



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

(43) Date of publication:
16.09.2015 Bulletin 2015/38

(51) Int Cl.:
D04B 15/88 (2006.01)

(21) Application number: **13853958.0**

(86) International application number:
PCT/JP2013/078049

(22) Date of filing: **16.10.2013**

(87) International publication number:
WO 2014/073340 (15.05.2014 Gazette 2014/20)

(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

(72) Inventors:
• **ONISHI, Yasushi**
Kobe-shi
Hyogo 651-2242 (JP)
• **MITANI, Naoya**
Kobe-shi
Hyogo 651-2242 (JP)

(30) Priority: **07.11.2012 JP 2012245768**

(74) Representative: **Gassner, Wolfgang et al**
Dr. Gassner & Partner mbB
Patentanwälte
Marie-Curie-Strasse 1
91052 Erlangen (DE)

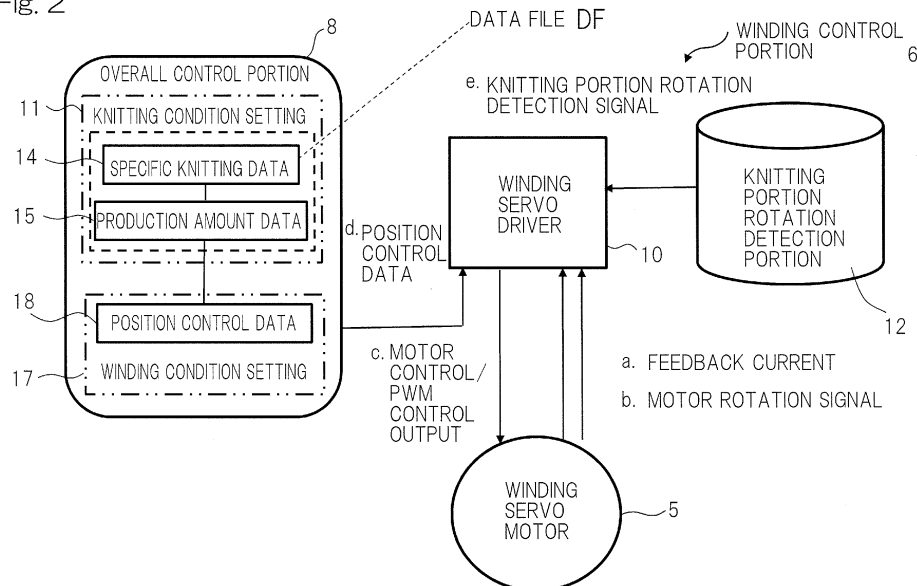
(71) Applicant: **Precision Fukuhara Works, Ltd.**
Kobe-shi
Hyogo 651-2242 (JP)

(54) **METHOD AND DEVICE FOR CONTROLLING WINDING IN CIRCULAR KNITTING MACHINE**

(57) In a winding control method and device for a circular knitting machine, in a position control mode in which control is performed such that winding is performed in a winding amount corresponding to position control data, a winding control portion (6) changes production amount data in response to a change in specific knitting

data which affects a production amount of the knitted fabric during operation, of the knitting conditions, and sets the position control data corresponding to the winding amount of the knitted fabric such that the position control data changes in synchronization with the change in the production amount data.

Fig. 2



Description

CROSS REFERENCE TO THE RELATED APPLICATION

[0001] This application is based on and claims Convention priority to Japanese patent application No. 2012-245768, filed November 7, 2012, the entire disclosure of which is herein incorporated by reference as a part of this application.

BACKGROUND OF THE INVENTION

(Field of the Invention)

[0002] The present invention relates to a method and device for controlling winding of a tubular knitted fabric produced by a circular knitting machine.

(Description of Related Art)

[0003] In general, a circular knitting machine includes: a knitting portion which rotates a cylinder including knitting needles received in needle grooves, by drive of a motor and feeds yarns to the knitting needles to produce a tubular knitted fabric; and a winding mechanism portion which winds the tubular knitted fabric produced by the knitting portion. In the winding mechanism portion, a servo motor which is accurately controllable at a high speed is often used for driving a winding roller, and control of winding the knitted fabric is performed by providing a command pulse synchronized with operation of the knitting portion, to a servo driver. In this case, a torque control mode (whereby output torque of the servo motor is controlled at a constant value) and a position control mode (whereby a rotation angle of the servo motor is controlled at a constant value) are often used.

[0004] In a circular knitting machine having an electronic needle selection function, the amount of a knitted fabric produced per one rotation of a cylinder of a knitting portion may change during operation due to a change in a knitting condition of the knitted fabric such as a knit structure, the number of stitches, knitting timing, a used yarn, or the like. For example, a production amount of a knitted fabric of all knit is larger than that of a knitted fabric with a knit structure including welt or tuck, and the production amount increases as the number of stitches increases. It is known to use the above-described torque control mode in order to respond to the change in the production amount (e.g., Patent Document 1). By keeping the output torque of a torque (servo) motor constant, the torque motor is controlled such that constant winding tension is maintained to perform automatic torque adjustment, even when the production amount of a knitted fabric is changed.

[0005] Meanwhile, when using the torque control mode in which constant winding tension is maintained, there is the problem in that depending on the knitting condition

(such as a yarn used, a knit structure, or the like), a stop step, which is a knitting defect, is likely to occur due to influence of the winding tension, the properties of the yarn used, or the like. A stop step defect is where a 'line-like step' is formed in a produced cylindrical knitted fabric along the circumference of the knitted fabric at the time of stop of operation or a lateral step which is a knitting defect in which a helical step is formed in the knitted fabric during operation.

[0006] On the other hand, in the position control mode, unlike the torque control mode, a knitted fabric can be wound in a set constant amount, and thus it is possible to stably wind a knitted fabric having less stop steps or lateral steps. The position control mode is a mode whereby a knitted fabric production amount corresponding to the rotation angle of the servo motor per one rotation of the cylinder of the knitting portion, is manually preset (i.e. movement amount data per one pulse of a command pulse number to the servo motor is manually preset), and this is provided as position control data to the servo motor driver for winding a knitted fabric at constant winding tension. When one piece of the position control data is set with a control operation portion, a knitted fabric is constantly wound in an amount corresponding to the position control data during operation.

(Related Document)

[Patent Document]

[0007]

[Patent Document 1] JP Patent No. 2733760

[Patent Document 2] JP Laid-open Patent Publication No. 2010-285700

SUMMARY OF THE INVENTION

[0008] However, when the position control mode is used as it is, it may be possible to respond to a slight change in the production amount of the knitted fabric in some cases, but, for example, as in garment length knitting, when the production amount of the knitted fabric greatly changes during operation due to a change in a knit structure or the like which is caused by the electronic needle selection function, an allowable range where it is possible to respond to the change by adjustment of a winding amount may be exceeded. In this case, the winding tension of the knitted fabric extremely decreases or increases, and the quality of the knitted fabric is adversely affected by a knitting scar, or the operation may be disabled and not allowed to continue due to yarn breakage or an alarm of a yarn feeding device, whereby it may not be possible to appropriately and stably produce a knitted fabric and thus winding thereof is also not possible. In order to prevent this, it is necessary to stop the operation and perform a re-set in response to a great change in the production amount of the knitted fabric. Naturally, this

causes a decrease in production efficiency.

[0009] As a way of using the position control mode while responding to a change in the production amount of the knitted fabric, there is a method known whereby the winding of the knitted fabric is automatically performed such that winding of the knitted fabric is started in the torque control mode, and the mode is shifted to the position control mode after a winding state in the torque control mode becomes stable (e.g., Patent Document 2). This method is effective to shift the mode at start of operation but is not able to respond to a great change in the production amount during operation.

[0010] One purpose of the present invention is to provide a winding control method and device for a circular knitting machine which allow a knitted fabric to be wound at appropriate and stable winding tension in a position control mode even when a production amount of the knitted fabric greatly changes during operation.

[0011] In order to achieve the above objective, a winding control method and device for a circular knitting machine according to the present invention winds a tubular knitted fabric produced by a knitting portion on the basis of set knitting conditions for the knitted fabric, by a winding mechanism portion (including a winding roller and a winding servo motor for roller drive) and controls the winding mechanism portion by a winding control portion. Providing a position control mode in which control is performed by the winding control portion such that winding is performed in a winding amount corresponding to position control data; and changing production amount data, in the position control mode, in response to a change in specific knitting data which affects a production amount of the knitted fabric during operation, of the knitting conditions, and the position control data corresponding to the winding amount of the knitted fabric is set such that the position control data changes in synchronization with the change in the production amount data.

[0012] According to this configuration (in the position control mode), control is maintained whilst the production amount data is changed in response to a change in the specific knitting data affecting a production amount of the knitted fabric during operation, or of knitting data regarding the knitting conditions. The position control data corresponding to the winding amount of the knitted fabric is set such that the position control data changes in synchronization with the change in the production amount data. Thus, in the position control mode, even when there is a big change in the production amount of the knitted fabric, the production amount data is changed on the basis of a change in the specific knitting data and the position control data is synchronized with the change in the production amount data and it is possible to cause the production amount and the winding amount of the knitted fabric to coincide with each other. It is, consequently, possible to wind the knitted fabric at an appropriate and stable winding tension.

[0013] Preferably, the specific knitting data includes at least one of knit structure data, stitch number data, knit-

ting timing data and yarn used data and a change in the production amount data (corresponding to a change in the specific knitting data) is previously stored and the change in the production amount data and the change in the position control data are synchronized. The changed position control data is then set on the basis of the change in the specific knitting data allowing a rapid response and enabling a more appropriate and stable winding of the knitted fabric.

[0014] In addition, the specific knitting data is set per one course of a knit structure, that is, per one row in a lateral direction of the knit structure. Therefore, it is possible to appropriately and stably wind the knitted fabric for each course where there is a change in the production amount of the knitted fabric.

[0015] Preferably, a change in knitting operation data corresponding to a change in the specific knitting data of the knitting conditions is previously stored; the knitting operation data and pre-defined data corresponding to the production amount data are collated; production amount data is obtained from matched pre-defined data; the production amount data is changed by repeating this, and the position control data is set such that the position control data changes in synchronization with the change in the production amount data. Here, the pre-defined data is paired with the knitting operation data and has previously been set as data to be collated with the knitting operation data. Therefore, the collation of the knitting operation data and the pre-defined data is used instead of the above correspondence between the change in the production amount data and the change in the position control data and it is possible to cause the production amount and the winding amount of the knitted fabric to coincide with each other by utilizing the configuration of an existing device which is not configured with specifications which allow setting of production amount data, as it is.

[0016] Preferably, the knitting operation data comprises of the rotation speed of the knitting portion. Therefore, it is possible to more simply set the position control data with respect to a change in the specific knitting data.

[0017] Preferably, the rotation speed data and the pre-defined data are collated for each course of a knit structure. If the rotation speed data has not altered, setting of the production amount data and the position control data is kept as it is without obtaining production amount data corresponding to the matched pre-defined data and synchronizing the production amount data and the position control data and collation is performed for a next course. In addition, four types of the pre-defined data are set; the first is the pre-defined data of an inching speed; the second is the pre-defined data of a low speed i.e. lower than the first data; the third is the pre-defined data of an intermediate speed higher than the first data and the fourth is the pre-defined data of a high speed i.e. higher than the third data. Therefore, it is possible to more simply set the position control data with respect to a change in the specific knitting data.

[0018] Any combination of at least two constructions, disclosed in the appended claims and/or the specification and/or the accompanying drawings should be construed as included within the scope of the present invention. In particular, any combination of two or more of the appended claims should be equally construed as included within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] In any event, the present invention will become more clearly understood from the following description of preferred embodiments thereof, when taken in conjunction with the accompanying drawings. However, the embodiments and the drawings are given only for the purpose of illustration and explanation, and are not to be taken as limiting the scope of the present invention in any way whatsoever; the scope is to be determined by the appended claims. In the accompanying drawings, like reference numerals are used to denote like parts throughout the several views, and:

Fig. 1 is a front view of the entirety of a circular knitting machine according to an embodiment of the present invention;

Fig. 2 is a block diagram of a winding control portion 6 of a first embodiment;

Fig. 3 is a flowchart showing an operation of the first embodiment;

Fig. 4 is a block diagram of a winding control portion 6 of a second embodiment; and

Fig. 5 is a flowchart showing an operation of the second embodiment.

DESCRIPTION OF EMBODIMENTS

[0020] Hereinafter, embodiments of the present invention will be described with reference to the drawings, but embodiments of the present invention are not limited to these embodiments. Fig. 1 is a front view of the entirety of a circular knitting machine having an electronic needle selection function according to a first embodiment of the present invention. As shown in Fig. 1, a circular knitting machine includes: a knitting portion 2 which produces a tubular knitted fabric and a winding portion which includes a winding mechanism portion 3 which winds the produced tubular knitted fabric and a winding control portion 6 which controls the winding mechanism portion 3. A device body including the knitting portion 2 is provided with a control operation portion 20 for performing data input to the device, various displays etc.

[0021] In Fig. 1, the knitting portion 2 is installed above a bed 22 which is supported by a quantity/number of legs 21. A number of posts 24 are positioned upright on the bed 22 and a horizontal limb 25 is fixed to upper portions of the posts 24 by connecting parts. Yarn feeding sections 9 are supported by the horizontal limb 25. Below the bed 22, the winding mechanism section 3 is installed. This

includes: a quantity of pulling rollers 4a which nip and pull a produced knitted fabric and feed it downwards under tension; a winding roller 4b which winds the knitted fabric as it is fed through; and a winding servo motor 5 for the roller drive. The control operation section 20 and an overall control area 8 which controls the entirety of the circular knitting machine are provided below the bed 22.

[0022] Fig. 2 shows a block diagram of the winding control portion 6 found in devices such as those illustrated in Figure 1. The overall control portion 8 controls the entirety of the circular knitting machine and manages the setting of knitting and winding conditions together in the machine. Specific knitting data 14 which affects the production amount of a knitted fabric during operation, of the knitting conditions and production amount data 15 which changes in response to a change in the specific knitting data 14 are previously stored in the knitting condition setting section 11. The specific knitting data 14 and the corresponding data relating to the production amount 15 constitute a data file DF.

[0023] The specific knitting data 14 includes at least one of the following; knit structure data, stitch number data, knitting timing data and used yarn data. In addition, all data from the data file DF is read via information transmission units such as a USB, a LAN and the like.

[0024] Position control data 18 which corresponds to a winding amount of the knitted fabric is set in a winding condition setting section 17. The position control data 18 changes in synchronization with the production amount data 15. By reading the data file DF, the position control data 18 changes in synchronization with the production amount data 15 which changes on the basis of an alteration to the specific knitting data 14. The position control data 18 is inputted per one course of a knit structure so as to correspond thereto.

[0025] The knitting portion 2 in Fig. 1 rotates the cylinder in the knitting portion 2 which includes a quantity of knitting needles. These needles are driven/slid into needle grooves (not shown) by way of a main motor 7 and in accordance with the knitting conditions set for the desired knitted fabric. The yarns are fed from the yarn feeding portions 9 to the knitting needles and helically stacks stitches to produce a tubular knitted fabric. The main motor 7 which rotates the cylinder of the knitting portion 2 is controlled to drive at a predetermined rotation speed by the overall control portion 8, for example, through frequency control by an inverter.

[0026] The winding control portion 6 in Fig. 2 includes a winding servo driver 10 which is positioned in the winding mechanism portion 3 in Fig. 1, the overall control portion 8, and a knitting portion rotation detection portion (rotary encoder) 12 which is situated in the winding mechanism portion 3 in Fig. 1 and detects a rotation speed of the cylinder by the main motor 7 (which drives the cylinder and are connected to the winding mechanism portion 3 and a gear ring disposed within the bed).

[0027] The winding servo driver 10 performs a PWM

control output (shown by c) with respect to the winding servo motor 5 to perform PWM control of the winding servo motor 5, and controls a rotation angle of the winding servo motor 5 by providing, to the winding servo motor 5, an output pulse number for a command pulse synchronized with a rotation angle of the cylinder (a knitting portion rotation detection signal shown by e) driven by the main motor 7 which is inputted from the knitting portion rotation detection portion 12. In addition to these motor control/PWM control output portions and knitting portion rotation detection signal input, the winding servo driver 10 includes, a serial communication for the overall control portion, a feedback current detection between the winding servo driver 10 and a later-described winding servo motor 5, as well as a motor rotation angle input portion, which is not shown.

[0028] In a position control mode, control is performed in which the winding servo motor 5 in Fig. 2 is rotated at a constant rotation angle (a motor rotation signal shown by b) with respect to rotation of the cylinder of the knitting portion. In this position control, the rotation angle of the winding servo motor 5 is controlled with high accuracy while constant winding tension is maintained. Thus, it is possible to constantly wind a knitted fabric in the same production amount and at a stable winding tension, since there is no change to influence the mechanical load to a gear, the roller or the like of the winding mechanism portion 3.

[0029] The overall control portion 8 transmits position control data (shown by d), corresponding to the knit structure data of the current course, to the winding servo driver 10. The winding servo driver 10 performs a PWM control output corresponding to the position control data, with respect to the winding servo motor 5, thereby performing motor control (shown by c) with the position control data and current of the winding servo motor 5 in the position control mode.

[0030] When the specific knitting data 14 for a particular knitting condition is read, the overall control portion 8 controls an actuator (which is not shown) stitching, timing, a striper and the like of knitting portion 2 and the electric power supplied to the device.

[0031] Hereinafter, an operation of the winding control device of the first embodiment having the above configuration will be described. Fig. 3 is a flowchart showing the operation. As a preliminary step before entering the flowchart, for example, a data file DF is created per one course of a knit structure. The data file DF of the specific knitting data 14 and the corresponding production amount data 15 described above is previously stored in the overall control portion 8.

[0032] First, the data file DF in the overall control portion 8 is read (step S1). Then, operation is started, and production of a knitted fabric is started under knitting conditions including the read knit structure (step S2). Thereafter, the device reads the production amount data which is inputted so as to correspond to the knit structure data of the present course (step S3) and synchronizes the

read production amount data and the position control data, the obtained position control data is outputted to the servo driver 10, the rotation angle of the winding servo motor 5 is controlled, and the device causes execution to be performed in a winding amount corresponding to the position control data (step S4), and proceeds to step S3. Since the production amount data is set per one course of the knit structure, the production amount data is read per course and executed. Then, steps S3 and S4 are repeated until stop of operation.

[0033] The overall control portion 8 can be equipped with a compensation program which provides a command to the winding mechanism portion 3 to increase/decrease a winding amount (earlier or later by several pulses) in order to compensate for a difference between a production amount and a winding amount of a knitted fabric. Such differences can be caused by the magnitude of a change in the production amount of the knitted fabric which is caused when the winding amount is increased/decreased simultaneously with a change in the knit structure or the like; and timing when the servo driver 10 receives the position control data.

[0034] As described above in the first embodiment, in the position control mode, control is performed in which:

- the production amount data is changed in response to a change in the specific knitting data which affects a production amount of a knitted fabric during operation, of the knitting data regarding the knitting conditions;
- the position control data corresponding to the winding amount of the knitted fabric is set so as to be synchronized with the change in the production amount data. Thus, even when a change in the production amount of the knitted fabric is great, in the position control mode which less affects the quality of a knitted fabric, a change in the production amount data is immediately obtained from a change in the specific knitting data and the position control data is synchronized with the change in the production amount data. In this way, it is possible to cause the production amount and the winding amount of the knitted fabric to coincide with each other. Therefore, it is possible to wind the knitted fabric at an appropriate and stable winding tension without stopping device operation. In addition, it is possible to respond to a complicated change in the knitting conditions.

[0035] Next, a winding control device of a second embodiment will be described. Regarding the overall control portion 8, unlike the first embodiment in which the overall control portion 8 directly synchronizes the production amount data 15 and the position control data 18 to substantially simultaneously perform control of knitting condition setting and control of winding condition setting, in the second embodiment, an existing device to which production amount data does not correspond is utilized as it is, and control of knitting condition setting and control

of winding condition setting are separately performed.

[0036] Fig. 4 shows a diagram of the winding control portion 6 in the device of the second embodiment. The overall control portion 8 controls the entirety of

- the circular knitting machine and the specific knitting data 14 which affects a production amount of a knitted fabric during operation and
- the knitting conditions and knitting operation data 16. This alters in response to a change in the specific knitting data 14, such as rotation speed data of the knitting portion 2 and of the knitting conditions previously stored in the knitting condition setting portion 11. The rotation speed data 16 is composed of numerical values which can be altered and created quickly and easily. The specific knitting data 14 and the rotation speed data 16 constitute a data file DF.

[0037] The position control data 18 corresponding to a winding amount of a knitted fabric is set in the winding condition setting portion 17. By reading the data file DF, a position control data collation portion 19 collates the rotation speed data 16 and predefined data 30 per one course of the knit structure to obtain the production amount data 15 corresponding to the matched predefined data 30, the production amount data 15 is changed by repeating this, and the position control data 18 changes in synchronization with this change. In this manner, the position control data 18 is set on the basis of a change in the specific knitting data 14.

[0038] The existing device is able to cause knitting data such as knit structure data of knitting conditions to be inputted and read in knitting condition setting and to execute knitting. However, the existing device is not configured with specifications which allow production amount data to be inputted and read to execute winding as in the first embodiment. Since winding condition setting is performed in other control, in order to allow the existing device to execute this, capital investment, for example in the development of software to create and read software etc. and the extension of a circuit is required. However, the configuration of the existing device is utilized in the second embodiment as it is.

[0039] In addition, regarding the specific knitting data, for example, the knit structure data or such like has a large data volume and it is difficult to collate such data; it also takes time and effort to create pre-defined data. Thus, in the second embodiment, although it is difficult to respond to a complicated change in knitting conditions, collation of the predefined data and the knitting operation data such as the rotation speed data of the knitting portion is used instead of the correspondence between the production amount data and the position control data, the existing device is simply used as it is, and the production amount and the winding amount of the knitted fabric are caused to coincide with each other.

[0040] When the rotation speed of the knitting portion 2 is not equal to or lower than a predetermined speed,

depending on the knitting conditions such as a knit structure, the number of stitches, knitting timing, yarn used etc. which constitute the specific knitting data, knitting cannot be performed without defect, or the actuator, automatic stitching, automatic timing control, the stripper etc. cannot be operated. Thus, the existing device is configured with specifications which allow the rotation speed data to be inputted to a data file, and the rotation speed data changes in response to a change in the specific knitting data, which responds to a change in a production amount of a knitted fabric. The other configuration is the same as the first embodiment.

[0041] Fig. 5 is a flowchart showing an operation of the second embodiment. As a preliminary step before entering the flowchart, a data file DF is created per one course of a knit structure. The data file DF of the specific knitting data 14 and the corresponding rotation speed data 16 described above is previously stored in the overall control portion 8.

[0042] First, the overall control portion 8 is caused to read the data file DF (step T1). Then, operation is started, and production of a knitted fabric is started under knitting conditions including the read knit structure (step T2).

[0043] Thereafter, the device reads the rotation speed data corresponding to the knit structure data of the present one course (step T3) and confirms whether the rotation speed data has changed from the rotation speed data of the last course in response to a change in the specific knitting data 14 (step T4). If the rotation speed data has not changed, the device does not change the production amount data and the position control data (step T7-2) and proceeds to step T3. If the rotation speed data has changed, the device performs collation to determine whether the rotation speed data is predefined data which is set as "high speed" (step T5-1). If the rotation speed data is "high speed", the device obtains the production amount data corresponding to the predefined data (step T6-1). Similarly, the device performs collation to determine whether the rotation speed data is predefined data which is set as "intermediate speed", "inching", or "low speed" (step T5-2, T5-3, or T5-4), and if matched, the device obtains the corresponding production amount data (step T6-2, T6-3, or T6-4).

[0044] Thereafter, the device synchronizes the obtained production amount data and the position control data, the obtained position control data is outputted to the servo driver 10, the rotation angle of the winding servo motor 5 is controlled, and the device causes execution to be performed in a winding amount corresponding to the position control data (step T7-1), and proceeds to step T3. It should be noted that if the rotation speed data does not belong to any rotation speed data, that is, if there is data abnormality, the device does not change the production amount data and the position control data (step T7-2) and proceeds to step T3. The rotation speed data is read per course, and steps T3 to T7-1 or T7-2 are repeated until stop of the knitting machine. As described above, the position control data changes in synchroniza-

tion with a change in the production amount data.

[0045] As described above, in the second embodiment, the collation of the predefined data and the knitting operation data (rotation speed data) is used instead of the correspondence between the production amount data and the position control data in the first embodiment, whereby the production amount and the winding amount of the knitted fabric are caused to coincide with each other by simply utilizing the configuration of the existing device as it is.

[0046] As described above, in the present invention, even when the production amount of the knitted fabric greatly changes during operation, in the position control mode which less affects the quality of a knitted fabric, it is possible to wind the knitted fabric at an appropriate and stable winding tension without stopping the device.

[0047] Although the preferred embodiments have been described above with reference to the accompanying drawings, those skilled in the art will readily conceive various changes and modifications within the framework of obviousness upon the reading of the specification herein presented of the present invention. Accordingly, such changes and modifications are, unless they depart from the scope of the present invention as delivered from the claims annexed hereto, to be construed as included therein.

[Reference Numerals]

[0048]

1	circular knitting machine
2	knitting portion
3	winding mechanism portion
4	winding roller
5	winding servo motor
6	winding control portion
8	overall control portion
11	knitting condition setting portion
14	specific knitting data
15	production amount data
16	knitting operation data (rotation speed data)
17	winding condition setting portion
18	position control data
19	position control data collation portion
30	predefined data
DF	data file

Claims

1. A winding control method for a circular knitting machine which winds a tubular knitted fabric produced by a knitting portion on the basis of set knitting conditions for the knitted fabric, by a winding mechanism portion including a winding roller and a winding servo motor for roller drive and controls the winding mechanism portion by a winding control portion, the method

comprising:

providing a position control mode in which control is performed by the winding control portion such that winding is performed in a winding amount corresponding to position control data; and

changing production amount data, in the position control mode, in response to a change in specific knitting data which affects a production amount of the knitted fabric during operation, of the knitting conditions, and setting the position control data corresponding to the winding amount of the knitted fabric such that the position control data changes in synchronization with the change in the production amount data.

2. The winding control method for the circular knitting machine as claimed in claim 1, wherein the specific knitting data includes at least one of knit structure data, stitch number data, knitting timing data, and used yarn data, and a change in the production amount data corresponding to a change in the specific knitting data is previously stored, and the changed position control data is set on the basis of the change in the specific knitting data.

3. The winding control method for the circular knitting machine as claimed in claim 2, wherein the specific knitting data is set per one course of a knit structure.

4. The winding control method for the circular knitting machine as claimed in claim 1, wherein a change in knitting operation data corresponding to a change in the specific knitting data of the knitting conditions is previously stored, the knitting operation data and predefined data corresponding to the production amount data are collated, production amount data is obtained from matched predefined data, the production amount data is changed by repeating this, and the position control data is set such that the position control data changes in synchronization with the change in the production amount data.

5. The winding control method for the circular knitting machine as claimed in claim 4, wherein the knitting operation data is rotation speed data of the knitting portion.

6. The winding control method for the circular knitting machine as claimed in claim 5, wherein the rotation speed data and the predefined data are collated per one course of a knit structure, and if the rotation speed data has not changed, setting of the production amount data and the position control data is kept as it is without obtaining production amount data corresponding to matched predefined data and syn-

chronizing the production amount data and the position control data, and collation is performed for a next course.

7. The winding control method for the circular knitting machine as claimed in claim 5 or 6, wherein four types of the predefined data are set, first data is predefined data of an inching speed, second data is predefined data of a low speed lower than the first data, third data is predefined data of an intermediate speed higher than the first data, and fourth data is predefined data of a high speed higher than the third data. 5 10
8. A circular knitting machine which winds a tubular knitted fabric produced by a knitting portion on the basis of set knitting conditions for the knitted fabric, by a winding mechanism portion including a winding roller and a winding servo motor for roller drive; and comprises a winding control device configured to control the winding mechanism portion by a winding control portion, wherein the winding control portion is configured 15 20
- to provide a position control mode in which control is performed such that winding is performed in a winding amount corresponding to position control data, 25
- to change production amount data in response to a change in specific knitting data which affects a production amount of the knitted fabric during operation, of the knitting conditions, and 30
- to set the position control data corresponding to the winding amount of the knitted fabric such that the position control data changes in synchronization with the change in the production amount data. 35

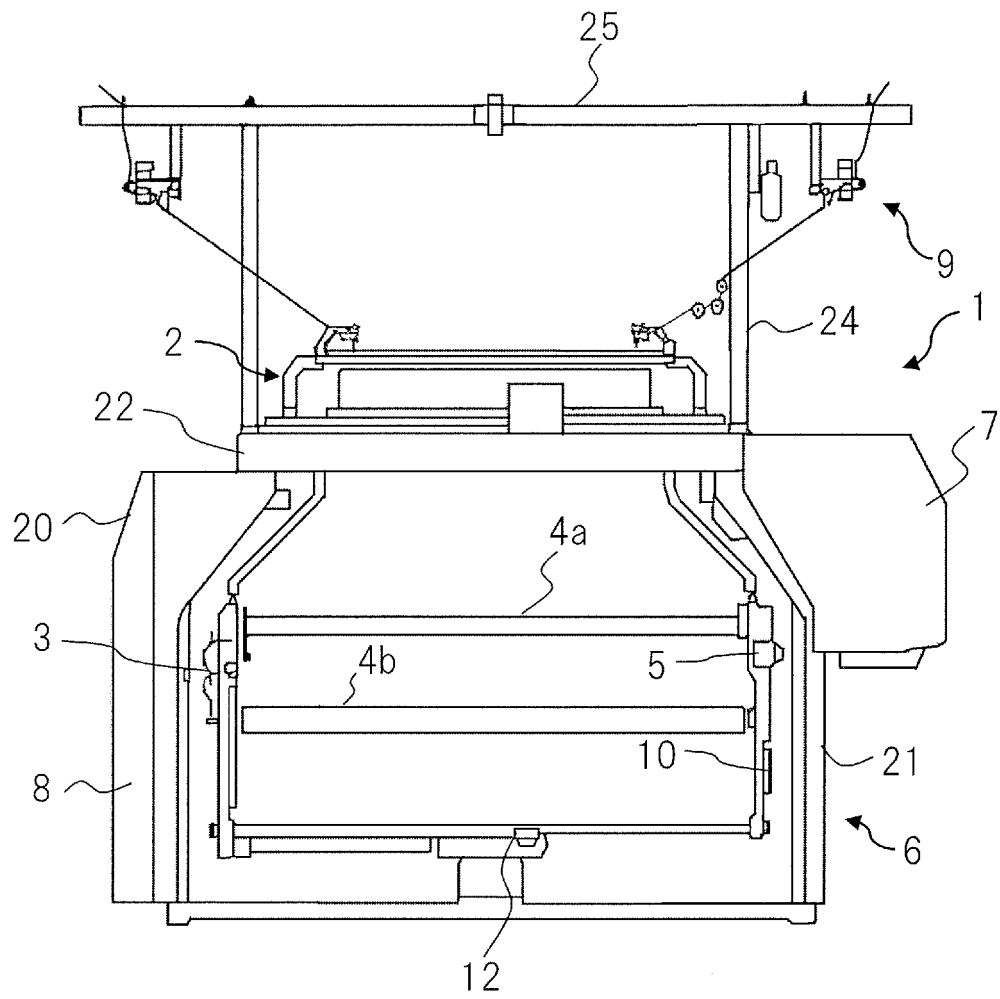
40

45

50

55

Fig. 1



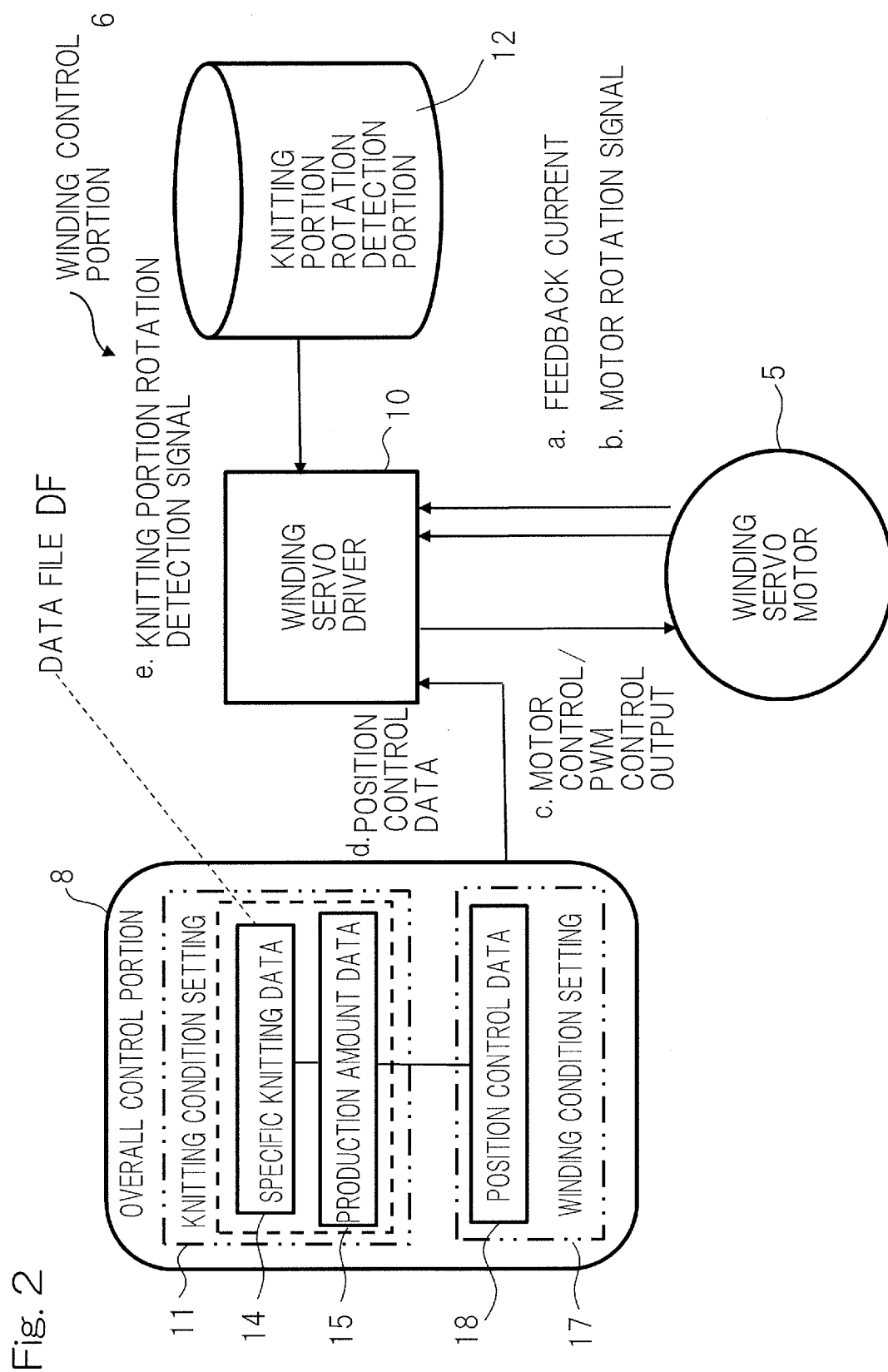
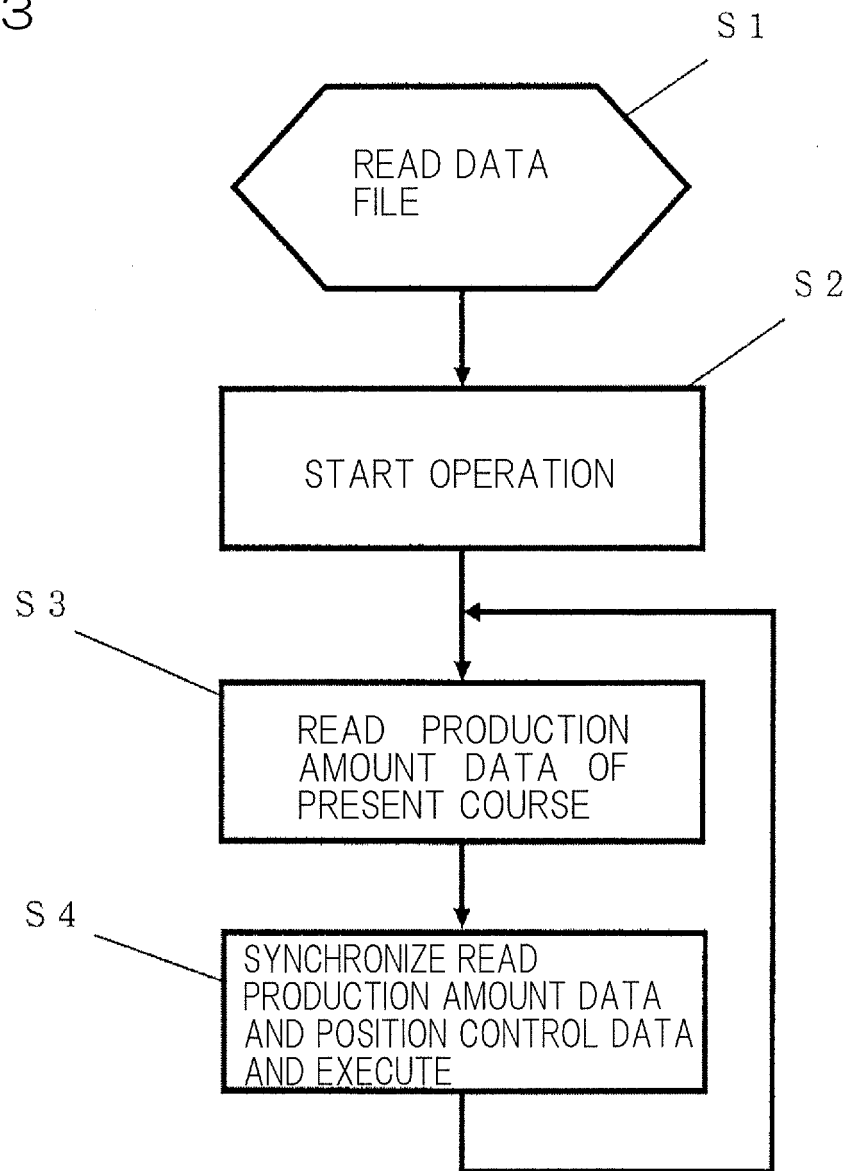


Fig. 3



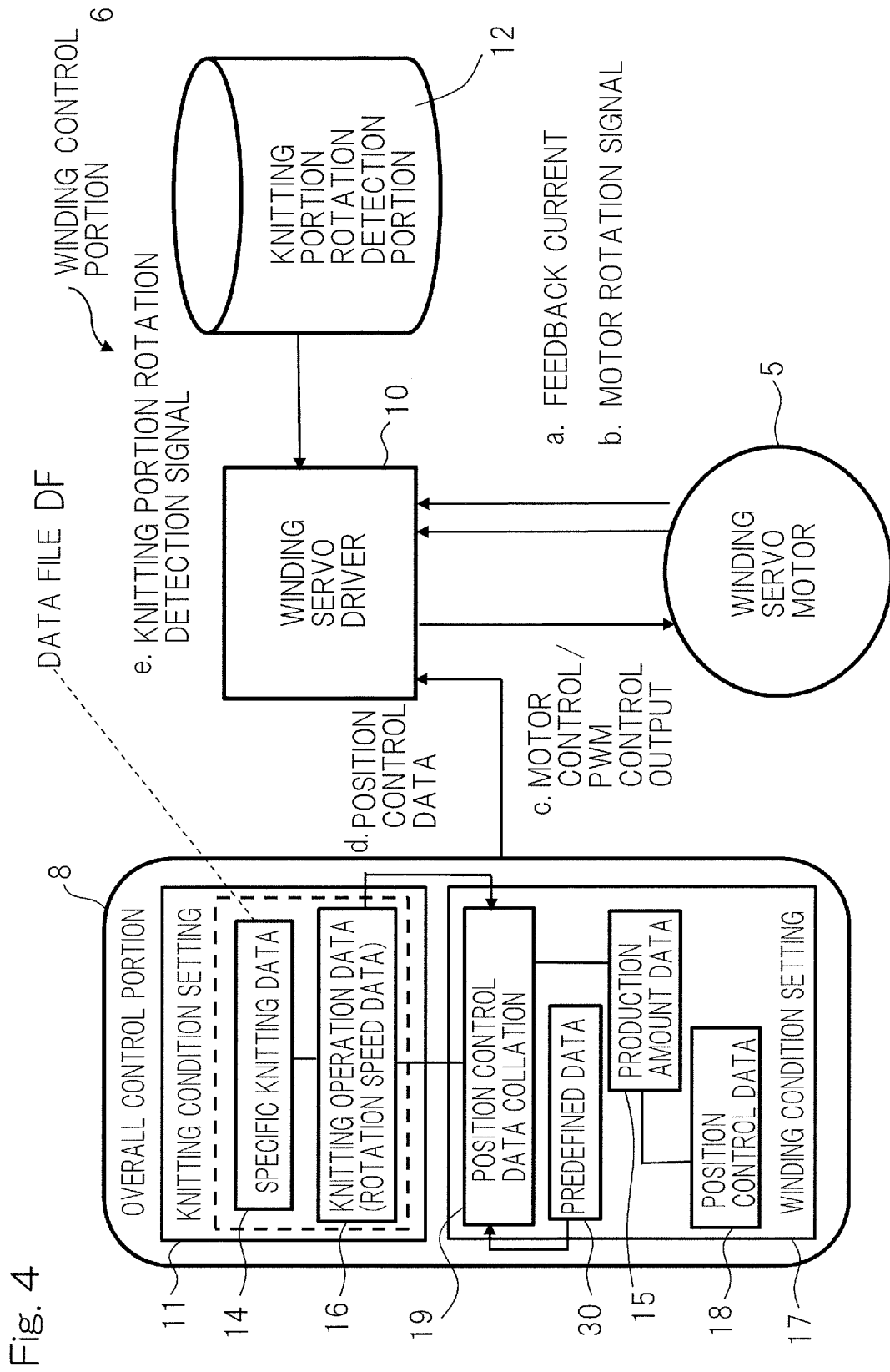
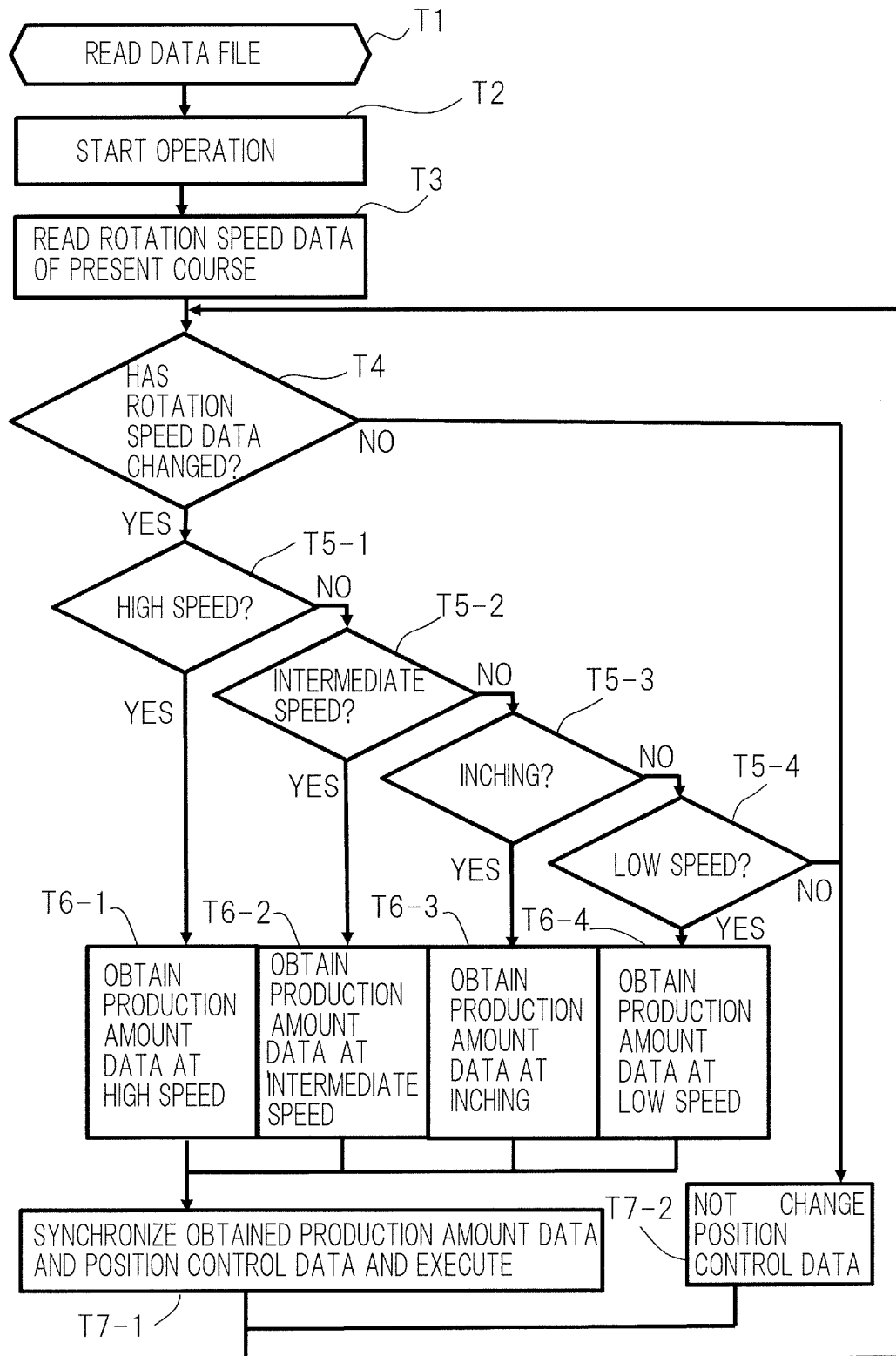


Fig. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/078049

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/88 (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)

D04B15/88-15/90

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 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 2010-285700 A (Precision Fukuhara Works, Ltd.), 24 December 2010 (24.12.2010), entire text (particularly, paragraph [0006]); all drawings & EP 2261407 A1 & CN 101922085 A & TW 201104032 A	1-3, 8 4-7
A	JP 56-140143 A (Shima Idea Center Co., Ltd.), 02 November 1981 (02.11.1981), entire text; all drawings (Family: none)	1-8

☒ 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
07 January, 2014 (07.01.14)Date of mailing of the international search report
21 January, 2014 (21.01.14)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/078049

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2013-019082 A (Precision Fukuhara Works, Ltd.), 31 January 2013 (31.01.2013), entire text; all drawings & EP 2546401 A1 & CN 102877208 A & TW 201319348 A	1-8
A	JP 05-071050 A (Precision Fukuhara Works, Ltd.), 23 March 1993 (23.03.1993), entire text; all drawings (Family: none)	1-8

Form PCT/ISA/210 (continuation of 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 2012245768 A [0001]
- JP 2733760 B [0007]
- JP 2010285700 A [0007]