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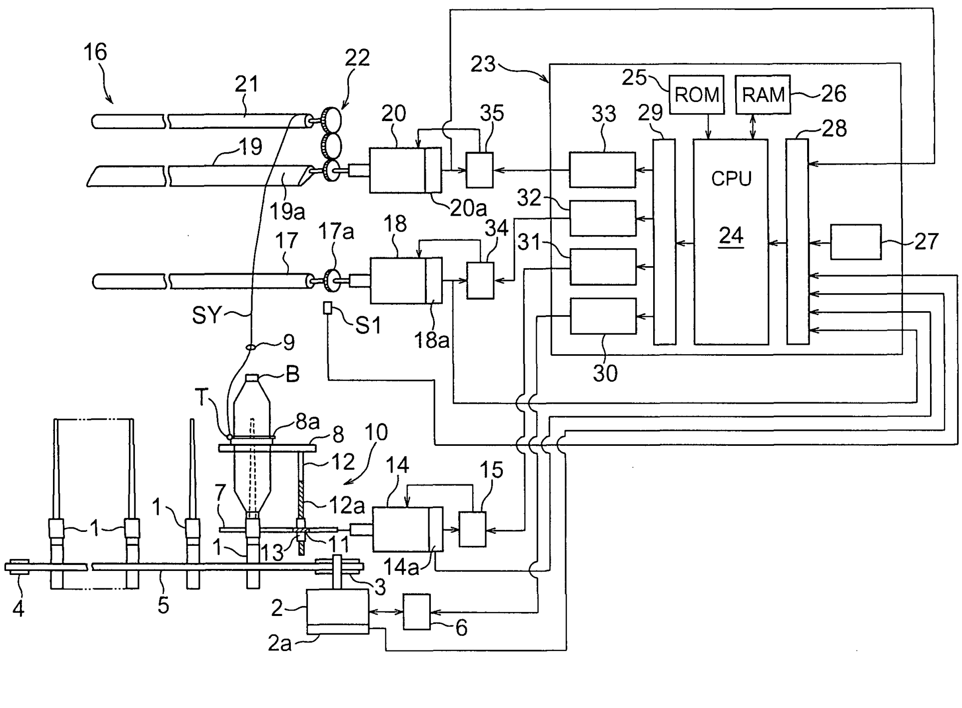
(54) **Device for producing special yarn**

(57) A device for producing special yarn changes the speed of a front roller (17) in accordance with a plurality of pattern data sets which show the change in thickness of spun yarn to produce special yarn corresponding to the pattern data including at least information on a pitch between slubs. A CPU (24) controls a first servo-motor (18) so as to spin yarn obtained through execution of a one cycle repetitive pattern in accordance with an executable program for executing the one cycle repetitive pattern including the pattern data sets greater than the pattern data sets stored in a work memory (26) based on the pattern data sets stored in the work memory (26).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a device for producing special yarn, and more particularly to a device for producing (spinning) special yarn called slub yarn or fancy yarn whose thickness is not constant but varies.

2. Description of the Related Art

[0002] Up to now, there has been special yarn called slub yarn or fancy yarn whose thickness is not constant and which is partially formed thick. As shown in Fig. 2, special yarn (slub yarn) SY is produced such that the thickness of a slub S (thick yarn portion) (slub thickness D), length (slub length L), and interval (pitch P between slubs) thereof each vary. A fine spinning frame used for the case of producing such special yarn has the same basic structure as a ring fine spinning frame. In the fine spinning frame, a front roller and a back roller in a draft part (draft device) can be independently driven through speed change. As a device for producing special yarn, there has been proposed a device which includes: a driving device that drives at least one of a front roller system and a back roller system of a fine spinning frame by means of a variable-speed motor; a control device that controls the number of revolutions of the variable-speed motor; and an output device that outputs control data to the control device, and in which a draft ratio is changed in accordance with the control data (refer to JP 62-110926 A (p.3, Fig. 1)). JP 62-110926 A (p.3, Fig. 1) discloses: a method of previously storing pattern data on thickness unevenness for forming a slub (thickness unevenness) as control data; and a method in which a control voltage and time of the variable-speed motor are generated at random by means of a computer to change the draft ratio, thereby producing special yarn having a slub without substantial periodicity.

[0003] However, in the case of designing the special yarn SY, if there is a small amount of setting data on the slub thickness D, slub length L, and pitch P between slubs, an undesirable state arises in which a design resulting from a repetitive pattern appears on a cloth woven from the special yarn SY. The amount of setting data sets needs to be increased for preventing such a state. Approximately 100 is insufficient for the number of data sets, and approximately 1, 000 is required for the number of pattern data sets for one cycle. However, this requires time and effort to input the data. On the other hand, a method for forming pattern data at random with a computer requires hardly any time or effort to input the data, and can prevent the design from appearing on the woven cloth. However, each data set of the slub S is random, and thus, the same yarn cannot be produced among full bobbins. As a result, there is a problem in that reproducibility of cloth woven from the special yarn is not guaranteed.

SUMMARY OF THE INVENTION

[0004] The present invention has been made in view of the above problem, and therefore has an object to provide a device for producing special yarn with high reproducibility, which is capable of producing slub yarn in which it is difficult for design resulting from repeated slubs to appear on a cloth woven therefrom even with a small amount of input data.

[0005] The present invention provides a device for producing special yarn, in which a front roller and a back roller that constitute a draft part are driven by separate variable-speed motors and in which at least one of the speeds of the front roller and the back roller is changed in accordance with pattern data including at least information on a pitch between slubs which shows change in thickness of spun yarn to produce the special yarn corresponding to the pattern data. The device includes: first storage means that stores a plurality of pattern data sets; second storage means that stores an executable program for executing a one cycle repetitive pattern consisting of pattern data sets greater than that stored in the first storage means; third storage means that stores information on the pattern data during execution; and control means that controls the variable-speed motors so as to spin yarn obtained by executing the one cycle repetitive pattern in accordance with the executable program.

[0006] In this case, "storing a plurality of pattern data sets" also includes a case where: one set of reference pattern datum is stored; plural pattern data sets, each of which is generated by multiplying a value included in the stored reference pattern data by a predetermined rate in accordance with a predetermined rule, are used to execute a repetitive pattern, thereby substantially storing the plurality of pattern data sets. Furthermore, "one cycle repetitive pattern" indicates the arrangement of the pattern data in which a plurality of different pattern data sets are aligned sequentially and executably without including the same repetitive pattern. "Based on the stored pattern data" is not limited to the stored pattern data itself, but includes using pattern data generated by multiplying a value included in reference data by a predetermined rate with the stored pattern data as the reference data in accordance with a predetermined rule. Furthermore, "information on the pattern data during execution" includes information for specifying the pattern data being presently executed and the pattern data to be executed next.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] In the accompanying drawings:

Fig. 1 is a structural diagram of a device for producing special yarn;

Fig. 2 is a partial schematic diagram of special yarn;

Figs. 3A and 3B are schematic diagrams each showing pattern data stored in a pattern table; and

Fig. 4 is a schematic diagram showing a pattern table in accordance with Embodiment 3 of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

[0008] Hereinafter, with reference to Figs. 1 to 3B, Embodiment 1 in which the present invention is implemented into a device for producing special yarn, which forms slubs by changing the speed of a front roller, will be described. Fig. 1 is a structural diagram of the device for producing special yarn, and Fig. 2 is a partial schematic diagram of special yarn.

[0009] The device for producing special yarn basically has the same structure as a ring fine spinning frame. As shown in Fig. 1, spindles 1 are rotationally driven by a spindle driving system including a drive pulley 3 driven by a motor 2, a driven pulley 9, and a tangential belt 5 wound around between both the pulleys 3 and 4. A variable-speed motor which is driven through an inverter 6 is used as the motor 2, and the motor 2 includes a rotary encoder 2a. A line shaft 7 is rotatably arranged along a spindle column. The line shaft 7 is provided with a lifting and lowering unit 10 (only one unit is shown) at a predetermined interval, which lifts and lowers a ring rail 8 including a ring 8a along which a traveller T runs and a lappet angle (not shown) including a snail wire 9.

[0010] The lifting and lowering unit 10 includes a screw gear 11 which is rotatably fitted and fixed to the line shaft 7, and a nut body 13 which is screwed into a screw portion 12a formed in the lower portion of a porker pillar 12 supporting the ring rail 8 and which engages with the screw gear 11. The line shaft 7 is coupled to a driving shaft of a servo-motor 14 through a gear mechanism (not shown), and the servo-motor 14 is driven through reciprocal rotation, thereby lifting and lowering the ring rail 8. Note that the above structure is basically the same as a structure of a device disclosed in, for example, JP 02-277826A. The servo-motor 14 includes a rotary encoder 14a, and is controlled through a servo-driver 15. The line shaft 7, the lifting and lowering unit 10, the porker pillar 12, and the like constitute a lifting driving system.

[0011] A front roller 17 (only bottom roller is shown) that constitutes a draft part 16 is coupled to a first servo-motor 18 as a variable-speed motor. A middle roller 19 (only bottom roller is shown) that constitutes a back roller is coupled to a second servo-motor 20 as a variable-speed motor. A back bottom roller 21 that also constitutes the back roller is coupled to the middle roller 19 through a gear train 22. In other words, the front roller 17 and the other draft rollers upstream of the front roller 17, that is, the back rollers are respectively driven by the separate variable-speed motors. Both the servo-motors 18 and 20 respectively include rotary encoders 18a and 20a. The middle roller 19 includes an apron 19a. A sensor S1, which outputs a pulse signal in accordance with rotation of the front roller 17, is arranged in the vicinity of a gear 17a integrally and rotatably fixed to the front roller 17.

[0012] A control device 23 that controls the respective motors 2, 14, 18, and 20 includes a central processing unit (CPU) 24 that constitutes a control means. The control device 23 includes a program memory 25 as a second storage means, a work memory 26 as first and third storage means, an input device 27, an input interface 28, an output interface 29, motor driving circuits 30 and 31, a first servo-motor driving circuit 32, and a second servo-motor driving circuit 33. The CPU 24 is connected to the rotary encoders 2a, 14a, 18a, and 20a, the sensor S1, and the input device 27 through the input interface 28. The CPU 24 is connected to the inverter 6 through the output interface 29 and the motor driving circuit 30, and is connected to the servo-driver 15 through the output interface 29 and the motor driving circuit 31. The CPU 24 is connected to the servo-motor 18 through the output interface 29, the first servo-motor driving circuit 32, and a servo-driver 34, and is connected to the second servo-motor 20 through the output interface 29, the second servo-motor driving circuit 33, and a servo-driver 35.

[0013] The CPU 24 operates based on predetermined program data stored in the program memory 25. The program memory 25 consists of a read only memory (ROM), in which the program data and various kinds of data necessary for executing the program are stored.

[0014] The program data includes a control program for the motor 2 and the servo-motor 14 in winding operation, and a program for controlling the speed of the first servo-motor 18 in forming slubs by changing the speed of the front roller 17.

[0015] The program data also includes an executable program for executing a one cycle repetitive pattern composed of more pattern data than pattern data stored in the work memory 26 based on the pattern data in the work memory 26.

[0016] As shown in Fig. 2, special yarn SY consists of spun yarn in which reference portions Y0 each having a thickness as a reference of the spun yarn and slubs S each of which is thicker than the reference portion Y0 are alternately and consecutively provided. One pattern indicates a combination of one reference portion Y0 and one slub S. The special yarn SY is the yarn spun in a state in which a plurality of different patterns are sequentially aligned.

[0017] When a thickness of the slub S (slub thickness), length of the slub S (slub length), and pitch that is an interval between adjacent slubs S (pitch between slubs) are represented by D, L, and P, respectively, pattern data is composed of the values of the slub thickness D, slub length L, and pitch P between slubs of one pattern. The slub thickness D is expressed in % in the case where a thickness of the reference portion Y0 is taken as 100%. For example, when the slub thickness D is one and a half times as thick as the thickness of the reference portion Y0, D = 150% is established. Also, when the slub thickness D is twice as thick as that of the reference portion Y0, D = 200% is established. The one cycle repetitive pattern indicates an arrangement in which a plurality of different pattern data sets are aligned sequentially and executably without including the same repetitive pattern.

[0018] The pattern data are stored in a plurality of pattern tables (two in Embodiment 1). That is, the work memory 26 includes two pattern tables 40A and 40B, in which a plurality of pattern data sets A1, A2 ... A(n-1), An and plurality of pattern data sets B1, B2 ... B(k-1), Bk are stored, respectively. It is set such that at least the pitches P between slubs differ from one another among plural pattern data sets A1, A2 ... A(n-1), An and plural pattern data sets B1, B2 ··· B(k-1), Bk. The numbers of pattern data sets stored in the pattern tables 40A and 40B differ from each other. The respective pattern data sets A1, B1, and the like are stored as combinations of the data values of the slub thickness D, slub length L, and pitch P between slubs, (Da1, La1, Pa1), (Db1, Lb1, Pb1), and the like.

[0019] The executable program is constituted so as to make a sequence in which the CPU 24 sequentially executes the pattern data from the different pattern tables 40A and 40B. That is, the repetitive pattern for one cycle is set such that one of the pattern data A1, A2, and the like of the pattern table 40A and one of the pattern data B1, B2, and the like of the pattern table 40B are alternately aligned. For example, the pattern data sets A1 to An of the pattern table 40A and the pattern data sets B1 to Bk of the pattern table 40B are sequentially and alternately executed. After the last pattern data set of the corresponding pattern table is executed, as regards the pattern table, the execution is repeated from the first pattern data set in the sequential order.

[0020] The various kinds of data stored in the program-memory 25 include spinning conditions such as a fiber material, count of spun yarn having a reference thickness, and draft ratio, and data corresponding to spindle rotational speed at the time of steady operation, rotational speeds of the first servo-motor 18 and the second servo-motor 20, and lifting and lowering speed of the ring rail 8. Furthermore, the various kinds of data include an acceleration gradient and a deceleration gradient at the time of control of the speed of the first servo-motor 18 in forming slubs, and a computing equation of the rotational speed of the front roller 17 for attaining the slub thickness D(%) corresponding to the pattern data of the special yarn.

[0021] The work memory 26 consists of a random access memory (RAM), and temporarily stores data input by the input device 27, processing results in the CPU 24, and the like. The work memory 26 includes a back-up power source (not shown).

[0022] The input device 27 is used for inputting data on spinning conditions such as pattern data of special yarn, count of spun yarn having a reference thickness, spindle rotational speed at the time of spinning of the spun yarn having a reference thickness, lift length, and chase length.

[0023] Next, the action of the device constituted above will be described. Prior to operation of a frame, the spinning conditions are first input with the input device 27. The data on the pattern data of the special yarn, count of spun yarn having a reference thickness, spindle rotational speed at the time of spinning of the spun yarn having a reference thickness, lift length, chase length, and the like are input as the spinning conditions. In the case where some of the spinning conditions are the same as those at the time of the last operation and are already stored and left in the work memory 26, only the other operation conditions which differ from those at the time of the last operation are input.

[0024] Then, with a start-up of the frame, the motor 2, the servo-motor 14, the first servo-motor 18, and the second servo-motor 20 are driven and controlled in accordance with a command from the control device 23. The CPU 24 calculates the rotational speeds of the respective motors in accordance with the output signals from the respective rotary encoders 2a, 14a, 18a, and 20a. Subsequently, the CPU 24 outputs the command signals for driving the spindle driving system, a draft part driving system, and the lifting driving system in synchronization at the predetermined speed corresponding to the spinning conditions to the inverter 6 and the servo-drivers 15, 34, and 35 through the output interface 29 and the respective driving circuits 30 to 33. The spindle driving system, the draft part driving system, and the lifting driving system are independently driven in synchronization. The special yarn SY delivered from the draft part 16 is wound around a bobbin B via the snail wire 9 and the traveller T.

[0025] The CPU 24 reads out the pattern data to be executed from the pattern table 40A and the pattern table 40B alternately based on the sequence regulated by the executable program, and stores the data in the work memory 26. And the CPU 24 controls the number of revolutions of the front roller 17 so as to attain the slub thickness D, slub length L, and pitch P between slubs shown by the pattern data to be executed. The CPU 24 calculates the length of the spun yarn corresponding to the slub length L and pitch P between slubs based on the number of revolutions of the front roller 17 in accordance with the output signal from the sensor S1, thereby determining an acceleration starting point and a deceleration starting point of the front roller 17.

[0026] The CPU 24 controls the first servo-motor 18 such that the front roller 17 rotates at the reference speed N0 corresponding to the thickness of the reference portion Y0 in spinning the reference portion Y0. Furthermore, in spinning the slub S, the CPU 24 calculates the rotational speed of the front roller 17 corresponding to the slub thickness D%, and reduces the rotational speed to the calculated one. After starting the reduction, the CPU 24 controls the first servo-motor 18 such that the speed is increased so as to be the reference speed N0 again when the slub is spun for its length L. As a result, spinning for one pattern data is completed. After that, the speed of the front roller 17 is controlled so as to achieve the rotational speed corresponding to the pattern data sequentially.

[0027] The respective sequences for reading the pattern data sets A1, A2 ··· A(n-1), An and the pattern data sets B1, B2 ··· B(k-1), Bk from the respective pattern tables 40A and 40B are A1 to An with respect to the pattern table 40A and B1 to Bk with respect to the pattern table 40B. As to the pattern table 40A, after the last pattern data An is executed, the first pattern data set A1 is executed again sequentially. As to the pattern table 40B, after the last pattern set data Bk is executed, the first pattern data set B1 is executed again sequentially. The number of the pattern data sets (pattern data number) of the one cycle repetitive patterns obtained in accordance with the above sequence is twice as many as the least common multiple of the pattern data sets numbers of the respective pattern tables 40A and 40B.

[0028] For example, if n = 3 and k = 2 are established, the executable sequence of the CPU 24 corresponds to the sequence of A1, B1, A2, B2, A3, B1, A1, B2, A2, B1, A3, B2, A1, B1 ···. In this case, the repetitive pattern with a data number of 12, i.e., A1, B1 to A3, B3, is executed. The number of the input pattern data sets corresponds to n+k = 3+2 = 5; however, the same effect as that in inputting 12 data sets which is twice as many as the least common multiple of the pattern data set number n (=3) of the pattern table 40A and the pattern data set number k (=2) of the pattern table 40B (3 x 2 = 6) can be obtained.

[0029] Furthermore, if n = 4 and k = 2 are established, the executable sequence of the CPU 24 corresponds to the sequence of A1, B1, A2, B2, A3, B1, A4, B2, A1, B1 ···. In this case, the pattern data set number corresponds to n+k = 4+2 = 6; however, the same effect as that in inputting 8 data sets which are twice as great as the least common multiple of the pattern data set number n (=4) and the pattern data set number k (=2) (2 x 2 = 4) can be obtained.

[0030] That is, in the case where the pattern data set number input to one of the pattern tables 40A and 40B is a divisor of the pattern data set number input to the other, the least common multiple of the two numbers is equal to the larger pattern data set number. Thus, the least common multiple is not large in comparison with the sum of the pattern data set numbers (n + k). Therefore, the pattern data set numbers input to the respective pattern tables 40A and 40B are preferably set such that the pattern data set number of one of the pattern tables is not a divisor of the pattern data set number of the other pattern table. It is more preferable that the pattern data set numbers of the respective pattern tables be prime numbers.

[0031] As regards the pattern data set number that realizes a state in which a design resulting from a repetitive pattern does not appear on a cloth woven from the special yarn SY, approximately 100 is insufficient, and approximately 1,000 for one cycle is required. If it is supposed that a practical input pattern data set number is 50 as the total of the pattern data set numbers of the pattern tables 40A and 40B and that the respective pattern data set numbers are prime numbers, for example, 33 and 17, the pattern data set number of the one cycle repetitive pattern is 33 x 17 x 2 = 1, 122. That is, the pattern data set number of the one cycle repetitive pattern can be greatly increased in comparison with the input data set number.

[0032] Embodiment 1 provides the following effects.

(1) Based on the pattern data stored in the work memory 26, the executable program for executing the one cycle repetitive pattern which consists of the pattern data sets greater than the pattern data sets stored in the work memory 26 is stored in the program memory 25. Then, the producing device includes the CPU 24 (control means) that controls the first servo-motor 18 so as to spin yarn obtained by executing the one cycle repetitive pattern in accordance with the executable program. Therefore, it is possible to produce the special yarn SY (slub yarn) with high reproducibility, where it is difficult for designs resulting from repetition of slubs to appear on a cloth woven therefrom, even with a small amount of input data (pattern data).

(2) The pattern data are stored in plural pattern tables 40A and 40B, and the one cycle repetitive pattern is set such that the pattern data of the different pattern tables are alternately aligned. Therefore, on the condition that the same pattern data set number is adopted, it becomes easier to set a one cycle repetitive pattern in which the same pattern data are not consecutively aligned but which has a large number of pattern data in comparison with the case of a one pattern table.

(3) The numbers of the pattern data sets stored in the respective pattern tables 40A and 40B differ from each other. The executable program that determines the sequence of executing the pattern data is structured so as to be the sequence through which the pattern data sets from the different pattern tables 40A and 40B are alternately and sequentially executed. Therefore, the sequence of executing the pattern data sets can be simply determined.

(4) In the case where the number of the pattern data sets stored in the pattern tables 40A and 40B are primes, the number of pattern data sets which constitute the one cycle repetitive pattern become larger than that of the other, even if the same total number of pattern data sets is adopted.

(5) Each of the pattern data sets include not only the information on the pitch P between slubs but also the information on the slub thickness D and slub length L. Therefore, it is possible to produce special yarn with a more complicated pattern.

(6) In the case of setting an arrangement of the one

cycle repetitive pattern data with the use of the plurality of pattern data sets stored in the respective pattern tables 40A and 40B, the entire arrangement of the one cycle repetitive pattern data is not stored in the work memory 26. Therefore, the capacity of the work memory 26 can be reduced in comparison with the case of storing the entire arrangement of the one cycle repetitive pattern data in the work memory 26.

(7) The thickness of the spun yarn is changed by changing the speed of the front roller 17. In the method of forming the slubs S by changing the draft ratio by changing the speed of the middle roller 19, even if the draft ratio decreases by the acceleration of the middle roller 19, the appearance state of the slub S is difficult to confirm due to the influence of fleece existing between the tip end of the apron 19a of the middle roller 19 and the nip point of the front roller 17. Therefore, in the case of a short slub (with a length of several tens of mm), the slub S does not become clear. However, in Embodiment 1, changing the thickness of the spun yarn is performed by changing the speed of the front roller 17. Accordingly, the slub S is clear even if the slub length L has a small value.

Embodiment 2

[0033] Next, Embodiment 2 will be described. Embodiment 2 is different from Embodiment 1 in that the CPU 24 determines the order of respectively reading the pattern data sets A1, A2, ··· A(n-1), An and the pattern data sets B1, B2, ··· B(k-1), Bk from the pattern tables 40A and 40B based on a rule different from that in Embodiment 1 and in that the pattern data set number of the pattern table 40A may be the same as that of the pattern table 40B. The other parts of the structure of the producing device in Embodiment 2 are the same as those in Embodiment 1. The same structural parts as those in Embodiment 1 are denoted by the same reference symbols, and the descriptions thereof are omitted or simplified here.

[0034] In Embodiment 2, in the case where the pattern data set number of the pattern table 40A differs from that of the pattern table 40B, the pattern data sets A1, A2, ... A(n-1), An and the pattern data sets B1, B2, ... B(k-1), Bk are sequentially and alternately read from the respective pattern tables 40A and 40B based on the same rule as in Embodiment 1.

[0035] On the other hand, in the case where the pattern data set number of the pattern table 40A is the same as that of the pattern table 40B, that is, when k = n, for pattern table 40A, the pattern data sets are executed sequentially in the sequence of A1 to An from the first cycle to the n-th cycle. However, for pattern table 40B, the pattern data sets are executed sequentially in the sequence of B1 to Bk during the first cycle. During the next cycle, the execution starts with the second pattern data set B2, and ends with the pattern data set B1. That is, for pattern table 40B, during the i-th cycle, the execution starts with the i-th pattern data set, and ends with the (i-1)-th pattern data set.

[0036] For example, when n and k are both 3, the executable sequence of the CPU 24 corresponds to the sequence of A1, B1, A2, B2, A3, B3, A1, B2, A2, B3, A3, B1, A1, B3, A2, B1, A3, B2, A1, B1 ···. In this case, the pattern data set number amounts to n + k = 3 +3 = 6. However, the same effect as that in inputting 18 data sets that are twice as great as the product of the pattern data set number n (= 3) of the pattern table 40A and the pattern data set number k (= 3) of the pattern table 40B (3 x 3 = 9). can be obtained

[0037] For example, when n and k are both 4, the executable sequence of the CPU 24 corresponds to the sequence of A1, B1, A2, B2, A3, B3, A4, B4, A1, B2, A2, B3, A3, B4, A4, B1, A1, B3, A2, B4, A3, B1, A4, B2, A1, B4, A2, B1, A3, B2, A4, B3, A1, B1 ···. In this case, the pattern data set number amounts to n + k = 4 + 4 = 8. However, the same effect as that in inputting 32 data sets that are twice as great as the product of the pattern data set number n (= 4) of the pattern table 40A and the pattern data set number k (= 4) of the pattern table 40B (4 x 4= 16) can be obtained.

[0038] That is, when the pattern data set numbers of the pattern tables 40A and 40B are n and k, respectively, the pattern data set number of the one cycle repetitive pattern corresponds to the product of: the combination of selecting one piece of datum from the pattern data in the pattern table 40A; the combination of selecting data from the pattern data in the pattern table 40B; and the number of pattern tables, i.e., ${}_nC_1 \times {}_kC_1 \times 2$.

[0039] Accordingly, Embodiment 2 provides the following effects over and above the same effects as effects (1), (2), and (5) to (7) of Embodiment1.

(8) Regardless of whether the pattern data set numbers n and k stored in the respective pattern tables 40A and 40B are equal to each other or not, and of whether n or k is a divisor of the other or not, the pattern data set number of the one cycle repetitive pattern corresponds to the product of the combination of selecting data from the pattern data in the pattern tables 40A and 40B respectively, and the number of pattern tables, i,e., ${}_nC_1 \times {}_kC_1 \times 2$. Accordingly, the degree of freedom of setting the number of data sets input to each of the pattern tables 40A and 40B is increased in comparison with the case in Embodiment 1.

Embodiment 3

[0040] Next, Embodiment 3 will be described. Embodiment 3 differs from Embodiments 1 and 2 in that one pattern table is provided and in that the data set number stored in the pattern table is one. The other parts of the structure of the producing device in Embodiment 3 are the same as those in Embodiment 1. The same structural parts as those in Embodiment 1 are denoted by the same reference symbols, and descriptions thereof are omitted or simplified.

[0041] In Embodiment 3, as shown in Fig. 4, reference pattern data set C0 is stored in a pattern table 40C as a combination of data values of the slub thickness D, slub length L, and pitch P between slubs (Dc0, Lc0, Pc0) . Then, the executable program is constituted such that the CPU 24 forms a plurality of different pattern data sets Ci based on a predetermined rule from the data values of the reference pattern data set C0 and a plurality of pattern data sets Ci(Dci, Lci, Pci) are executed in a predetermined sequence.

[0042] For example, the CPU 24 successively multiplies the data values of the reference pattern data set C0 by a coefficient increased by a predetermined rate (forexample, 5%), thereby forming the pattern data sets Ci (Dci, Lci, Pci). Note that i indicates the i-th number in a predetermined sequence. As the sequence, an arithmetic progression or a geometric progression are used. Dci = Dc0 × 1.05 x i, Lci = Lc0 x 1.05 x i, and Pci = Pc0 × 1.05 x i are established. Then, the CPU 24 executes a plurality of pattern data sets Ci(Dci, Lci, Pci) in a predetermined sequence.

[0043] That is, in Embodiment 3, the reference pattern data set C0 is stored in the pattern table 40C, the pattern data which is set by multiplying the values of the slub thickness D, slub length L, and pitch P between slubs included in the stored reference pattern data set C0 by the predetermined rate based on a predetermined rule. Therefore, the same effects as obtained when substantially storing a plurality of pattern data sets can be obtained.

[0044] Accordingly, Embodiment 3 provides the following effects over and above the sameeffectsas effects (1) and (5) to (7) of Embodiment 1.

(9) Since the number of the pattern table 40C storing the pattern data is one, a storage region of the work memory 26 required for storing the pattern table 40C can be decreased.

(10) Since only reference pattern data set C0 is input (stored) into the pattern table 40C, the input of the pattern data requires much less time and effort.

[0045] The present invention is not limited to the Embodiments described above. For example, the following implementations may be adopted.

[0046] It is sufficient that the pattern data include at least the information on the pitch P between slubs. For example, at least one of the slub thickness D and the slub length L, which constitute the pattern of the special yarn SY, may be maintained constant. In such a case, the constant condition does not need to be set for the pattern data, and the constitution of the pattern data becomes simple.

[0047] Instead of the structure in which the pattern data is input to the work memory 26, a structure in which the pattern data is input to the rewritable ROM (EPROM, EEPROM) or in which the pattern data is previously stored in the program memory 25 may be adopted. In those cases, the rewritable ROM or the programmemory 25 constitutes the first storage means.

[0048] In Embodiments 1 and 2, the sequence of reading the pattern data sets in each of the pattern tables does not have to start with A1 or B1. Any starting point may be adopted as long as a predetermined sequence is used.

[0049] In the case of setting the arrangement of the one cycle repetitive pattern data with the use of a plurality of pattern data sets stored in a plurality of pattern tables, as shown in Embodiment 1, the arrangement is not limited to one in which the pattern data sets of the different pattern tables are alternately aligned, but an arrangement which allows the pattern data sets from the same pattern table to be consecutively aligned in a part of the arrangement may be adopted. In this case, even if the pattern data set number input to the pattern table is the same adopted, the number of the repetitive pattern data sets in one cycle can be increased.

[0050] The present invention is not limited to the structure in which all the pattern data stored in the pattern tables are used to execute the one cycle repetitive pattern, as shown in Embodiments 1 and 2, but a structure in which pattern data sets greater than the pattern data sets used in executing the one cycle repetitive pattern are previously stored in the pattern tables and the pattern data sets selected from among the stored pattern data sets are used to execute the one cycle repetitive pattern may be adopted. In this case, when the pattern data sets are stored in the program memory 25, inputting the pattern data requires little time and effort. In addition, inputting the pattern data does not need to be performed newly whenever different special yarn SY is produced. Accordingly, a special yarn SY can be produced more easily.

[0051] Instead of the structure in which a plurality of pattern data sets are stored in a plurality of pattern tables, a structure in which a plurality of pattern data sets are stored in one pattern table may be adopted.

[0052] In the case of setting the arrangement of the one cycle repetitive pattern data with the use of a plurality of pattern data sets, the entire arrangement of the one cycle repetitive pattern data may be stored in the work memory 26. In this case, even when the arrangement sequence of the pattern data sets is set by using, for example, a table of random numbers, the same special yarn SY can be produced with high reproducibility by storing the set pattern data arrangement in the work memory 26.

[0053] When inputting the pattern data by the input device 27, instead of the structure in which sequential inputting of the slub thickness D(%), slub length L, and pitch P between slubs is performed, the structure in which the input device 27 selects one from among the plural kinds of pattern data previously stored in the program memory 25 may be adopted.

[0054] When the thickness of the yarn to be spun is changed, the structure changing the speed of the middle roller 19 (back roller) may be adopted instead of that changing the speed of the front roller 17. In a ring fine spinning frame, the time of a full bobbin is estimated from an integrated value of the rotational speeds of the front roller 17, and preparing for doffing is performed in accordance with the time of a full bobbin. Also, a cleaning device that travels along the frame is automatically retracted to the position so as not to interfere with doffing operation. In the method of forming slubs S by changing the draft ratio by changing the speed of the front roller 17, the time of a full bobbin is difficult to be estimated, which interferes with preparing for doffing or automatically putting the cleaning device back to the retraction position. However, in the case of changing the thickness of the spun yarn by changing the speed of the middle roller 19, the estimation of the time of a full bobbin can be carried out as that in the conventional ring fine spinning frame.

[0055] In the case of producing the special yarn (slub yarn) SY mainly including slubs S each having a thickness with which changing the speed of either the front roller 17 or the middle roller 19 (back roller) cannot deal, the speeds of both the front roller 17 and the middle roller 19 may be changed to spin the slubs S. In the case of significantly changing the thickness of the slub S with respect to the thickness of the reference portion Y0, the draft ratio corresponding to a desired thickness may not be obtained only by changing the rotational speed of the front roller 17 or the middle roller 19. However, in spinning the slubs S, the front roller 17 is decelerated while the middle roller 19 (backroller) isaccelerated, relative to the speed at the time of spinning the reference portion Y0. As a result, the draft ratio corresponding to the desired thickness can be obtained.

[0056] In the case that the slub thickness D(%) shown by the pattern data has a value no less than a predetermined value (for example, 200%), when the slub thickness D(%) has a value less than the predetermined value, a structure in which spinning is performed by changing the speed of either the front roller 17 or the middle roller 19 may be adopted. In this case, regardless of the slub thickness D(%), the control can be simple in comparison with the case of changing the speed of both the front roller 17 and the middle roller 19.

[0057] In the case of the structure in which changing the speed of the front roller 17 is not performed at the time of spinning the slub S, a structure in which the spindles 1 and the front roller 17 are driven by the same motor may be adopted.

[0058] Instead of the structure in which the middle roller 19 is coupled to the back bottom roller 21 through the gear train 22, a structure in which the middle roller 19 and the back bottom roller 21 are driven by separate variable-speed motors may be adopted.

[0059] The present invention may be applied to a device including a draft roller having four lines or more.

Claims

1. A device for producing special yarn, in which a front roller and a back roller that constitute a draft part are driven by separate variable-speed motors and in which at least one of the speeds of the front roller and the back roller is changed in accordance with pattern data including at least information on a pitch between slubs which shows change in thickness of spun yarn to produce the special yarn corresponding to the pattern data, **characterized in that** the device comprises:

    first storage means that stores a plurality of pattern data sets;
    second storage means that stores an executable program for executing a one cycle repetitive pattern, based on the stored pattern data sets in the first storage means, consisting of pattern data sets greater than that stored in the first storage means;
    third storage means that stores information on the pattern data sets during executing; and
    control means that controls the variable-speed motors so as to spin yarn obtained by executing the one cycle repetitive pattern in accordance with the executable program.

2. A device for producing special yarn according to claim 1,
characterized in that:

    the pattern data sets are stored in a plurality of pattern tables; and
    the executable program is set such that the pattern data sets from the different pattern tables are arranged alternately.

3. A device for producing special yarn according to claim 2, **characterized in that** the number of pattern data sets stored in each of the pattern tables is a prime number.

4. A device for producing special yarn according to claim 2 or 3, **characterized in that**:

    two pattern tables are provided;
    the numbers of the pattern data sets stored in the respective pattern tables differ from each other; and
    the pattern data sets are read one by one from the respective pattern tables in a predetermined sequence, and after the last pattern data set in the reading sequence is executed, the execution starts again from the first pattern data set.

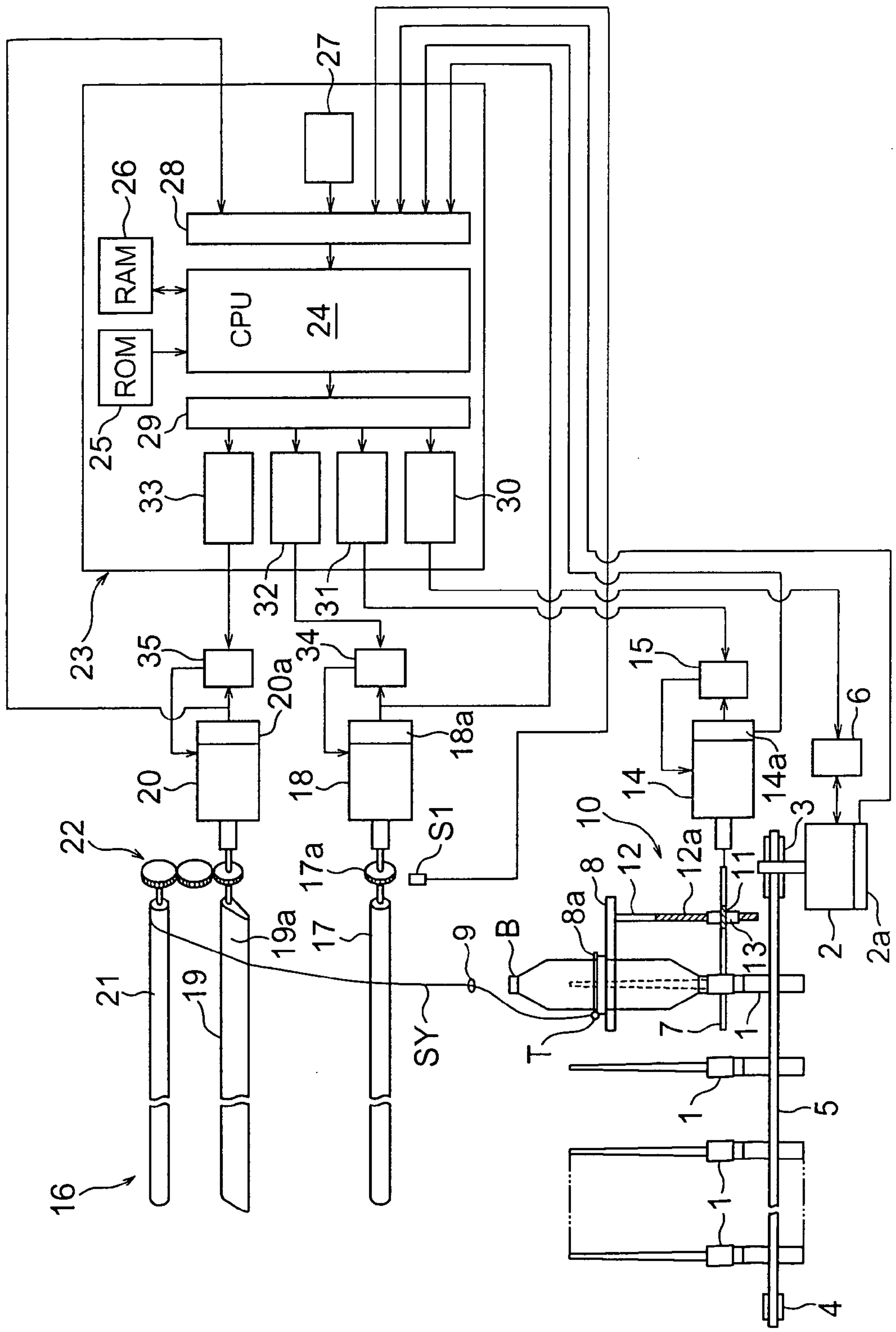
5. A device for producing special yarn according to claim 2,

characterized in that:

two pattern tables are provided;
in the case where the numbers of the pattern data sets stored in the respective pattern tables differ from each other, the pattern data sets are read one by one from the respective pattern tables in a predetermined sequence, and after the last pattern data set in the reading sequence is executed, the execution starts again from the first pattern data set; and
in the case where the numbers of the pattern data sets stored in the respective pattern tables are each n, the pattern data sets in one of the pattern tables are executed in a predetermined sequence from a first cycle to a n-th cycle, and in the other pattern table, from a second cycle, execution starts sequentially from a second pattern data set in the previous cycle, and ends with execution of the first pattern data set in the previous cycle.

6. A device for producing special yarn according to any of claims 1 to 5, **characterized in that** each of the pattern data sets also includes the information on slub thickness and slub length.

FIG. 1


CPU
24
RAM
ROM
26
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23
34
35
20a
20
18a
18
22
17a
S1
15
14
14a
6
3
2
2a
10
8
8a
12
12a
11
13
B
9
SY
T
7
1
21
19
19a
17
16
5
4

FIG. 2

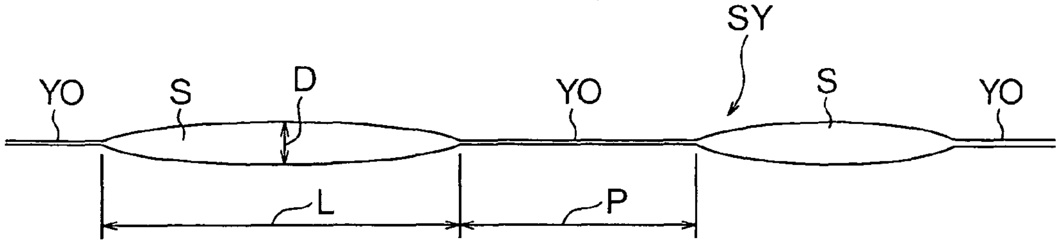

FIG. 3

(a) 40A

PATTERN DATA	DATA VALUE
A1	Da1, La1, Pa1
A2	Da2, La2, Pa2
A3	Da3, La3, Pa3
•	•
•	•
A (n-1)	Da (n-1), La (n-1), Pa (n-1)
An	Dan, Lan, Pan

(b) 40B

PATTERN DATA	DATA VALUE
B1	Db1, Lb1, Pb1
B2	Db2, Lb2, Pb2
B3	Db3, Lb3, Pb3
•	•
•	•
B (k-1)	Db (k-1), Lb (k-1), Pb (k-1)
Bk	Dbk, Lbk, Pbk

FIG. 4

40C

PATTERN DATA	DATA VALUE
C0	Dc0, Lc0, Pc0

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EUROPEAN SEARCH REPORT

Application Number
EP 05 02 2119

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D02G
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 March 2006	D'Souza, J

CATEGORY OF CITED DOCUMENTS

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