(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 331 294 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.07.2003 Bulletin 2003/31

(51) Int Cl.[7]: **D03C 11/00**, D03D 47/40

(21) Application number: **03001452.6**

(22) Date of filing: **22.01.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT SE SI SK TR
Designated Extension States:
AL LT LV MK RO

(30) Priority: **23.01.2002 JP 2002014858**

(71) Applicant: **TSUDAKOMA KOGYO KABUSHIKI KAISHA**
Kanazawa-shi, Ishikawa-ken 921-8650 (JP)

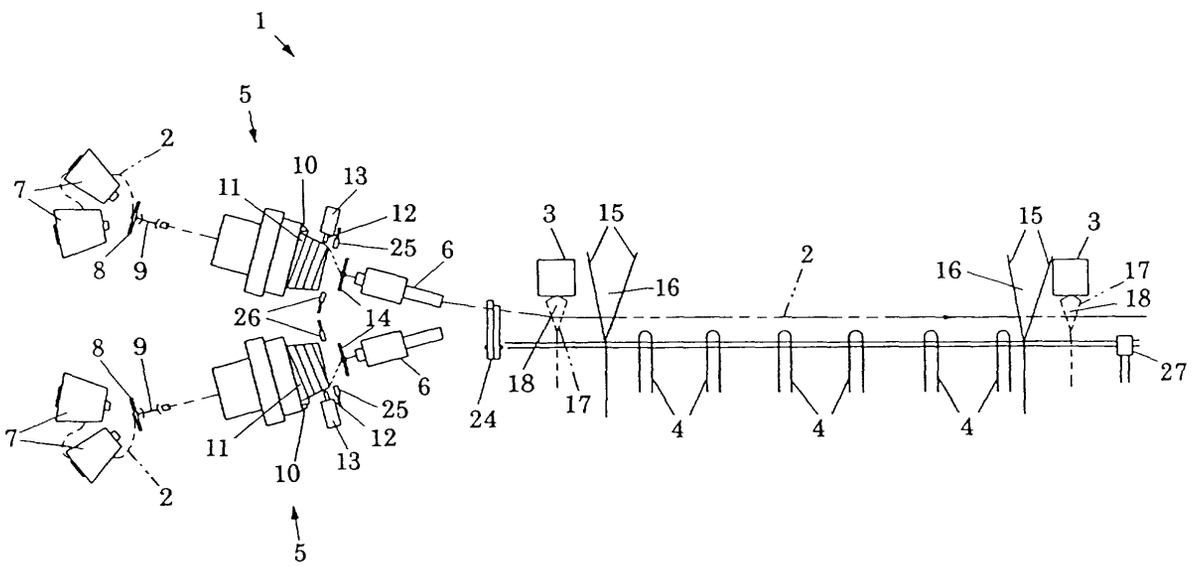
(72) Inventor: **Hasegawa, Hiroaki,**
c/o Tsudakoma Kogyo K. K.
Kanazawa-shi, Ishikawa-ken 921-8650 (JP)

(74) Representative: **Goddar, Heinz J., Dr. et al**
FORRESTER & BOEHMERT
Pettenkoferstrasse 20-22
80336 München (DE)

(54) Electric selvage device control method for fluid-jet loom

(57) An electric selvage device control method times the selvage shed closing operation of an electric selvage device (3) to close a selvage shed (18) of selvage yarns (17) by the electric selvage device (3) at an optimum phase of a weaving cycle. A sensor (25, 26, 27, 44, 45) provides a detection signal upon the detection of the passage of a picked weft yarn (2) by a predetermined position. The electric selvage device (3) is driven on the basis of the detection signal for the selvage shed closing operation to grip the picked weft yarn (2) by the selvage yarns (17) without obstructing the travel of the picked weft yarn (2)at the earliest possible phase of the weaving cycle.

FIG.1



EP 1 331 294 A2

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an electric selvage device control method of controlling an electric selvage device included in a fluid-jet loom, that grips a picked weft yarn by selvage yarns at a phase angle of the main shaft of the fluid-jet loom, corresponding to time when the picked weft yarn passes a predetermined position.

Description of the Related Art

[0002] A twist selvaging method using twist selvage devices is disclosed in Jpn. Pat. No. 2933889. This prior art twist selvaging method places twist selvage devices on a picking side, i.e., the side from which a weft yarn is picked, and an arriving side, a side at which a picked weft yarn arrives, respectively, of a loom, drives servomotors included in the twist selvage devices independent of a control operation for controlling driving the loom, and controls the respective operating speeds of the servomotors to synchronize the respective shedding operations of the twist selvage devices with the shedding operation of the loom.

[0003] Generally, unwinding resistance, i.e., force that acts on a weft yarn being unwound from a yarn package, varies with the diameter of the yarn package and position where the weft yarn is separated from the yarn package. Therefore, the weft yarn is wound on a yarn storage drum included in a length-metering storage device at a different tension in a yarn layer of a different hardness. Unwinding tension, i.e., tension that acts on the weft yarn being unwound, of the weft yarn varies in unwinding the weft yarn from the yarn storage drum of the length-metering storage device, and the traveling conditions including the traveling speed of the picked weft yarn vary accordingly. When weft yarns of different types are used for weaving, the different weft yarns travel in different traveling conditions specific to their characteristics, and the traveling conditions change with the change of the pressure of a picking fluid.

[0004] As mentioned above, this prior art twist selvaging method synchronizes the selvage shedding operation of the twist selvage devices with the shedding operation of the loom. However, since the traveling condition (traveling speed) of the picked weft yarn varies constantly for the foregoing reasons, the picked weft yarns arrive at different positions, respectively, at time when the selvage yarns grip the picked weft yarns when the selvage shedding operation of the selvage devices is synchronized with the warp shedding operation of the loom. If the traveling speed of a picked weft yarn is low and the selvage shed closing timing is excessively early, the selvage yarns in the closed shed obstruct the picked weft yarn. If the traveling speed of a picked weft yarn is high and the selvage shed closing timing is excessively late, the picked weft yarn cannot properly be gripped, the inserted weft yarn slackens and, consequently, loose selvage is formed.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide an electric selvage device control method of controlling electric selvage devices included in a fluid-jet loom, including detecting the passage of a picked weft yarn by a predetermined position by a sensor, and driving the electric selvage devices disposed on the picking side and the arriving side, respectively, of the fluid-jet loom on the basis of a detection signal provided by the sensor so as to close sheds of selvage yarns to grip the picked weft yarn. The electric selvage device control method detects the actual traveling condition of the picked weft yarn and controls a selvage shedding operation on the basis of the detected actual traveling condition of the picked weft yarn. Therefore, the travel of the picked weft yarn is not obstructed, and the picked weft yarn can be gripped by the selvage yarns at the earliest possible phase angle of the main shaft of the fluid-jet loom. Consequently, the picked weft yarn can be surely prevented from slackening.

[0006] According to one aspect of the present invention, an electric selvage device control method of controlling at least one electric selvage device included in a fluid-jet loom and disposed on either a picking side from which a weft yarn is inserted in a fabric or an arriving side at which a picked weft yarn arrives of the fluid-jet loom, independent of the operation of the fluid-jet loom by a selvage device controller for a selvage shed closing operation comprises: detecting the passage of a picked weft yarn by a predetermined position by a sensor and driving the electric selvage device on the basis of a detection signal provided by the sensor so that a selvage shed of selvage yarns is closed to grip the picked weft yarn.

[0007] Since the sensor detects the passage of the picked weft yarn by the predetermined position, the picked weft yarn can be always gripped by the selvage yarns upon the arrival at an optimum position even if the picked weft yarn travels at a traveling speed different from a normal traveling speed and the picked weft yarn arrives at a position where the same is gripped by the selvage yarns at a phase angle of the main shaft of the fluid-jet loom different from a normal weft-gripping phase angle. The selvage yarns do not obstruct the travel of the picked weft yarn because the selvage yarns grip the picked weft yarn upon the arrival of the picked weft yarn at the optimum position. The selvage yarns grip the picked weft yarn before the same slackens because the shed or sheds of the selvage yarns is closed at the earliest possible phase angle. Thus, the selvage yarns prevent the picked weft yarn from slackening with

reliability. The operation for closing the selvage shed of the selvage yarns on the picking side grips the picked weft yarn by the selvage yarns to prevent the slackening of the picked weft yarn on the picking side due to the return of the picked weft yarn caused by the cutting operation of a yarn cutter. The operation for closing the selvage shed of the selvage yarns on the arriving side grips the picked weft yarn by the selvage yarns to prevent the slackening of the picked weft yarn on the arriving side during a warp shedding operation and a beating motion. Thus, the electric selvage devices are able to exercise the functions of a weft yarn braking device and a weft yarn stretching nozzle.

[0008] The electronic selvage device control method may drive the electric selvage device a predetermined time after the sensor has detected the passage of the picked weft yarn by the predetermined position and has provided the detection signal.

[0009] The predetermined time is represented by second or by a phase angle of the main shaft of the fluid-jet loom and is determined according to the predetermined position. If the predetermined position is determined such that the predetermined time is short, error is reduced accordingly and the picked weft yarn can be gripped at the optimum position. The predetermined time may be zero and the electric selvage device or the electric selvage devices may be driven at the generation of the detection signal by the sensor.

[0010] Speed information about the traveling speed of the picked weft yarn is obtained on the basis of the detection signal provided by the sensor, and an operation for driving the electric selvage device or the electric selvage devices may be timed according to the speed information.

[0011] The speed information may be a time (angle of rotation of the main shaft) necessary for the picked weft yarn to travel a distance between two points including the predetermined position or traveling speed, and the phase angle of the main shaft or the time when the picked weft yarn passes the predetermined position.

[0012] A method of determining a selvage device driving phase angle on the basis of the speed information may include setting a reference selvage device driving phase angle (reference phase angle of the main shaft), and changing the reference selvage device driving phase angle according to the change of the speed information. More concretely, a reference phase angle is determined, and the reference phase angle is compared with information to determine a change. The selvage device driving phase angle is advanced if the actual traveling speed is higher than a reference traveling speed, and the selvage device driving phase angle is delayed if the actual traveling speed is lower than the reference traveling speed in order that a weft yarn gripping operation is started always upon the arrival of the leading end of the picked weft yarn at an optimum position. A specific phase angle may be set, the driving of the electric selvage device or the electric selvage devices may be started at a predetermined time period (angle or time of rotation of the main shaft) after the specific phase angle, and the predetermined time period may be changed according to the speed information. The specific phase angle may be 0° or 150° or may be a phase angle at which the sensor detects the passage of the picked weft yarn by the predetermined position. The predetermined time period may be determined by calculation using the speed information or may be selected from predetermined time periods determined beforehand respectively for values of the speed information on the basis of a desired value of the speed information.

[0013] The electric selvage device control method may include placing electric selvage devices on the picking side and the arriving side of the fluid-jet loom, respectively, both the electric selvage devices respectively on the picking side and the arriving side are controlled for the selvage shed closing operation on the basis of the detection signal provided by the sensor, and closing the selvage shed of the selvage yarns on the picking side earlier than that of the selvage yarns on the arriving side before the picked weft yarn arrives at a position corresponding to an edge, on the arriving side, of the fabric. Thus, the selvage yarns on the picking side grip the picked weft yarn before the picked weft yarn arrives at the edge, on the arriving side, of the fabric to brake the picked weft yarn so that the traveling speed of the picked weft yarn is reduced. The holding pin of the length-metering storage device on the picking side touches the picked weft yarn to stop the picked weft yarn. Consequently, the traveling speed of the picked weft yarn is reduced to stop the picking motion. Thus, the picked weft yarn will not excessively be tensioned or broken, and the quality of the fabric will not be marred.

[0014] In the electric selvage device control method according to the present invention, the fluid-jet loom may be provided with a plurality of picking nozzles, the gripping operation of the selvage yarns is performed in an early phase when it is known that friction between the picked weft yarn and the selvage yarns is low from the detection signal provided by the sensor and a yarn type signal, or the gripping operation of the selvage yarns is performed in a late phase when it is known that friction between the picked weft yarn and the selvage yarns is high from the detection signal provided by the sensor and the yarn type signal. Since the selvage yarns grip the picked weft yarn after the same has traveled a sufficient distance, the selvage yarns do not obstruct the travel of the picked weft yarn.

[0015] In the electric selvage device control method according to the present invention, electric selvage devices are disposed on the picking side and the arriving side, respectively, and the respective selvage shed closing operations of the electric selvage device on the picking side and the electric selvage device on the arriving side are controlled on the basis of a single detection signal. Thus, a single sensor is used for controlling both the electric selvage devices.

[0016] In the electric selvage device control method according to the present invention, the passage of the leading end of the picked weft yarn by the predetermined position is detected.

[0017] In the electric selvage device control method according to the present invention, the passage of the picked weft yarn by the predetermined position is detected through the measurement of the length of the weft yarn unwound from the yarn storage drum of the length-metering storage device.

[0018] In the electric selvage device control method according to the present invention, the arrival of the picked weft yarn at a predetermined position is detected by a sensor placed near an edge, on the arriving side, of a fabric on the fluid-jet loom, and the electric selvage device performs the selvage shed closing operation for the next weaving cycle upon the detection of arrival of the picked weft yarn at the predetermined position. Thus, the shedding operation of the electric selvage devices can be controlled without using any special sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above and other objects, features and advantages of the present invention will become more apparent from the following description taken in connection with the accompanying drawings, in which:

Fig. 1 is a schematic plan view of a part, including first and second picking devices and first and second electric selvage devices, of an air-jet loom;

Fig. 2 is a schematic side elevation of the electric selvage device;

Fig. 3 is a schematic plan view of the electric selvage device;

Fig. 4 is a block diagram of an electric selvage device control system;

Fig. 5 is a diagram showing signals generated by first and second yarn sensors, operation of first and second motors included in the first and the second electric selvage device, and the variation of the traveling speed of a picked weft yarn with the phase angle of the main shaft of the air-jet loom;

Fig. 6 is a diagram showing signals generated by a pick sensor, operation of the first and the second motor included in the first and the second electric selvage device, and the variation of the traveling speed of a picked weft yarn with the phase angle of the main shaft of the air-jet loom;

Fig. 7 is a schematic plan view of an electric selvage device and a yarn sensor;

Fig. 8 is a diagram showing signals generated by the first and the second yarn sensor, operation of the first and the second motor included in the first and the second electric selvage device, and the variation of the traveling speed of a picked weft yarn with the phase angle of the main shaft of the air-jet loom; and

Fig. 9 is a diagram showing signals generated by the first and the second yarn sensor, operation of the first and the second motor included in the first and the second electric selvage device, and the variation of the traveling speed of a picked weft yarn with the phase angle of the main shaft of the air-jet loom.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Figs. 1, 2, 3 and 4 are views of assistance in describing a double-picker air-jet loom 1 provided with first and second electric selvage devices 3 disposed on its picking and arriving sides, respectively.

[0021] Referring to Fig. 1, the double-picker air-jet loom 1 is provided with first and second length-metering storage devices 5 and first and second picking nozzles 6 for two types of weft yarns 2. Each weft yarn 2 is unwound from one of two yarn packages 7. The leading end of the weft yarn 2 wound on one of the yarn packages 7 is connected to the trailing end of the weft yarn 2 wound on the other yarn package 7. The weft yarn 2 unwound from the yarn package 7 is led through a balloon breaker 8 and a tension device 9 to the length-metering storage device 5. Each of the length-metering storage devices 5 has a storage drum 11, a holding pin 12 and a revolving arm 10. The revolving arm 10 guiding the weft yarn 2 revolves around the storage drum 11 to wind the weft yarn 2 around the storage drum 11, while the holding pin 12 holds the weft yarn 2 on the storage drum 11. A length of the weft yarn 2 necessary for one picking cycle is stored on the storage drum 11.

[0022] In picking the weft yarn 2 stored on the storage drum 11, a pin operating device 13 retracts the holding pin 12 from outer surface of the drum 11, the picking nozzle 6 draws the weft yarn 2 unwound from the storage drum 11 therein through a yarn guide 14. Then, the picking nozzle 6 jets air, i.e., a picking fluid, to pick the weft yarn 2. The picked weft yarn 2 travels from the picking side through a shed 18 of selvage yarns 17, i.e., leno selvage yarns, formed by the first electric selvage device 3, a shed 16 of warp yarns 15, and a shed 18 of selvage yarns 17 formed by the second electric selvage device 3 to the arriving side. A plurality of auxiliary nozzles 4 jet air to urge the picked weft yarn 2 toward the arriving side. The picked weft yarn 2 thus inserted in a fabric 22 is beaten up by a reed 21 into a cloth fell 23. A yarn cutter 24 cuts a part, near an edge on the picking side of the fabric 22, of the picked weft yarn 2.

[0023] First yarn sensors 25 and second yarn sensors 26 measure the lengths of the weft yarns 2 unwound from the storage drums 11 (the numbers of coils of the unwound weft yarns 2). The first yarn sensor 25 and the second yarn sensor 26 are disposed diametrically opposite to each other with respect to the storage drum 11, and generate two detection signals every time one

coil of the weft yarn 2 is unwound from the storage drum 11.

[0024] The leading end of a normally picked weft yarn 2 arrives at a predetermined position on the arriving side corresponding to a pick sensor 27. The pick sensor 27 detects the arrival of the leading end of the picked weft yarn 2 at the predetermined position. Upon the detection of the leading end of the picked weft yarn 2, the pick sensor 27 generates a signal of a fixed level and the air-jet loom 1 continues its weaving operation. If a mispick occurs and the leading end of the picked weft yarn 2 is unable to reach the predetermined position and to be detected by the pick sensor 27, the pick sensor 27 generates a mispick signal and gives the same to a main controller 40. Then, the main controller 40 stops the air-jet loom 1.

[0025] A selvage device controller 20 drives each of the electric selvage devices 3 independently in synchronism with the weaving operation of the air-jet loom 1. The electric selvage devices 3 open and close the sheds 18 of the selvage yarns 17 to grip a parts on the picking side and on the arriving side of the picked weft yarn 2 so that selvages are woven.

[0026] The first and the second electric selvage device 3 are identical and are electric leno devices. Figs. 2 and 3 show the electric selvage device 3 on the arriving side by way of example. The electric selvage device 3 is provided with a motor 32 including a rotor 33 provided with a rotor shaft 34. Two selvage yarns 17 unwound from two selvage yarn packages 19 are led through balloon breakers 28, tension devices 29 and yarn guides 30 into a yarn guide bore 34a formed through the rotor shaft 34 of the motor 32. Twisting arms 31 are attached to the rotor shaft 34 of the rotor 33 so as to extend on the opposite sides of the rotor shaft 34. The motor 32 of the electric selvage device 3 turns the twisting arms 31 to form a selvage of a leno weave by the two selvage yarns 17.

[0027] The two selvage yarns 17 are separated from each other at the outlet of the yarn guide bore 34a of the rotor shaft 34, are passed through yarn guide holes 31a formed in the extremities of the twisting arms 31, and are extended through a space between two guide pins 35 to the cloth fell 23. The twisting arms 31 are formed by processing a thin metal sheet and are flexible. The two guide pins 35 are held on a guide pin holder 36. The two guide pins 35 permits the selvage yarns 17 to move for shedding in the space between the two guide pins 35 and determine the positions of the selvage yarns 17 with respect to a direction along the width of the fabric 22. When the twisting arms 31 are on a plane perpendicular to the surface of the fabric 22, the shed of the two selvage yarns 17 is fully open. When the twisting arms 31 are on a plane parallel to the surface of the fabric 22, the shed of the two selvage yarns 17 is fully closed.

[0028] Fig. 4 shows the selvage device controller 20 and the associated circuit elements. The selvage device controller 20 receives a phase angle signal indicating the phase angle of the main shaft 37 of the air-jet loom 1 from an encoder 38 connected to the main shaft 37, control signals and yarn type signals from the main controller 40, delay angle signals for different types of yarns from a setting device 39, and count-up signals from counters 41 and 42 connected to the first yarn sensor 25 and the second yarn sensor 26 and disposed beside the edges of the fabric 22. The selvage device controller 20 controls individually the respective motors 32 of the electric selvage device 3 on the picking side and the electric selvage device 3 on the arriving side.

[0029] The main controller 40 receives the phase angle signal indicating the phase angle of the main shaft 37 of the air-jet loom 1 from the encoder 38 connected to the main shaft 37. The main controller controls the components of the air-jet loom 1 for operations in synchronism with the weaving operation of the air-jet loom 1. The main controller 40 gives control signals to the selvage device controller 20 to control the operations of the selvage device controller 20. The selvage device controller 20 receives the phase angle signal, the control signals, the yarn type signals, the delay angle signal and the count-up signal, and controls the motors 32 of the electric selvage devices 3 to start and stop the motors 32 in synchronism with the weaving operation of the air-jet loom 1.

[0030] Fig. 5 is a diagram showing signals generated by the first yarn sensor 25 and the second yarn sensor 26, the operating conditions of the first and second motors 32 of the first and the second electric selvage device 3, and the variation of the traveling speed of a picked weft yarn 2 with the phase angle of the main shaft 37 of the air-jet loom 1.

[0031] Upon the detection of the passage of the picked weft yarn 2 by the predetermined position, the selvage device controller 20 makes at least either the electric selvage device 3 on the picking side or the electric selvage device 3 on the arriving side close the shed of the selvage yarns 17 to grip the picked weft yarn 2 by the selvage yarns 17. The first yarn sensor 25 or the second yarn sensor 26 of the length-metering storage device 5 detects the passage of the picked weft yarn 2 by the predetermined position. The selvage device controller 20 uses the output signal of either the first yarn sensor 25 or the second yarn sensor 26 as a detection signal, depending on the width of the fabric 22.

[0032] When the twisting arms 31 are on the plane perpendicular to the surface of the fabric 22, the guide holes of the twisting arms 31 are vertically spaced from each other to keep the shed 18 of the selvage yarns 17 open. While the picked weft yarn 2 is traveling past the predetermined position, the first yarn sensor 25 generates a third pulse signal, and the counter 41 gives a count-up signal to the selvage device controller 20. Then, the selvage device controller 20 actuates the motor 32 of the electric selvage device 3 on the picking side to turn the twisting arms 31 through an angle of 180°.

Consequently, the shed 18 of the selvage yarns 17 is inverted to grip a part, on the picking side, of the picked weft yarn 2. The selvage device controller 20 actuates the motor 32 of the electric selvage device 3 on the arriving side a predetermined delay angle of rotation of the main shaft after the inversion of the shed 18 of the selvage yarns 17 on the picking side to invert the shed 18 of the selvage yarns 17 on the arriving side to grip a part, on the arriving side, of the picked weft yarn 2.

[0033] Since the picked weft yarn 2 travels from the picking side to the arriving side, the part, on the picking side, of the picked weft yarn 2 and the part, on the arriving side, of the picked weft yarn 2 are gripped when the main shaft 37 is at different phase angles, respectively; that is, the part, on the arriving side, of the picked weft yarn 2 is gripped a predetermined delay angle after the phase angle at which the part, on the picking side, of the picked weft yarn 2 is gripped. For example, the setting device 39 sets a delay angle of 25° for the electric selvage device 3 on the picking side and a delay angle of 65° for the electric selvage device 3 on the arriving side. The selvage device controller 20 actuates the motor 32 of the electric selvage device 3 on the picking side after the rotation of the main shaft 37 of the air-jet loom 1 through an angle of 25° from a phase angle at which the selvage device controller 20 receives the count-up signal (the third pulse), and actuates the motor 32 of the electric selvage device 3 on the arriving side after the rotation of the main shaft 37 of the air-jet loom 1 through an angle of 65° from a phase angle at which the selvage device controller 20 receives the count-up signal. After the rotation of the main shaft 37 through an angle of 15° from a phase angle at which the motor 32 of the electric selvage device 3 on the picking side is actuated, the shed 18 of the selvage yarns 17 is closed to start gripping the traveling picked weft yarn 2 so that the picked weft yarn 2 is braked and the traveling speed of the picked weft yarn 2 is reduced. The twisting arms 31 are inverted and stopped after the rotation of the main shaft 37 through an angle of 30° from a phase angle at which the motor 32 of the electric selvage device 3 on the picking side is actuated. Thus, the selvage yarns 17 extending between the guide holes 31a of the twisting arms 31 and the cloth fell 23 are twisted to form the selvage. The picked weft yarn 2 is held firmly between the cloth fell 23 and the intersection point of the twisted selvage yarns 17 on the picking side.

[0034] Generally, the picked weft yarn 2 is stopped suddenly and is tensioned excessively if the holding pin 12 of the length-metering storage device 5 operates to stop the weft yarn 2 upon the completion of a picking cycle. Since the picked weft yarn 2 is gripped by the selvage yarns 17 for deceleration before the holding pin 12 operates, the quality of the picked weft yarn 2 is not deteriorated, the picked weft yarn 2 will not be broken, and the fabric 22 can be woven in a high quality. The weft yarn 2 thus inserted in the fabric 22 is gripped firmly by the selvage yarns 17 after the completion of the picking cycle, and the yarn cutter 24 cuts the picked weft yarn 2, which has not suddenly been stopped and is not excessively tensioned. Therefore, the inserted weft yarn 2 is not slackened (draw back) when cut by the yarn cutter 24 and hence firm selvages can be formed.

[0035] After the rotation of the main shaft 37 through an angle of 15° from a phase angle at which the motor 32 of the electric selvage device 3 on the arriving side is actuated, the shed 18 of the selvage yarns 17 is closed to start gripping the traveling picked weft yarn 2. The twisting arms 31 are inverted and stopped after the rotation of the main shaft 37 through an angle of 30° from a phase angle at which the motor 32 of the electric selvage device 3 on the arriving side is actuated. Thus, the selvage yarns 17 extending between the guide holes 31a of the twisting arms 31 and the cloth fell 23 are twisted to form the selvage. The picked weft yarn 2 is held firmly between the cloth fell 23 and the intersection point of the twisted selvage yarns 17 on the arriving side.

[0036] Thus, the salvage device controller 20 makes the selvage yarns 17 grip the picked weft yarn 2 as early as possible according to the traveling condition of the picked weft yarn 2 without obstructing the travel of the picked weft yarn 2. Consequently, the inserted weft yarn is not slackened by the operation for closing the shed of the warp yarns 15 and the beating operation, and firm selvages can be formed.

[0037] The selvage yarns 17 extending between the guide holes 31a of the twisting arms 31, and the yarn guide 30 are twisted in the reverse direction. Therefore, the selvage device controller 20 controls the electric selvage device 3 such that an operation for turning the twisting arms 31 through an angle of 180° in one direction is performed about hundred times to twist the selvage yarns 17 extending between the rotor 33 and the yarn guide 30 in the turning direction, the twisting arms 31 are turned one full turn in the opposite direction, and then an operation for turning the twisting arm 31 through an angle of 180° in the opposite direction is performed about hundred times to untwist completely the selvage yarns 17 extending between the twisting arms 31 and the guide roller 30.

[0038] Delay angles specific to types of weft yarns are stored in the setting device 39. Usually, small delay angles are set and a selvage shed closing operation for closing the shed 18 of the selvage yarns 17 is started at early phase angles for weft yarns on which the selvage yarns 17 exert comparatively low frictional resistances. Thus, the selvage shed closing operation for closing the shed 18 of the selvage yarns 17 is timed properly and the selvage yarns 17 are able to surely grip the picked weft yarn 2.

[0039] Delay times may be used instead of the delay angles for timing the selvage shed closing operation. The selvage shed closing operation may be started after the travel of the picked weft yarn by a predetermined distance from time when the selvage device controller 20 receives the count-up signal (the third pulse). The

selvage device controller 20 measures the time interval between the successive pulses generated by the first yarn sensor 25 or the second yarn sensor 26, calculates the traveling speed of the picked weft yarn 2 on the basis of the time interval between the successive pulses and the length of one coil of the weft yarn 2, calculates a time necessary for the picked weft yarn 2 to travel the predetermined distance on the basis of the calculated traveling speed, and starts the selvage shed closing operation at the calculated time after the reception of the third pulse. A yarn sensor specially for the length-metering storage device 5 capable of moving in a circumferential direction along the storage drum 11 maybe used instead of the first yarn sensor 25 or the second yarn sensor 26. An optimum position of the yarn sensor relative to the storage drum 11 can be determined according to the width of the fabric, which facilitates timing the selvage shed closing operation.

[0040] An electric planetary selvage device may be used instead of the electric leno device as the electric selvage device 3. This control, in addition to being used for the selvage shed closing operation for closing the shed 18 of the selvage yarns 17 in the present weaving cycle, may use the present weaving cycle as a detection cycle, may execute control in the following weaving cycles on the basis of results of detection, and may execute the selvage shed closing operation in the same weaving cycles.

[0041] Fig. 6 is a diagram of assistance in explaining a control procedure, which detects the passage of the picked weft yarn 2 by the predetermined position, for controlling the selvage shed closing operation. The predetermined position is near the edge, on the arriving side, of the fabric 22. The pick sensor 27 is disposed at the predetermined position. The pick sensor 27 provides a pick signal upon the detection of the picked weft yarn 2 at the predetermined position near the edge, on the arriving side, of the fabric 22. The pick signal is used for determining picking condition and for controlling the electric selvage device 3. Angles or times of rotation of the main shaft 37 of the air-jet loom 1 are set for different types of weft yarns. Angles or times of rotation of the main shaft 37 through which the main shaft 37 rotates in a time between time when the pick sensor 27 detects the picked weft yarn 2 and times when the electric selvage device 3 on the picking side and the electric selvage device 3 on the arriving side start the selvage shed closing operation in the next weaving cycle are determined.

[0042] Fig. 7 shows two pick sensors 44 and 45 arranged in the picking direction on a reed holder 43 to detect the leading end of the picked weft yarn 2. Detection signals provided by the pick sensor 44 disposed at an upper position with respect to the picking direction and the pick sensor 45 disposed at a lower position with respect to the picking direction upon the detection of the leading end of the picked weft yarn 2 are given to the electric selvage device 3 on the picking side and the electric selvage device on the arriving side, respectively. Since the traveling condition of the picked weft yarn 2 can be directly detected, the passage of the picked weft yarn by the predetermined position can be further accurately detected. Only one pick sensor may be used instead of the two pick sensors 44 and 45, and the respective selvage shed closing operations of the electric selvage device 3 on the picking side and the electric selvage device 3 on the arriving side may be started after the rotation of the main shaft 37 through different delay angles or for different time delays from the generation of a detection signal by the pick sensor.

[0043] Figs. 8 and 9 are diagrams of assistance in explaining methods of obtaining information about the traveling speed of the picked weft yarn 2, timing the actuation of the motors 32 according to the information about the traveling speed, and driving the electric selvage devices 3.

[0044] The method illustrated by Fig. 8 determines reference driving phase angles of the main shaft 37 at which the motor 32 on the picking side and the motor 32 on the arriving side are started, respectively. An actual angle through which the main shaft 37 rotates in a time between the second and the third pulse provided by the first yarn sensor 25 is determined as information about the traveling speed of the picked weft yarn 2. The difference between the actual angle of rotation and the set reference angle is calculated, angular corrections for the motors 32 are calculated on the basis of the difference, the reference driving phase angles are corrected by using the angular corrections, and the motors 32 are started at the corrected driving phase angles, respectively. It is preferable that the motors 32 are started at phase angles earlier than the reference driving phase angles, respectively, when the actual angle of rotation is small and the traveling speed of the picked weft yarn 2 is high, and the motors 32 are started at phase angles later than the reference driving phase angles, respectively, when the actual angle of rotation is large and the traveling speed of the picked weft yarn 2 is low. Thus, the picked weft yarn gripping operation is started always upon the arrival of the leading end of the picked weft yarn 2 at an optimum position regardless of the traveling speed. Formulas for calculating the reference driving phase angles, the set reference of rotation and the angular corrections may be modified according to the type of the weft yarn and weaving conditions.

[0045] Amethod illustrated by Fig. 9 sets a phase angle at which the third detection signal of the first yarn sensor 25 is provided as a specific phase angle, the motors 32 are actuated predetermined angles of rotation of the main shaft 37 after the specific phase angle, respectively, and the predetermined angles are changed according to the information about the traveling speed. The method, similarly to the method illustrated by Fig. 8, determines an actual angle through which the main shaft 37 rotates in a time between the second and the third pulse provided by the first yarn sensor 25 as infor-

mation about the traveling speed of the picked weft yarn 2, and the predetermined angles are changed to change the phase angles at which the motors 32 are to be started, respectively. The specific phase angle may be a phase angle at which the first yarn sensor 25 generates the second detection signal or a phase angle of 0° or 150°. A plurality of time periods corresponding to the values of the information about the traveling speed may be determined beforehand and a predetermined time period corresponding to the value of the information about the traveling speed may be selected instead of changing the predetermined time period by calculation.

[0046] Thus, the electric selvage device control method of controlling the electric selvage devices included in the air-jet loom detects the passage of a picked weft yarn by the predetermined position by the yarn sensor, and drives the electric selvage devices on the basis of the detection signal provided by the yarn sensor so as to close the selvage sheds of selvage yarns to grip the picked weft yarn.

[0047] Thus, the picked weft yarn is gripped by the selvage yarns always upon the arrival of the picked weft yarn at the optimum position even if the traveling speed of the picked weft yarn changes and the phase angle of the main shaft at which the electric selvage device operates to grip the picked weft yarn changes. The selvage yarns and the gripping operation of the selvage yarns do not obstruct the travel of the picked weft yarn because the selvage yarns grip the picked weft yarn upon the arrival of the picked weft yarn at the optimum position. The picked weft yarn can be surely prevented from slackening because the picked weft yarn can be gripped by the selvage yarns at the earliest possible phase angle of the main shaft. The selvage shed closing operation of the electric selvage device on the picking side grips the picked weft yarn by the selvage yarns to prevent slackening of the picked weft yarn by the yarn cutting action of the yarn cutter, and the selvage shed closing operation of the electric selvage device on the arriving side grips the picked weft yarn by the selvage yarns to prevent slackening by the warp shed closing operation and the beating motion, so that the air-jet loom does not need any weft yarn braking device and any weft yarn stretching nozzle.

[0048] The electronic selvage device control method drives the electric selvage device a predetermined time after the sensor has provided the detection signal, and the predetermined time is determined according to the predetermined position. Therefore, if the predetermined position is determined such that the predetermined time is short, error is reduced accordingly and the picked weft yarn can be gripped at the optimum position.

[0049] The speed information about the traveling speed of the picked weft yarn is determined on the basis of the detection signal provided by the sensor, and operation for driving the electric selvage device is timed according to the speed information. Therefore, the operation of the electric selvage device for gripping the picked weft yarn can be started upon the arrival of the leading end of the picked weft yarn at the optimum position even if the traveling speed of the picked weft yarn changes. Thus, the picked weft yarn is gripped by the selvage yarns always at the optimum position.

[0050] Both the electric selvage device on the picking side and the electric selvage device on the arriving side are driven for the selvage shed closing operation on the basis of the detection signal provided by the yarn sensor, and the electric selvage device on the picking side closes the selvage shed on the picking side before the electric selvage device on the arriving side closes the selvage shed on the arriving side, and before the leading end of the picked weft yarn arrives at a position corresponding to the edge, on the arriving side, of the fabric. Thus, the picked weft yarn is gripped by the selvage yarns on the picking side before the leading end of the picked weft yarn arrives at the position corresponding to the edge, on the arriving side, of the fabric, so that the traveling picked weft yarn is braked, is decelerated and is stopped. Consequently, the picked weft yarn is not excessively tensioned, is not broken and the quality of the fabric is not spoiled because the picking operation is stopped after the traveling speed of the picked weft yarn has been reduced.

[0051] The electric selvage device control method of controlling the electric selvage devices of the air-jet loom provided with the plurality of picking nozzles performs the selvage shed closing operation on the basis of the detection signal provided by the yarn sensor and the yarn type signal. Therefore, the gripping operation of the selvage yarns is performed in an early phase when it is known that friction between the picked weft yarn and the selvage yarns is low or the gripping operation of the selvage yarns is performed in a late phase when it is known that friction between the picked weft yarn and the selvage yarns is high. Thus, the selvage yarns do not obstruct the travel of the picked weft yarn because the selvage yarns grip the picked weft yarn after the picked weft yarn has traveled a sufficient distance.

[0052] In the electric selvage device control method according to the present invention, the respective selvage shed closing operations of the electric selvage device on the picking side and the electric selvage device on the arriving side are controlled on the basis of a single detection signal. Thus, both the electric selvage devices can be controlled by using the single yarn sensor.

[0053] In the electric selvage device control method according to the present invention, the passage of the leading end of the picked weft yarn by the predetermined position is detected directly. Thus, the passage of the picked weft yarn by the predetermined position can be accurately detected, and satisfactory control operations can be achieved.

[0054] In the electric selvage device control method according to the present invention, the passage of the picked weft yarn by the predetermined position is de-

tected through the measurement of the length of the weft yarn unwound from the yarn storage drum of the length-metering storage device. Thus, the predetermined position can be set close to the electric selvage device on the picking side, and hence a sufficient time is available for the control of the selvage shed closing operation of the electric selvage device.

[0055] In the electric selvage device control method according to the present invention, the passage of the picked weft yarn by the predetermined position is detected by the yarn sensor placed beside the edge, on the arriving side, of the fabric, and the electric selvage device performs the shed closing operation for the next weaving cycle upon the detection of passage of the picked weft yarn by the predetermined position. Thus, the selvage shed closing operation of the electric selvage device can be controlled without using any special sensor.

[0056] Although the invention has been described in its preferred embodiments with a certain degree of particularity, obviously many changes and variations are possible therein. It is therefore to be understood that the present invention may be practiced otherwise than as specifically described herein without departing from the scope and spirit thereof.

[0057] The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. An electric selvage device control method of controlling at least one electric selvage device (3) included in a fluid-jet loom (1), disposed on either a picking side from which a weft yarn (2) is inserted in a fabric or an arriving side at which a picked weft yarn (2) arrives of the fluid-jet loom (1), and driven independent of the operation of the fluid-jet loom (1) by a selvage device controller (20) for a selvage shed closing operation, said electric selvage device control method comprising:

   detecting the passage of a picked weft yarn (2) by a predetermined position by a sensor (25, 26, 27, 44, 45); and
   driving the electric selvage device (3) by the selvage device controller (20) on the basis of a detection signal provided by the sensor (25, 26, 27, 44, 45) so that a selvage shed of selvage yarns (17) is closed to grip the picked weft yarn (2).

2. The electric selvage device control method according to claim 1, wherein the electric selvage device is driven for the selvage shed closing operation a predetermined time after the sensor (25, 26, 27, 44, 45) has detected the passage of the picked weft yarn (2) by the predetermined position and has provided a detection signal.

3. The electric selvage device control method according to claim 1, wherein speed information about the traveling speed of the picked weft yarn (2) is obtained on the basis of the detection signal provided by the sensor (25, 26, 27, 44, 45), and an operation for driving the electric selvage device (3) is timed according to the speed information.

4. The electric selvage device control method according to any one of claims 1 to 3, wherein an electric selvage device (3) is disposed on the picking side, an electric selvage device (3) is disposed on the arriving side, both the electric selvage devices (3) are driven for a selvage shed closing operation for closing selvage sheds (18) of the selvage yarns (17) on the basis of the detection signal provided by the sensor (25, 26, 27, 44, 45), and the selvage shed (18) of the selvage yarns (17) on the picking side is closed earlier than that on the arriving side before the picked weft yarn (2) arrives at a position corresponding to an edge, on the arriving side, of the fabric (22).

5. The electric selvage device control method according to any one of claims 1 to 3, wherein air-jet-loom (1) is provided with a plurality of picking nozzles (6), and the selvage shed closing operation is controlled on the basis of the detection signal provided by the sensor (25, 26, 27, 44, 45) and a yarn type signal indicating the type of the picked weft yarn (2).

6. The electric selvage device control method according to any one of claims 1 to 3, wherein an electric selvage devices (3) are placed on the picking side and the arriving side of the fluid-jet loom (1), respectively, and both the electric selvage devices (3) are controlled for the selvage shed closing operation on the basis of a single detection signal.

7. The electric selvage device control method according to any one of claims 1 to 3, wherein the passage of the leading end of the picked weft yarn (2) by the predetermined position is detected.

8. The electric selvage device control method according to any one of claims 1 to 3, wherein the passage of the picked weft yarn (2) by the predetermined position is detected through the measurement of length of the weft yarn (2) unwound from a yarn storage drum (11) included in a length-metering storage device (5).

9. The electric selvage device control method accord-

ing to any one of claims 1 to 3, wherein the arrival of the picked weft yarn (2) at a predetermined position is detected by a sensor (27) placed near an edge, on the arriving side, of a fabric on the fluid-jet loom (1), and the electric selvage device (2) performs the selvage shed closing operation for the next weaving cycle upon the detection of arrival of the picked weft yarn (2) at the predetermined position.

FIG.1

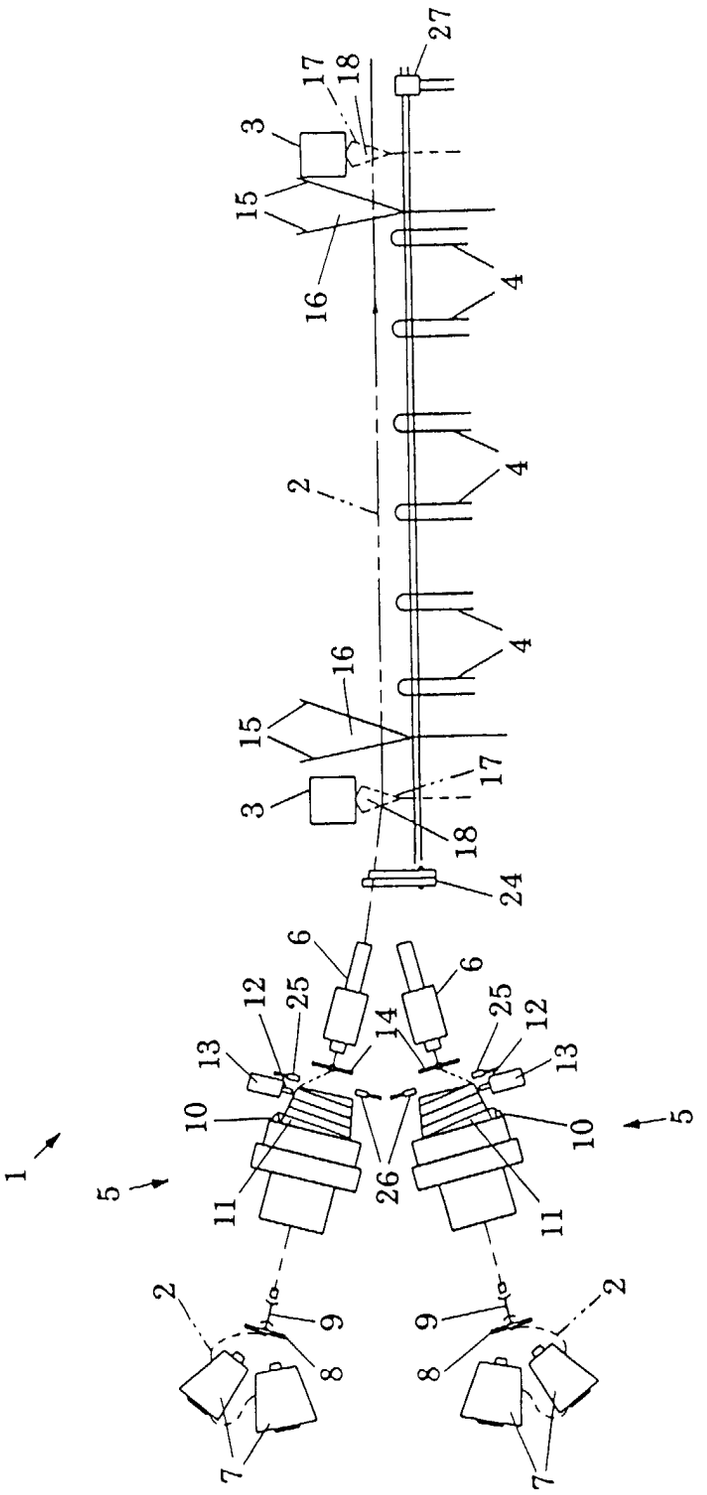


FIG.2

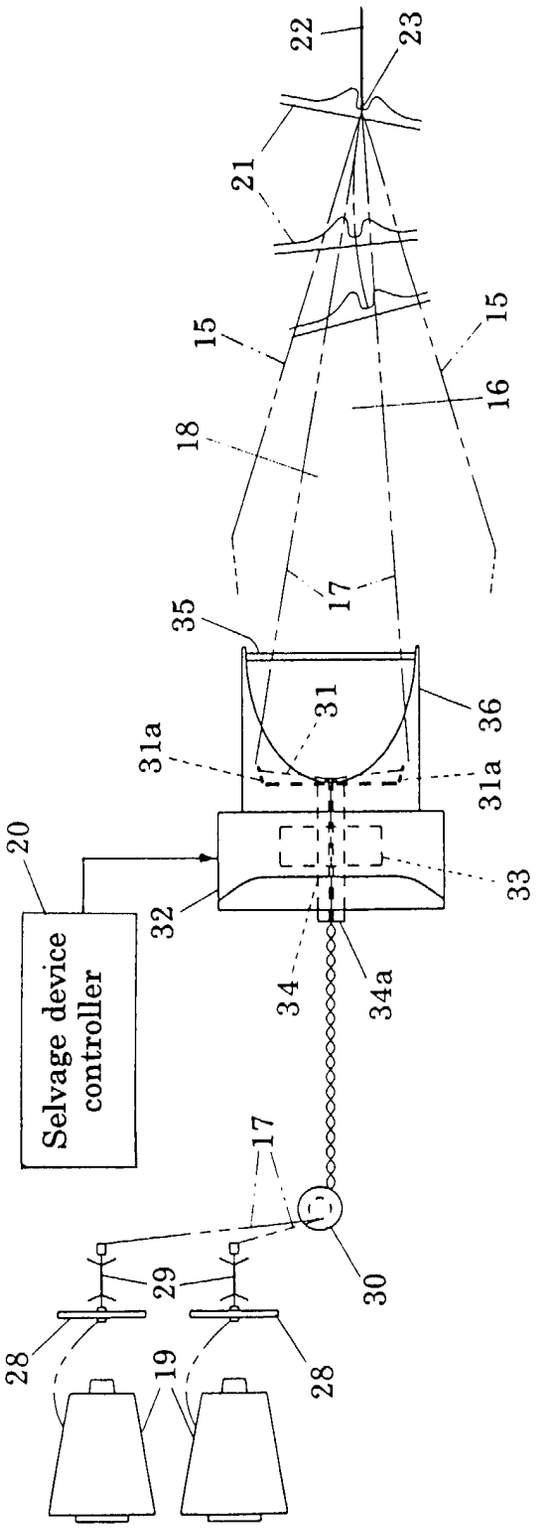

22
23
21
15
15
16
18
17
35
31
36
31a
31a
20
33
32
34
34a
Selvage device controller
17
29
30
28
19
28

FIG.3

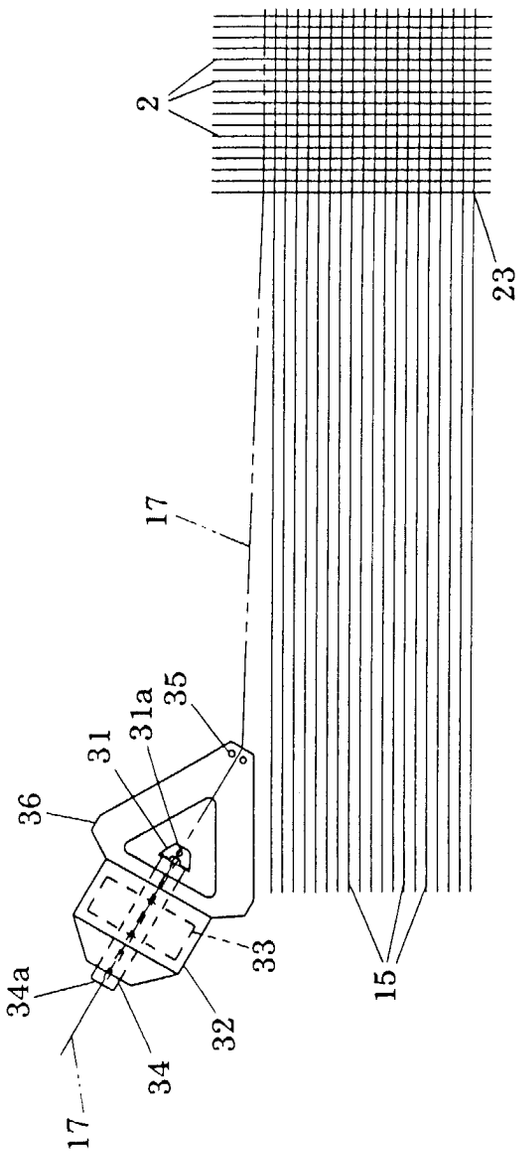


FIG.4

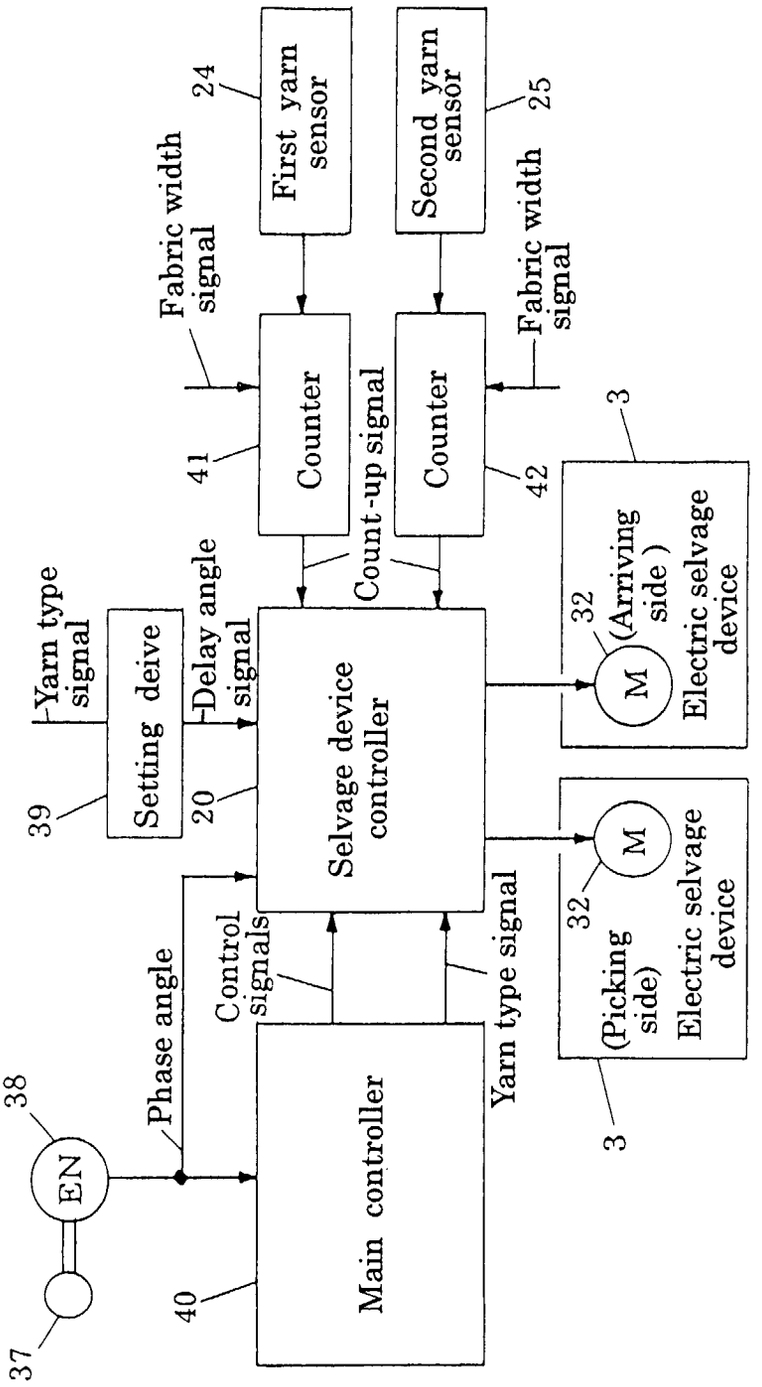

First yarn sensor
24
Second yarn sensor
25
Fabric width signal
Fabric width signal
Counter
41
Counter
42
Count-up signal
Yarn type signal
Delay angle signal
Setting deive
39
20
Selvage device controller
32
(Arriving side)
M
Electric selvage device
3
38
EN
37
Phase angle
Control signals
Main controller
40
Yarn type signal
32
(Picking side)
M
Electric selvage device
3

FIG.5

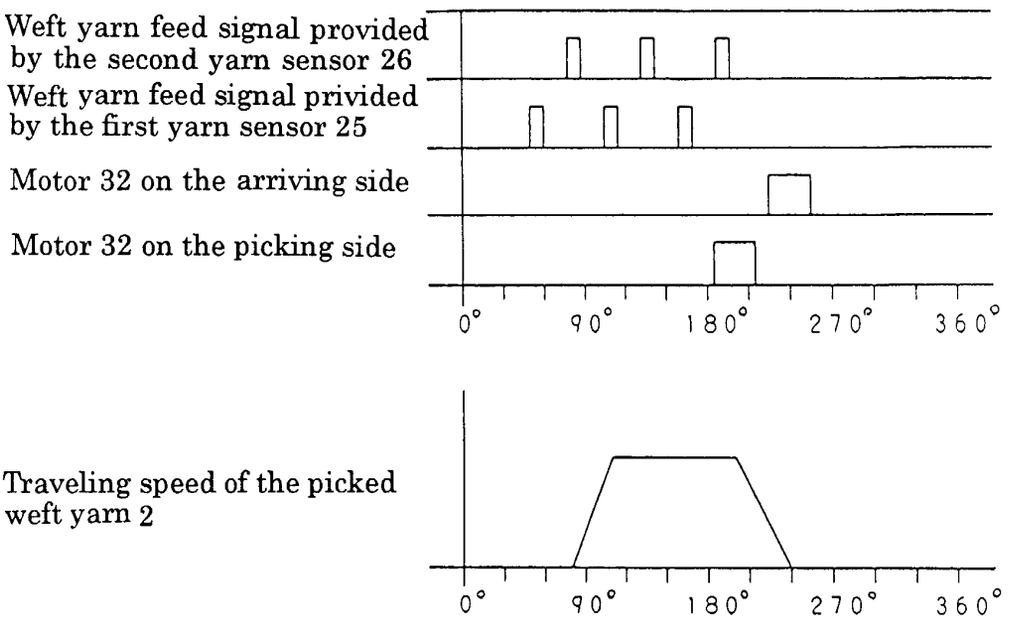

Weft yarn feed signal provided by the second yarn sensor 26
Weft yarn feed signal privided by the first yarn sensor 25
Motor 32 on the arriving side
Motor 32 on the picking side
0°
90°
180°
270°
360°
Traveling speed of the picked weft yarn 2
0°
90°
180°
270°
360°

FIG.6

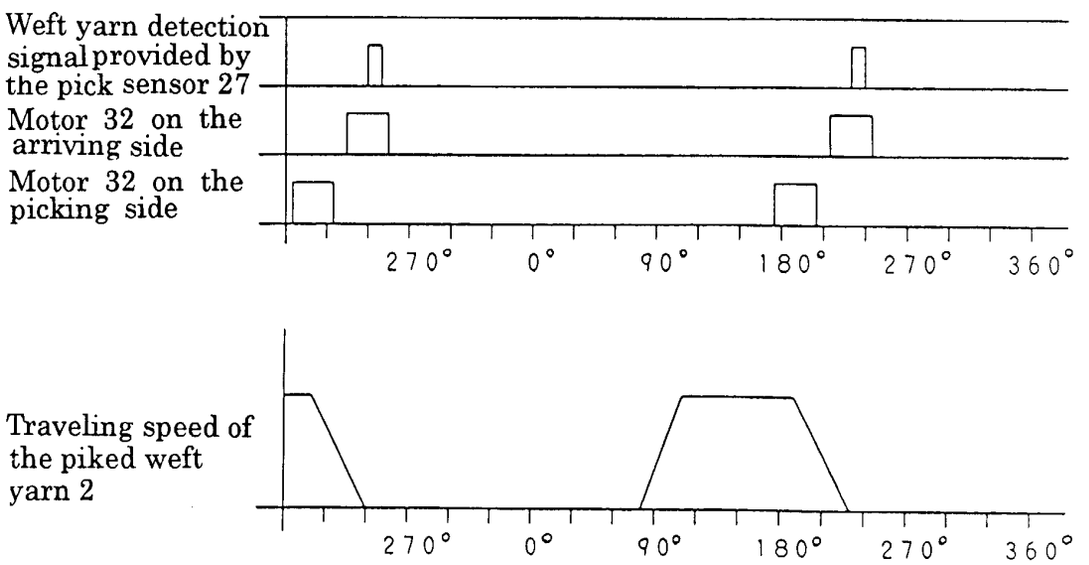

Weft yarn detection signal provided by the pick sensor 27
Motor 32 on the arriving side
Motor 32 on the picking side
270°
0°
90°
180°
270°
360°
Traveling speed of the piked weft yarn 2
270°
0°
90°
180°
270°
360°

FIG.7

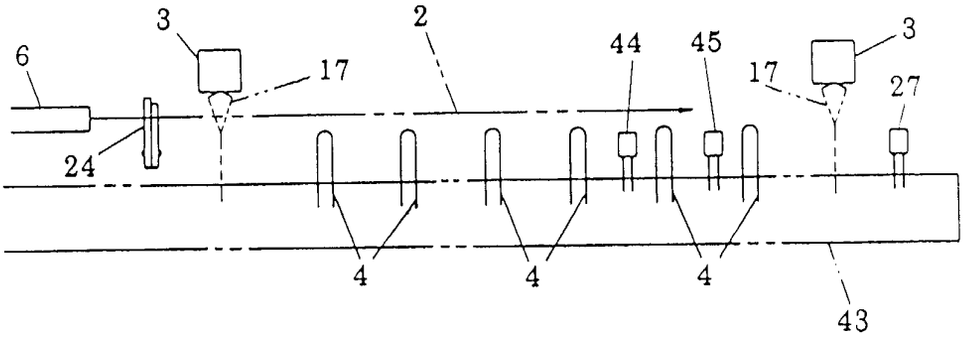

3
2
6
17
44
45
17
3
27
24
4
4
4
43

FIG.8

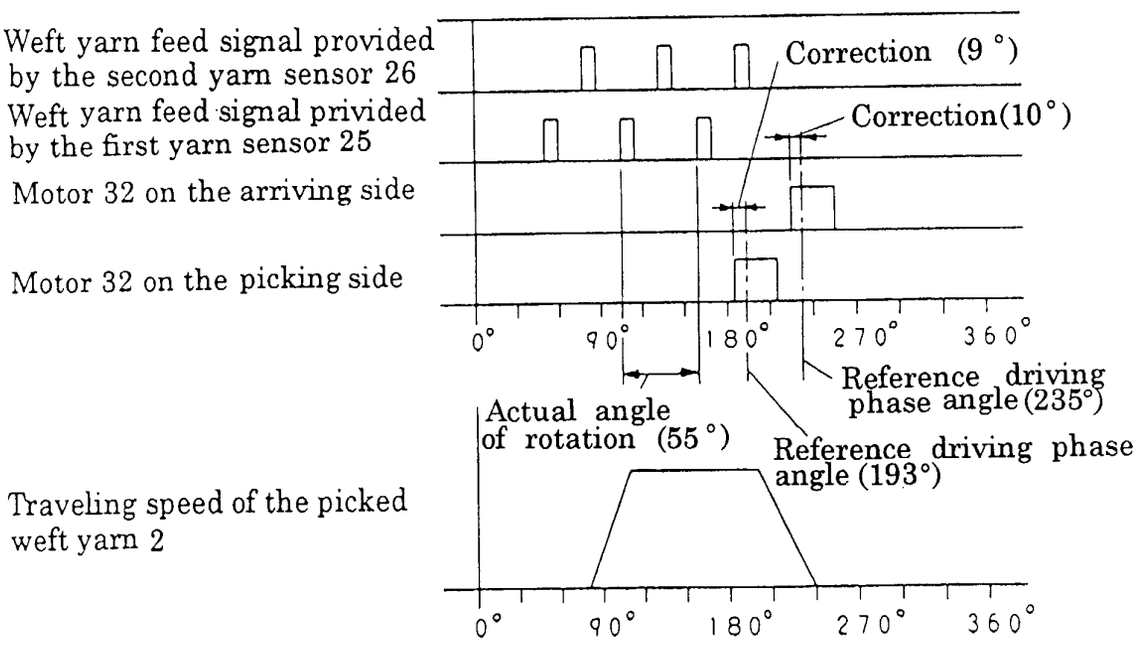
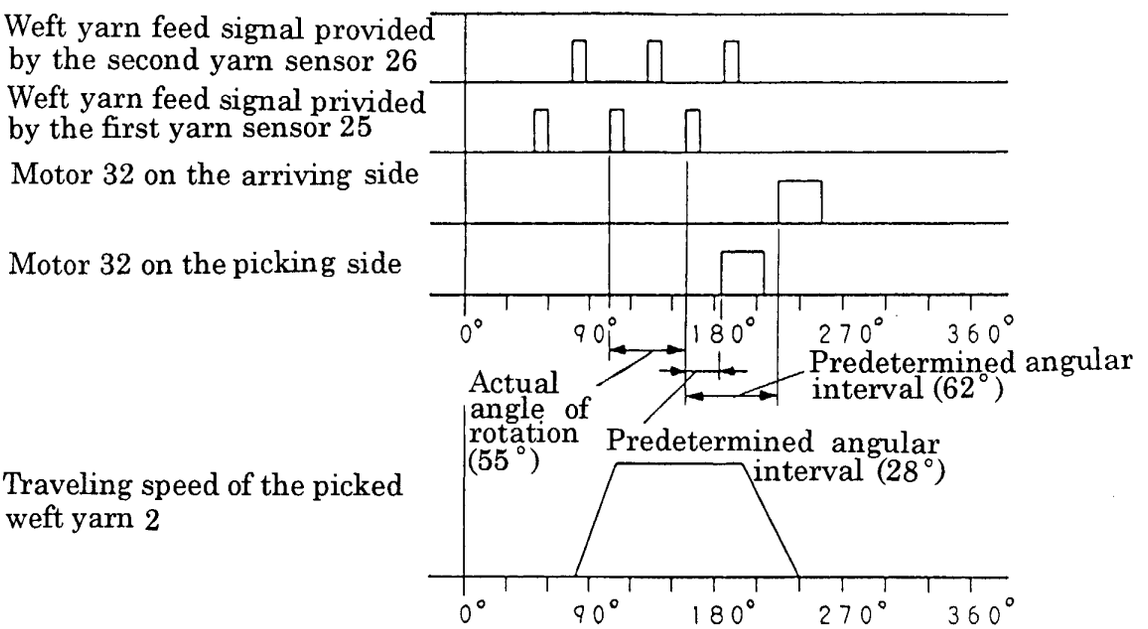

Weft yarn feed signal provided by the second yarn sensor 26
Weft yarn feed signal privided by the first yarn sensor 25
Motor 32 on the arriving side
Motor 32 on the picking side
Traveling speed of the picked weft yarn 2
Correction (9 °)
Correction(10°)
0°
90°
180°
270°
360°
Reference driving phase angle(235°)
Actual angle of rotation (55 °)
Reference driving phase angle (193°)

FIG.9


Weft yarn feed signal provided by the second yarn sensor 26
Weft yarn feed signal privided by the first yarn sensor 25
Motor 32 on the arriving side
Motor 32 on the picking side
0°
90°
180°
270°
360°
Actual angle of rotation (55°)
Predetermined angular interval (62°)
Predetermined angular interval (28°)
Traveling speed of the picked weft yarn 2
0°
90°
180°
270°
360°