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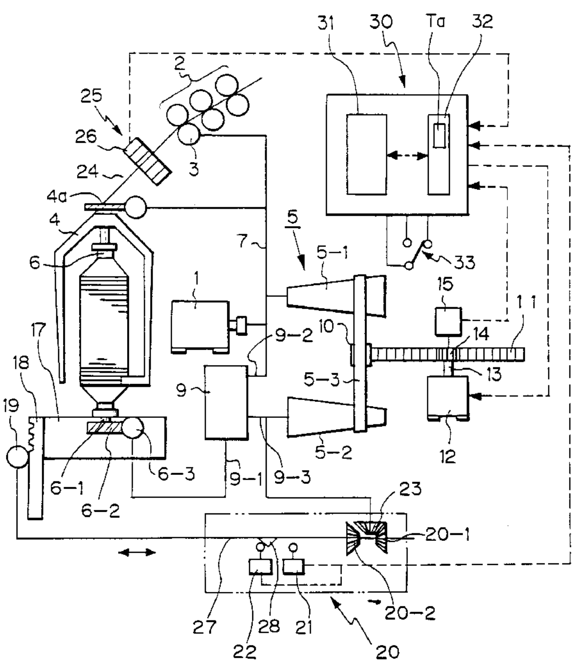
(54) **Taking-up roving in a flyer frame.**

(57) A flyer frame having a device for detecting a tension and constructed by photoelectric transducer units 26 arranged between a front roller 3 and a flyer top 4a for detecting a tension of a roving running to a bobbin during a data entry winding period from an empty state to a full bobbin state. A unit is provided for obtaining data for a correction of the bobbin speed, to thus obtain a desired tension. The corrected data at each corrected timing, such as a point of a change of the movement of a bobbin rail, is stored in a memory. The stored data is used instead of the tension detection for correcting the bobbin rotational speed during a usual winding period after the data entry period.

Fig. 1



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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of winding a roving on a bobbin in a bobbin lead type flyer frame.

2. Description of the Related Art

In a bobbin lead type flyer frame, a roving travelling at a constant speed from a front roller of a drafting unit is twisted by a rotation of a flyer top while being wound onto a bobbin, due to a difference between a rotational speed of the flyer rotating at a speed lower than a predetermined value and a rotational speed of the bobbin faster than the rotational speed of the flyer. Namely, the amount of roving wound on the bobbin correspond to a difference between the rotational speed of the bobbin and the rotational speed of the flyer. As will be easily understood, the larger the diameter of the bobbin, due to the winding of the roving thereon, higher the speed at which the roving is wound on the bobbin. Contrary to this, the speed of the roving running from the front roller of the drafting unit is maintained at a constant value. Therefore, to maintain the speed of the roving when wound on the bobbin at a value equal to the speed of the roving unwound from the front roller, i.e., in order to take up the roving unwound from the front roller on the bobbin, the rotational speed of the bobbin should be lowered in accordance with the increase in the diameter of the bobbin, due to the progress of the winding of the roving onto the bobbin. Therefore, a speed variation device is provided, which device is constructed by a pair of spaced-apart cone-shaped drums having a belt arranged therebetween to thereby obtain an output rotational speed which lowers the speed of a bobbin as the winding radius of the roving on the bobbin increases, so that a constant difference between the speed of the bobbin and that of the spindle is obtained. The cone drum speed variation device includes a means for obtaining an inching movement of the cone belt, which is energized by a vertical change in direction of a bobbin rail, i.e., a formation of a new winding layer of roving on the bobbin is started. Namely, the control of the speed of the bobbin is carried out in accordance with the number of layers of the roving wound on the bobbin.

A rate of increase in the diameter versus the number of layers wound on a bobbin, however, is varied in accordance with many other fixed factors during the spinning, such as a kind of fiber constructing the roving, a number of a count, i.e., a thickness of the roving produced, a number of twists, and a pressure of a presser applied to the bobbin during winding. As a result, the mere control of the speed of the bobbin by the cone drum device can not always make the winding speed of the roving equal to the speed of the roving running from the front roller of the drafting unit, and accordingly, the winding tension of the roving is varied, and thus an unevenness in the thickness of the roving is created. In a view of this, a technique has been proposed for detecting a tension of a roving to thus cause it to reflect the result of the control of the speed of the spindle, so that the speed of the roving from the front roller is equal to the winding speed of the bobbin, as the difference between the rotational speed of the bobbin and the rotational speed of the flyer. Japanese Unexamined Patent Publication No. 60-34628, also assigned to the assignee of the present invention, discloses a construction wherein an average position of a vertically vibrating roving running from the front roller of the drafting unit to a flyer top is detected, corresponding to a degree of "slack" in the roving running from the front roller to the flyer top, as an indication of a tension of the roving, and this is used for controlling the rotational speed of the bobbin so that the speed of the roving running from the front roller of the drafting unit is equal to the speed of the roving wound on a bobbin. In such a device, a plurality of pairs of photoelectric detectors are arranged so that they are spaced along the direction of the movement of the roving when it is vibrated. The device is further provided with means for calculating an average vertical position of the roving in the direction of the movement thereof when vibrated, means for calculating a deviation of the calculated mean position from a predetermined reference position as a desired tension of the roving, means for calculating a correction amount for the rotating speed of the bobbin from the calculated deviation and a correction factor, and means for outputting a correction signal directed to an actuator motor for controlling a correction of the rotational speed of the bobbin. As a result, the degree of slack in the roving running from the front roller to the flyer head is controlled to the desired value.

Note: as a well known technique, a counter is provided in a flyer frame for obtaining an accumulated number of rotations of the front roller of the drafting unit, which corresponds to the total length of the roving when wound, after the commencement of the winding of the roving onto an empty bobbin. Then the flyer frame continues to operate after the predetermined full bobbin length is detected, and stops only when a predetermined vertical position of the bobbin rail is reached. This technique allows for obtained full bobbins to maintain a fixed predetermined vertical position of the free end thereof, which makes it easy for the full bobbin to be subjected to an automated ending process at the following spinning process by an automated ending system, as disclosed, for example, in Japanese Unexamined Patent Publication No. 64-52828, owned by the assignee of the present invention. With regard to the stoppage of the bobbin rail at a predetermined vertical position after the full bobbin length is detected, reference should be made to a prior art such as Japanese Examined Utility Model Publication No. 60-1104, and to U.S. Patent Application No. 845,174, filed on March 3, 1992, and assigned to the assignee of the present invention.

The prior art device for controlling the winding speed of a roving (Japanese Unexamined Patent Publication No. 60-34628) makes it possible to obtain a predetermined constant degree of slack in the roving running from the front roller to the flyer top and thus a substantially constant tension of the roving is obtained, which can reduce any unevenness in the thickness of the obtained roving regardless of the above-mentioned various fixed factors used during the spinning. There are, however, other not fixed time dependent factors which can affect the tension of the roving, such as an air conditioning level and a frictional property of portions through which the roving passes; even the physical property of the fiber can cause the tension of the roving to be changed. Upon such a change, the roving position control device of the prior art executes the above-mentioned operation of positioning the roving at a predetermined position by changing the speed of the bobbin. Such a control of the speed of the bobbin, however, causes the weight per unit length of the roving to be varied, which causes the diameter of the wound bobbin to be varied when a predetermined constant length of the roving is wound thereon. As a result, a position of the bobbin rail is varied when the predetermined full bobbin length is detected from the predetermined number of the counter for . counting the number of the front roller, and thus the execution of the stoppage of the bobbin, for facilitating the automated ending process of the roving at the following spinning process, causes the total length of the roving to differ between bobbins obtained at different times. Namely, in this prior art ('828), a predetermined substantially constant tension is obtained by maintaining a predetermined constant vertical position of the roving running from the top roller to the flyer top, and therefore, any time-dependent change in spinning conditions in a long run that causes the tension to be changed, such as the physical properties of fibers constructing the rovings, air conditioning levels, and frictional resistance at portions through which the roving passes, can vary the speed of the bobbin and cause the wound diameter thereof to differ between bobbins, and thus a variation is generated in the position of the bobbin rail when the full bobbin length is obtained. Accordingly, the stoppage of the bobbin rail at the predetermined vertical position after the full bobbin length has been obtained can cause the total length of the roving to differ between bobbins obtained at different times, and thus all of the roving on the bobbins can not be consumed in the following spinning process when a timing is reached for changing the used bobbin to new full bobbins, which causes an increase in the amount of waste roving on the old bobbin. This necessitates a process for a treatment of the waste roving and increases the amount of reused fibers, which inevitably must lower the efficiency.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a technique which can overcome the above-mentioned drawback of the prior art.

According to one aspect of the present invention, a method is provided for correcting a taking up speed of a roving in a bobbin lead type flyer frame running from a front roller to a bobbin while the bobbin is vertically reciprocatedly moved, so that a bobbin speed is reduced as the direction of movement thereof is changed, said method comprising the steps of:

detecting a tension of a roving running from the front roller to the bobbin in an initial single winding period from an empty bobbin state to a full bobbin state;

correcting, at correction points distributed along the entire winding period, the rotational speed of the bobbin in accordance with values related to the detected tension, and;

storing the values related to a tension of the roving for respective correction points throughout said winding period;

said stored values being used for correcting the bobbin rotational speed at corresponding correction points during each winding period after said data entry period.

According to another aspect of the present invention, a bobbin lead type flyer frame is provided, comprising:

a drafting unit having a plurality of spaced-apart pairs of rollers;

a bobbin rail on which a bobbin is mounted;

a bobbin wheel for imparting a rotational movement to the bobbin on the bobbin rail;

a flyer subjected to a rotating movement for introducing a roving running from the drafting unit to the bobbin;

the rotational speed of the bobbin being higher than that of the flyer, which allows the roving unwound from the drafting unit to be taken up by the bobbin;

reciprocating means for obtaining a vertically reciprocating movement of the bobbin rail for a formation of layers of roving wound on the bobbin;

speed control means for controlling a predetermined reduction in the rotational speed of the bobbin each time the direction of the vertical movement of the bobbin rail is changed;

means for setting a data entry period of a winding of a roving onto the bobbin from an empty state to a full bobbin state;

means for detecting during said data entry period, a tension of a roving running from the front roller to the bobbin;

timing detecting means for detecting correction timings distributed along the entire winding period;

correcting means for correcting, upon the detection of said correction timings, said predetermined speed reduction in accordance with the tension detected by the tension detecting means, and;

memory means for storing data related to the tension detected for respective correction timings throughout said winding period;

said stored values being used for correcting the speed reduction at the corresponding correction timings during each winding period after the data entry period.

According to the present invention, when a spinning is commenced under a particular spinning condition, a roving tension is detected throughout a period from an empty bobbin state to a full bobbin sate, and a correction control of the bobbin rotational speed is executed in accordance with the detected roving tension. Data related to the roving tension in relation to the number of layers, is stored in a memory, and this stored data is used for correcting the bobbin rotational speed at subsequent spinning periods. As a result, a desired roving tension, i.e., desired winding state, is maintained without an actual detection of the tension. The omitting of a detection of the tension during the usual winding periods after the entry period eliminated the tendency for the system to respond to a small time dependent change in a spinning condition, such as air conditioning state. As a result, the bobbin speed does not respond to such a change, and accordingly the diameter of the full bobbin is maintained at a desired diameter, with the result that differences in a total roving length are minimized between full bobbins when a bobbin rail is stopped at a predetermined vertical position after a detection of a predetermined length of a roving by a predetermined roving length counter. This leads to a reduction of an amount of waste, and of labor for treating some, during a subsequent spinning process, to thereby increase the labor efficiency.

BRIEF EXPLANATION OF THE DRAWINGS

Fig. 1 is a general schematic view of a flyer frame according to the present invention;

Figs. 2 to 3 are flowcharts illustrating how the flyer frame according to the present invention is operated for controlling the rotational speed of a bobbin;

Figs. 4 to 6 are partial flowcharts illustrating the operation of the flyer frame of different embodiments of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, an embodiment of the present invention will be explained with reference to the attached drawings. In Fig. 1, which schematically illustrates a flyer frame, reference numeral 1 denotes a main motor, 2 a drafting unit, 4 a flyer, 5 a cone drum type speed control unit, and 6 a bobbin. The cone drum type speed control unit 5 is constructed by a pair of parallel spaced apart cone drums 5-1 and 5-2, and a belt for kinematically connecting the cone drums 5-1 and 5-2 with each other. The main motor 1 is connected to a front roller 3 of the drafting unit 2, the flyer 4 and the top or inlet side cone drum 5-1, via a transmission system 7; although shown schematically in Fig. 1, this is constructed by V-shaped pulleys, V-shaped belts and gear trains. The bobbin 6 is mounted to a bobbin wheel 6-1, to which a gear wheel 6-2 is connected; the gear wheel 6-2 engaging a gear 6-3 connected to a differential gear mechanism 9 at the outlet shaft 9-1 thereof. In addition to the outlet shaft 9-1, the transmission mechanism 9 has a first inlet shaft 9-2 connecting the transmission line 7 to the main motor 1 and second inlet shaft 9-3 connected to the bottom or outlet side cone drum 5-2. Namely, the rotational movement of the main motor 1 at a constant rotational speed and the rotational movement of a different speed determined by the position of the belt 5-3 with respect to the cone drums 5-1 and 5-2 are combined at the differential mechanism 9 and transmitted to the outlet shaft 9-1.

The cone drum type speed control unit 5 is further provided with a belt shifter 10, to which a rack 11 is connected. A pinion 14 engages the rack 11 and is connected to a motor 12 at the outlet shaft 13 thereof for imparting a rotational movement to the pinion 14 to thus obtain a linear movement of the rack 11, which causes the belt shifter 10 to be correspondingly moved so that the locations of the engagement of the belt 5-3 with respect to the cone drums 5-1 and 5-2 are changed, and accordingly, the rotational speed of the bottom cones drum 5-2 is changed, and applied to the differential mechanism 9. As a result, the rotational speed of the outlet shaft 9-1, which is the rotational speed of the main motor 1 plus the rotational speed of the cone drum 5-2, is changed. An encoder 15 is connected to the outlet shaft 13 of the motor 12 whereby a pulse signal is obtained which indicated the number of rotations of the outlet shaft 13 of the motor 12.

The bobbin wheels 6-1 on which the bobbins 6 are connected are rotatably mounted on a bobbin rail 17, which has a lifter rack 18, with which a pinion 19 engages for a vertical reciprocation movement of the lifter rack 18. A unit 20 is provided for controlling the direction of the rotation of the pinion 19, for obtaining a vertical reciprocating movement of the bobbin rail 17. The unit 20 includes a pair of bevel pinions 20-1 and 20-1 arrange to face each other at the small diameter ends thereof, a drive pinion 23 arranged between the pinions 20-1 and 20-2, and a reversing rod

27 on which the pinions 20-1 and 20-2 are connected and which is connected to the pinion 19. As well known to those skilled in this art, the reversing rod 27 is connected, at an end not shown in Fig. 1, to a mechanism activated each time the bobbin rail 17 reaches the top or bottom position thereof, for changing a direction of a linear movement of the reversing rod 27 between a first position where at the drive pinion 23 engages the first reversing pinion 20-1 to thus cause the pinion 19 to rotate in one direction and move the rack 18 connected to the bobbin rail 17 in one vertical direction, and a second position where at the drive pinion 23 engages the second reversing pinion 20-2 to thus cause the pinion 19 to rotate in the opposite direction and move the rack 18 connected to the bobbin rail 17 in the opposite vertical direction. As a result, a vertical reciprocating movement of the bobbin rail 17 is attained while the roving is wound on the bobbin 6. A pair of limit switches 21 and 22 are stationary arranged such so that a dog member 28 mounted on the reversing rod 27 is located between the limit switches 21 and 22. The switches 21 and 22 are operated alternately when a change of the direction of the movement of the rod 27 occurs, i.e., the direction of the vertical movement of the bobbin rail 17 is changed.

Arranged between the front roller 3 of the drafting unit 2 and a flyer top 4a of the flyer 4 is an assembly 25 for detecting a position of a roving, as disclosed in Japanese Unexamined Patent Publication No. 60-34628 owned by the assignee of the present invention. As disclosed in this patent publication, the assembly 25 includes a plurality of photoelectric detection units 26 spaced along the direction of the movement of the roving 24 between the front roller 8 and the flyer top 4a, when the roving 24 is vibrated. Each photoelectric detection unit 26 includes a light emitter and a light receiver horizontally spaced such that the roving 24 is located between the light emitter and the light receiver. Means are provided for calculating an average vertical position of the roving in the direction of the vibrating movement thereof, and means are provided for calculating a tension of the roving from the calculated average vertical position of the roving.

Reference numeral 30 denotes a control device, i.e., microcomputer unit, including a central processing unit (CPU) 31 and a memory 32. Connected to the control device 30 are the photoelectric detection units 26 of the position detection assembly 25, the limit switches 21 and 22, and the encoder 15, so that signals therefrom are input the control device 30. A switch 33 also is connected to the control device 30 for switching the operation of the control device 30 between a data entry mode wherein data is introduced for carrying out the rotational speed control of the bobbin according to the present invention, and a usual mode wherein the control of the rotational speed of the bobbin is carried out in accordance with the stored data. The control device 30 is also connected to the motor 12 for outputting a signal operating the motor 12.

The memory 32 includes programs for carrying out the tension control in accordance with the flow charts shown in Figs. 2 and 3, and a table Ta of data of the amount of the inching movement of the rack 11 with respect to the number of changes of the direction of the vertical movement of the bobbin rail 17 from the beginning of the winding of the roving onto an empty bobbin, i.e., the number of layers of roving on the bobbin. As described later, in response to the detected tension, the control device 30 calculates the amount of movement of the rack 11, and corrects the rotational speed of the bobbin so that a desired tension of the roving is obtained each time the direction of the vertical reciprocal movement is changed. Namely, before a spinning is first commenced time under a particular spinning condition, the data entry switch 33 is switched to the data entry side, and at the same time as the spinning commences, the programs stored in the memory are started. The photo-electric detectors 26 monitor the positions of the roving 24 while it is vibrated, and an average position thereof is calculated as described in Japanese Unexamined Patent Publication No. 60-34628, and a correction amount L_I of the rotational speed of the bobbin 6 is calculated and input to the rack inching motor 12 each time the direction of the movement of the bobbin rail 17 is changed for commencing the formation of a new layer of a roving on the bobbin. The encoder 15 detects the calculated amount of the rotation of the motor 12. The rotation of the control motor 12 causes the rack 11 to be moved to the left in Fig. 1, to lower the rotational speed of the bobbin 6, and the tension of the roving is simultaneously corrected so that the tension of the roving 24 from the front roller 3 to the bobbin 6 is controlled to a target value. This correction of the bobbin rotational speed is executed each time a change of the direction of the movement of the bobbin rail 17 is detected by the limit switches 21 and 22, and accordingly, from the layers I to n (which corresponds to a full bobbin state), corrected values of the movement of the rack, L_1 to L_n are obtained and are stored in the memory 32, to thus correspond with the layer numbers as shown in the following table.

Layer Number	Rack Inching Amount
1	L_1
2	L_2
3	L_3
:	:
:	:
n	L_n

When a full bobbin state is obtained, the frame is stopped, and for commencing the following spinning under the same condition, the data entry switch 33 is switched to allow the program to control the rotational speed of the bobbin 9 in accordance with the data obtained at the data entry operation. Namely, upon detection of the number n of the layer of the roving by the limit switches 21 and 22, the amount L_n of the movement of the rack corresponding to the number n of the layer is read from the above table Ta and is output to the motor 12. As a result, from the begging of the winding (n = 1) to the full bobbin state (n = n), the tension of the roving from the front roller 3 to the bobbin 6 is controlled to a target value, as in the case in the data entry operation. Furthermore, according to the present invention, the data memorized at the initial data entry operation is used for controlling the bobbin rotational speed in the following usual spinning process, as long as the current spinning condition is maintained. This means that the time dependent factors, such an air conditioning level, which otherwise cause the tension sensor 25 to control the bobbin rotational speed, do not affect the bobbin winding condition, i.e, the diameter thereof. As a result, the bobbin diameter is maintained without being affected by any change in the time dependent factors, and thus any variation in a change of position when the bobbin rail is stopped at the predetermined vertical position after the predetermined full bobbin length is obtained, is minimized.

The operation of the control device according to the present invention will be explained in detail with reference to the attached flowcharts. Figure 2 shows a routine for controlling a rotating speed of a bobbin. At step 100, it is determined if the data entry switch 33 is ON. As described above, the data entry switch is made ON throughout a complete winding process, from an empty bobbin to full bobbin, when there is a change in a spinning condition for obtaining data for obtaining a correct amount of the movement of the rack 11, which is used in a following winding process as long as the spinning condition is maintained. When it is determined that the data entry switch 33 is ON, the routine goes to step 102 and it is determined if it is a start of the winding from an empty sate of a bobbin. When a result of the determination at step 102 is yes, the routine goes to step 104, and a counter n for counting the number of layers of the roving on the bobbin is set to 1 as an initial value. At step 106 a tension of a roving from the front roller 3 to the flyer top 4a is detected, the details of which are shown in Fig. 3, whereby an average position of the roving when vibrated is detected. This principle is disclosed in Japanese Unexamined Patent Publication No. 60-34623. In the routine shown in Fig. 3, an average vertical position of the roving 24, as an indication of the roving tension, is detected by using signals from the photo-electric detectors 26 of the sensor assembly 25. In accordance with this embodiment, an average roving position detection is repeated 5 times for each stroke of the bobbin rail between the top and bottom position thereof, and each detection is carried out by a 50 times scanning of the photoelectric detectors 25. Figure 3 shows details of the routine of step 112. At step 200, a counter M is initialized to 1. This counter is used for counting a number of repetitions during a winding of one layer of the roving, and counters S, S2, ..., Sm, which will be explained later, are cleared (0). At step 202, it is determined if a value of the repetition counter M is larger than 5. Upon the commencement of the winding of new layer of the roving on the bobbin 6, the value of the counter M is set to 1 at step 200 and the routine goes to step 204, where a value of a scanning counter U for counting the number of scannings by the detectors 26 is initialized to 1, and then at step 206 it is determined if a value of the counter U is larger than 50, i.e., a 50 times scanning has been repeated. When it is determined that a 50 times scanning at this scanning point has not been repeated, the routine goes to step 208 and a counter m is set to 1, which indicates that a photoelectric detector 26 has been checked to determine if it is blocked by the roving 24 running between the front roller 3 and the flyer top 4a. At step 210, it is determined if the m-th detector 26 is blocked by the roving 24, i.e., the light from the light emitter corresponding to the m-th detector 26 is blocked by the roving 24. When it is determined that the m-th detector 26 is blocked by the roving 24, the routine goes to step 212 and a counter S_m is incremented. This counter S_m indicates an accumulated number of blockages by the roving 24 during the sampling at this scanning point; otherwise the routine 210 is by-passed. At step 214, it is determined if the counter m is equal to k, which is the total number of vertically spaced apart detectors 26 of the detector assembly 25. When it is not determined that m = k, i.e., a check of all of the detectors 26 in this single scan has not been completed, the routine goes to s tep 216 and the counter m is incremented and a check of the blockage by the roving by the m + 1 th counter is carried out in a similar way. When the check of the blockage of the all of the detectors for this one scanning is completed, i.e., m = k, the routine goes to 218 and the scanning counter U is incremented. When a

50 times scanning of the detectors 26 at the scanning point is completed, the determination at the step 206 is yes and the routine goes to step 220, where it is determined whether or not a sampling time t1 has elapsed. The sampling time t1 is selected such that 5 scanning points are obtained from the beginning to the end of the winding of a layer of the roving. Namely, if it take t_A seconds to complete a winding of this layer of the roving, the sampling period t1 must be $t_A/6$ seconds. Namely, a 50 times scanning is executed at every $t_A/6$ seconds. When the next scanning point has arrived, i.e., a time $t_A/6$ has elapsed from the preceding scanning, the routine goes to step 222 and the repetition counter M is incremented, and then goes to step 202 whereby the next 50 times scanning is executed. When the scanning is executed at 5 points along the vertical movement of the bobbin rail between the top and bottom end for winding a layer (n) of the roving, a yes determination is obtained at step 202, and thus the routine goes to step 224 and an accumulated average value of the blockage of the detectors is calculated by

$$X = \sum_{m=1}^{k}(m \times Sm) \;/\; \sum_{m=1}^{k} Sm,$$

which corresponds to a mean position of the roving 24, and indicates the roving tension. Namely, by executing the routine in Fig. 3, a 50 times scanning is executed at each of 5 points evenly distributed along a layer (n) of the roving, and an average vertical position of the roving X indicating a tension of the roving at the n-th layer is obtained.

Returning to Fig. 2, after the determination of the average roving position during the vibration thereof, corresponding to the tension of the roving at the step 106, the routine goes to step 108 and a difference ΔX of the detected mean roving position X with respect to the target reference roving position XT is calculated. Then, at step 110, an amount of movement L_n of the rack 11 for obtaining a desired reduction of the bobbin rotational speed when winding the next layer n is calculated by

$$L_n = \Delta X \times F + La,$$

where La is a predetermined fixed amount of movement of the rack 11 for obtaining a fixed reduction in the bobbin rotational speed caused by winding the layer n, and the term ΔX x F (F is a correction factor) is correction applied to the fixed reduction La to compensate for the tension of the roving. At step 112, the calculated value L_n is stored in the memory as a table Ta, with respect to the layer number n as already described.

At step 114, it is determined if the limit switch 21 or 22 is on, i.e., a change in the direction of the movement of the bobbin rail 17 has occurred. When it is determined that a direction change has occurred, the routine goes to step 116 and the signal L_n is output to the motor 12; this indicates the amount of movement of the rack 11 for this layer n of the winding of the roving on the bobbin. When the encoder 15 detects a number of rotations of the motor 12 corresponding to the value of the rack movement L_n, the movement of the motor 12 is stopped, and as a result, a correction of the movement of the rack 11, i.e., the rotational speed of the bobbin 6, is carried out to thus maintain the target tension of the roving 24 running from the front roller 3 to the flyer head 4a when this layer n of the roving is wound on the bobbin.

At step 118, the counter n is incremented, and then at step 120 it is determined if a full bobbin state has been obtained. Before the full bobbin state is obtained, the routine returns to step 106 for a repetition of the roving tension (X) detection at the winding of the next layer of the roving, a calculation of the amount Ln of the movement of the rack 11, which is executed upon a change of a direction of the bobbin rail 17 and is stored in the table Ta. When the full bobbin state has been obtained the entry period is finished.

Upon the completion of the single initial data entry period from the empty to full bobbin state, the data entry switch 33 is made OFF, and the routine goes from step 100 to step 130 in Fig. 2. At steps 130 and 132, which are the same as steps 102 and 104, the roving layer counter n is initialized, and at step 134, a value of the amount Ln of the movement of the rack 11, corresponding to the layer n, now being wound, is read from the table Ta in the memory 31. Upon the detection of a change of the movement of the bobbin rail 17 for commencing the winding of the new layer n, at step 138, the read out amount Ln for moving the rack 11 is output to the motor 12 to obtain a movement of the rack that obtains a desired reduction of the rotational speed of the bobbin. The value Ln of the movement of the rack 11, which was suitable for obtaining the desired winding condition for winding the n-th layer during the data entry period, is also used for winding the n-th layer at this winding period. Thus, a desired winding state can be obtained even though the tension is not detected in this usual winding period. Steps 140 and 142 are the same as steps 118 and 120 during the data entry period, and therefore, the steps following 134 are repeated until a full bobbin is obtained.

In the above embodiment, the control motor 12 is used not only for controlling usual fixed movement La at the step 110 for a usual reduction of the bobbin speed executed at each change of the reciprocal movement of the bobbin rail 17, but also for a correction ΔX x F at the step 110 for correcting the movement of the rack 11 in accordance with the detected tension. As a modification, the usual fixed movement at each change of the reciprocal movement of the bobbin rail may be attained by a conventional mechanical construction composed of a gear wheel and a latch for obtaining an rotation of the wheel for an amount corresponding the angle of a teeth of the gear wheel each time the direction of movement of the bobbin rail is reversed. Namely, the motor 12 is used only for correcting the movement of the rack 11 in accordance with the detected tension X.

In the first embodiment, the values of average tension measured when respective layers of the roving are wound during the data entry state are used for correcting the bobbin rotational speed when the winding of the following layers is commenced, and are stored in the memory so that the stored values correspond to the number of the layers, which allows the stored value to be used for correcting the bobbin rotational speed when the corresponding layers are wound in the following spinning process. In a modification, layers are grouped into a plurality of groups each including a plurality of layers, values of stored correction amounts for respective layers are averaged for each group, and the average values are commonly used for correcting the rack movement for the layers in the respective groups. Namely, one and the same amount of correction value is always used for the correction of the layers in the same group. Figure 4 shows an outline of a flowchart for this embodiment. The routine is executed after the completion of the entry period, i.e., after a YES result at step 120 (Fig. 2). At step 300, a first grouping is carried out for determining consecutive layers belonging to a first group, and at step 302, data of the rack movement Ln in this group is read and then averaged at step 304. The average value between the layers in this group is stored in the memory, and is used for a bobbin speed correction of the layers belonging to this group in a usual winding process. Such a grouping is executed until the end of the data Ln is reached at step 308.

In stead of storing the amount Ln of movement of the rack, the values of the average position of the roving as an indication of the roving tension can be stored in the memory in accordance with the number of layers (n), and used to calculate the amount of rack movement. In Fig. 5, which partly shows this embodiment, where step 112 in Fig. 2 in the first embodiment is changed to step 400, the tension Xn at a layer n at step 106 is stored to a table Ta'. Furthermore, step 134 during usual operating mode in Fig. 2 is changed to step 402 where the stored tension value Xn for the layer n is read and a step 404 where the rack movement Ln for the layer n is output to the motor 12 as in steps 108 and 110 of Fig. 2.

In another modification, during the usual operation based on the stored values, the tension of the roving is detected, and a detected value of the tension outside a permissible range causes a signal to be output as a warning or the flyer frame to be stopped. As shown in Fig. 6, the routine is located between steps 132 and 134 in Fig. 2, during the formation of each layer, at step 500 a tension X is detected as Fig. 3, and then at step 502 it is determined if the detected tension X is larger than a permissible minimum value a and smaller than a permissible maximum value b. When the detected tension is within the permissible range, the routine goes to the step following step 134 of Fig. 2 to execute a usual winding process. When it is determined that the tension X is outside the permissible range, the routine goes to step 504 to execute a warning process, e.g., lighting a warning lamp.

Although embodiments of the present invention are explained with reference to the attached drawings, many modifications and changes can be made by those skilled in this art without departing from the scope and spirit of the present invention.

Claims

1. A method of correcting a taking up speed of a roving in a bobbin lead type flyer frame running from a front roller to a bobbin while the bobbin is vertically reciprocatedly moved, so that a bobbin speed is reduced as a direction of this movement is changed, said method comprising the steps of:

   detecting a tension of a roving running from the front roller to the bobbin in an initial single winding period from an empty bobbin state to a full bobbin state;

   correcting, at correction points distributed along the entire winding period, the rotational speed of the bobbin in accordance with values related to the detected tension, and;

   storing the values related to a tension of the roving for respective correction points throughout said winding period;

   said stored values being used for correcting the bobbin rotational speed at corresponding correction points during each winding period after said data entry period.

2. A method according to claim 1, wherein the stored values are used for correcting the bobbin speed at the correction points.

3. A method according to claim 1, wherein the stored values are values of detected tension, and wherein a step is further provided for calculating, based on the stored tension values, the correction values at corresponding correction points during each winding period after said data entry period.

4. A method according to claim 1, wherein said correction is made simultaneously with a reduction in the rotational speed upon a change of the vertical movement of the bobbin.

5. A method according to claim 1, wherein said de-

tection of the tension is made by detecting a mean vertical position of the roving running from the front roller to the bobbin.

6. A bobbin lead type flyer frame comprising:

a drafting unit having a plurality of spaced-apart pairs of rollers;

a bobbin rail on which a bobbin is mounted;

a bobbin wheel for imparting a rotational movement to the bobbin on the bobbin rail;

a flyer subjected to a rotating movement for introducing a roving from the drafting unit to the bobbin;

the rotational speed of the bobbin being higher than that of the flyer, which allows the roving from the drafting unit to be taken up by the bobbin;

reciprocating means for obtaining a vertically reciprocating movement of the bobbin rail for a formation of layers of roving wound on the bobbin;

speed control means for controlling a predetermined reduction in the rotational speed of the bobbin each time a direction of the vertical movement of the bobbin rail is changed;

means for setting a data entry period of a winding of a roving onto the bobbin from an empty state to a full bobbin state;

means for detecting, during said data entry period, a tension of a roving running from the front roller to the bobbin;

timing detecting means for detecting correction timings distributed along the entire winding period;

correcting means for correcting, upon the detection of said correction timings, said predetermined speed reduction in accordance with the tension detected by the tension detecting means, and;

memory means for storing data related to the detected tension for respective correction timings throughout said winding period;

said stored values being used for correcting the speed reduction at the corresponding correction timings during each winding period after the data entry period.

7. A flyer frame according to claim 6, wherein said memory means store the values for correcting the bobbin speed at the correction points.

8. A flyer frame according to claim 6, wherein said memory means store the values of detected tension, and wherein it further includes means for calculating, based on the stored tension values, the correction values at corresponding correction points during each winding period after said data entry period.

9. A flyer frame according to claim 6, wherein said timing detecting means detect the change of the movement of the vertical movement of the bobbin rail, so that the correction by the correction means is carried out simultaneously with the predetermined speed reduction by said speed control means.

10. A flyer frame according to claim 6, wherein said speed control means comprise a rack and pinion mechanism, and a cone drum mechanism connected thereto for controlling the speed of the spindle, an electric motor for operating the rack and pinion means, and means for operating the electric motor so that said predetermined speed reduction of the bobbin is obtained each time the direction of movement of the bobbin rail is reversed;

wherein said timing detecting means comprise means for detecting the change of the direction of the vertical movement of the bobbin rail, and;

wherein said correction means outputs a signal directed to said electric motor so that the correction of the bobbin rotational speed in accordance with the detected tension is carried out simultaneously with the predetermined speed reduction by said electric motor.

11. A flyer frame according to claim 6, wherein said speed control means comprise a rack and pinion mechanism, and a cone drum mechanism connected thereto for controlling the rotational speed of the spindle, and;

wherein said correction means comprise an electric motor connected to the rack and pinion means, and means for outputting a signal to said electric motor so that a correction of the bobbin rotational speed in accordance with the tension is carried out.

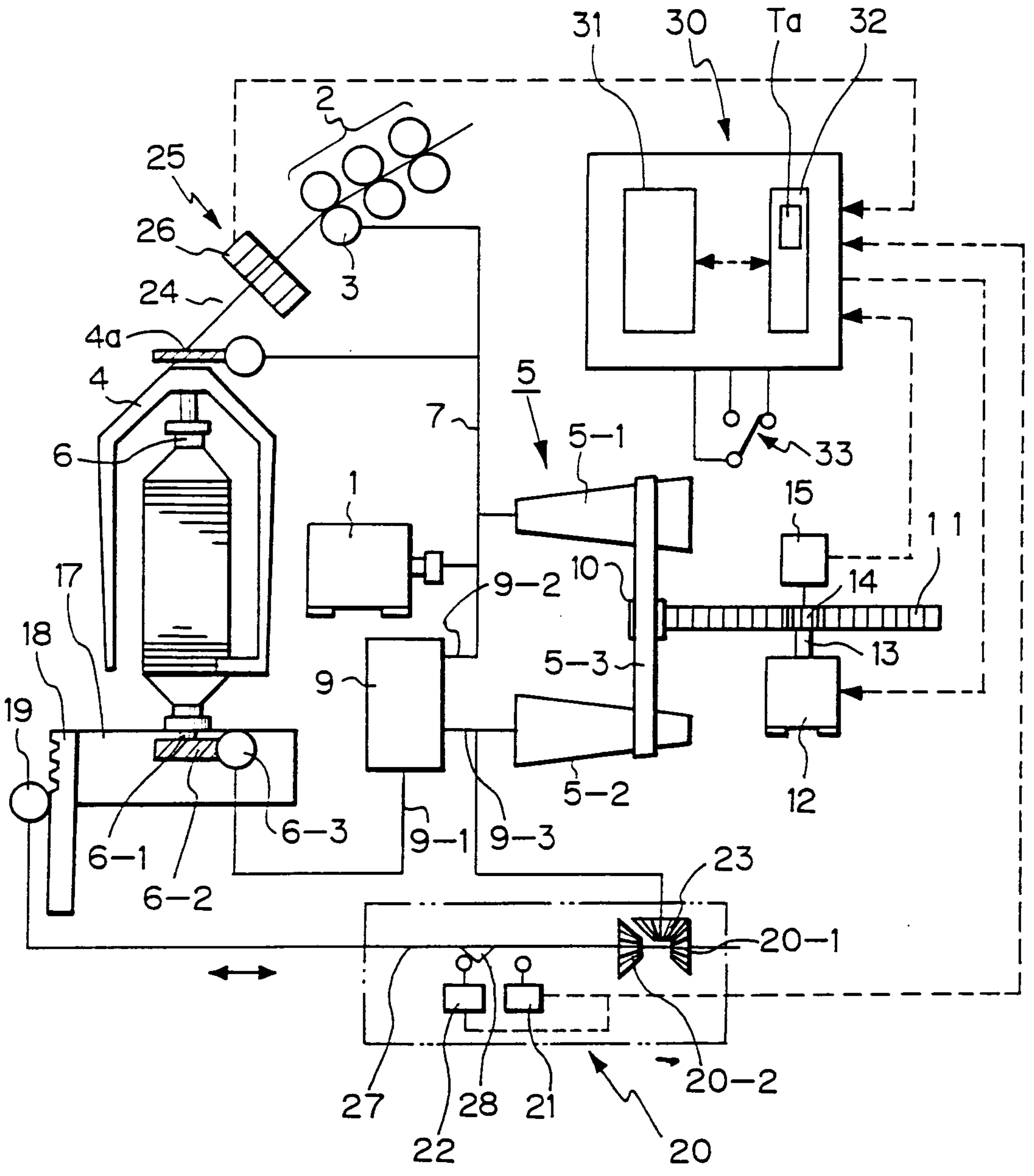
12. A flyer frame according to claim 6, wherein said tension detecting means comprise a plurality of vertically spaced pairs of light transmitters and light receivers, each of which paris is arranged astride the roving running from the top roller to the bobbin, means for detecting a blockage of the light receivers by the roving running between the front roller and the bobbin, and means for calculating, based on the blockage by the receivers, an average position of the roving as an indication of the tension.

13. A flyer frame according to claim 12, wherein said blockage detection means comprise a scanning means for scanning the pairs of detectors, and means for repeating the scanning a predetermined number of times.

14. A flyer frame according to claim 6, wherein it further comprises means for dividing the total number of the layer into a plurality of groups means for calculating an average value of the stored value related to tension belonging to respective groups, and means for correcting the bobbin speed in accordance with the average value at the correction points belonging to the same group during each winding period after the data entry period.

15. A flyer frame according to claim 6, further comprising means for detecting a roving tension during the winding period after the data entry period, and means for sounding an alarm when it is detected that the detected tension is outside a required range.

Fig. 1


31
30
Ta
32
2
25
26
3
24
4a
4
5
7
6
5—1
33
1
15
1 1
17
10
9—2
14
18
5—3
13
9
19
12
5—2
6—3
9—1
9—3
6—1
6—2
23
20—1
20—2
27
28
21
22
20

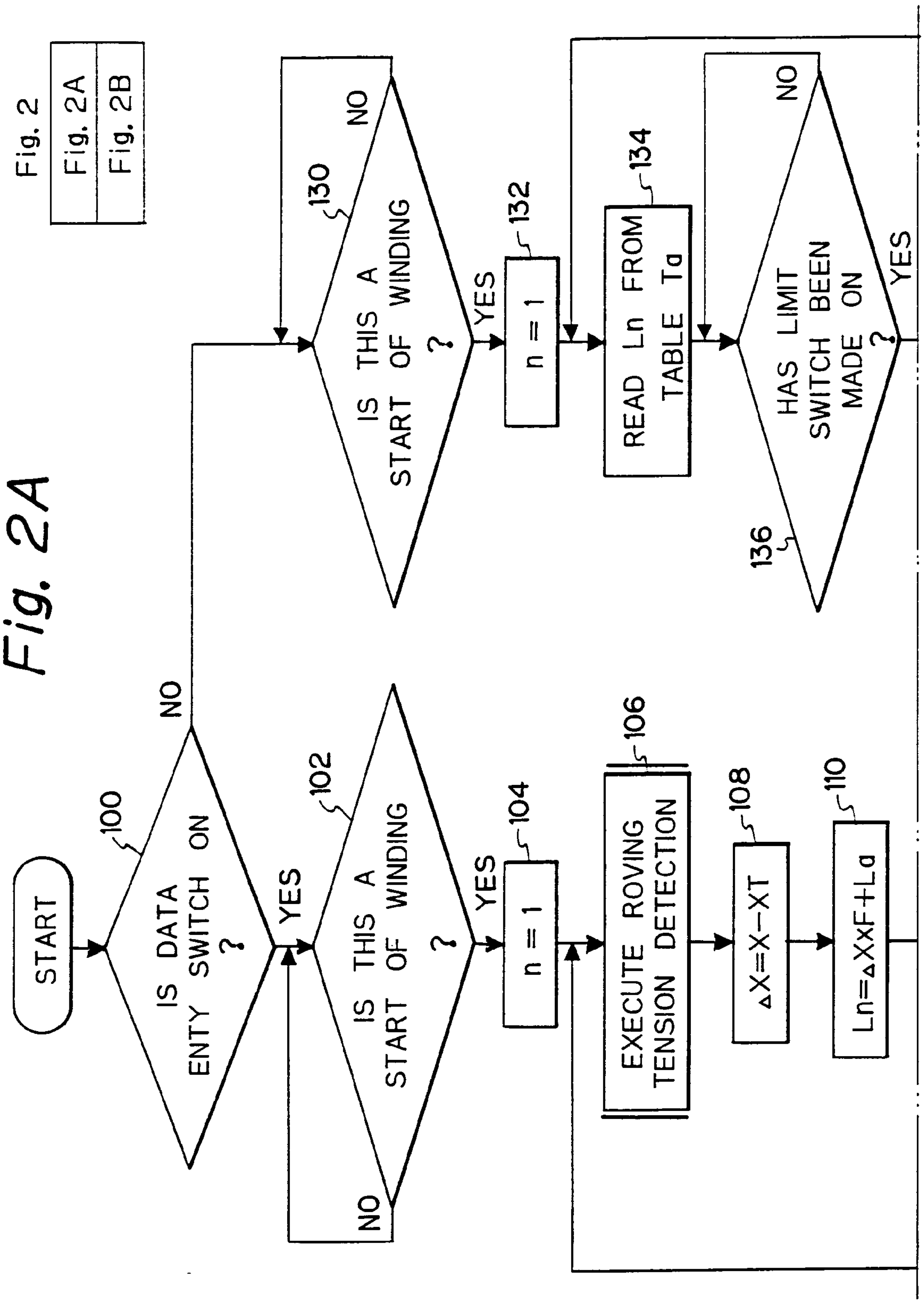


Fig. 2
Fig. 2A
Fig. 2B
START
IS DATA ENTY SWITCH ON ?
100
YES
NO
IS THIS A START OF WINDING ?
102
YES
NO
n = 1
104
EXECUTE ROVING TENSION DETECTION
106
ΔX=X−XT
108
Ln=ΔX×F+La
110
IS THIS A START OF WINDING ?
130
YES
NO
n = 1
132
READ Ln FROM TABLE Ta
134
HAS LIMIT SWITCH BEEN MADE ON ?
136
YES
NO

Fig. 2A

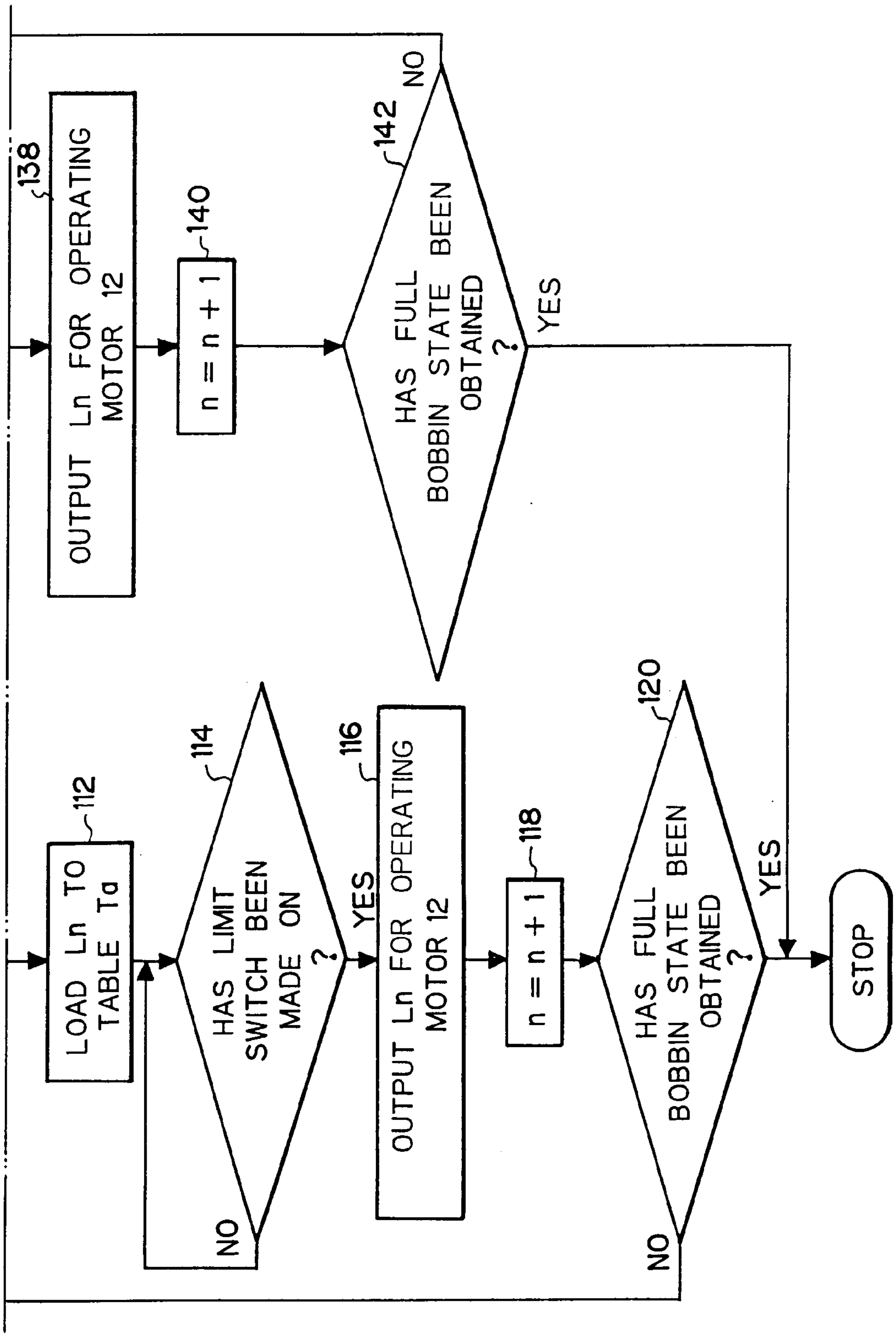
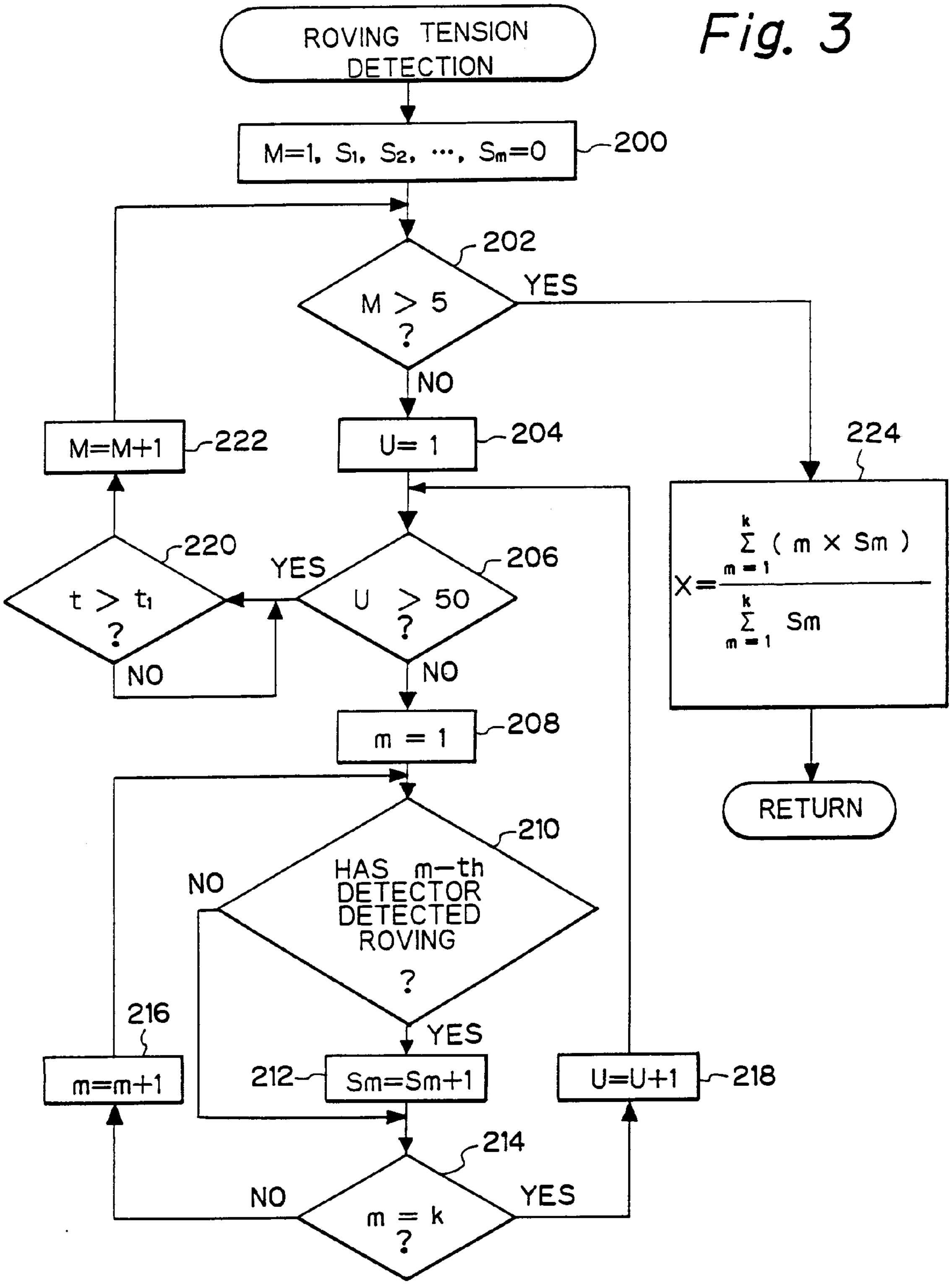

LOAD Ln TO TABLE Ta
112
HAS LIMIT SWITCH BEEN MADE ON ?
114
YES
NO
OUTPUT Ln FOR OPERATING MOTOR 12
116
n = n + 1
118
HAS FULL BOBBIN STATE BEEN OBTAINED ?
120
YES
NO
STOP
OUTPUT Ln FOR OPERATING MOTOR 12
138
n = n + 1
140
HAS FULL BOBBIN STATE BEEN OBTAINED ?
142
YES
NO

Fig. 2B



$$X=\frac{\sum_{m=1}^{k}(m \times Sm)}{\sum_{m=1}^{k} Sm}$$

Fig. 3

Fig. 4

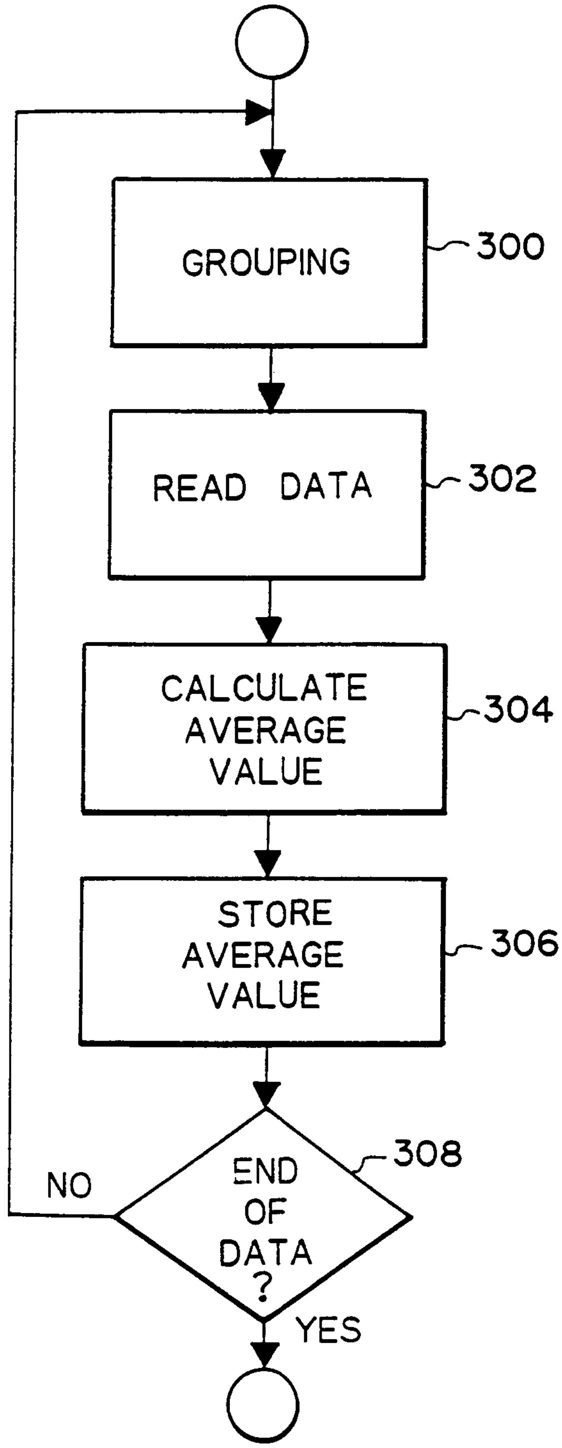

GROUPING
300
READ DATA
302
CALCULATE AVERAGE VALUE
304
STORE AVERAGE VALUE
306
END OF DATA ?
308
NO
YES

Fig. 5

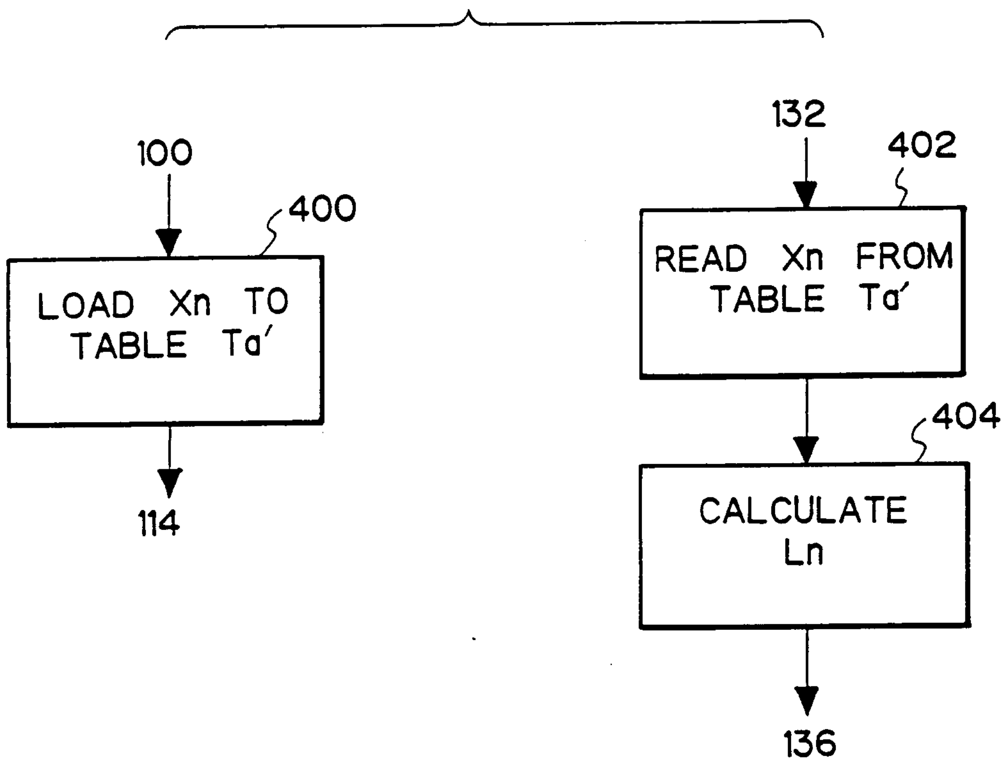
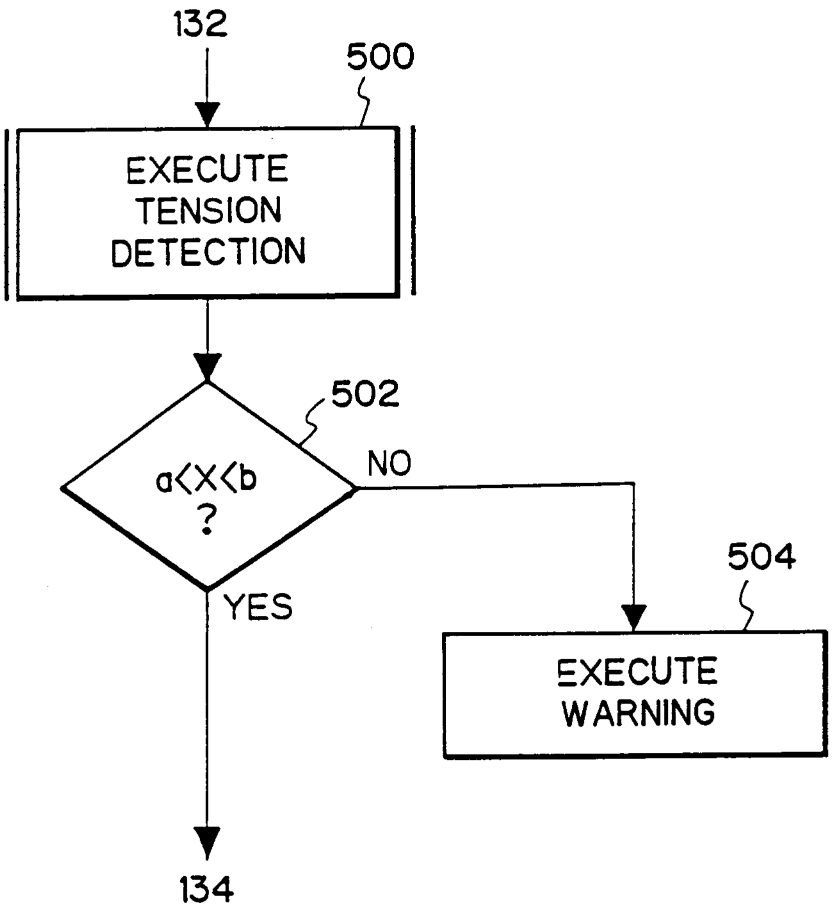

100
400
LOAD Xn TO TABLE Ta'
114
132
402
READ Xn FROM TABLE Ta'
404
CALCULATE Ln
136

Fig. 6


132
500
EXECUTE TENSION DETECTION
502
a<X<b ?
NO
YES
504
EXECUTE WARNING
134

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 81 0443

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	DE-A-3 206 272 (W. SCHLAFHORST AG & CO) * page 8, line 6 - page 9 * * abstract; claims 1-6; example *	1-3 6-9	D01H1/30 D01H13/16 D01H13/10
A	PATENT ABSTRACTS OF JAPAN vol. 15, no. 126 (C-817)27 March 1991 & JP-A-30 08 818 (TEIJIN LTD) 16 January 1991 * abstract *	1,6	
Y A	DE-A-2 813 887 (AICHI SPINNING CO. LTD.) * page 17, line 24 - page 18, line 8 * * page 29, line 15 - page 31, line 18; claims 1-9; figure 4 *	6-9 1-5, 10-15	
A	EP-A-0 077 199 (K.K.TOYODA JIDOSHOKKI) * page 17, line 22 - page 18, line 19; figure 7 *	1,6,10	
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 309 (C-318)(2032) 2 December 1985 & JP-A-60 146 016 (TOYODA JIDO SEISAKUSHO K.K.) 1 August 1985 * abstract *	1,2,5-12	TECHNICAL FIELDS SEARCHED (Int. Cl.5) D01H B65H
A	US-A-4 500 043 (BROWN) * claims 1-3; figure 1 *	1,6,12, 13	
A,P	EP-A-0 470 273 (TEJIN SEIKI CO.LTD.) * column 6, line 10 - line 45; claims 1-5 *	1,6	
A,D	EP-A-0 134 195 (HOWA KOGYO K.K.) * page 6, line 15 - page 8, line 12; claims 1-5; figures 1,3 *	1-15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 SEPTEMBER 1992	TAMME H.-M.N.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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