elastic yarn 30 is connected to the pulling piece 20. The elastic yarn 30 is connected to tension measuring means 40, to be described later, and turned back vertically upward by a pulley arranged on the lower side of the storage unit 10. The yarn 3Y is pulled vertically downward by the pulling piece 20 by the pulling towards the vertically downward side by the elastic yarn 30 and the weight of the pulling piece 20. The pulling piece 20 moves along the vertical direction so as to be at the position where the force of being pulled vertically upward by the yarn 3Y and the force of being pulled vertically downward by the elastic yarn 30 are balanced. For example, the pulling piece 20 moves vertically upward when the usage amount of the yarn 3Y by the flat knitting machine 4 is greater than the supply amount of the yarn 3Y by the yarn supplying device 1, and the pulling piece 20 moves vertically downward when the supply amount is greater than the usage amount of the yarn 3Y. In this case, the stretching amount of the elastic yarn 30 also changes by the position of the pulling piece 20, and the contractive force of the elastic yarn 30 also changes.

[0025] The pulling piece 20 in the present embodiment is a plastic ring. With a ring-shaped pulling piece 20, a state

in which the pulling piece 20 is hooked to the yarn 3Y can be obtained by inserting the yarn 3Y through the ring. The acceleration of the movement of the pulling piece 20 corresponding to the fluctuation in the usage amount of the yarn 3Y can be enhanced by obtaining the pulling piece 20 made of light plastic. As a result, an excessive tension can be prevented from being applied on the yarn 3Y when the storage amount of the yarn 3Y is reduced, and the tension can be promptly applied on the yarn 3Y to remove the slack of the yarn 3Y when the storage amount of the yarn 3Y is increased.

[0026] The shape of the pulling piece 20 merely needs to be a shape that can hook the yarn, and is not limited to a ring shape. For example, it may be a roller having a groove at an intermediate portion in the thickness direction, an S-shaped hook, or the like. In the former case, the yarn 3Y is to be hooked to the groove of the roller, and the elastic yarn 30 is to be attached to a shaft part of the roller. In the latter case, the yarn 3Y is to be hooked to one end of the S-shaped hook, and the elastic yarn 30 is to be attached to the other end. A tension spring may be used in place of the elastic yarn 30 as an elastic body for pulling the pulling piece 20 into the storage unit 10.

[0027] According to the yarn storage device 2 having the above configuration, the amount of yarn 3Y reeled out from the storage unit 10 changes according to the change in the usage amount of the yarn 3Y in the flat knitting machine 4, and the fluctuation in the tension acting on the yarn 3Y can be moderated. For example, if the usage amount of the yarn 3Y is increased, the pulling piece 20 is moved vertically upward, and the amount of yarn 3Y reeled out from the storage unit 10 increases. On the other hand, if the usage amount of the yarn 3Y is reduced, the pulling piece 20 is moved vertically downward, and the amount of yarn 3Y reeled out from the storage unit 10 is reduced so that the yarn 3Y does not slacken.

[0028] In addition to the above configuration, the yarn storage device 2 of the yarn supplying system 100 of the present embodiment includes the tension measuring means 40 and deriving means 50 as a configuration for supplying the yarn 3Y to the flat knitting machine 4 while maintaining the tension acting on the yarn 3Y within an appropriate range.

[0029] The tension measuring means 40 is means for measuring the tension of the elastic yarn 30 that changes with displacement in the position of the pulling piece 20. For example, when the pulling piece 20 is moved vertically upward, the stretch of the elastic yarn 30 becomes greater than before the movement of the pulling piece 20, and the tension of the elastic yarn 30 detected by the tension measuring means 40 becomes greater. On the other hand, when the pulling piece 20 is moved vertically downward, the stretch of the elastic yarn 30 becomes smaller than before the movement of the pulling piece 20, and the tension of the elastic yarn 30 detected by the tension measuring means 40 becomes smaller. A commercially available tension measuring device can be used for the tension measuring means 40.

[0030] The deriving means 50 configured by a computer or the like includes a lookup table for storing a correlative relationship between the tension of the elastic yarn 30 and the physical amount for controlling the supply amount of the yarn 3Y from the bobbin 3 determined in advance. Fig. 2 shows an example of the lookup table in the present embodiment, where the position of the pulling piece 20 along the pulling direction is adopted for the physical amount for controlling the supply amount of the yarn 3Y. In this case, the deriving means 50 acquires the measurement result of the tension of the elastic yarn 30 from the tension measuring means 40 at a predetermined time interval, and derives the position of the pulling piece 20 by checking the measurement result with the lookup table of Fig. 2.

[0031] The lookup table of Fig. 2 is obtained as a result of the present inventors arranging a plurality of proximity sensors in the yarn storage device 2 of Fig. 1, and then measuring the tension of the elastic yarn 30 and the position of the pulling piece 20. As shown in Fig. 2, it is confirmed that the linear correlative relationship exists between the tension and the position.

[0032] The information on the position of the pulling piece 20 derived by the deriving means 50 is output to the control means 1C of the yarn supplying device 1. The control means 1C controls the motor 1M based on the information, and fine-tunes the reeling amount (supply amount) of the yarn 3Y from the bobbin 3 so that the pulling piece 20 is balanced near a predetermined position (e.g., intermediate position of the moving range of the pulling piece 20) in the pulling direction. For example, if the position of the pulling piece 20 is high, this means that the supply amount of the yarn 3Y from the bobbin 3 has not caught up to the usage amount of the yarn 3Y in the flat knitting machine 4, and hence the control means 1C increases the rotation speed of the motor 1M. On the other hand, if the position of the pulling 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.

[0033] The control means 1C of the yarn supplying device 1 may also have the function of the deriving means 50. In this case, the deriving means 50 in the yarn storage device 2 is not necessary, and the measurement result obtained with the tension measuring means 40 is directly input to the control means 1C. When determining the appropriate output of the motor 1M from the tension of the elastic yarn 30, the lookup table for determining the output of the motor 1M directly from the tension may be used.

[0034] The yarn storage device 2 of the present embodiment further includes position detection means 60 including a pair of proximity sensors (detection sensors) 60A, 60B arranged spaced apart in the pulling direction, and control means (not shown) for controlling the proximity sensors 60A, 60B. The proximity sensor 60A is arranged at an upper end position in the moving range of the pulling piece 20, and the proximity sensor 60B is arranged at a lower end position in the moving range of the pulling piece 20. According to the position detection means 60, the lookup table of Fig. 2 can

be calibrated through the following procedures, for example. First, the motor 1M is controlled to move the pulling piece 20 from the upper limit to the lower limit in the moving range. In this case, the tension of the elastic yarn 30 is measured when the pulling piece 20 comes at the position of each proximity sensor 60A, 60B. The lookup table storing the correlation of the position of the pulling piece 20 corresponding to each tension is calibrated from the detected tension of the elastic yarn 30 and the position of the pulling piece 20. In this case, the lookup table can be calibrated with the measurement at two points because the tension of the elastic yarn 30 and the position of the pulling piece 20 have a linear relationship. Lastly, the lookup table before the calibration is overwritten with the calibrated lookup table. The influences of temperature change in the usage environment of the yarn supplying system 100, degradation over years of the elastic yarn 30, and the like that affect the supply state of the yarn 3Y can be removed by periodically carrying out the calibration.

[0035] The proximity sensors 60A, 60B may be used to monitor so that the pulling piece 20 does not exceed the upper and lower limits of the moving range at the time of the operation of the yarn supplying system 100. In such a case, the yarn supplying device 1 and the flat knitting machine 4 are to make an emergency stop based on the detection results of the proximity sensors 60A, 60B. If the proximity sensors 60A, 60B are used only to calibrate the lookup table, the positions of the proximity sensors 60A, 60B do not need to be arranged at the upper and lower end positions of the moving range of the pulling piece 20, and may be arranged at any position of the moving range.

[0036] According to the yarn supplying system 100 having the configuration described above, the yarn 3Y can be supplied to the flat knitting machine 4 while maintaining the tension acting on the yarn 3Y in a constant range. As a result, the knitted fabric having a stable quality can be knitted. Drawbacks such as the supply of the yarn 3Y to the flat knitting machine 4 being stopped and the like when the yarn 3Y is broken are less likely to occur, whereby the knitted fabric can be knitted with satisfactory productivity.

[0037] The receiving device of the yarn 3Y in the present embodiment can be any device as long as it receives the yarn 3Y to produce some kind of product, and is not limited to flat knitting machine 4. For example, it may be a warp knitting machine, a weaving machine, a yarn twisting device, or the like.

[0038] Furthermore, in the embodiment described above, 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 pulling piece 20 is maintained near an intermediate area of a range in which the pulling piece 20 reciprocates. 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 pulling piece 20 at a position above the intermediate area of the moving range and prepare for the rapid reduction in the usage amount of the yarn 3Y. In this case, the pulling piece 20 can be prevented from lowering too much and slackening the yarn 3Y by the rapid reduction in the usage amount of the yarn 3Y. 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 pulling piece 20 at a position lower than the intermediate area of the moving range to prepare for the rapid increase in the usage amount of the yarn 3Y. In this case, the pulling piece 20 can be prevented from rising too much and causing an excessively large tension to be applied on the yarn 3Y by the rapid increase in the usage amount of the yarn 3Y. The magnitude of the usage amount of the yarn 3Y in the flat knitting machine 4 can be grasped from the output of the motor 1M.

DESCRIPTION OF REFERENCE NUMERALS

[0039]

100	yarn supplying system		
1	yarn supplying device	2	yarn storage device
1C	control means	1M	motor
10	storage unit		
20	pulling piece		
30	elastic yarn (elastic body)		
40	tension measuring means		
50	deriving means		
60	position detection means		
	60A, 60B		proximity sensor (detection sensor)
3	bobbin		
	3Y		yarn
4	flat knitting machine (receiving device of yarn)		

Claims

1. A yarn supplying system having:

5 a yarn supplying device for reeling out a yarn from a bobbin, and
 a yarn storage device for temporarily storing the yarn reeled out from the bobbin and then feeding the yarn to
 a receiving device in a middle of a yarn supplying path, which extends from the yarn supplying device to the
 receiving device of the yarn, **characterized in that**
 the yarn storage device includes
 10 a storage unit for storing the yarn,
 a pulling piece, which is hooked to the yarn to pull the yarn into the storage unit and which linearly reciprocates
 along a pulling direction, and
 an elastic body for pulling the pulling piece in the pulling direction, and
 the yarn supplying system further includes
 15 tension measuring means for measuring a tension of the elastic body,
 deriving means for deriving a physical amount from a measurement result of the tension measuring means
 using a correlative relationship between the tension of the elastic body and the physical amount for controlling
 a supply amount of the yarn from the bobbin determined in advance, and
 control means for controlling the supply amount of the yarn from the bobbin based on the derived physical amount.

2. The yarn supplying system according to claim 1, **characterized in that**

a detection sensor for detecting a position of the pulling piece is arranged in at least two areas in a range in which
 the pulling piece reciprocates, and
 when the pulling piece is detected at the position of each detection sensor, the tension of the elastic body is detected
 25 with the tension measuring means, and the correlative relationship is calibrated based on a result thereof.

3. The yarn supplying system according to claim 1 or 2, **characterized in that** the control means controls the supply
 amount of the yarn such that a position at which the pulling piece is balanced changes within the range in which the
 pulling piece reciprocates in accordance with a usage amount of the yarn in the receiving device.

Fig. 1

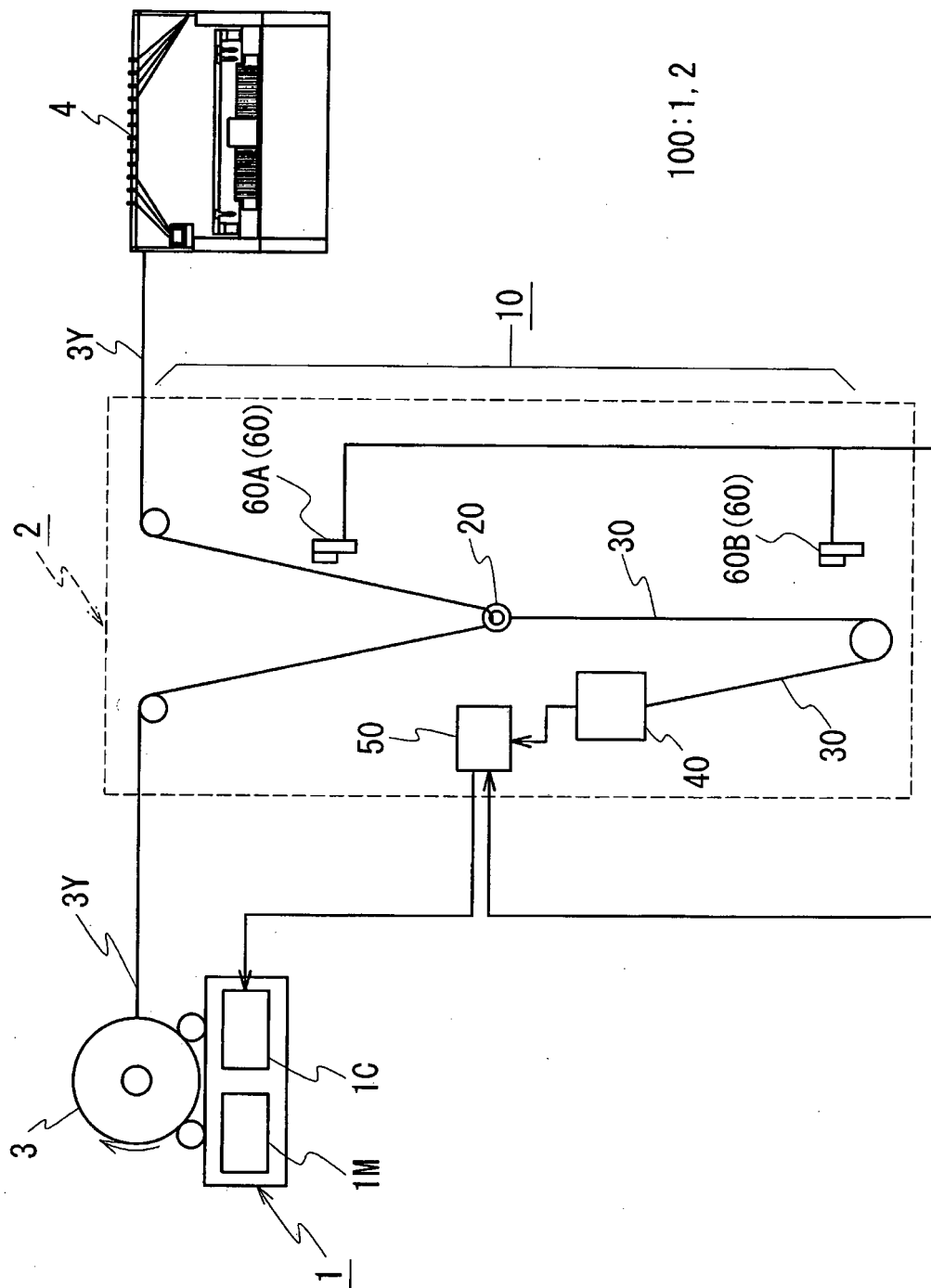
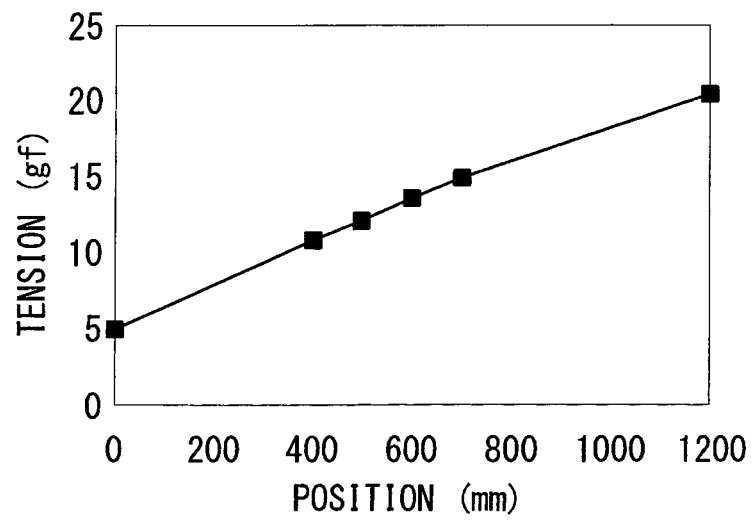


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/059300

A. CLASSIFICATION OF SUBJECT MATTER

B65H59/38 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65H59/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	JP 4-140276 A (Mitsubishi Heavy Industries, Ltd.), 14 May 1992 (14.05.1992), page 1, lower left column, line 14 to page 1, upper right column, line 2; page 2, lower right column, line 7 to page 3, upper left column, line 18; fig. 1 (Family: none)	1, 3 2
A	JP 5-294561 A (Fujikura Ltd.), 09 November 1993 (09.11.1993), paragraphs [0005] to [0010]; fig. 1 (Family: none)	1-3

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 May, 2011 (24.05.11)

Date of mailing of the international search report

07 June, 2011 (07.06.11)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006299426 A [0005]