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(72) Inventors:
• **Shinozaki, Yutaka**
Kariya-shi, Aichi 448-8671 (JP)
• **Kojima, Naoki**
Kariya-shi, Aichi 448-8671 (JP)

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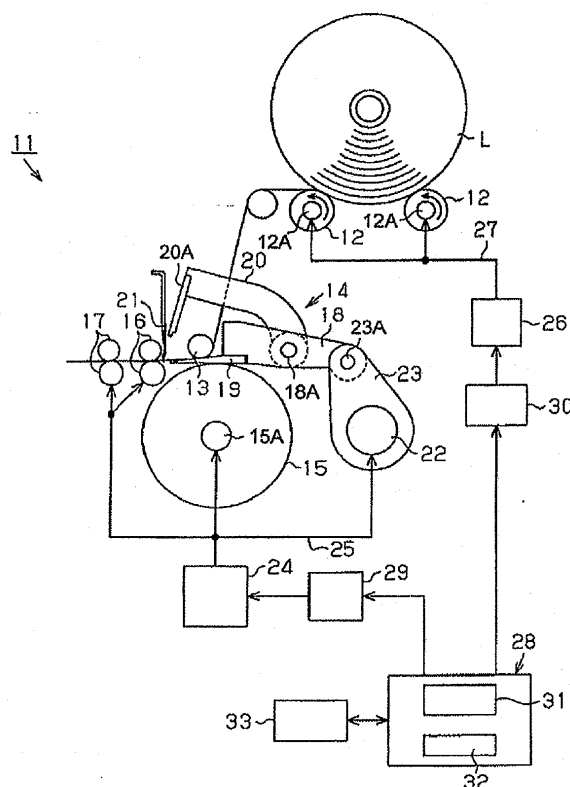
(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

(71) Applicant: **Kabushiki Kaisha Toyota Jidoshokki**
Kariya-shi, Aichi 448-8671 (JP)

(54) **Device and method for controlling feed of lap in comber**

(57) The comber is operable to produce a sliver from a lap wound in the form of a lap roll and has a plurality of combing heads each having a lap feeder. The lap feeder has a motor that can be driven independently of a combing drive device. The lap feed control device is characterized in that it includes an arithmetic-logic unit and a control unit. When the comber is operated with the motor driven at a constant speed on a trial basis, variation of weight of the sliver relative to decrease of diameter of the lap roll is measured. The arithmetic-logic unit calculates a speed change pattern of the motor from the measurements to equalize the weight of the sliver or reduce the variation of the weight of the sliver. The control unit controls operation of the motor of the lap feeder in accordance with the speed change pattern.

FIG. 1



Description**BACKGROUND OF THE INVENTION**

[0001] The present invention relates to a device and a method for controlling feed of lap in a comber.

[0002] The comber has a plurality of combing heads each having a combing cylinder. Lap fed from lap roll is gripped by a nipper device located at its retracted position and combed at the front end thereof by the combing cylinder to remove short fibers from the lap, thus forming fleece. The fleece is moved toward a pair of detaching rollers by forward movement of the nipper device. In accordance with the forward movement of the fleece, the paired detaching rollers are rotated in reverse direction thereby to move back the previous fleece. Thus, the rear end of the previous fleece and the front end of the newly combed fleece (following fleece) are lapped one on another. When the paired detaching rollers are rotated in forward direction, the fleece is removed from the nipper device. In addition, the following fleece and the previous fleece are joined together and the rear end of the following fleece is combed by top comb. The fleece fed by each combing head is bundled into sliver. The slivers formed by the respective combing heads are bundled into a single strand of sliver, drafted by drafting part and stored in a sliver can by coiler mechanism. Thus, the comber is operable to produce a sliver from the lap wound in the form of a lap roll.

[0003] Due to the change of diameter of the lap roll from a full lap roll where consumption lap length of lap roll is zero to an empty roll where consumption lap length of lap roll is 100%, the weight of feed lap of the same length varies. If the comber is operated at a constant lap feed speed, therefore, the weight of the sliver for a given length thereof varies greatly.

[0004] To prevent the above variation of the sliver weight, Japanese Unexamined Patent Application Publication (Japanese translation of PCT international Application) No. 6-502894 suggests a method of correcting the variation of weight of lap due to the change of diameter of lap roll by increasing lap feed speed in the process of combing operation from the full lap roll to the empty roll. To control the lap feed speed, the above-cited reference discloses a method of determining controlled variable of driving speed of a pair of lap rollers (or a pair of lap arbors) on which the lap roll is placed, in accordance with the deviation of the measurements of a device that measures lap feed weight or the sliver weight. The above-cited reference also suggests a method of increasing the lap feed speed in a linear and continuous fashion from the beginning of lap feeding (open-loop control) without measuring the lap feed weight or sliver weight.

[0005] In order to determine controlled variable of the driving speed in accordance with the deviation of the measurements of lap feed weight or sliver weight, there needs to be a device that measures the lap feed weight or sliver weight. However, such device is large in size and hence increases the cost of the comber. In addition, measuring the sliver weight is disadvantageous in terms of accuracy because the measuring point of the sliver weight is spaced far away from the lap roll and also in that the amount of waste cotton needs to be considered.

[0006] The method by the open-loop control that dispenses with the measuring step is disadvantageous in terms of the controlling accuracy because the sliver weight does not simply decrease in accordance with a decrease of lap roll diameter.

[0007] The present invention is directed to providing a device and a method for controlling feed of lap in a comber according to which variation of sliver weight due to the change of lap roll diameter is corrected effectively without using a device for measuring the weight of lap or sliver thereby to equalize the sliver weight or reduce the variation of the sliver weight.

SUMMARY OF THE INVENTION

[0008] As a result of research for the relationship between the change of the lap roll diameter and the variation of the sliver weight, the present inventors found that the variation of the sliver weight due to the change of the lap roll diameter is generally reproducible and also that the variation of the sliver weight due to the change of the lap roll diameter is obtained by manually measuring the finished sliver weight. The present invention has been made based on such findings. It is noted that the term "finished sliver weight" means the weight of the sliver made by all the laps supplied from lap rolls of a plurality of combing heads of a comber.

[0009] In accordance with a first aspect of the present invention, there is provided a lap feed control device for controlling feed of lap in a comber. The comber is operable to produce a sliver from the lap wound in the form of a lap roll and has a plurality of combing heads each having a lap feeder. The lap feeder has a motor that can be driven independently of a combing drive device. The lap feed control device is characterized in that the lap feed control device includes an arithmetic-logic unit and a control unit. When the comber is operated with the motor driven at a constant speed on a trial basis, variation of weight of the sliver relative to decrease of diameter of the lap roll is measured. The arithmetic-logic unit calculates a speed change pattern of the motor from the measurements of the variation of the weight of the sliver to equalize the weight of the sliver or reduce the variation of the weight of the sliver. The control unit controls operation of the motor of the lap feeder in accordance with the speed change pattern.

[0010] It is noted that the term "speed change pattern" is not limited to a pattern that represents speed change of

motor directly, but also refers to a pattern according to which speed change ratio is changed.

[0011] In accordance with a second aspect of the present invention, there is provided a lap feed control method for controlling feed of lap in a comber. The comber is operable to produce a sliver from the lap wound in the form of a lap roll and has a plurality of combing heads each having a lap feeder. The lap feeder has a motor that can be driven independently of a combing drive device. The lap feed control method is characterized by the steps of measuring weight of the sliver for each predetermined length while operating the comber with the motor driven at a constant speed on a trial basis, calculating a speed change pattern of the motor from the measurements of the weight of the sliver in view of change of lap roll diameter to equalize the weight of the sliver or reduce the variation of the weight of the sliver, and controlling operation of the motor of the lap feeder in accordance with the speed change pattern.

[0012] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a schematic side view showing a combing head of a comber according to an embodiment of the present invention;

Fig. 2 is a graph showing the relation between consumption lap length and sliver weight; and

Fig. 3 is a graph showing the relation between the consumption lap length and speed change factor.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] The following will describe the comber according to the embodiment of the present invention with reference to Figs. 1 through 3. The comber has a plurality of combing heads 11 (eight combing heads in the present embodiment), one of which is shown in Fig. 1. It is noted that the left-hand side and right-hand side of Fig. 1 correspond to the front and the rear of the combing head 11, respectively. Referring to Fig. 1, the combing head 11 includes a pair of lap rollers 12, a nipper device 14, a combing cylinder 15 and two pairs of detaching rollers 16, 17. The nipper device 14 has a feed roller 13 and the paired detaching rollers 17 are located forward of the paired detaching rollers 16.

[0015] The nipper device 14 has a nipper frame 18 that is pivotally supported by a shaft 23A so as to be swingable back and forth and disposed above the combing cylinder 15. The nipper frame 18 has at the bottom thereof a bottom nipper 19. A nipper arm 20 is pivotally supported by a shaft 18A mounted to the nipper frame 18. A top nipper 20A is fixed to the distal end of the nipper arm 20. The top nipper 20A is operated to be opened and closed at a predetermined time in synchronization with the back-and-forth movement of the nipper frame 18 thereby to hold lap in cooperation with the bottom nipper 19. A top comb 21 is mounted to the nipper frame 18 at a position that is forward of the bottom nipper 19 and operable to move in synchronization with the nipper frame 18.

[0016] A reciprocally rotatable nipper shaft 22 is located at a position that is behind the combing cylinder 15 and below the nipper frame 18. The rear end of the nipper frame 18 is pivotally supported by the shaft 23A at the distal end of a nipper frame drive arm 23 whose proximal end is fixed on the nipper shaft 22 for rotation therewith. The nipper frame 18 is swingable back and forth by the reciprocal rotation of the nipper shaft 22 so that the front end of the bottom nipper 19 is moved toward and away from the detaching rollers 16, 17. The comber includes a drive shaft (not shown) that is common to all the combing heads 11 and driven by a main motor 24, and the rotation of the drive shaft is transmitted to the combing cylinder 15, the nipper shaft 22 and the detaching rollers 16, 17 via a power transmission device 25 such as transmission gear or crank mechanism. The nipper device 14 is driven in synchronization with the combing cylinder 15. The main motor 24 and the power transmission device 25 cooperate to form the combing drive device of the present invention.

[0017] The comber further includes a lap roller drive shaft (not shown) that is common to all the combing heads 11 and driven by a lap roller drive motor 26 to drive a lap roller shaft 12A of the lap roller 12 via a belt transmission device 27. The lap roller shaft 12A is driven independently of the main motor 24. The lap roller drive motor 26 serves as the motor of the present invention and can be driven independently of the combing drive device. The main motor 24 and the lap roller drive motor 26 are driven via inverter devices 29 and 30, respectively, that are controlled by command of a control device 28. The lap roller 12, the lap roller shaft 12A, the lap roller drive motor 26 and the belt transmission device 27 cooperate to form the lap feeder of the comber of the present invention.

[0018] The control device 28 includes a central processing unit (CPU) 31, a memory 32, and an input and display device 33. The CPU 31 is operated in accordance with program data stored in the memory 32. The input and display

device 33 has a touchscreen that allows input of data by touching any input area displayed on its display screen. The input and display device 33 serves as both input device and display device. The input and display device 33 is used for inputting data representative of various combing conditions of the comb, such as the type of fiber to be combed (or fiber length), weight of sliver, number of nips, and any other data.

[0019] The following will describe the control device 28 that serves as the lap feed control device in the comb. The input and display device 33 is also used for inputting the measurements of weight of sliver (finished sliver weight). The memory 32 serves not only as an input unit of the measurements of the sliver weight, but also as a storage unit for data of speed-change pattern of the lap roller drive motor 26 calculated by the CPU 31. The CPU 31 serves not only as an arithmetic-logic unit that calculates the speed change pattern of the lap roller drive motor 26 from the measurements entered in the input unit of measurements of the sliver weight, but also as a control unit that controls the operation of the lap roller drive motor 26 in accordance with the speed-change pattern calculated by the arithmetic-logic unit and stored in the memory unit.

[0020] The CPU 31 calculates the speed change pattern of the lap roller drive motor 26 from the measurements of the sliver weight entered in the memory 32 and stores data of the calculated speed change pattern in the memory 32. The CPU 31 regards the speed change ratio as 1/weight ratio in calculating the speed change pattern. It is noted that the term "speed change ratio" means the changed speed/reference speed, and also that the term "weight ratio" means (the sliver weight determined at a lap roll diameter when speed is changed) / (the sliver weight at a reference lap roll diameter).

[0021] The program according to which the CPU 31 calculates the speed change pattern is subject to the action of a filter that blocks the variation of the sliver weight that is not caused by the change of the lap roll diameter in calculating the speed change pattern from the measurements entered in the memory 32. That is, the arithmetic-logic unit has the filter for the entered measurements and the filter is operable to block the variation of the sliver weight in a range that is less than unit length of the sliver (9.144 meters or 10 yards in the present embodiment). The unit length of the sliver is appropriately settable.

[0022] The following will describe the operation of the control device 28. When the comb is manufactured in a factory, data of the speed change pattern that equalizes the sliver weight or reduces the variation of the sliver weight in view of the change of the lap roll diameter is not stored in the memory 32. The lap roller drive motor 26 is driven at a constant speed corresponding to the speed of the combing cylinder 15. In order for the CPU 31 to calculate the speed change pattern that equalizes the sliver weight or reduces the variation of the sliver weight in view of the change of the lap roll diameter, the comb is operated with the lap roller drive motor 26 driven at a constant speed on a trial basis. During this trial operation, the sliver weight is measured by workman. This step corresponds to the step of measuring the weight of the sliver of the present invention. The measurements of the weight are inputted into the memory 32 using the input and display device 33 and stored in the memory 32. This step corresponds to the step of inputting the measurements of the weight of the sliver.

[0023] It is difficult to indicate the measurements so as to correspond to the lap roll diameter because it is difficult to detect the change of the lap roll diameter accurately. Thus, consumption lap length is used in place of the lap roll diameter. The relation between the consumption lap length and the sliver weight is shown by the graph of Fig. 2, wherein the horizontal axis of the graph represents the consumption lap length and the vertical axis represents the sliver weight. When the consumption lap length is zero, the lap roll is full. As the consumption lap length increases, the lap roll diameter decreases. The vertical axis of the graph does not represent the sliver weight directly, but it shows the weight in percentage. Specifically, the vertical axis represents the sliver weight in percentage wherein the sliver weight is 100% when the consumption lap length is zero. Fig. 2 suggests that the sliver weight is not simply proportional to the lap roll diameter, but varied in a complicated manner.

[0024] The CPU 31 calculates the speed change pattern from the relation between the sliver weight stored and the consumption lap length in the memory 32. This step corresponds to the step of calculating speed change pattern of the present invention. The graph of Fig. 2 is filtered and smoothened by the CPU 31. In filtering the graph of Fig. 2, if the unit length of the sliver is 10 yards or more, the accuracy of the arithmetic-logic unit is reduced. If the unit length of the sliver is too short, the number of data is increased and additional work is required.

[0025] The CPU 31 calculates speed change factor (indicated by percentage) for the consumption lap length x using the following equation:

$$\text{Speed change factor (\%)} = 100 * \{1 / (\text{sliver weight for the consumption lap length x} / \text{sliver weight when the consumption lap length is zero})\} = 100 * (\text{speed change ratio})$$

[0026] In the present embodiment, when the CPU 31 calculates the speed change pattern, reference lap feed speed

used in calculating the speed change ratio is used as lap feed speed when the consumption lap length is 0%.

[0027] A manner of changing of the speed change factor during combing operation from the state of full lap roll (consumption lap length being 0%) to the time for replacement of the lap roll L (consumption lap length being 100%) is shown by the graph of Fig. 3. The horizontal axis of the graph of Fig. 3 represents the consumption lap length (indicated in percentage) and the vertical axis represents the speed change factor (indicated in percentage) with respect to the lap feed speed when the consumption lap length is zero. Thus, the curve of Fig. 3 shows speed change pattern for the consumption lap length.

[0028] The speed change pattern has a plurality of transition points (nine transition points in the present embodiment) and a plurality of sections (eight sections in the present embodiment) divided by the transition points. The transition points correspond to the consumption lap lengths previously entered by the input and display device 33, respectively. The speed change factor is set for each transition point. The intervals between any two adjacent transition points (or the sections) have different lengths. In the range for a section where the change of the sliver weight is relatively large with respect to the consumption lap length, the section is set relatively short. In the range for a section where the change of the sliver weight is relatively small with respect to the consumption lap length, the section is set relatively long. The position of the transition point, or the consumption lap length (%) of the transition point, may be set by manually inputting the data through the input and display device 33.

[0029] The CPU 31 calculates speed change factors for the respective consumption lap lengths of the transition points and stores data for the relation between the consumption lap length of each transition point and the speed change factor for the consumption lap length in the memory 32, as shown in Table 1 below. This step corresponds to the step of storing speed change pattern.

Table 1

transition point	consumption lap length (%)	speed change factor (%)
0	0	100.0
1	5	101.5
2	10	101.9
3	20	101.9
4	30	102.3
5	60	102.5
6	90	103.6
7	95	103.0
8	100	101.4

[0030] In the speed change pattern of Table 1, the CPU 31 calculates the speed change factor between any two adjacent transition points based on the value of the speed change factor of the transition points. In the present embodiment, the speed change factor between any two adjacent transition points is calculated from the gradient of a straight line connecting the transition points.

[0031] The speed change pattern shown in Fig. 3, wherein the speed change factor is 100% when the consumption lap length is 0%, is represented by the relation between the consumption lap length and the speed change factor for the consumption lap length. The speed change factor corresponds to a value that indicates a speed change ratio in percentage. That is, the speed change pattern has a plurality of transition points and a plurality of sections divided by the transition points. The speed change ratio is set at each transition point and the speed change ratio between any two of the adjacent transition points is set in accordance with the speed change ratios of the two adjacent transition points.

[0032] The following will describe a manner of controlling the lap roller drive motor 26 of the lap feeder by the control device 28. Replacement of the lap rolls L of the comb is performed simultaneously for all the combing heads 11. The replacement of an empty roll with a full lap roll L is detected by the control device 28 via manual operation or automatic detector. The control device 28 detecting the replacement resets the consumption lap length (%) to zero and is set to its initial state.

[0033] After the combing operation is restarted, the control device 28 controls the speed of the lap roller drive motor 26 via the inverter device 30 in accordance with the speed change pattern stored in the memory 32. This step corresponds to the step of controlling motor of the present invention. The CPU 31 calculates the consumption lap length by integrating the motor speed corresponding to indicated frequency of the lap roller drive motor 26 by time. The reference speed of the lap roller drive motor 26 corresponding to 100% of speed change factor is set previously.

[0034] The speed changing of the lap roller drive motor 26 is accomplished by multiplying the reference speed by speed change factor (%) at consumption lap length $x\%$ corresponding to the time of speed change. Speed change point entered by the input and display device 33 includes only the starting point and the end point of the speed change pattern and the transition points between the sections. However, the CPU 31 automatically calculates the speed change factor between any two adjacent transition points from fixed gradient of the straight line connecting the transition points, and uses the speed change factor to calculate the speed of the lap roller drive motor 26 at each consumption lap length $x\%$ thereby to direct the frequency corresponding to the above speed of the lap roller drive motor 26 to the inverter device 30. By doing so, the CPU 31 controls the operation of the lap roller drive motor 26.

[0035] When the combing condition of the comb under which speed change pattern is stored in the memory 32 is changed, the comb is operated with the lap roller drive motor 26 driven at a constant speed under the present combing condition on a trial basis. The CPU 31 calculates the speed change pattern corresponding to the combing operation as described above and stores the speed change pattern in the memory 32. Thus, the CPU 31 controls the operation of the lap roller drive motor 26 in accordance with the speed change pattern corresponding to the combing operation.

[0036] The above-described embodiment offers the following advantageous effects.

(1) The comb is operable to produce a sliver from the lap wound in the form of a lap roll and has a plurality of combing heads 11 each having a lap feeder. The lap feeder has a lap roller drive motor 26 that can be operated independently of a combing drive device. The lap feed control device includes an arithmetic-logic unit (CPU 31) and a control unit (CPU 31). When the comb is operated with the lap roller drive motor 26 driven at a constant speed on a trial basis, variation of weight of the sliver relative to decrease of diameter of the lap roll is measured. The arithmetic-logic unit calculates a speed change pattern of the lap roller drive motor 26 from the measurements of the variation of the sliver weight. The control unit controls the operation of the lap roller drive motor 26 in accordance with the speed change pattern calculated by the arithmetic-logic unit. Therefore, the comb corrects the variation of sliver weight effectively due to the change of lap roll diameter thereby to equalize the sliver weight or reduce the variation of the sliver weight without using a device for measuring the weight of lap or sliver. Because no measurement device that requires adjustment or calibration (or correction) is used in the lap feed control device, no individual difference derivable from such adjustment or calibration occurs in the combers, which is advantageous in a combing mill using a plurality of combers.

(2) In calculating the speed change pattern of the lap feed speed, the arithmetic-logic unit (CPU 31) regards the speed change ratio as $K / \text{weight ratio}$. The weight ratio is represented by (sliver weight determined at a lap roll diameter when speed is changed) / (sliver weight at a reference lap roll diameter) and K is a proportional constant. The proportional constant K is set at 1. Thus, if the sliver weight is not varied, no change of the speed of the lap roller drive motor 26 occurs. If the sliver weight is decreased relative to the sliver weight corresponding to the reference lap roll diameter, the speed of the lap roller drive motor 26 is increased. Conversely, if the sliver weight is increased relative to the sliver weight corresponding to the reference lap roll diameter, the speed of the lap roller drive motor 26 is decreased. Therefore, the variation of the sliver weight is appropriately reflected on the lap feed speed.

(3) The arithmetic-logic unit has a filter that is operable to block the variation of the sliver weight in a range that is less than unit length of the sliver. Thus, the variation of the sliver weight that is not due to the change of the lap roll diameter is blocked by the filter when the arithmetic-logic unit calculates the speed change pattern from the measurements of the variation of the sliver weight. As compared to the case where the arithmetic-logic unit has no filter, equalization of the sliver weight or reduction of the variation of the sliver weight can be performed more effectively.

(4) The speed change pattern has a plurality of transition points and a plurality of sections divided by the transition points. The speed change ratio is set at each transition point. The speed change ratio between two of the adjacent transition points is set in accordance with the speed change ratios of the two adjacent transition points. The speed change ratio between the two adjacent transition points is calculated from the gradient of a straight line connecting the two adjacent transition points by the arithmetic-logic unit (CPU 31). Therefore, the speed change control of the lap roller drive motor 26 is appropriately performed throughout the lap feed operation even when the number of input data of speed change point necessary for calculating the speed change pattern is few.

(5) The speed change pattern is represented by the change of value of speed change factor (%) relative to the consumption lap length (%). The speed change factor (%) is represented by $100 * \{1 / (\text{sliver weight for the consumption lap length } x / \text{sliver weight when the consumption lap length is zero})\}$. Therefore, when the speed change pattern is shown in the drawing, the variation of the lap feed speed relative to the consumption lap length is easily understandable.

(6) In controlling the speed change of the lap roller drive motor 26 in accordance with the speed change pattern stored in the memory 32, the CPU 31 calculates the consumption lap length by integrating the motor speed corresponding to indicated frequency of the lap roller drive motor 26 by time. Therefore, the CPU 31 can calculate the consumption lap length without using any sensor for measuring the consumption lap length.

(7) In the lap feed control method in a combler according to the present embodiment, the sliver weight is measured for each predetermined length of the sliver while the combler is operated with the lap roller drive motor 26 driven at a constant speed on a trial basis. The speed change pattern of the lap roller drive motor 26 is calculated from the measurements of the sliver weight by the arithmetic-logic unit (CPU 31) in view of the change of lap roll diameter, thereby to equalize the sliver weight or reduce the variation of the sliver weight. Operation of the lap roller drive motor 26 is controlled in accordance with the speed change pattern by the control unit (CPU 31). Therefore, the variation of sliver weight due to the change of lap roll diameter is corrected effectively without using a lap weight measurement device or a sliver weight measurement device, thereby to equalize the sliver weight or reduce the variation of the sliver weight.

[0037] The present invention has been described in the context of the above-described embodiment, but it is not limited to the embodiment. It is obvious to those skilled in the art that the invention may be practiced in various manners as exemplified below.

[0038] The speed change pattern may be calculated according to the speed change ratio being equal to $K / \text{weight ratio}$ instead of the speed change ratio being equal to $1 / \text{weight ratio}$, where "K" means a proportional constant. It is noted that the value of the proportional constant K calculated previously by test for material of lap is stored in the memory 32. As compared to the case where the proportional constant K is set at a constant value such as 1 regardless of the material of lap, the method according to the present invention is effective to equalize the sliver weight or to reduce the variation of sliver weight.

[0039] The lap feed speed (or lap roller speed) during the time when the consumption lap length is other than zero may be set at the reference speed. In this case, the speed change of the lap roller drive motor 26 differs from that in the case where the lap feed speed when the consumption lap length is zero is set at the reference speed. The speed of the lap roller drive motor 26 may be changed so as to decrease with respect to the reference speed.

[0040] A device that measures consumption lap length may be provided in the combler so that the speed change of the lap roller drive motor 26 is controlled in accordance with the consumption lap length measured by the measuring device. For example, the lap roller shaft 12A may be provided with a pulse generator that generates to the control device 28 pulses that are indicative of the speed of the lap roller 12 and hence the consumption lap length directly. Thus, the speed of the lap roller 12 may follow the speed change pattern of the lap roller drive motor 26 with an increased accuracy. Alternatively, the lap roller speed may be feedback-controlled. In these cases, further accurate control may be achieved.

[0041] The speed change pattern of the lap roller drive motor 26 is not limited to the change of the speed change factor relative to the consumption lap length. The speed change pattern of the lap roller drive motor 26 may directly represent the speed change of the lap roller drive motor 26 relative to the consumption lap length.

[0042] Although the speed change pattern of the lap roller drive motor 26 represents speed change factor or speed change in relation to the consumption lap length as a substitution for the lap roll diameter, it may represent speed change factor or speed change in relation to the lap roll diameter. In this case, a sensor for detecting the lap roll diameter is required.

[0043] The combing cylinder shaft 15A may be provided with a pulse generator that generates to the control device 28 pulses that are indicative of the speed of the combing cylinder shaft 15A, and the lap feed speed may be controlled in synchronization with the measured speed of the combing cylinder shaft 15A. In this case, control with further increased accuracy is achieved.

[0044] The control device 28 need not necessarily have a structure for calculating the speed change pattern for controlling the speed change of the lap roller drive motor 26. The control device 28 only needs to have a storage unit storing therein the speed change pattern and a control unit that controls the operation of the lap roller drive motor 26 in accordance with the speed change pattern stored in the storage unit. In the present embodiment wherein the sliver weight is measured for each predetermined length of the sliver while the combler is operated at a constant speed of the lap roller drive motor 26 on a trial basis, a device provided independent of the combler may calculate the speed change pattern of the lap roller drive motor 26 from the measurements of the sliver weight in view of the change of the lap roll diameter. In this case, data of the calculated speed change pattern is stored in the storage unit of the control device 28 provided in the combler via any removable media such as USB memory or magnetic optical disk. That is, the device used for the step of inputting the measurements of the sliver weight and the step of calculating speed change pattern may be provided separately from the combler. Calculating the speed change pattern based on the measurements of the sliver weight may be performed by a personal computer.

[0045] The number of sections of the speed change pattern is not limited to eight, but may be other than eight.

[0046] The interval between any two adjacent transition points of the speed change pattern may be the same. In this case, the number of transition points should be preferably increased so that the speed change pattern is made reflecting the change of the consumption lap length in the range where a large variation occurs.

[0047] The control device 28 may calculate the speed change factor from the measurements and provide the data of the calculated speed change factor to the lap feed control unit without storing the data of speed change pattern in the memory 32.

Claims

1. A lap feed control device (28) for controlling feed of lap in a comber, wherein the comber is operable to produce a sliver from the lap wound in the form of a lap roll (L) and has a plurality of combing heads (11) each having a lap feeder (12, 12A, 26, 27), wherein the lap feeder (12, 12A, 26, 27) has a motor (26) that can be driven independently of a combing drive device (24, 25), the lap feed control device (28) being **characterized in that** the lap feed control device (28) includes an arithmetic-logic unit (31) and a control unit (31), wherein when the comber is operated with the motor (26) driven at a constant speed on a trial basis, variation of weight of the sliver relative to decrease of diameter of the lap roll (L) is measured, wherein the arithmetic-logic unit (31) calculates a speed change pattern of the motor (26) from the measurements of the variation of the weight of the sliver to equalize the weight of the sliver or reduce the variation of the weight of the sliver, wherein the control unit (31) controls operation of the motor (26) of the lap feeder (12, 12A, 26, 27) in accordance with the speed change pattern.
2. The lap feed control device according to claim 1, **characterized in that** the arithmetic-logic unit (31) regards a speed change ratio as $K / \{(\text{the weight of the sliver determined at the diameter of the lap roll (L) when speed is changed}) / (\text{the weight of the sliver at a reference diameter of the lap roll (L)}) \}$ in calculating the speed change pattern, wherein K is a proportional constant.
3. The lap feed control device according to claim 2, **characterized in that** the proportional constant K is set at a value that is previously calculated for material of the lap.
4. The lap feed control device according to claim 2 or 3, **characterized in that** the speed change pattern has a plurality of transition points and a plurality of sections divided by the transition points, wherein the speed change ratio is set at each transition point, wherein the speed change ratio between two of the adjacent transition points is set in accordance with the speed change ratios of the two adjacent transition points.
5. The lap feed control device according to any one of claims 1 through 4, **characterized in that** the arithmetic-logic unit (31) has a filter for the measurements, wherein the filter is operable to block the variation of the weight of the sliver in a range that is less than unit length of the sliver.
6. The lap feed control device according to any one of claims 1 through 5, **characterized in that** the speed change pattern is represented by a change of a speed change ratio or a speed change factor relative to consumption lap length.
7. A lap feed control method for controlling feed of lap in a comber, wherein the comber is operable to produce a sliver from the lap wound in the form of a lap roll (L) and has a plurality of combing heads (11) each having a lap feeder (12, 12A, 26, 27), wherein the lap feeder (12, 12A, 26, 27) has a motor (26) that can be driven independently of a combing drive device (24, 25), the lap feed control method being **characterized by**:
 - a step of measuring weight of the sliver for each predetermined length while operating the comber with the motor (26) driven at a constant speed on a trial basis;
 - a step of calculating a speed change pattern of the motor (26) from the measurements of the weight of the sliver in view of change of diameter of the lap roll (L) to equalize the weight of the sliver or reduce variation of the weight of the sliver; and
 - a step of controlling operation of the motor (26) of the lap feeder (12, 12A, 26, 27) in accordance with the speed change pattern.
8. The lap feed control method according to claim 7, **characterized in that** the speed change pattern is represented by a change of a speed change ratio or a speed change factor relative to consumption lap length.

FIG. 2

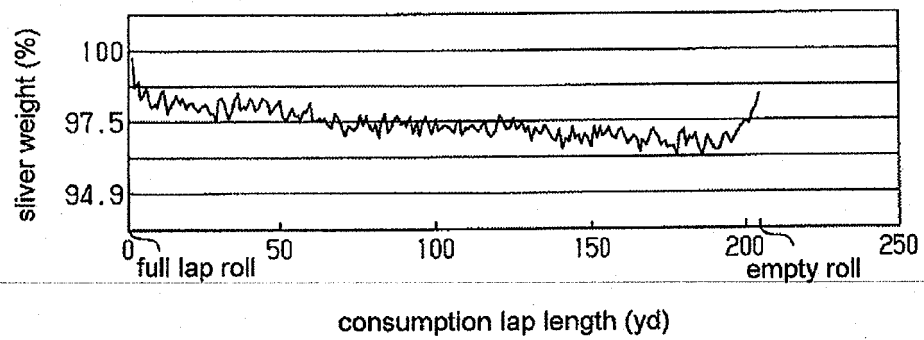
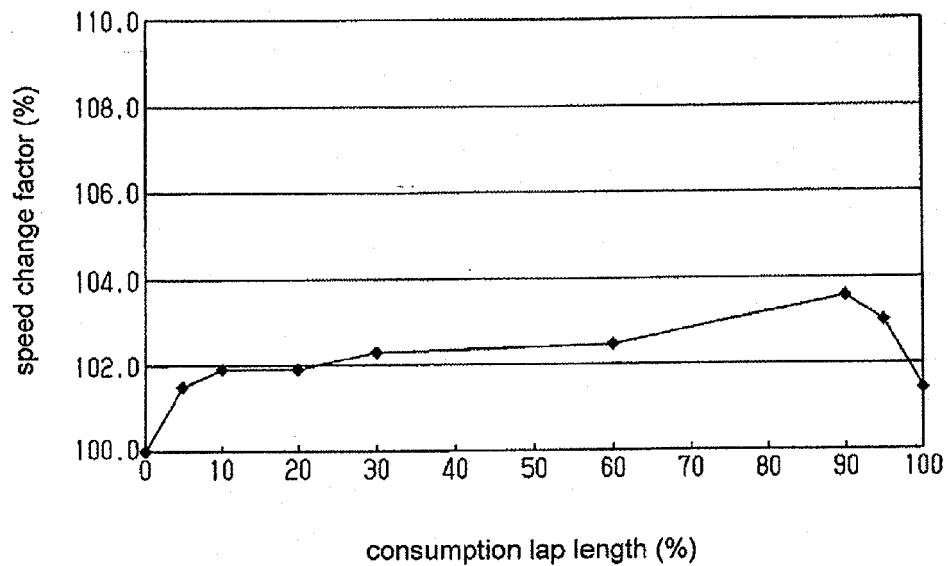


FIG. 3





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 9812

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	EP 0 615 009 A1 (RIETER AG MASCHF [CH]) 14 September 1994 (1994-09-14) * claim 1; figure 1 *	1-8	INV. D01G19/08
A	EP 0 978 581 A2 (RIETER AG MASCHF [CH]) 9 February 2000 (2000-02-09) * claim 1; figure 1 *	1-8	
A	WO 92/05301 A1 (RIETER AG MASCHF [CH]) 2 April 1992 (1992-04-02) * page 10, lines 9-24; claim 1; figure 1 *	1-8	
A	DE 10 2006 002390 A1 (RIETER AG MASCHF [CH]) 19 July 2007 (2007-07-19) * claim 1; figure 1 *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01G
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 16 July 2012	Examiner Dupuis, Jean-Luc
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EPO FORM 1503 03 82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 15 9812

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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16-07-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0615009 A1	14-09-1994	CH 686675 A5	31-05-1996
		CN 1094766 A	09-11-1994
		DE 59403494 D1	04-09-1997
		EP 0615009 A1	14-09-1994

EP 0978581 A2	09-02-2000	CN 1243893 A	09-02-2000
		DE 19835372 A1	10-02-2000
		EP 0978581 A2	09-02-2000

WO 9205301 A1	02-04-1992	EP 0502137 A1	09-09-1992
		JP H05502701 A	13-05-1993
		US 5377385 A	03-01-1995
		WO 9205301 A1	02-04-1992

DE 102006002390 A1	19-07-2007	CN 101003921 A	25-07-2007
		DE 102006002390 A1	19-07-2007

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6502894 W [0004]