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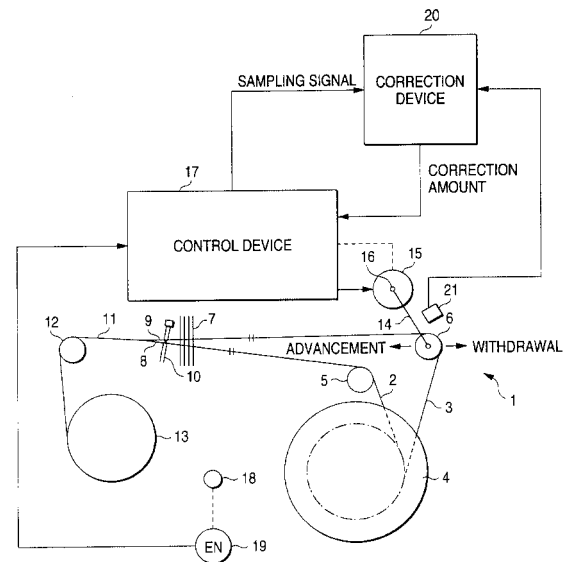
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(54) **Method for controlling tension of warp**

(57) In a method for controlling the tension of a warp for production of a textile with the number of crossing of the warp with respect to the weft smaller in one part compared with the other part of the textile in the width direction, a warp (3) corresponding to one part with a small number of crossing and a warp (2) corresponding to the other part with a large number of crossing are drawn out from a warp beam (4) and are placed on different rolls (5,6), and the roll (6) dedicated to the warp (3) corresponding to one part is movably provided in the direction crossing with the axis of the roll (6). The method includes the steps of: temporarily reducing the tension of the warp (3) corresponding to one part via the dedicated roll (6) immediately before beating; increasing the tension of the warp (3) corresponding to one part via the dedicated roll (6) after beating so as to regain a target tension value; detecting the position of the dedicated roll (6); calculating the deviation of the detected position and a preset target position; and correcting at least one of the degree of reducing the tension and the target tension value so as to decrease the deviation.

*FIG. 1*



## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to a method for controlling the tension of a warp for production of textiles, such as satin stripe textiles, fine pattern textiles, and textiles dotted with small patterns, partially with a different textile texture in the width direction of the textile, that is, with the number of crossing of the warp with respect to the weft smaller in a part compared with the other part. More specifically, it relates to a method for controlling the tension of a warp in the part with a small number of crossing, that is, of a warp corresponding to the part of the textile with the small number of crossing.

#### 2. Description of the Related Art

**[0002]** In the case of producing a textile with different textile textures in the width direction of the textile, such as satin stripe textiles, with the number of crossing of the warp with respect to the weft smaller in the part compared with the other part, warps with numbers of crossings different with each other, are drawn out from a warp beam via different rolls.

**[0003]** However, if the numbers of crossing of the warps with respect to the weft are different in the width direction of the textile, even though the warps are drawn out from one warp beam, the weaving ratio (length of the consumed warps per a unit textile length) is smaller in the textile texture with a small number of crossing, so that the warp in the part tends to be loosened on the warp line. Therefore, shedding failure is generated so that the weft is caught by the warp during the picking of the weft, and thus a problem of the weft picking failure arises.

**[0004]** In view of the problem, in the technique disclosed in Japanese Patent No. 2,764,638, the tension of the warp in the part with a small number of crossing is reduced positively in the loosening control period from closure of the warps to beating, and the tension of the warp is increased in the tension control period other than the loosening control period so as to provide a target tension value.

**[0005]** Specifically, the loosening roll is advanced by a preset amount in the loosening control period so as to temporarily reduce the tension of the warp, then, the loosening roll is withdrawn by the preset amount, and a predetermined torque is applied on the loosening roll in the consecutive tension control period so as to regain the target tension value.

**[0006]** Moreover, as another method, the torque applied on the loosening roll is varied so as to reduce the tension of the warp by providing the tension value obtained by subtracting a preset amount from a normal target tension value as the target tension value in the loos-

ening control period, and a torque for increasing the tension of the warp is applied on the loosening roll by the tension control based on the normal target tension value in the subsequent tension control period.

**[0007]** According to the conventional technique, by reducing the tension of the warp in the part with a small number of crossing immediately before beating, the warp is woven extra by a desired length according to the beating operation. However, even by the method, the weaving ratio of the warp may not be same as that of the warp in the other part with a large number of crossing.

**[0008]** For example, since the warp cannot be woven by a sufficient length if loosening of the part with the small number of crossing is not transmitted sufficiently to a cloth fell with the beating operation, the weaving ratio of the warp is smaller than that of the warp in the part with the large number of crossing. As a result, the warp in the part with the small number of crossing is loosened, so as to generate the shedding failure.

**[0009]** In contrast, since the warp is woven by an excessive length if loosening of the part with the small number of crossing is transmitted excessively to the cloth fell with the beating operation, the weaving ratio of the warp is larger than that of the warp in the part with the large number of crossing. As a result, the tension of the warp in the part with the small number of crossing tends to increase so as to easily generate cut-off of the warp.

### SUMMARY OF THE INVENTION

**[0010]** Accordingly, in view of the conventional problems, an object of the invention is to provide a method for controlling the tension of a warp for having the weaving ratio of a warp with a small number of crossing equal to that of a warp with a large number of crossing by modifying the tension of the warp with the small number of crossing based on the detected position of a roller dedicated to the warp immediately before beating, so as to solve the above-mentioned problems.

**[0011]** In order to achieve the object, a first aspect of the invention is a method for controlling the tension of a warp with a warp tension controlling apparatus for production of a textile with the number of crossing of the warp with respect to the weft smaller in a part compared with the other part of the textile in the width direction, wherein a warp corresponding to the part with a small number of crossing (hereinafter referred to simply as a "warp with a small number of crossing") and a warp corresponding to the other part with a large number of crossing (hereinafter referred to simply as a "warp with a large number of crossing") are drawn out from a warp beam and are placed on different rolls, the roll dedicated to the warp with the small number of crossing is movably provided in the direction crossing with the axis of the roll, and wherein the method comprises the steps of: temporarily reducing the tension of the warp with the

small number of crossing via the dedicated roll immediately before beating; increasing the tension of the warp with the small number of crossing via the dedicated roll after beating for regaining a target tension value; detecting the position of the dedicated roll; calculating the deviation of thus detected position and a preset target position; and correcting at least one of the degree of reducing the tension and the target tension value so as to decrease the deviation.

**[0012]** A second aspect of the invention is a method for controlling the tension of a warp with a warp tension controlling apparatus for production of a textile with the number of crossing of the warp with respect to the weft smaller in a part compared with the other part in the width direction of the textile, wherein a warp with a small number of crossing and a warp with a large number of crossing are drawn out from a warp beam and are placed on different rolls, the roll dedicated to the warp with the small number of crossing is movably provided in the direction crossing with the axis of the roll, and wherein the method comprises the steps of: temporarily moving the dedicated roll by a predetermined amount so as to reduce the tension of the warp with the small number of crossing immediately before beating; applying a force to the dedicated roll so as to increase the tension of the warp after beating for regaining a target tension value; detecting the position of the dedicated roll; calculating the deviation of thus detected position and a preset target position; and correcting at least one of the predetermined amount and the target tension value so as to decrease the deviation.

**[0013]** A third aspect of the invention is a method for controlling the tension of a warp with a warp tension controlling apparatus for production of a textile with the number of crossing of the warp with respect to the weft smaller in a part compared with the other part in the width direction of the textile, a warp with a small number of crossing and a warp with a large number of crossing are drawn out from a warp beam and are placed on different rolls, the roll dedicated to the warp with the small number of crossing is movably provided in the direction crossing with the axis of the roll, and wherein the method comprises the steps of: changing the force applied on the dedicated roll by a predetermined amount so as to reduce the tension of the warp immediately before beating; applying a force to the dedicated roll so as to increase the tension of the warp after beating for regaining a target tension value; detecting the position of the dedicated roll; calculating the deviation of the detected position and a preset target position; and correcting at least one of the predetermined amount and the target tension value so as to decrease the deviation.

**[0014]** Since the roll dedicated to the warp with the small number of crossing is provided swingably for applying a swinging torque on the dedicated roll, the tension of the warp can be controlled.

**[0015]** The position of the dedicated roll can be detected periodically.

**[0016]** Since the position of the dedicated roll is detected each at a plurality of preset rotation angles in one rotation of the main shaft of a weaving machine so that the average value of the obtained plurality of the detected positions is calculated, the correction can be executed based on the deviation of the average value and the preset target position.

**[0017]** Moreover, since the position of the dedicated roll is detected at one or more preset rotation angles in one rotation of the main shaft of a weaving machine over a plurality of rotations of the main shaft so that the average value of the obtained plurality of the detected positions is calculated, the correction can be executed based on the deviation of the average value and the preset target position.

**[0018]** Furthermore, since the position of the dedicated roll is detected at a single preset rotation angle in one rotation of the main shaft of a weaving machine so that the deviation of the detected position and the preset target position per each detection is calculated, the correction can be executed based thereon.

**[0019]** According to the first aspect of the invention, the dedicated roll moves reciprocally according to the tension control of the warp with the small number of crossing during the production of the textile. Even though the weaving ratio of the warp with the small number of crossing is equal to that of the warp with the large number of crossing initially, if the weaving ratio of the warp with the small number of crossing becomes smaller than that of the warp with the large number of crossing subsequently due to change of a condition such as the physical properties of the warps, the path length from the warp beam to a cloth fell of the warp with the small number of crossing is increased, and thus consequently the position of the dedicated roll in the reciprocal motion is changed due to the path length increase of the warp so as to get out of the target position. That is, the position of the dedicated roll is changed to the direction away from the cloth fell so as to move reciprocally at the position. At the time, the position of the dedicated roll is detected, the deviation with respect to the target position is calculated, and at least one of the degree of reducing the tension of the warp with the small number of crossing immediately before beating and the target tension value to be used for the tension control after beating is corrected so as to decrease the deviation.

**[0020]** In the case only the degree of reducing the tension so as to decrease the deviation is corrected, more specifically, in the case the degree of reducing the tension is increased, since the tension of the warp with the small number of crossing is controlled so as to be smaller immediately before subsequent beating, the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is increased, and consequently the weaving ratio of the warp with the small number of crossing is increased. Accordingly, the position of the dedicated roll is changed so as to decrease

the deviation, that is, so as to get closer to the cloth fell.

**[0021]** The above-mentioned operation is repeated until the deviation is offset. When the deviation is offset, the weaving ratio of the warp with the small number of crossing is same as that of the warp with the large number of crossing.

**[0022]** Moreover, in the case only the target tension value so as to decrease the deviation is corrected, more specifically, in the case the target tension value is reduced, since the tension of the warp with the small number of crossing controlled based on the corrected small target tension value is reduced immediately before subsequent beating, the tension immediately before beating is still smaller so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is increased, and consequently, the weaving ratio of the warp with the small number of crossing is increased. Accordingly, the position of the dedicated roll is changed so as to decrease the deviation.

**[0023]** Furthermore, in the case the degree of reducing the tension and the target tension value are both corrected so as to decrease the deviation, since both of the above-mentioned effects can be provided, the tension of the warp with the small number of crossing can be controlled so as to be still smaller immediately before subsequent beating so that the weaving ratio of the warp with the small number of crossing can be increased rapidly therefor.

**[0024]** In contrast, in the case the weaving ratio of the warp with the small number of crossing becomes larger than that of the warp with the large number of crossing, the path length of the warp with the small number of crossing from the warp beam to the cloth fell is reduced, and thus consequently, the position of the dedicated roll in the reciprocal motion is changed due to the path length reduction of the warp so as to get out of the target position. That is, the position of the dedicated roll is changed to the direction closer to the cloth fell so as to move reciprocally at the position. At the time, the position of the dedicated roll is detected, the deviation with respect to the target position is calculated, and at least one of the degree of reducing the tension of the warp with the small number of crossing immediately before beating and the target tension value to be used for the tension control after beating is corrected so as to decrease the deviation. Specifically, either the degree of reducing the tension of the warp is reduced or the target tension value is increased. Accordingly, the tension of the warp with the small number of crossing is controlled so as to be higher immediately before beating so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is reduced, and as a result, the weaving ratio of the warp with the small number of crossing is lowered. The above-mentioned operation is repeated until the deviation is offset, so that the weaving ratio of the warp with the small number of crossing is finally equal to that of the warp with the large number of crossing.

**[0025]** Furthermore, in the case the degree of reducing the tension and the target tension value are both corrected so as to decrease the deviation, the tension of the warp with the small number of crossing can be controlled so as to be still larger immediately before subsequent beating so that the weaving ratio of the warp with the small number of crossing can be reduced rapidly therefor.

**[0026]** According to the above-mentioned correction based on the deviation of the position of the dedicated roll and the target position, a textile can be obtained with the warp with the small number of crossing and the warp with the large number of crossing consumed in the same amount in the entire period from the start to the finish of the production of the textile.

**[0027]** According to the second aspect of the invention, in the case the weaving ratio of the warp with the small number of crossing becomes smaller than that of the warp with the large number of crossing, for the same reason as mentioned above, the deviation of the detected position of the dedicated roll and the target position is calculated for increasing the predetermined amount for movement of the dedicated roll and/or reducing the target tension value to decrease the deviation. Specifically, either the degree of reducing the tension of the warp or the target tension value is increased.

**[0028]** Accordingly, the tension of the warp with the small number of crossing is further small immediately before subsequent beating so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is increased, and as a result, the weaving ratio of the warp with the small number of crossing is increased. The correcting operation is repeated until the deviation is offset so that the weaving ratio of the warp with the small number of crossing can finally be equal to that of the warp with the large number of crossing.

**[0029]** Moreover, in the case the weaving ratio of the warp with the small number of crossing becomes larger than that of the warp with the large number of crossing, similarly, the deviation of the detected position of the dedicated roll and the target position is calculated, so as to reduce the predetermined amount for movement of the dedicated roll and/or increase the target tension value so as to decrease the deviation.

**[0030]** Accordingly, the tension of the warp with the small number of crossing becomes further high immediately before subsequent beating so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is reduced, and as a result, the weaving ratio of the warp with the small number of crossing is reduced. The correcting operation is repeated until the deviation is offset so that the weaving ratio of the warp with the small number of crossing can finally be equal to that of the warp with the large number of crossing.

**[0031]** According to the third aspect of the invention, in the case the weaving ratio of the warp with the small

number of crossing becomes smaller than that of the warp with the large number of crossing, for the same reason as mentioned above, the deviation of the detected position of the dedicated roll and the target position is calculated, so as to increase the predetermined amount of the force to be applied on the dedicated roll and/or reduce the target tension value so as to decrease the deviation.

**[0032]** Accordingly, the tension of the warp with the small number of crossing becomes small immediately before subsequent beating so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is increased, and as a result, the weaving ratio of the warp with the small number of crossing is increased. The correcting operation is repeated until the deviation is offset so that the weaving ratio of the warp with the small number of crossing can finally be equal to that of the warp with the large number of crossing.

**[0033]** Moreover, in the case the weaving ratio of the warp with the small number of crossing becomes larger than that of the warp with the large number of crossing, similarly, the deviation of the detected position of the dedicated roll and the target position is calculated, so as to reduce the predetermined amount of the force on the dedicated roll and/or increase the target tension value so as to decrease the deviation.

**[0034]** Accordingly, the tension of the warp with the small number of crossing is higher immediately before subsequent beating so that the loosening amount of the warp to be transmitted to the cloth fell with the beating operation is reduced, and as a result, the weaving ratio of the warp with the small number of crossing is reduced. The correcting operation is repeated until the deviation is offset so that the weaving ratio of the warp with the small number of crossing can finally be equal to that of the warp with the large number of crossing.

**[0035]** Since the dedicated roll can be provided swingably for applying a swinging torque on the dedicated roll, the tension of the warp can be controlled. Specifically, the dedicated roll can be provided swingably via an arm mounted on the output shaft of a motor for controlling the tension of the warp according to the output torque of the motor.

**[0036]** Since the position of the dedicated roll is detected periodically, for example, the position of the dedicated roll is detected each at a plurality of preset rotation angles in one rotation of the main shaft of a weaving machine, the deviation of the average value of the obtained plurality of the detected positions and the target position can be calculated accurately as the change amount of the dedicated roll position according to the change of the warp path length.

**[0037]** Moreover, since the position of the dedicated roll is detected at one or a plurality of preset rotation angles in one rotation of the main shaft of a weaving machine over a plurality of rotations of the main shaft so that the average value of the obtained plurality of the

detected positions is calculated, the correction is executed based on the deviation of the average value and the preset target position so that the same effects as the mentioned above can be obtained.

**[0038]** Furthermore, it is also possible to detect the position of the dedicated roll at a single preset rotation angle in one rotation of the main shaft of a weaving machine for executing the correction based on the deviation of the detected position and the target position per each detection.

## BRIEF DESCRIPTION OF THE DRAWINGS

### [0039]

FIG. 1 is a side view of an apparatus for controlling the tension of a warp for adopting a method for controlling the tension of a warp according to the invention;

FIG. 2 is a block diagram of a control device;

FIG. 3 is a block diagram of a correction device;

FIG. 4 is a graph for explaining the position of a swing roll corresponding to the tension control period and the position control period in one cycle; and

FIG. 5 is a block diagram of a control device.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0040]** FIG. 1 shows an embodiment of a method for controlling the tension of a warp according to the invention adopted in a warp tension controlling apparatus 1 for satin stripe textiles. A warp 2 with a large number of crossing for the base texture and a warp 3 with a small number of crossing for the satin stripe are both drawn out from the same warp beam 4 so as to be placed independently on a tension roll 5 and a swing roll 6, dedicated for each warp 2, 3, put through a heddle frame 7 for forming a shed 8 and being crossed here with a weft 9, and being beaten by a reed 10 for producing a woven fabric 11. The woven fabric 11 is taken up by a winding beam 13 via a breast beam 12.

**[0041]** The warp beam 4 is rotatably driven by a feed out motor (not shown) for drawing out both the warp 2 for the base texture (hereinafter referred to simply as the "warp 2") and the warp 3 for the satin stripe (hereinafter referred to simply as the "warp 3"). The feed out motor is rotated based on a basic rate determined by the winding diameter of the warp wound on the warp beam 4, the rotation rate of the weaving machine, and the weft density. The tension of the warp 2 is detected by a tension detector (not shown) via the tension roll 5, the deviation of the target tension value for the warp 2 and the detected value is calculated in a feed out control device (not shown), and then, the rotation rate of the feed out motor is controlled in the direction for offsetting the deviation.

**[0042]** The swing roll 6 as the subject for control is

supported rotatably at the tip end of an arm 14 so as to be moved forward or backward according to swinging of the arm 14 in the front and back direction. The arm 14 is interlocked with an output shaft 16 of a servo motor 15 for controlling the swing roll 6. The servo motor 15 is controlled by a control device 17 so as to temporarily reduce the tension of the warp 3 immediately before beating and increase the tension of the warp 3 after beating for regaining the target tension value, in one cycle of the weaving machine (one rotation of the main shaft 18 of the weaving machine).

**[0043]** Therefore, the control device 17 inputs a rotation angle signal from an encoder 19 interlocked with the main shaft 18 of the weaving machine as well as a correction amount signal from a correcting device 20 for controlling the rotation of the servo motor 15. Here, the correcting device 20 detects periodically the position of the swing roll 6 with respect to the moving direction by a position sensor 21, compares the detected position and the target position to find the deviation, finds the correction amount to offset the deviation, and inputs the same into the control device 17. The position sensor 21 is a distance sensor directed to the arm 14 for outputting the swinging position of the arm 14 as the position of the swing roll 6. The position sensor 21 is not limited to a distance sensor, but for example, it can be a linear scale disposed along the moving direction on the side of an end part of the swing roll 6 or on the side of the arm 14. Or other known sensors can be used as well.

**[0044]** FIG. 2 shows a specific embodiment of the control device 17. A rotation angle signal of the encoder 19 is inputted to a timing signal generator 22. The timing signal generator 22 generates, for example, according to the rotation angle of the main shaft 18 of the weaving machine, a signal indicating a zero rotation angle, and for example, generates a sampling signal per five each rotation angle for inputting the same into the correcting device 20. In addition, the timing signal generator 22 inputs a timing signal corresponding to the position control period including the beating point to a position control unit 23, and further, inputs a timing signal corresponding to the tension control period including the maximum shedding point of the warp to a tension control unit 24.

**[0045]** The position control unit 23 with the timing signal inputted generates a command signal for the rotation amount based on the rotation amount after correction with a correction amount described later added to the rotation amount preset in a setting unit 25 in the position control period for driving a servo controller 27 so as to rotate the servo motor 15 in the forward direction for advancing the swing roll 6 by a predetermined amount. Accordingly, the tension of the warp 3 can be temporarily reduced immediately before beating.

**[0046]** The position control unit 23 comprises an integrator (not shown) for inputting the correction amount signal from the correction device 20 to the integrator, and outputs to the servo controller 27 the rotation amount obtained by adding the output from the integra-

tor (integration amount of the correction amount) to the output from the setting unit 25.

**[0047]** Moreover, the tension control unit 24 with the timing signal inputted generates a command signal for the current value corresponding to the target tension value with a correction amount described later added to the target tension value preset in a setting unit 26 in the tension control period for driving a servo controller 27 so as to rotate the servo motor 15 with a torque corresponding to the target tension value after the correction. Accordingly, the tension of the warp 3 can be increased in the tension control period after beating via the swing roll 6 so as to regain the target tension value with the correction amount added. At the time, the swing roll 6 is disposed at a position wherein the torque of the servo motor 15 and the tension of the warp 3 are balanced. The rotation amount of the servo motor 15 is detected by a pulse generator 28 so as to be fed back negatively as a feed back signal to the position control unit 23 and the servo controller 27.

**[0048]** The tension control unit 24 also comprises an integrator (not shown) for inputting the correction amount signal from the correction device 20 to the integrator, and outputs to the servo controller 27 the current value corresponding to the target tension value after correction obtained by adding the output from the integrator (integration amount of the correction amount) to the output (target tension value) from the setting unit 26 as the command signal.

**[0049]** FIG. 3 shows a specific embodiment of the correction device 20. A detection signal from the position sensor 21 is amplified by an amplifier 29 so as to be inputted into a roll position calculator 30. The roll position calculator 30 inputs a detection signal from the position sensor 21 each time a sampling signal is inputted so as to store the detected position, finds the average value of the stored detected positions per one cycle of the weaving machine from a signal showing a zero rotation angle, and sends this out to a comparator 31. The comparator 31 compares the average value and a target position preset in a setting unit 32 for finding the deviation, and inputs a signal corresponding to the positional deviation to a correction amount calculator 33. The target position can be the average position of the swing roll 6 in one cycle of the weaving machine with an appropriate degree of the temporal reduction of the tension of the warp 3 via the dedicated roll immediately before beating, that is, the average position of the swing roll 6 in one cycle of the weaving machine in the production of the textile with the weaving ratio of the warp 3 equal to that of the warp 2. Such an average position can be calculated preliminarily by test weaving.

**[0050]** The correction amount calculator 33 calculates the correction amount for the rotation amount of the servo motor 15 for advancing the swing roll 6 according to the deviation and the correction amount for the target tension value preset in the setting unit 26 each time the deviation is inputted, so that the former correction

amount is outputted to the position control unit 23 and the latter correction amount is outputted to the tension control unit 24.

[0051] FIG. 4 shows the position control period and the tension control period in one cycle of the weaving machine. The position control period including the beating point (zero rotation angle), is for example, set in the period with a 270 to 20 degree rotation angle of the main shaft 18. Moreover, the tension control period including the maximum shedding point (as an example, 180 degree rotation angle), is for example, set in the period with a 20 to 270 degree rotation angle.

[0052] Therefore, the servo motor 15 generates a torque corresponding to the target tension value after the correction in the tension control period with a 20 to 270 degree rotation angle of the main shaft 18. Further, in the position control period with a 270 to 20 degree rotation angle, the servo motor 15 is rotated by the rotation amount after the correction from the rotation position in the tension control period so as to be kept at the position.

[0053] Since the swing roll 6 is moved by the servo motor 15 by a predetermined amount in the advancing direction in the position control period, the tension of the warp 3 immediately before beating is controlled lower than the tension of the warp 3 in the tension control period. Moreover, according to the tension control in the tension control period, the tension of the warp 3 in the period is higher than the tension in the position control period. Therefore, since the servo motor 15 increases the tension of the warp 3 immediately after transition from the position control period to the tension control period, the swing roll 6 is withdrawn.

[0054] In the production of a textile, if the weaving ratios of the warp 2 and the warp 3 are equal, the average value of the swing roll 6 position in one cycle of the weaving machine is substantially same as the target position. In the case the weaving ratio of the warp 3 becomes smaller than the weaving ratio of the warp 2 due to change of the warp physical properties or the warp tension balance or other disturbances in the production of the textile, the warp 3 drawn out from the warp beam 4 becomes excessive so that the swing roll 6 is moved reciprocally at a position displaced in the withdrawing direction therefor.

[0055] The correction device 20 finds the deviation of the average value of the position and the target position of the swing roll 6 in one cycle of the weaving machine, and outputs the correction amount corresponding to the deviation to the position control unit 23 and the tension control unit 24.

[0056] Accordingly, since the position control unit 23 increases the output rotation amount to the servo controller 27, consequently the advancing amount of the swing roll 6 is increased so that the degree of reducing the tension of the warp is larger in the position control period, and thus the tension of the warp 3 immediately before beating is still lower so as to increase the weaving

ratio of the warp 3.

[0057] Furthermore, since the tension control unit 24 reduces the current value to the servo controller 27, the swinging torque applied on the swing roll 6 is reduced, and consequently the tension of the warp 3 in the tension control period is maintained at a value lower by the correction of the target tension value. Since the tension of the warp 3 immediately before beating is further lower thereby, the weaving ratio of the warp 3 can be increased rapidly.

[0058] Moreover, in contrast, if the weaving ratio of the warp 3 is larger than the weaving ratio of the warp 2, the warp 3 drawn out from the warp beam 4 becomes insufficient so that the swing roll 6 is moved reciprocally at a position displaced in the advancing direction therefor.

[0059] The correction device 20 finds the deviation of the average value of the position and the target position of the swing roll 6 in one cycle of the weaving machine, and outputs the correction amount corresponding to the deviation to the position control unit 23 and the tension control unit 24.

[0060] Accordingly, since the position control unit 23 reduces the output rotation amount to the servo controller 27, consequently the advancing amount of the swing roll 6 is reduced so that the degree of reducing the tension of the warp is smaller in the position control period, and thus the tension of the warp 3 immediately before beating is higher so as to reduce the weaving ratio of the warp 3.

[0061] Furthermore, since the tension control unit 24 increases the current value to the servo controller 27, the torque applied on the swing roll 6 is increased, and consequently the tension of the warp 3 in the tension control period is maintained at a value higher by the correction of the target tension value. Since the tension of the warp 3 immediately before beating is further higher thereby, the weaving ratio of the warp 3 can be reduced rapidly.

[0062] Although a correction amount signal from the correction device 20 is outputted both to the position control unit 23 and the tension control unit 24 in the above-mentioned embodiment, the correction amount signal can be outputted only to the position control unit 23 or to the tension control unit 24 instead.

[Other Embodiments]

[0063] The control for reducing the warp tension immediately before beating can be executed by the tension control unit 24. The tension control unit 24 is provided as shown in FIG. 5. A predetermined value for subtraction of the target tension value for reducing the tension of the warp 3 immediately before beating is inputted in a setting unit 53. In this case, the position control unit 23 and the setting unit 25 of the control device 17 can be eliminated.

[0064] A gate circuit 52 is driven to open the gate in

a 270 to 20 degree rotation angle by the timing signal input.

**[0065]** In the case the gate circuit 52 is driven, the predetermined value on the setting unit 53 side is outputted as the subtraction value for the target tension value from the setting unit 26 side, more specifically, for the target tension value after correction obtained by adding the output from an integrator 50 to the target tension value set in the setting unit 26. The tension control unit 24 outputs a command signal based on the final target tension value obtained by subtracting the predetermined value on the setting unit 53 side from the corrected target tension value to a servo controller 72. Accordingly, the torque applied on the swing roll 6 is reduced, and thus the tension of the warp 3 immediately before beating can be reduced as well.

**[0066]** The value obtained by adding the output of the integrator 51 to the predetermined value of the setting unit 53 is outputted to the gate circuit 52 as the corrected predetermined value (subtracted value).

**[0067]** In the case the gate circuit 52 is not driven, that is, in a predetermined period after beating (20 to 270 degree rotation angle), the value obtained by adding the output from the integrator 50 to the target tension value preset in the setting unit 26 is regarded as the target tension value after correction, and a command signal corresponding thereto is outputted to the servo controller 72.

**[0068]** The correction device 20 finds the correction amount for modifying the predetermined value to be outputted to the gate circuit 52 and the correction amount (for the integrator 50) for modifying the target tension value of the setting unit 26 based on the deviation, and outputs the corresponding correction amount to the integrator 51 and the integrator 50.

**[0069]** In the case the weaving ratio of the warp 3 becomes smaller than the weaving ratio of the warp 2 due to change of the warp physical properties or the warp tension balance or other disturbances in the production of the textile, the warp 3 drawn out from the warp beam 4 becomes excessive so that the swing roll 6 is moved reciprocally at a position displaced in the withdrawing direction therefor.

**[0070]** The correction device 20 finds the deviation of the average value of the position and the target position of the swing roll 6 in one cycle of the weaving machine, and outputs the correction amount corresponding to the deviation to the integrator 50 and the integrator 51. Specifically, a negative correction amount is outputted to the integrator 50 for lowering the target tension value to be the base for the command signal to be outputted to the servo controller 72 in a predetermined period after beating (20 to 270 degree rotation angle), and a positive correction amount is outputted to the integrator 51 for further lowering the target tension value in the other period including the beating period (270 to 20 degree rotation angle).

**[0071]** Accordingly, since the tension of the warp 3 im-

mediately before beating is lowered rapidly, the weaving ratio of the warp 3 can be increased.

**[0072]** The correction amount can be outputted only to the integrator 51 without the output to the integrator 50, or the correction amount can be outputted only to the integrator 50 without the output to the integrator 51.

**[0073]** In the above-mentioned description, the correction device 20 can detect the position of the swing roll 6 each at one or more set rotation angles in one rotation of the main shaft of a weaving machine from the plurality of rotations of the main shaft of the weaving machine, so that the average value of the obtained plurality of the detected positions is calculated, and the correction is executed based on the deviation of the average value and the preset target position.

**[0074]** Furthermore, the position of the swing roll can be detected at a single set rotation angle in one rotation of the main shaft of a weaving machine, so that the correction is executed based on the deviation of the detected position and the target position per each detection.

**[0075]** Moreover, the position of the swing roll 6 can be detected per predetermined time instead of the rotation angle of the main shaft of a weaving machine. For example, with the predetermined time set as a time sufficiently shorter than the time necessary for one rotation of the main shaft, a plurality of positions can be detected during one rotation, so as to find the average value of the detected positions per predetermined rotations (one rotation or a plurality of rotations) of the main shaft.

**[0076]** Although two warps corresponding to parts with different numbers of crossing are drawn out like a sheet from a warp beam in the above-mentioned embodiment, three or more warps corresponding to parts with different numbers of crossing can be drawn out like a sheet from one warp beam. At the time, each warp can be drawn out via a roll dedicated to each of them, with the rolls corresponding to the other warps, except the warp corresponding to the part with the largest number of crossing, provided movably, and each roll can be controlled independently according to the above-mentioned embodiment.

**[0077]** According to the invention, by modifying the tension of the warp in a part with a small number of crossing immediately before beating based on the detected position of a roller dedicated to the warp, the weaving ratio of the warp can be equal to the weaving ratio of a warp in a part with a large number of crossing, so that a textile with a good quality can be produced stably.

**[0078]** While only certain embodiments of the invention have been specifically described herein, it will apparent that numerous modifications may be made thereto without departing from the spirit and scope of the invention.

## Claims

1. A method for controlling the tension of a warp with a warp tension controlling apparatus for production of a textile that one part in the width direction has a small number of crossing of the warp with respect to the weft compared with the other part thereof, wherein a warp (3) corresponding to one part with a small number of crossing and a warp (2) corresponding to the other part with a large number of crossing are drawn from a warp beam (4) and are placed on different rolls (5, 6), the roll (6) dedicated to the warp (3) corresponding to one part is movably provided in the direction crossing with the axis of the roll (6), the method characterized by comprising the steps of:

temporarily reducing the tension of the warp (3) corresponding to one part via the dedicated roll (6) immediately before beating;  
increasing the tension of the warp (3) corresponding to one part via the dedicated roll (6) after beating for regaining a target tension value;  
detecting the position of the dedicated roll (6);  
calculating the deviation of the detected position and a preset target position of the dedicated roll (6); and  
correcting at least one of the degree of reducing the tension and the target tension value so as to decrease the deviation.

2. The method for controlling the tension of a warp according to claim 1, wherein the step of temporarily reducing the tension of the warp (3) comprises the step of temporarily moving the dedicated roll (6) by a predetermined amount.
3. The method for controlling the tension of a warp according to claim 1 or 2, wherein the step of temporarily reducing the tension of the warp (3) comprises the step of changing the force applied on the dedicated roll (6) by a predetermined amount.
4. The method for controlling the tension of a warp according to claim 2 or 3, wherein the step of correcting at least one of the degree of reducing the tension and the target tension value comprises the step of correcting at least one of the predetermined amount and the target tension value.
5. The method for controlling the tension of a warp according to one of the preceding claims, wherein the step of increasing the tension of the warp (3) comprises the step of applying a force to the dedicated roll (6).
6. The method for controlling the tension of a warp ac-

ording to one of the preceding claims, wherein the dedicated roll (6) is swingably provided so that a swinging torque is applied on the dedicated roll (6).

7. The method for controlling the tension of a warp according to one of the preceding claims, wherein the position of the dedicated roll (6) is detected periodically.
8. The method for controlling the tension of a warp according to one of the preceding claims, wherein the position of the dedicated roll (6) is detected each at a plurality of preset rotation angles in one rotation of the main shaft (18) of a weaving machine, the average value of the obtained plurality of the detected positions is calculated, and the correction is executed based on the deviation of the average value and the preset target position.
9. The method for controlling the tension of a warp according to one of claims 1 to 7, wherein the position of the dedicated roll (6) is detected at one or more preset rotation angles in one rotation of the main shaft (18) of a weaving machine over a plurality of rotations of the main shaft (18), the average value of the obtained plurality of the detected positions is calculated, and the correction is executed based on the deviation of the average value and the preset target position.
10. The method for controlling the tension of a warp according to one of claims 1 to 7, wherein the position of the dedicated roll (6) is detected at a single preset rotation angle in one rotation of the main shaft (18) of a weaving machine, and the correction is executed based on the deviation of the detected position and the preset target position per each detection.

**FIG. 1**

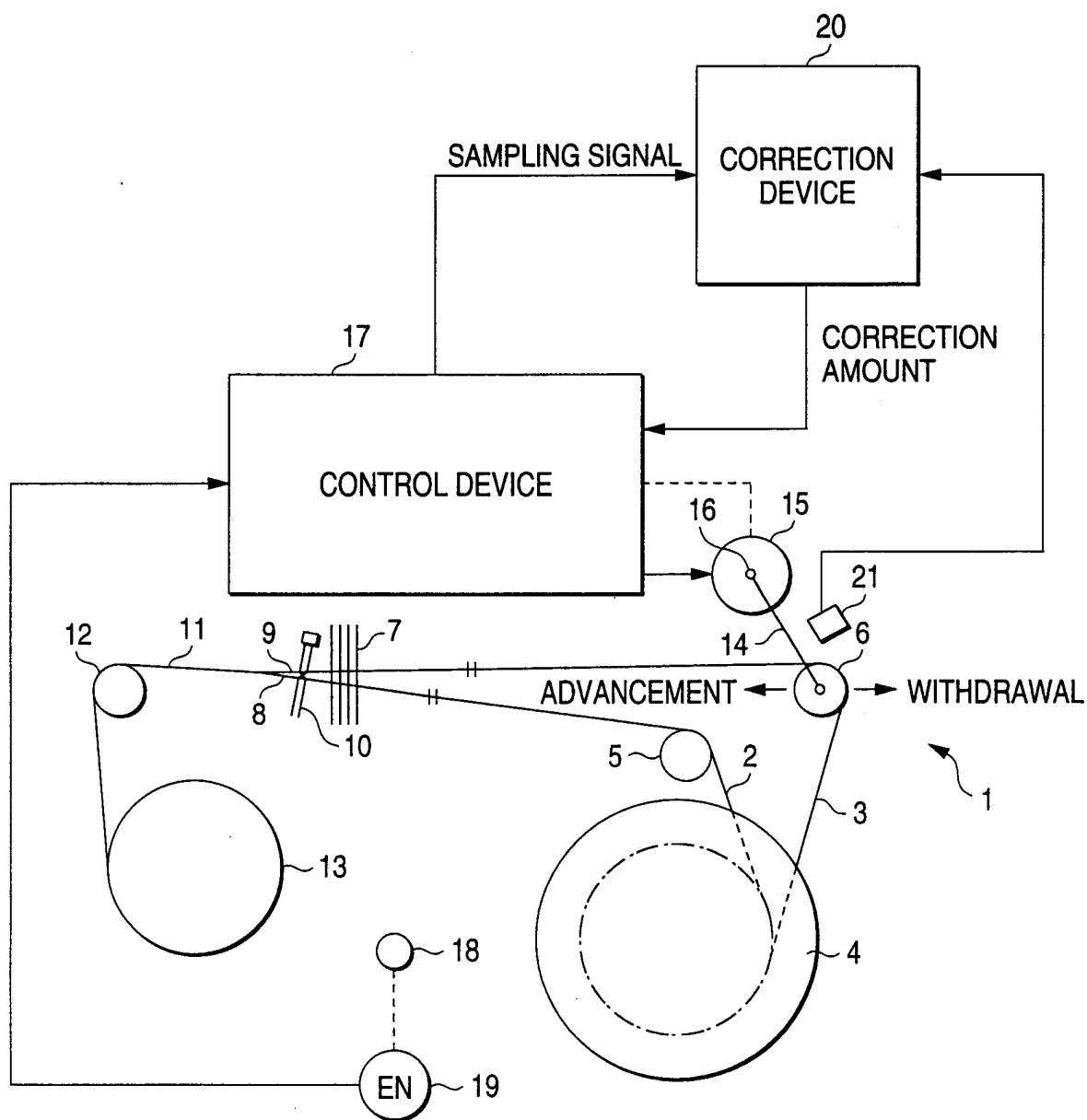


FIG. 2

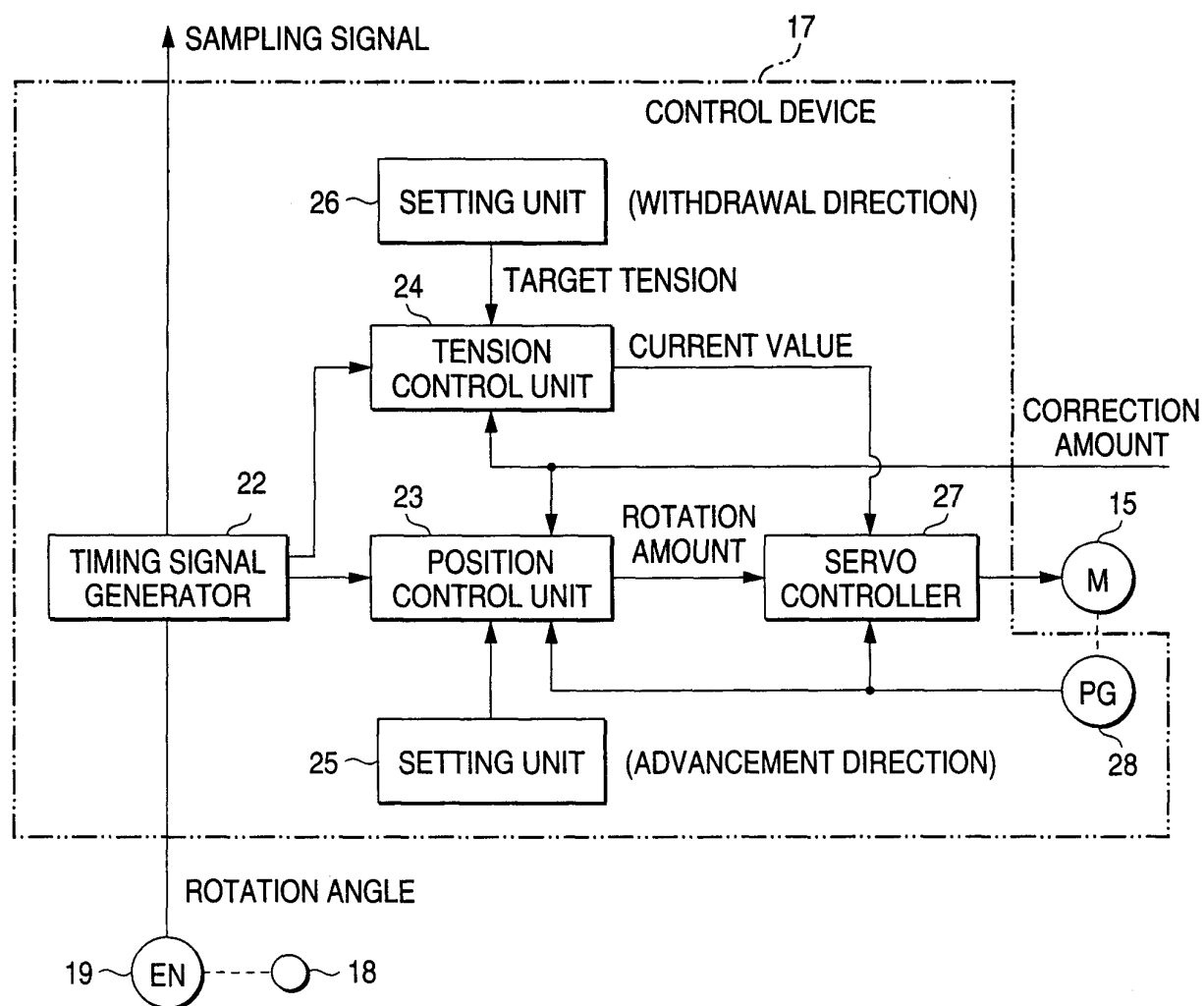


FIG. 3

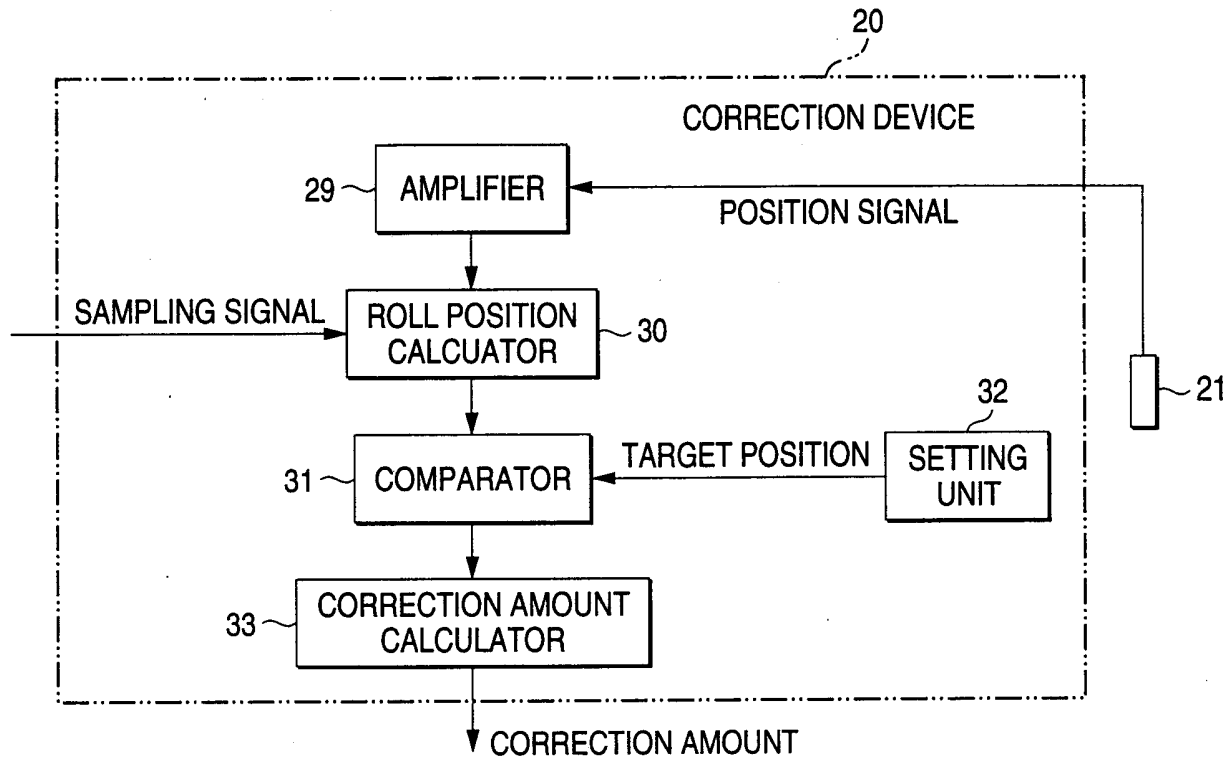


FIG. 4

[ POSITION OF EASING ROLL 6 ]

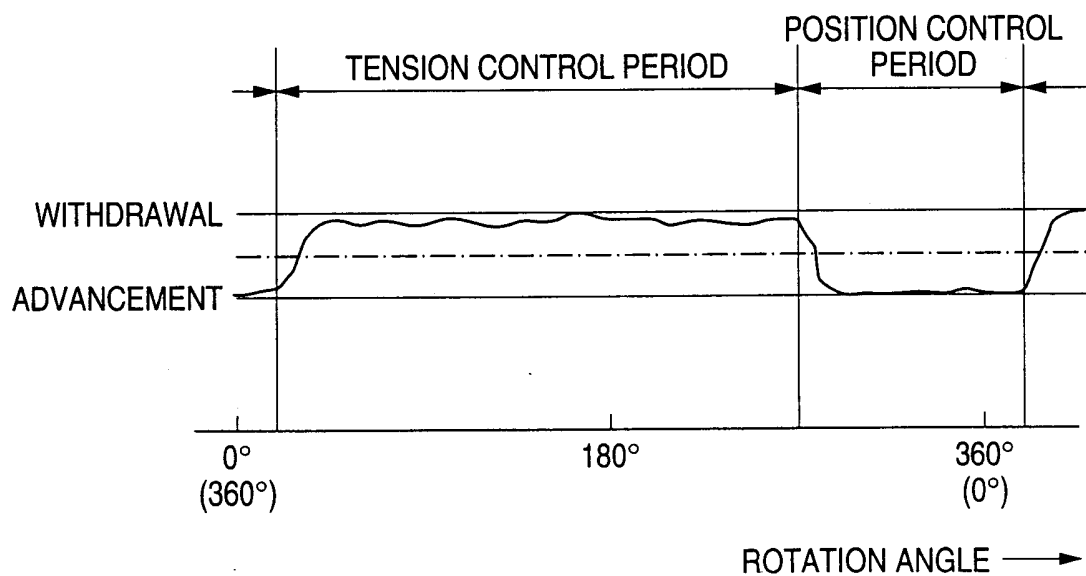
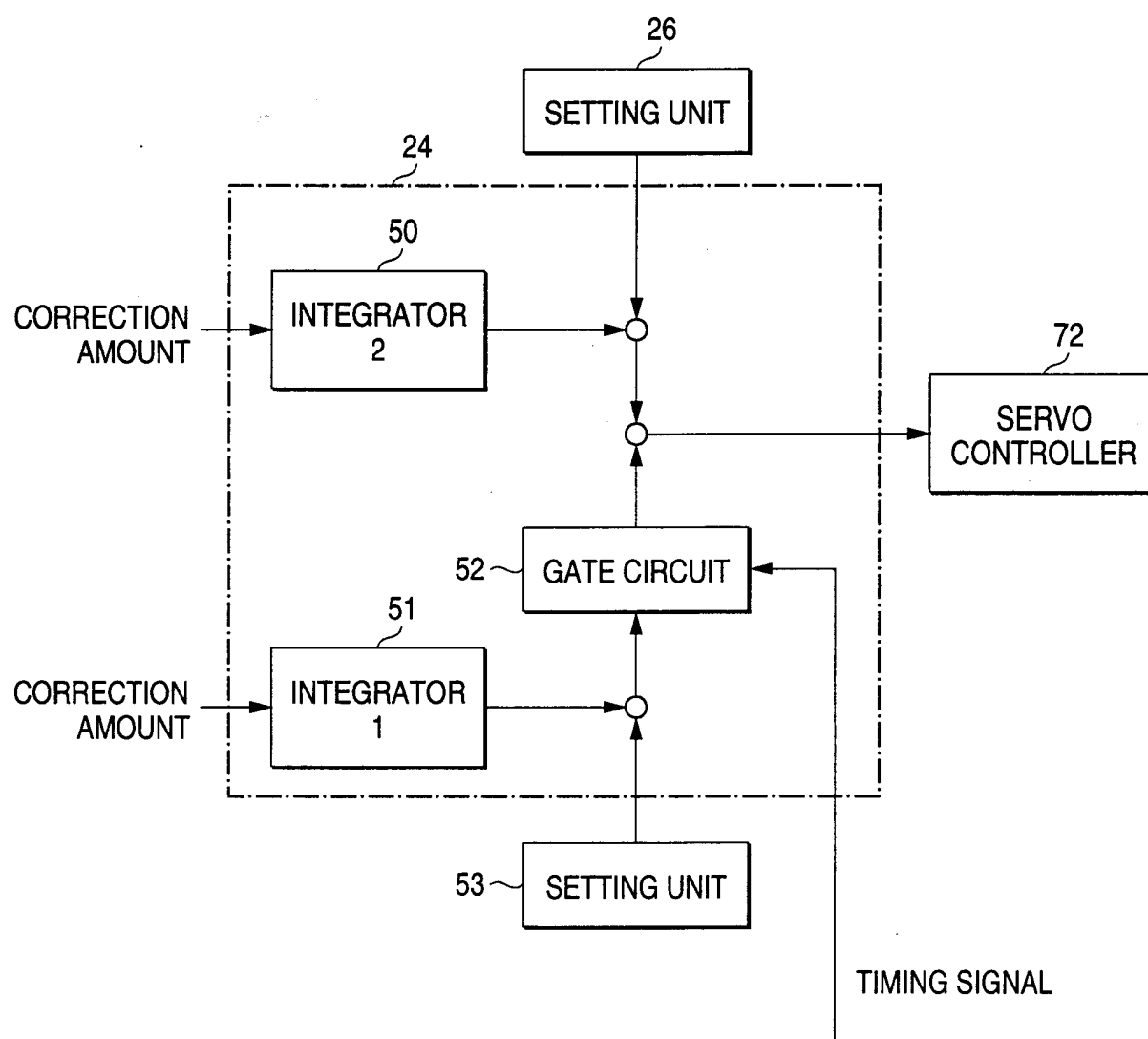


FIG. 5





European Patent  
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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 3397

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           |                                                          |                                                 |
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| Place of search<br><b>THE HAGUE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           | Date of completion of the search<br><b>19 March 2001</b> | Examiner<br><b>Rebiere, J-L</b>                 |
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19-03-2001

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