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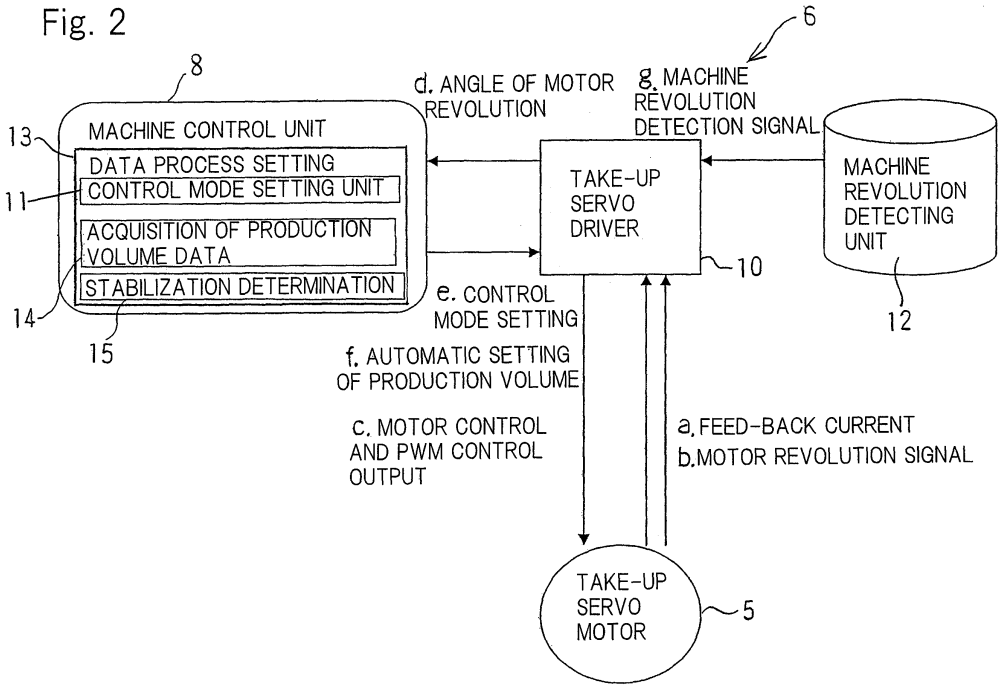
(54) Method of and device for controlling fabric take-up in circular knitting machine

(57) A take-up control device (6) includes a control mode setting means (11) capable of setting a control mode for a take-up servo motor (5) to one of a torque control mode, under which the take-up servo motor (5) is driven so as to maintain a winding tension of the knitted fabric at a constant value, and a position control mode, under which the take-up servo motor (5) is driven at a constant angle of rotation relative to revolutions in the knitting unit (2). This take-up control device (6) is operable to initiate the take-up of the knitted fabric under the torque control mode and to shift the control mode from the torque control mode to the position control mode, after a take-up condition under the torque control mode is determined as stabilized by a stabilization determining means (15), to perform an automatic take-up of the knitted fabric.

Fig. 2



EP 2 261 407 A1

Description

BACKGROUND OF THE INVENTION

(Field of the Invention)

[0001] The present invention relates to a method of and a device for controlling the take-up of a tubular knitted fabric in a tubular form while the tension, under which the knitted fabric is taken up, is maintained at a constant value.

(Description of the Prior Art)

[0002] The circular knitting machine includes a knitting unit, in which a cylinder having a plurality needle grooves is revolved by a drive, exerted by a motor, with yarns supplied to the knitting needles, to thereby form tubular knitted fabric; and a take-up mechanism for winding up the tubular knitted fabric so formed by the knitting unit. In recent years, with the increasing variety of available yarns and with the increasing demand for more varied and higher quality fabrics, a servo motor of a type capable of being precisely controlled at a high speed is quite often used in order to drive a take-up roll employed in the take-up mechanism. In such case, it has been well known in the art that the take-up control unit is utilized to perform a control of a take-up of the knitted fabric by applying command pulses, synchronized with the operating speed of the knitting machine, to the servo motor so that the servo-motor speed control mode, the servo-motor position control mode and the servo-motor torque control mode can be used.

[0003] In taking up the knitted fabric in the circular knitting machine, it is necessary to take up the knitted fabric under a constant winding tension and, for example, when the winding tension is not constant in the case of a stretchable yarn and/or a knitting structure, the knitted fabric tends to be taken up in a stretched state or a slackened state, resulting in product deficiency. Also, in the case of the large take-up, in which the winding diameter of a roll of cloth is large and the weight of the cloth is also large, the winding diameter of the roll at the time the take-up of the knitted fabric is initiated differs considerably from the winding diameter of the roll at the end of the fabric take-up and, therefore, the winding tension applied to the knitted fabric changes. For this reason, the control is made to change the torque of the winding motor in dependence on the yarn and the knitting structure and, also, the winding diameter of the take-up roll so that the winding tension can be kept constant.

[0004] It is to be noted that in the case of the large take-up referred to above, it has been known to measure the winding diameter of the fabric take-up roll in terms of the voltage with a potentiometer and then to perform to the DC motor an electric current addition necessary to compensate for a deficiency in rotation of the take-up motor such as, for example, a DC motor resulting from a load variation brought about by a weight addition of the fabric so that the knitted fabric can be taken up under a constant winding tension. This known control method utilizing the potentiometer, however, does not only involve a problem associated with increase in number of component parts including, for example, the potentiometer, but is getting no longer used since continuous fibers are knitted in recent years and the level of quality required is upgraded.

[0005] In the conventional take-up control, the Japanese Patent No. 2733760, for example, discloses the system, in which the torque control of a torque (servo) motor is used in taking up the fabric from the knitting machine and in which the torque motor is so controlled as to progressively increase the torque according to change in weight of the roll during the fabric take-up to thereby automatically adjust the torque.

[0006] Another conventional take-up control system has also been well known, in which the position control of the servo motor is utilized to take up the knitted fabric and in which the knitted fabric is taken up under a constant winding tension by previously supplying according to the yarn or the knitting structure, the amount of production of the knitted fabric, which is the angle of rotation of the servo motor for one complete revolution in the knitting unit, that is, data on the amount of movement (position control data) for one pulse of the number of the command pulses to the servo motor driver.

[0007] It has however been found that since although the servo motor torque control is effective to achieve the winding tension within a constant range if the torque is changed with change in weight of the roll or with change of the yarn and/or the knitting structure, this torque is originally the one obtained from the torque of the motor shaft, influences brought about by a change in mechanical load such as, for example, gears and/or rollers employed in the take-up mechanism cannot be avoided and, in particular when start and stop are repeated, the take-up of the knitted fabric is considerably affected and, therefore, such system cannot necessarily be regarded as a take-up control under a stabilized winding tension.

[0008] On the other hand, the conventional servo motor position control is complicated to such an extent as to result in difficulty in automating the take-up control, because each time the yarn or the knitting structure is changed, it is necessary to set the data on the amount of movement per pulse of the number of the command pulses to be supplied to the servo motor so that a proper winding tension can be attained. Also, in the case of a new yarn and/or a new knitting structure, in order to properly set the data on the amount of movement referred to above, it is necessary to ascertain the condition of the knitting fabric at the start of winding once a roll of knitted fabric has been formed based on, for example, the provisional setting, and, therefore, automation is further difficult to achieve.

SUMMARY OF THE INVENTION

[0009] In view of the foregoing, the present invention has been devised to substantially eliminate the above discussed problems and is intended to provide an improved fabric take-up control method and a fabric take-up control device, both for a circular knitting machine, which are effective to achieve an automatic take-up of a knitted fabric under a proper and stabilized winding tension even when the yarn or the knitting structure is changed.

[0010] In order to accomplish the foregoing object of the present invention, there is provided a take-up control method for a circular knitting machine, the knitting machine comprising a take-up mechanism including a take-up roll and a take-up servo motor for driving the take-up roll, for taking up a tubular knitted fabric, formed by a knitting unit, by means of the take-up mechanism and controlling the take-up mechanism by means of a take-up control device, which take-up control device is capable of setting a control mode for the take-up servo motor to one of a torque control mode, under which the take-up servo motor is driven so as to maintain a winding tension of the knitted fabric at a constant value, and a position control mode, under which the take-up servo motor is driven at a constant angle of rotation relative to revolutions in the knitting unit, and is operable to initiate the take-up of the knitted fabric under the torque control mode and to shift the control mode from the torque control mode to the position control mode, after a take-up condition under the torque control mode is determined as stabilized, to perform an automatic take-up of the knitted fabric.

[0011] It is to be noted that stabilization of the take-up condition is intended to mean a condition, in which the operating speed of the knitting machine is stabilized and the angle of rotation of the take-up servo motor for each complete revolution in the knitting unit attains a substantially constant value.

[0012] The present invention also provides a take-up control device for a circular knitting machine, the circular knitting machine comprising a take-up mechanism including a take-up roll and a take-up servo motor for driving the take-up roll, for taking up a tubular knitted fabric, formed by a knitting unit, by means of the take-up mechanism and controlling the take-up mechanism by means of a take-up control device, which take-up control device includes a control mode setting means capable of setting a control mode for the take-up servo motor to one of a torque control mode, under which the take-up servo motor is driven so as to maintain a winding tension of the knitted fabric at a constant value, and a position control mode, under which the take-up servo motor is driven at a constant angle of rotation relative to revolutions in the knitting unit; in which case the take-up control device is operable to initiate the take-up of the knitted fabric under the torque control mode and to shift the control mode from the torque control mode to the position control mode, after a take-up condition under the torque control mode is determined as stabilized, to perform an automatic take-up of the knitted fabric.

[0013] According to the present invention, since the take-up of the knitted fabric is initiated under the torque control mode, it is possible to take up the knitted fabric under a proper winding tension even though the yarn and/or the knitting structure is/are changed. Also, since after the take-up condition is determined as stabilized, the control mode is automatically shifted from the torque control mode onto the position control mode to take up the knitted fabric, it is possible to accomplish a proper and stabilized take-up of the knitted fabric. Accordingly, even when the yarn and/or the knitting structure is/are changed, the knitted fabric can be automatically taken up under a proper and stabilized winding tension.

[0014] In a preferred embodiment of the present invention, production volume data, which is the angle of rotation of the take-up servo motor for one complete revolution in the knitting unit from the take-up servo driver, may be acquired while the take-up under the torque control mode is taking place, and the take-up condition is then determined as stabilized when a predetermined number of production volume data on the knitted fabric converges within a predetermined range. In this case, the production volume data of the knitted fabric, when the take-up condition is stabilized, is automatically set to the take-up control device to shift the control mode to the position control mode. Accordingly, since a predetermined number of the production volume data on the knitted fabric is acquired during the take-up of the knitted fabric under the torque control mode and, based on this, the take-up condition is determined as stabilized so that the production volume data (position control data) of the take-up servo motor in dependence on the change of the yarn and/or the knitting structure can be automatically set to shift the control mode from the torque control mode to the position control mode, the knitted fabric can be automatically taken up under a proper and stabilized winding tension.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] 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, which 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 schematic front elevational view showing a circular knitting machine in its entirety;

Fig. 2 is a block diagram showing a fabric take-up controller for the circular knitting machine according

to a preferred embodiment of the present invention; and

Fig. 3 is a flow chart showing the sequence of operation of the fabric take-up control device for the circular knitting machine shown in Fig. 2.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0016] A preferred embodiment of the present invention will be described in detail with reference to the accompanying drawings. Fig. 1 is a schematic front elevational view showing a circular knitting machine 1 in its entirety. As shown in Fig. 1, the circular knitting machine 1 includes a knitting unit 2 for forming a tubular knitted fabric, and a take-up unit made up of a take-up mechanism 3 for winding up the tubular knitted fabric so formed and a take-up controller 6 for controlling the take-up mechanism 3. A knitting control panel 20 is provided in the knitting machine, including the knitting unit 2, for inputting data to the knitting machine and providing various visual indications and/or displays.

[0017] As best shown in Fig. 1, the knitting unit 2 is mounted above a bed 22 that is supported by a plurality of legs 21. The bed 22 includes a plurality of posts 24 having their lower ends secured thereto and also having their upper ends, on which respective horizontal members 25 are fixedly mounted by means of connecting members. Yarn supply units 9 are supported by the horizontal members 25. The knitting unit 2 is so designed and so configured that while a cylinder (not shown), accommodating a plurality of knitting needles slidably accommodated within needle grooves, is driven by a main motor 7, yarns from the yarn supply units 9 can be supplied to the knitting needles to stack helically stitches to thereby form the tubular knitted fabric.

[0018] The take-up mechanism 6 including a take-up roll 4 for winding up the knitted fabric and a take-up servo motor 5 for driving the take-up roll 4 is disposed beneath the bed 22. The knitting control panel 20 and a machine control unit 8 for controlling the circular knitting machine 1 in its entirety are disposed at a location downwardly and leftwards of the bed 22. Although not shown, safety gates for inhibiting an access to the inside of the circular knitting machine 1 are disposed at a location downwardly and forwards of the bed 22, which gates are closed during the operation of the knitting machine 1 for security purpose, but are opened when the knitting machine 1 is halted for removal of the knitted fabric or for machine maintenance.

[0019] The main motor 7 for revolving the cylinder which is part of the knitting unit 2 is so controlled by the machine control unit 8 for the circular knitting machine 1, for example, according to a frequency control implemented by an inverter as to be driven at a predetermined number of revolutions.

[0020] Fig. 2 illustrates a block diagram showing the fabric take-up controller 6 referred to above. The fabric take-up controller 6 includes a take-up servo driver 10, provided in the take-up mechanism 3 best shown in Fig. 1, a control mode setting means 11 included in a data process setting unit 13 included in the machine control unit 8, and a machine revolution detecting unit (rotary encoder) 12 for detecting the number of revolutions of the cylinder caused by the main motor 7.

[0021] The take-up servo driver 10 is of a type capable of performing a PWM control by providing the take-up servo motor 5 with, for example, a PWM control output (as indicated by c) and is operable to supply the number of output command pulses, synchronized with the angle of revolution (represented by a machine revolution detection signal indicated by g) of the cylinder caused by the main motor 7 that is inputted from the machine revolution detecting unit 12, to the take-up servo motor 5 to thereby control the angle of revolution of the take-up servo motor 5. Although not shown, the take-up servo driver 10 includes, in addition to the motor control and PWM control output unit and a machine revolution detection signal input unit, a serial communication unit cooperable with the data process setting unit 13, a feed-back current detecting unit and a motor revolution angle input unit both connected with the take-up servo driver 10 as will be described later.

[0022] The control mode setting means 11 shown in Fig. 2 is operable to set a control mode of the take-up servo motor 5 to a torque control mode and a position control mode (indicated by e). The torque control mode is a mode during which the take-up servo motor 5 is so controlled as to be driven to enable the winding tension of the fabric to be maintained at a constant value. During this torque control, regardless of change in yarn and knitting structure and/or change in weight of the roll, the winding tension within a constant range can be obtained.

[0023] On the other hand, the position control mode is a mode, during which the take-up servo motor 5 is so controlled as to be driven at a constant angle of rotation (represented by the motor rotation signal indicated by b) relative to the revolution in the knitting unit 2. During this position control, the angle of rotation of the take-up servo motor 5 is highly precisely controlled while the constant winding tension is maintained and, therefore, contrary to the torque control referred to above, it is possible to wind up the knitted fabric under the stabilized winding tension because it will not be adversely affected by a change in mechanical load such as gears and rollers of the take-up mechanism 3.

[0024] The data process setting unit 13 shown in Fig. 2 is operable to process data associated on the knitting machine itself and, also, the take-up unit itself and then to set data and is provided with a production volume data acquiring means 14 and a stabilization determining means 15, in addition to the control mode setting means 11 referred to previously.

[0025] The production volume data acquiring means 14 is operable to acquire the angle of rotation (the angle of motor rotation indicated by d) of the take-up servo motor 5 for one complete revolution in the knitting unit 2 from

the take-up servo driver 10, while the take-up under the torque control mode is taking place, and then to perform a process of acquiring a predetermined number of production volume data of the knitted fabric, which is the angle of rotation of the take-up servo motor 5 for one complete revolution in the knitting unit 2. The production volume data referred to above are represented by distance data (position control data) per pulse of the output command pulses supplied to the take-up servo motor 5 that are synchronized with the angle of revolution of the cylinder caused by the main motor 7 as hereinbefore described.

[0026] In the case of the normal take-up, under the torque control mode, the production volume data of the winding tension appropriate to the knitted fabric in dependence on the change in yarn and/or knitting structure can be obtained. On the other hand, under the position control mode, the position control is accomplished by the production volume data obtained during the torque control mode to provide the constant winding tension (torque) appropriate to the take-up of the knitted fabric.

[0027] In the case of a large take-up, in which the roll diameter is large, under the torque control mode, the production volume data of the winding tension appropriate to the knitted fabric can be obtained before the change takes place in the roll weight. On the other hand, under the position control mode, the position control is accomplished by the production volume data similarly obtained during the torque control mode to provide the constant winding tension (torque) appropriate to the knitted fabric even though the roll weight changes.

[0028] The stabilization determining means 15 referred to above is operable to perform a process of determining that the take-up condition is stabilized, when a predetermined number of production volume data on the knitted fabric, that is, the distance data for each pulse of the command pulses to be supplied to the take-up servo motor 5 converges within a predetermined range. By way of example, when the difference between the maximum and minimum of the ten distance data for each complete revolution in the knitting unit 2 converges within $\pm$ 1% of the average value thereof, the take-up condition is determined as stabilized. It is, however, to be noted that the take-up condition may be determined as stabilized when the distance data converges at a predetermined value.

[0029] Thereafter, in the data process setting unit 13, the distance data (position control data), which are the production volume data of the knitted fabric, are automatically set (as indicated by f) and are then supplied to the take-up servo driver 10 to shift from the torque control mode onto the position control mode.

[0030] In this way, the data process setting unit 13 performs a mode setting (indicated by e) of one of the torque control mode and the position control mode and an automatic setting of the production volume data (indicated by f), both to the take-up servo driver 10. When the take-up servo driver 10 provides the take-up servo motor 5 with the PWM control output referred to hereinbefore, the motor control (shown by c) by the electric current of the take-up servo motor 5, which results in a proper winding tension under the torque control mode, and by the distance data (position control data) of the take-up servo motor 5, which has been automatically set under the position control mode, is performed.

[0031] As hereinabove described, in the take-up condition under the torque control mode, the predetermined number of the production volume data of the knitted fabric is acquired; based on this the take-up condition is determined as stabilized; the distance data (position control data) of the take-up servo motor 5 is automatically set to suit to the yarn and/or the knitting structure, resulting in shift from the torque control mode onto the position control mode. Accordingly, there is no need to set the distance data of the take-up servo motor 5 so as to set the winding tension properly each time the yarn and/or the knitting structure is changed, which has hitherto been required, and, hence, even though the yarn or the knitting structure is changed, the knitted fabric can be automatically taken up stably and under a proper winding tension.

[0032] It is to be noted that connection of the knitting machine side with the take-up unit side for controlling the take-up mechanism 3 is implemented by the use of, for example, a four-pole slip ring (not shown) and by means of two lines for the supply of AC24V (24 volt alternating electric current) and two lines for the serial communication signal. For example, an abnormality that the knitted fabric is caught by any other device or equipment in the knitting machine during the course is detected by the take-up servo driver 10 and is serially communicated to the knitting machine side so that an error output can be displayed on the knitting control panel 20. Although the conventional control method utilizing the potentiometer requires the use of, for example, an eight-pole slip ring, the number of poles can be considerably reduced when compared with that, and the number of component parts such as the potentiometer can also be reduced.

[0033] The sequence of operation of the take-up control device employed in the circular knitting machine 1 of the structure described hereinabove will now be described with particular reference to the flowchart shown in Fig. 3. At the outset, decision is made at step S 1 to determine whether or not the safety gates of the circular knitting machine 1 are closed. The safety gates are closed during the operation of the circular knitting machine 1 and, when the circular knitting machine 1 is halted, the safety gates are opened for removal of the knitted fabric and/or maintenance of the machine. Where the safety gates are opened, the take-up servo motor 5 is halted at step S2 and the program flow returns to step S 1.

[0034] If the safety gates are closed at step S1, it is confirmed at step S3 whether or not measurement of the production volume data should be carried out. If measurement should not be carried out, the tape-up servo motor 5 is set under the position control mode at step S8.

[0035] On the other hand, if it is confirmed at step S3

that the measurement of the production volume data should be carried out, the take-up servo motor 5 is set under the torque control mode at step S4 and the production volume for each complete revolution in the knitting unit 2 then performing the take-up under the torque control mode, that is, the distance data (position control data) for each pulse of the command pulses to be supplied to the take-up servo motor 5 is subsequently measured the predetermined number of times at step S5.

[0036] Thereafter, at step S6, a decision is made to determine whether or not the production volume for each complete revolution in the knitting unit 2 has been stabilized, that is, whether or not as a result of the distance data having been measured the predetermined number of times, the difference between the maximum value thereof and the minimum value thereof converges within the predetermined range. When it is determined that the production volume has not yet been stabilized, the program flow returns to step S5. On the other hand, when it is determined that the production volume has been stabilized, the distance data

[0037] (position control data), which are the production volume data during the position control mode, are automatically set at step S7 and the torque control mode is then shifted onto the position control mode at step S8.

[0038] By the time the safety gates are opened, the take-up servo motor 5 continues to operate under the position control mode at step S8. It is to be noted that in the event that the take-up control unit 6 detects an abnormality during the operation, the take-up servo motor 5 is halted and the program flow returns to the initial step, that is, the start.

[0039] In the manner hereinabove described, since in the present invention the take-up of the knitted fabric is initiated under the torque control mode, a proper winding tension can be employed even though the yarn or the knitting structure is changed. Also, after the take-up condition is determined as having been stabilized, the shift onto the position control mode can be automatically accomplished to continue the take-up of the knitted fabric and, accordingly it is possible to take up under a proper and stabilized winding tension. Accordingly, even when the yarn or the knitting structure is changed, the take-up can be automatically performed under the proper and stabilized winding tension, allowing ACT (Automatic Control Tension) to be achieved.

[0040] It is to be noted that although in the illustrated embodiment, the encoder is utilized for the machine revolution detecting unit 12, a resolver or a proximate sensor may be employed in place of the encoder.

[0041] It is also to be noted that although in the illustrated embodiment, the slip ring has been described as employed in connection between the knitting machine side and the take-up unit side, the slip ring may be superseded by a rotary connecting connector such as, for example, a non-contact device, which is a means for supplying an electric power to a rotary body and for interfacing signals between them.

[0042] Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings which are used only for the purpose of illustration, those skilled in the art will readily conceive numerous 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.

Claims

1. A take-up control method for a circular knitting machine, the knitting machine comprising a take-up mechanism including a take-up roll and a take-up servo motor for driving the take-up roll, for taking up a tubular knitted fabric, formed by a knitting unit, by means of the take-up mechanism and controlling the take-up mechanism by means of a take-up control device, which take-up control device is:

   capable of setting a control mode for the take-up servo motor to one of a torque control mode, under which the take-up servo motor is driven so as to maintain a winding tension of the knitted fabric at a constant value, and a position control mode, under which the take-up servo motor is driven at a constant angle of rotation relative to revolutions in the knitting unit; and
   operable to initiate the take-up of the knitted fabric under the torque control mode and to shift the control mode from the torque control mode to the position control mode, after a take-up condition under the torque control mode is determined as stabilized, to perform an automatic take-up of the knitted fabric.

2. The take-up method for the circular knitting machine as claimed in claim 1, in which production volume data, which is the angle of rotation of the take-up servo motor for one complete revolution in the knitting unit from the take-up servo driver, are acquired while the take-up under the torque control mode is taking place, and the take-up condition is determined as stabilized when a predetermined number of production volume data on the knitted fabric converges within a predetermined range; and the production volume data of the knitted fabric, when the take-up condition is stabilized, is automatically set to the take-up control device to shift the control mode to the position control mode.

3. A take-up control device for a circular knitting machine, the knitting machine comprising a take-up mechanism including a take-up roll and a take-up

servo motor for driving the take-up roll, for taking up a tubular knitted fabric, formed by a knitting unit, by means of the take-up mechanism and controlling the take-up mechanism by means of a take-up control device, which take-up control device comprises:

a control mode setting means capable of setting a control mode for the take-up servo motor to one of a torque control mode, under which the take-up servo motor is driven so as to maintain a winding tension of the knitted fabric at a constant value, and a position control mode, under which the take-up servo motor is driven at a constant angle of rotation relative to revolutions in the knitting unit; and
the take-up control device being operable to initiate the take-up of the knitted fabric under the torque control mode and to shift the control mode from the torque control mode to the position control mode, after a take-up condition under the torque control mode is determined as stabilized, to perform an automatic take-up of the knitted fabric.

4. The take-up control device for the circular knitting machine as claimed in claim 3, further comprising a production volume data acquiring means for acquiring production volume data, which is the angle of rotation of the take-up servo motor for one complete revolution in the knitting unit from the take-up servo driver, while the take-up under the torque control mode is taking place, and a stabilization determining means for determining whether or not the take-up condition is determined as stabilized when a predetermined number of production volume data on the knitted fabric converges within a predetermined range; and the production volume data of the knitted fabric, when the take-up condition is stabilized, and in which the production volume data of the knitted fabric are automatically set to the take-up control device to shift the control mode to the position control mode.

Fig. 1

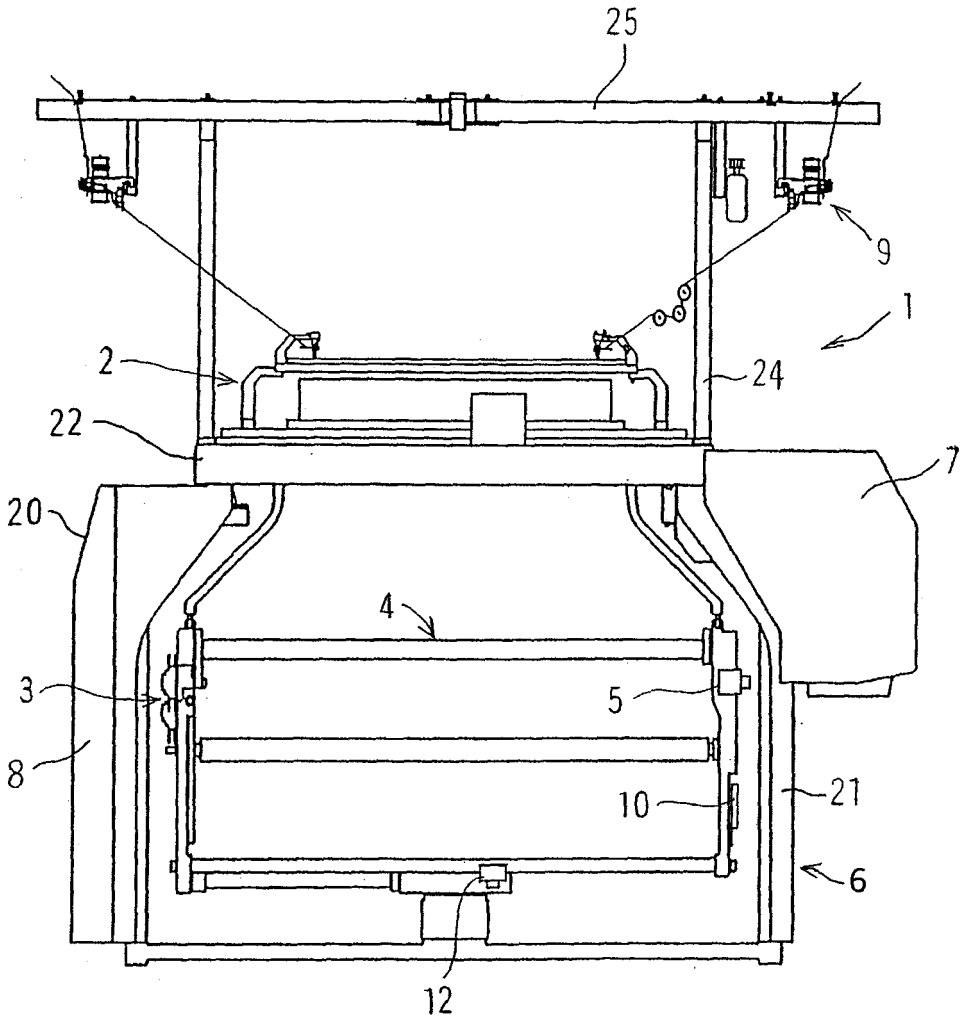


Fig. 2

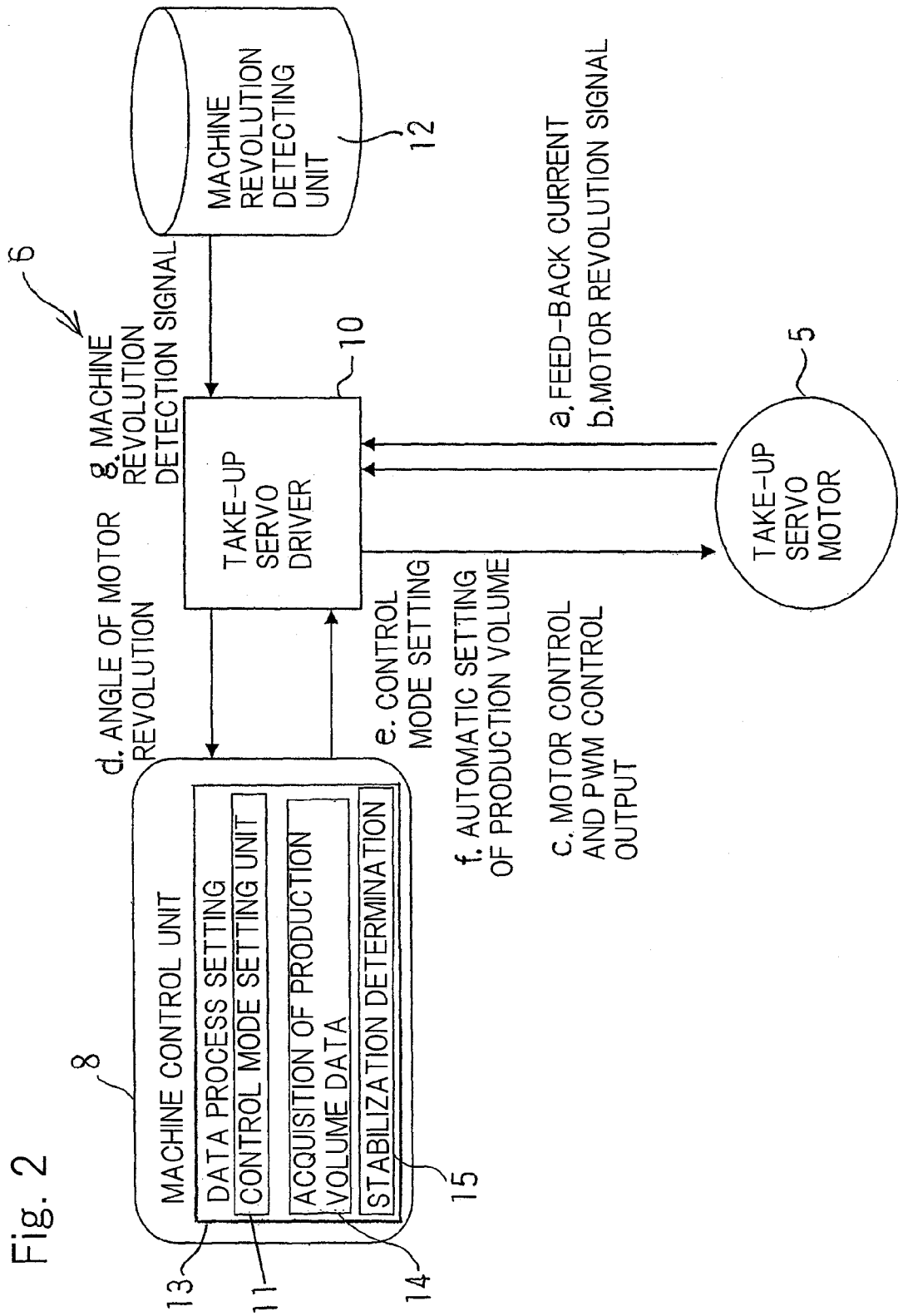
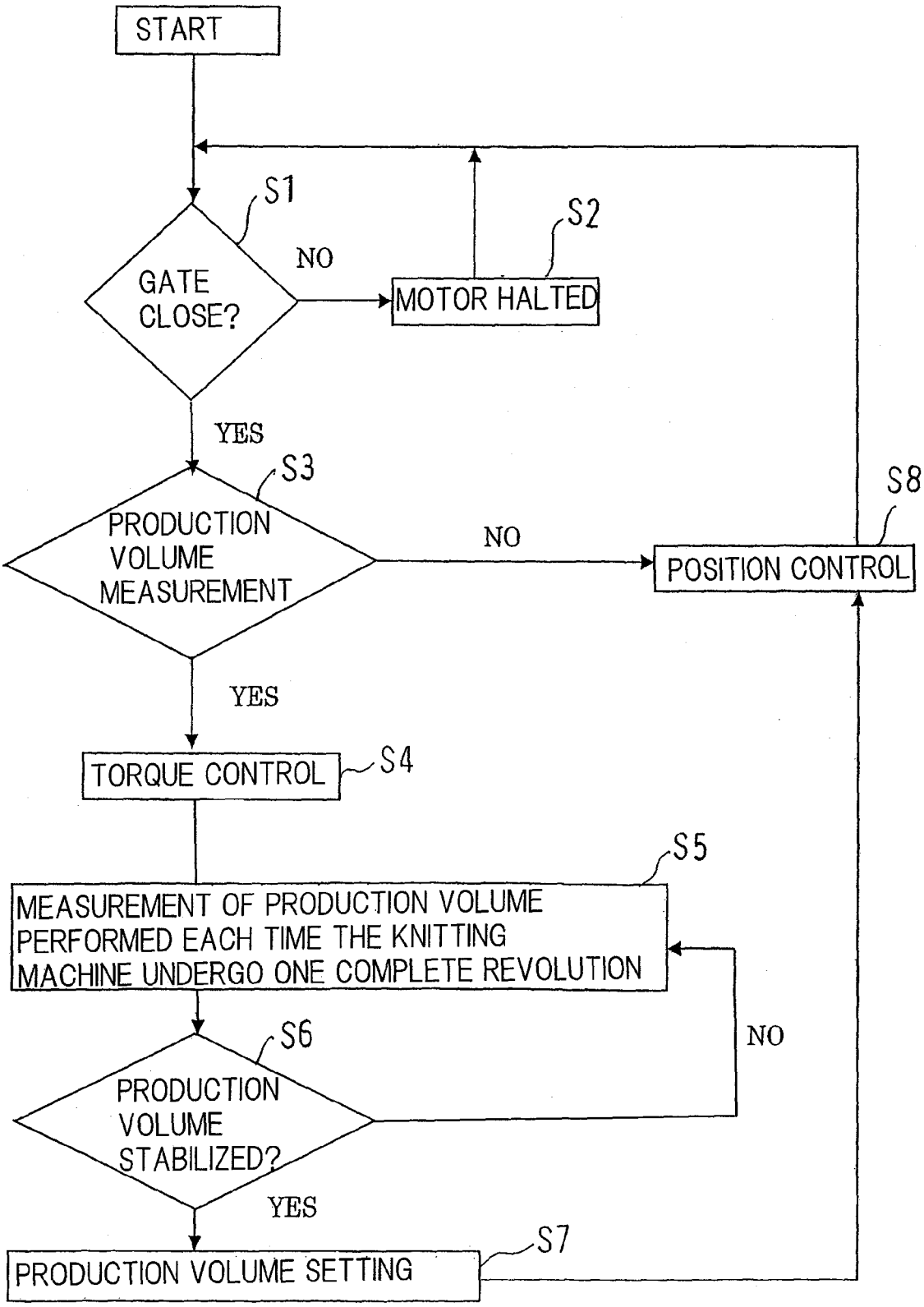

6
MACHINE REVOLUTION DETECTING UNIT
12
g. MACHINE REVOLUTION DETECTION SIGNAL
TAKE-UP SERVO DRIVER
10
a, FEED-BACK CURRENT
b, MOTOR REVOLUTION SIGNAL
5
TAKE-UP SERVO MOTOR
d. ANGLE OF MOTOR REVOLUTION
e. CONTROL MODE SETTING
f. AUTOMATIC SETTING OF PRODUCTION VOLUME
c. MOTOR CONTROL AND PWM CONTROL OUTPUT
8
MACHINE CONTROL UNIT
DATA PROCESS SETTING
CONTROL MODE SETTING UNIT
ACQUISITION OF PRODUCTION VOLUME DATA
STABILIZATION DETERMINATION
15
13
11
14

Fig. 3


START
S1
GATE CLOSE?
NO
S2
MOTOR HALTED
YES
S3
PRODUCTION VOLUME MEASUREMENT
NO
S8
POSITION CONTROL
YES
TORQUE CONTROL
S4
S5
MEASUREMENT OF PRODUCTION VOLUME PERFORMED EACH TIME THE KNITTING MACHINE UNDERGO ONE COMPLETE REVOLUTION
S6
PRODUCTION VOLUME STABILIZED?
NO
YES
PRODUCTION VOLUME SETTING
S7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 16 4302

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 10 2005 052638 A1 (PRECISION FUKUHARA WORKS LTD [JP]) 8 June 2006 (2006-06-08) * paragraphs [0001], [0025], [0026], [0028]; figures 1, 3, 4 * * paragraph [0031] - paragraph [0045] *	1-4	INV. D04B15/88 B65H23/198
A	US 4 236 390 A (BLANK JOCHEN ET AL) 2 December 1980 (1980-12-02) * column 1, line 1 - column 3, line 31; figure 1 * * column 4, line 63 - column 5, line 6; claims 1, 5, 6 *	1-4	
A	US 5 566 604 A (SPERLING WERNER [DE] ET AL) 22 October 1996 (1996-10-22) * column 1, line 7 - line 22; claim 1; figure 1 *	1-4	

TECHNICAL FIELDS SEARCHED (IPC)
D04B
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 October 2010	Zirkler, Stefanie

CATEGORY OF CITED DOCUMENTS

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.....
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1 EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 16 4302

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11-10-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102005052638 A1	08-06-2006	CN 1786311 A	14-06-2006
		JP 2006161196 A	22-06-2006
US 4236390 A	02-12-1980	NONE	
US 5566604 A	22-10-1996	DE 9319096 U1	13-04-1995
		EP 0657570 A1	14-06-1995
		ES 2115132 T3	16-06-1998

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- JP 2733760 B **[0005]**