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(54) **Selvage warp yarn break detection system**

(57) The operation of a loom is quickly stopped by automatically detecting a break of each of selvage warp yarns moving up and down for shedding so as to prevent fabric quality from being degraded due to formation of loose selvages, and so forth.

A selvage warp yarn break detection system (30) incorporated in a selvage device (1), comprises a selvage warp yarn sensor (16) provided at a predetermined position where the pair of the selvage warp yarns (2) can be detected, respectively, and a selvage warp yarn fault detection circuit (31) with an input terminal thereof, connected to an output terminal of the selvage warp yarn sensor (16), wherein the pair of the selvage warp yarns (2) that are caused to vertically move accompa-

nying a weaving operation are detected by the selvage warp yarn sensor (16), and a detection signal from the selvage warp yarn sensor (16) is delivered to the selvage warp yarn fault detection circuit (31), whereupon the selvage warp yarn fault detection circuit (31) compares a generation pattern of the detection signal from the selvage warp yarn sensor (16) at the time of a normal weaving operation with a generation pattern of the detection signal from the selvage warp yarn sensor (16) at the time of a faulty weaving operation, and the selvage warp yarn fault detection circuit (31) outputs the selvage warp yarn fault signal when those operation patterns differ from each other.

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Description

TECHNICAL FIELD

[0001] The present invention relates to a selvage warp yarn break detection system for automatically detecting respective breaks of selvage warp yarns in a selvage device of a loom.

BACKGROUND TECHNOLOGY

[0002] Control technology for a leno selvage device is disclosed in JP, H 7 - 258943, A. With the selvage device, a support gear coaxial with a sun gear is rotated by a drive gear, and a pair of planet gears rotatably attached to the support gear are engaged with the sun gear fixedly mounted on a loom base so as to be rotated through the intermediary of relay gears. A pair of yarn guides are fixedly attached to the planet gears, respectively, while yarn feed bobbins are rotatably supported by the planet gears, respectively. A tension arm energized by a spring is provided so as to be in contact with a selvage warp yarn between the respective yarn guides and respective yarn feed bobbins, thereby providing the selvage warp yarn with tension.

[0003] A pair of the selvage warp yarns leading from the yarn feed bobbins, respectively, are guided through the yarn guides corresponding to the yarn feed bobbins, respectively, to be connected to a cloth fell of a fabric. Upon rotation of the yarn guides due to rotation of the support gear, the pair of the selvage warp yarns pinch and hold a weft yarn, thereby forming a selvage of a leno weave at an edge of the fabric.

[0004] In case of occurrence of a yarn break due to complete consumption of the respective selvage warp yarns or due to a break of the respective selvage warp yarns, restraint imposed by contact between the tension arm and the respective selvage warp yarns will be eliminated, whereupon the tip of the tension arm is caused to rock and come into contact with a yarn break sensor, thereby detecting the yarn break.

[0005] As described above, the break of the respective selvage warp yarns is detected through the intermediary of the tension arm, however, there can be a case where the tension arm falls in a state of malfunctioning due to adhesion of size, an oily agent, nap, etc. to the respective selvage warp yarns, resulting in erroneous detection. In such a case, fabric quality is impaired. Further, because the tension arm is rotated in conjunction with the respective planet gears, there is a risk of the tension arm malfunctioning due to centrifugal force acting thereon, thereby stopping the operation of a loom. Furthermore, there can be a case where the tension of the selvage warp yarn unwinding from the respective yarn feed bobbin changes, causing the tension arm to rock considerably. In such a case, the tension arm will come into contact with the yarn break sensor, which is erroneously detected as a yarn break. The

break of the respective selvage warp yarns occur mostly between the respective yarn guides and the cloth fell due to friction accompanying contact between the respective selvage warp yarns and a weft yarn at the time of picking and beating up. In that case, however, it takes time before a drop in the tension due to the break of the respective selvage warp yarns reaches the tension arm through the respective yarn guides to cause the tension arm to move, thereby enabling the break to be detected. Such delay in stopping the operation of the loom results in a loose selvage, thereby impairing fabric quality.

DISCLOSURE OF THE INVENTION

[0006] It is therefore an object of the invention to automatically detect respective breaks of selvage warp yarns moving up and down in shedding so as to quickly stop the operation of a loom, thereby preventing fabric quality from being degraded due to the formation of loose selvages, and so forth.

[0007] To that end, the invention provides in its first aspect a selvage warp yarn break detection system incorporated in a selvage device, and with the selvage warp yarn break detection system, a selvage warp yarn sensor is provided at a predetermined position where the pair of the selvage warp yarns can be detected, respectively, an output terminal of the selvage warp yarn sensor is connected to an input terminal of a selvage warp yarn fault detection circuit, the pair of the selvage warp yarns vertically moving accompanying a weaving operation are detected, respectively, by the selvage warp yarn sensor, and a detection signal from the selvage warp yarn sensor is delivered to the selvage warp yarn fault detection circuit, whereupon the selvage warp yarn fault detection circuit outputs a selvage warp yarn fault signal when a generation pattern of the detection signal differs from a generation pattern of the detection signal from the selvage warp yarn sensor at the time of a normal weaving operation.

[0008] More specifically, the selvage warp yarn break detection system according to the invention, incorporated in the selvage device for vertically moving a pair of selvage warp yarns, fed from a yarn feeder and connected to a cloth fell, by motion of yarn guides to thereby open and close a shed, and for holding an end of a weft yarn, comprises the selvage warp yarn sensor provided at the predetermined position where the pair of the selvage warp yarns can be detected, respectively, and the selvage warp yarn fault detection circuit with the input terminal thereof connected to the output terminal of the selvage warp yarn sensor, wherein the pair of the selvage warp yarns that are caused to vertically move accompanying the weaving operation are detected, respectively, by the selvage warp yarn sensor, and the detection signal from the selvage warp yarn sensor is delivered to the selvage warp yarn fault detection circuit, whereupon the selvage warp yarn fault detection circuit compares the generation pattern of the detection signal

from the selvage warp yarn sensor at the time of the normal weaving operation with the generation pattern of the detection signal from the selvage warp yarn sensor at the time of a faulty weaving operation, and the selvage warp yarn fault detection circuit outputs the selvage warp yarn fault signal when those operation patterns differ from each other.

[0009] The invention further provides in its second aspect a selvage warp yarn break detection system, incorporated in a selvage device for vertically moving a pair of selvage warp yarns, fed from a yarn feeder and connected to a cloth fell, by motion of yarn guides to thereby open and close a shed, and for holding an end of a weft yarn, comprising a selvage warp yarn sensor provided at a predetermined position, having detection regions extending in upper and lower direction directions, respectively, and a selvage warp yarn fault detection circuit with an input terminal thereof, connected to an output terminal of the selvage warp yarn sensor, wherein a pair of selvage warp yarns that are caused to vertically move accompanying a weaving operation are detected, respectively, by the selvage warp yarn sensor, and a detection signal from the selvage warp yarn sensor is delivered to the selvage warp yarn fault detection circuit, whereupon the selvage warp yarn fault detection circuit outputs a selvage warp yarn fault signal when a generation pattern of the detection signal from the selvage warp yarn sensor in a time period to detect the respective selvage warp yarns differs from a generation pattern of the detection signal from the selvage warp yarn sensor at the time of a normal weaving operation.

[0010] With these features, the selvage device may form a selvage of a leno weave, the pair of the yarn guides may be disposed so as to oppose each other with a warp line interjacent therebetween, centering substantially around the warp line, and the selvage warp yarns may be inserted through the yarn guides, respectively, from the yarn feeder fixedly attached to the loom base.

[0011] With the selvage warp yarn break detection system of the selvage device, according to the first or second aspect of the invention, the selvage device may be a leno selvage device provided with planet gears, the pair of yarn guides may be rotated substantially around a warp line and shifted by a planetary gear mechanism, and may be disposed so as to oppose each other with the warp line interjacent therebetween while the yarn feeder may be shifted in conjunction with the respective yarn guides.

[0012] Further, the selvage warp yarn sensor preferably detects respective portions of the selvage warp yarns, located between the respective yarn guides and the cloth fell, and may be made up of a photoelectric non-contact sensor or a piezoelectric contact sensor.

[0013] Further, the selvage warp yarn fault detection circuit may outputs the selvage warp yarn fault signal when the number of selvage warp yarn detections by the selvage warp yarn sensor during a predetermined

time period in a weaving cycle or within predetermined time from a predetermined time in the weaving cycle is less than that at the time of the normal weaving operation. Alternatively, the selvage warp yarn fault detection circuit may detect an interval between the selvage warp yarn detections, and when the respective selvage warp yarns are not detected by the selvage warp yarn sensor within predetermined time or during a predetermined time period in the weaving cycle, the selvage warp yarn fault detection circuit may output the selvage warp yarn fault signal.

[0014] Still further, the time period to detect the respective selvage warp yarns may be a whole period of one weaving cycle, and the detection regions may contain each upper and lower movement regions of the respective selvage warp yarns.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a side view of a selvage device;
 Fig. 2 is a plan view of the selvage device;
 Fig. 3 is an expanded front view of the principal part of the selvage device;
 Fig. 4 is a block diagram of a control system of a drive motor;
 Fig. 5 is a schematic representation showing various stages of a weaving operation and a signal, in relation to a phase angle of a main shaft of the selvage device;
 Fig. 6 is an expanded front view of the principal part of the selvage device with reference to another embodiment of the invention;
 Fig. 7 is a block diagram of a control system of a drive motor with reference to the embodiment shown in Fig. 6;
 Fig. 8 is a schematic representation with reference to the embodiment shown in Fig. 6, showing various stages of a weaving operation and signals, in relation to a phase angle of a main shaft of the selvage device;
 Fig. 9 is an expanded front view of the principal part of the selvage device with reference to still another embodiment of the invention;
 Fig. 10 is a block diagram of a control system of a drive motor with reference to the embodiment shown in Fig. 9;
 Fig. 11 is a schematic representation with reference to the embodiment shown in Fig. 9, showing various stages of a weaving operation and a signal, in relation to a phase angle of a main shaft of the selvage device; and
 Fig. 12 is an expanded front view of the principal part of the selvage device with reference to yet another embodiment of the invention;

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] Figs. 1 through 3 show an electric selvage device 1 driven by a dedicated motor by way of example. The electric selvage device 1 is normally installed on a yarn feeding side and a yarn arriving side, respectively, however, in these figures, the electric selvage device 1 installed only on one side is shown by way of example.

[0017] With the electric selvage device 1 shown in Figs. 1 through 3, a pair of selvage warp yarns 2 are drawn from yarn packages 3, respectively, and are led through respective balloon breakers 4, respective tensors 5, respective eyelets 6a, and a guide 6b, to be pulled into a yarn guide bore 8a at the axial center of a rotating shaft 8. Herein, the yarn packages 3 for the respective selvage warp yarns, the balloon breakers 4, the tensors 5, the eyelets 6a, and the guide 6b are fixedly attached to a loom base 18, thereby make up a yarn feeder 7.

[0018] Breaks of the respective selvage warp yarns 2, occurring inside the yarn feeder 7, are detected by respective yarn feed sensors 9a, 9b, disposed between the eyelets 6a and the guide 6b, and in contact with the respective selvage warp yarns 2. The yarn feed sensors 9a, 9b are made up of, for example, a microswitch, respectively, and are in contact with the respective selvage warp yarns 2 corresponding thereto, through the intermediary of respective adjustable pieces thereof.

[0019] Two lengths of the selvage warp yarns 2 are parted from each other on the outlet side of the yarn guide bore 8a at the axial center of the rotating shaft 8, and are guided, respectively, to a pair of yarn guides 11 disposed at respective ends of a rotating arm 10 in propeller-like shape, integral with the rotating shaft 8, before passing through two guide pins 12, thereby reaching a cloth fell 14 of a fabric 13. The rotating shaft 8 doubles as a shaft of a motor rotor 15a of a drive motor 15. The drive motor 15 is mounted on the loom base 18 with a motor bracket 17, and a fixture bolt 17a tightened up through a vertically slender fixture hole 17b, such that its position can be freely adjustable, and is driven in synchronization with weaving motion by an electric selvage device controller 20 shown in Fig. 4.

[0020] The rotating arm 10 thereby twists the two lengths of the selvage warp yarns 2 while pinching an end of a weft yarn 19 between the two lengths of the selvage warp yarns 2 to form a selvage of a leno weave, holding the end of the weft yarn 19. The weft yarn 19 is picked into a shed 23 formed by upper and lower warp yarns 22 and the selvage warp yarns 2, positioned on the upper and lower sides, respectively, and is beaten up into the cloth fell 14 of the fabric 13 by a reed 24.

[0021] In this connection, the rotating arm 10 is made of a thin metal sheet that is flexible. The two guide pins 12 are held by a guide pin holder 25, and permit the two lengths of the selvage warp yarns 2 to pass there-through and to effect shedding with the selvage warp yarns 2 by the rotation of the rotating arm 10, concur-

rently restraining the respective positions of the selvage warp yarns 2, in the direction of a weaving width. When the rotating arm 10 is in a posture perpendicular to the plane of the fabric 13, the two lengths of the selvage warp yarns 2 form the shed 23 at its maximum, and when the rotating arm 10 is rotated so as to be in a posture parallel with the plane of the fabric 13, the two lengths of the selvage warp yarns 2 close the shed 23, which remains in a closed state.

[0022] Now, the rotating shaft 8, the rotating arm 10 fixedly attached to an end of the rotating shaft 8, on the cloth fell 14 side thereof, and having the pair of the yarn guides 11, the drive motor 15 for driving the rotating arm 10, and the electric selvage device controller 20 for controlling rotation of the drive motor 15 make up a yarn guide drive 21.

[0023] Thus, the electric selvage device 1 is configured such that the pair of the yarn guides 11 are rotated around the rotating shaft 8 substantially on a warp line by causing the drive motor 15 of the yarn guide drive 21 to rotate intermittently on the basis of 180° increments in every weaving cycle on the yarn feeding side of the cloth fell 14 side of the fabric 13 so as to twist the pair of the selvage warp yarns 2, thereby holding the end of the weft yarn 19 with respective twisted parts of the two lengths of the selvage warp yarns 2. Needless to say, the pair of the selvage warp yarns 2 are fed from a pair of the yarn packages 3 of the yarn feeder 7, respectively, and are connected to the cloth fell 14 of the fabric 13.

[0024] Respective breaks of the selvage warp yarns 2, occurring in the vicinity of the yarn guide drive 21, are detected by a selvage warp yarn sensor 16 of a non-contact type, attached to the guide pin holder 25. The selvage warp yarn sensor 16 is, for example, an optical sensor comprising a light projector 16a and an optical receiver 16b. In the case of this example, the light projector 16a and the optical receiver 16b are disposed so as to oppose each other on a plane orthogonal to the rotating shaft 8, and respective detection regions thereof are formed so as to contain a portion of upper and lower movement regions, respectively, of the pair of the selvage warp yarns 2 moving up and down.

[0025] Fig. 4 is a block diagram showing mutual connection of the electric selvage device controller 20 for controlling the drive motor 15, a selvage warp yarn break detection system 30 as the principal part of the invention, and a main controller 29 and so forth, disposed on the periphery of the selvage warp yarn break detection system 30.

[0026] In Fig. 4, the main controller 29 drives a main shaft 27 of the loom by rotating a main motor 26, and executes control necessary for operation of the loom by detecting a phase angle of the main shaft 27 of the loom and a loom stoppage condition on the basis of an output of an encoder 28. Besides, the main controller 29 controls an operating condition of the electric selvage device controller 20 by capturing a signal for occurrence of a yarn break from the electric selvage device control-

ler 20. A phase angle signal, as the output of the encoder 28, is used to designate a period from a time at, for example, 60° in a weaving cycle to a time at 60° in the next weaving cycle as a predetermined time period in a weaving cycle or predetermined time from a predetermined time in the weaving cycle. The encoder 28 thereby sends out a detection start signal and a detection completion signal to a selvage warp yarn fault detection circuit 31 for identifying the predetermined time period or the predetermined time in order to detect a selvage warp yarn fault.

[0027] The electric selvage device controller 20 drives the drive motor 15 during weaving, and intermittently rotates the drive motor 15 by a half-turn (in 180° increments) at every picking (in one weaving cycle). As a result, the pair of the yarn guides 11 are rotated in 180° increments and shifted, thereby forming the shed 23 with the upper and lower selvage warp yarns 2. The upper and lower selvage warp yarns 2 are caused to cross the weft yarn 19 as picked, and subsequently, are caused to close the shed 23. The weft yarn 19 being gripped by the upper and lower selvage warp yarns 2 without slackening is beaten up into the cloth fell 14 by the reed 24. Thus, the two lengths of the selvage warp yarns 2 form a selvage of a leno weave at the cloth fell 14, and grip the end of the weft yarn 19 with portions thereof, within the selvage of the leno weave, thereby preventing the weft yarn 19 from slackening.

[0028] Since respective portions of the selvage warp yarns 2, on the yarn feeding side of the yarn guides 11, are twisted by the rotation of the yarn guides 11, the electric selvage device controller 20 periodically changes a rotation direction of the drive motor 15, thereby eliminating twist of the selvage warp yarns 2. Accordingly, a counter 32 counts the number of half-turns of the drive motor 15, and the rotation direction of the drive motor 15 is caused to be reversed every time when a count value of the number of the half-turns is in agreement with a predetermined number of twists on the yarn feeding side, thereby periodically changing a direction of each twist so as to prevent breaks of the selvage warp yarns 2, respectively, due to twisting thereof.

[0029] The selvage warp yarn sensor 16 detects motion of the selvage warp yarns 2 accompanying rotation and shift thereof during weaving, and generates a detection signal every time when presence of the respective selvage warp yarns 2 is detected, outputting the detection signal to the selvage warp yarn fault detection circuit 31. The selvage warp yarn fault detection circuit 31 has a counter function, and counts the number of the detection signals during a detection period based on the detection start signal and the detection completion signal from the encoder 28.

[0030] Fig. 5 is a schematic representation showing picking, motor rotation (the rotation of the drive motor 15), selvage warp yarn detection (the detection signal of the respective selvage warp yarns 2 by the selvage warp yarn sensor 16) during the detection period, and

a selvage warp yarn fault signal (an output signal of the selvage warp yarn fault detection circuit 31) in relation to a phase angle (time) of the main shaft 27 as indicated on the horizontal axis.

[0031] In the case of an example shown in Fig. 5, the detection start signal and the detection completion signal coincide with each other, both being at the phase angle of 60°. Upon the phase angle signal received from the encoder 28 reaching 60°, the selvage warp yarn fault detection circuit 31 stops counting the number of the detection signals of the respective selvage warp yarns 2 by the selvage warp yarn sensor 16 during a preceding detection period by use of the counter function thereof, and resets the number of counts at that point in time, simultaneously starting to count the number of the detection signals of the respective selvage warp yarns 2 by the selvage warp yarn sensor 16 during a succeeding detection period.

[0032] In the case where the number of counts by the selvage warp yarn fault detection circuit 31 is in agreement with a predetermined value in the respective detection periods, the selvage warp yarn fault detection circuit 31 determines that there is no fault with the respective selvage warp yarns 2, so that the selvage warp yarn fault signal is not sent out. However, if the number of counts by the selvage warp yarn fault detection circuit 31, in a certain detection period, is less than the predetermined value, that is, when the number of counts is "1" in Fig. 5, the selvage warp yarn fault detection circuit 31 determines that breaks of the selvage warp yarns 2, respectively, have occurred, thereby sending out the selvage warp yarn fault signal to the electric selvage device controller 20. Hereupon, the electric selvage device controller 20 sends out a signal for stopping the loom to the main controller 29 on the ground of the occurrence of the breaks. Consequently, the main controller 29 stops the loom immediately at this point in time.

[0033] With this example, since the yarn guides 11 are rotated in 180° increments at every picking, the predetermined value for the number of the counts becomes "2". At the time of reverse rotation of the yarn guides 11, for eliminating the twist of the selvage warp yarns 2, occurring on the yarn feeding side, an initial reverse rotation is a full-turn instead of a half-turn in order to maintain gripping of the weft yarn 19, so that the number of the counts becomes "4", which is not less than "2". Hence, this is not detected as a case of a yarn break.

[0034] Thus, the selvage warp yarn fault detection circuit 31 compares a generation pattern of the detection signal from the selvage warp yarn sensor 16 at the time of a normal weaving operation with that of the detection signal from the selvage warp yarn sensor 16 at the time of a faulty weaving operation, and outputs the selvage warp yarn fault signal when the respective generation patterns differ from each other, that is, the numbers of the counts of the detection signals from the selvage warp yarn sensor 16, in respective cases, differ from each other.

[0035] Respective breaks of the selvage warp yarns 2, occurring between the cloth fell 14 and the yarn guides 11, and between the yarn guides 11 and an end of the rotating shaft 8 of the drive motor 15, on the cloth fell 14 side thereof, respectively, are detected by the selvage warp yarn sensor 16 while respective breaks of the selvage warp yarns 2, occurring upstream of the guide 6b, are detected by the two yarn feed sensors 9a, 9b, of a contact type, respectively. Needless to say, upon detection of respective breaks of the selvage warp yarns 2 by the yarn feed sensor 9a, or 9b, respectively, the electric selvage device controller 20 sends out a signal for occurrence of the respective breaks to the main controller 29, whereupon the main controller 29 stops the operation of the loom immediately

[0036] Next, with another embodiment shown in Figs. 6 and 7, a selvage warp yarn sensor 16 comprises a first selvage warp yarn sensor 16c of a piezoelectric element type, and a second selvage warp yarn sensor 16d of a piezoelectric element type, both of which are embedded substantially in centers of a pair of guide pins 12, respectively, so as to oppose each other, while a selvage warp yarn fault detection circuit 31 comprises a first timer circuit 31a and a second timer circuit 31b. The first timer circuit 31a and the second timer circuit 31b correspond to the first selvage warp yarn sensor 16c, and the second selvage warp yarn sensor 16d, respectively.

[0037] Fig. 8 is a schematic representation with reference to the embodiment shown in Figs. 6 and 7, showing picking, motor rotation (the rotation of a drive motor 15), first selvage warp yarn detection (a detection signal of a selvage warp yarn 2 by the first selvage warp yarn sensor 16c), first timer circuit output (a selvage warp yarn fault signal from the first timer circuit 31a), second selvage warp yarn detection (a detection signal of the selvage warp yarn 2 by the second selvage warp yarn sensor 16d), and second timer circuit output (a selvage warp yarn fault signal from the second timer circuit 31b), in relation to a phase angle (time) of a main shaft 27 indicated on the horizontal axis.

[0038] With this example, detection time is set to 150 ms, longer than a time period for one cycle of respective weaving operations. When the first timer circuit 31a and the second timer circuit 31b receive respective detection signals of the first selvage warp yarn sensor 16c, and the second selvage warp yarn sensor 16d, corresponding to the first timer circuit 31a and the second timer circuit 31b, respectively, the first timer circuit 31a and the second timer circuit 31b reset their own timer functions, respectively, thereby starting to count time. If no detection signal is received within the detection time (150 ms), it is deemed that there have occurred breaks of the selvage warp yarns, respectively, and the selvage warp yarn fault signal is sent out to an electric selvage device controller 20.

[0039] Now, in the case of still another embodiment shown in Fig. 9, a selvage warp yarn sensor 16 is an optical sensor comprising a light projector 16a and an

optical receiver 16b, both of which are in slender form, and are disposed so as to be in parallel with, and to be opposed to two guide pins 12, respectively. The selvage warp yarn sensor 16 (both the light projector 16a and the optical receiver 16b) has detection regions in the shape of an ellipse, longer in the vertical direction, containing upper and lower movement regions of selvage warp yarns 2, respectively.

[0040] Fig. 10 corresponds to the embodiment shown in Fig. 9, having a configuration substantially the same as that of the device shown in Fig. 4, however, in this case, a selvage warp yarn fault detection circuit 31 has a comparator function, and detects a level (an output signal level) of a received light quantity from the optical receiver 16b, as a generation pattern of a detection signal, all the time without limiting a detection period, thereby comparing the level of the received light quantity with a predetermined threshold value.

[0041] As shown in Fig. 11, upon occurrence of breaks of the selvage warp yarns 2, respectively, the level of the received light quantity of the selvage warp yarn sensor 16 becomes higher than the threshold value, and consequently, the selvage warp yarn fault detection circuit 31 deems that a break has occurred to the respective selvage warp yarns 2, thereby sending out a selvage warp yarn fault signal to an electric selvage device controller 20. In this case, if a pair of the selvage warp yarns 2 overlap each other when a shed is closed, the received light quantity of the selvage warp yarn sensor 16 jumps for an instant, however, since this phenomenon lasts for very short time, and the optical receiver 16b does not detect an instantaneous large change in the level of the received light quantity through adjustment of the response characteristics of the optical receiver 16b, so that an erroneous assumption will not be made that the break has occurred to the respective selvage warp yarns 2.

[0042] Yet another embodiment shown in Fig. 12 represents an example where a break occurring to respective selvage warp yarns 2, between respective yarn packages 3 and a pair of yarn guides 11, and a break occurring to the respective selvage warp yarns 2, between the respective yarn guides 11 and a cloth cell 14, due to full consumption of the respective selvage warp yarns 2, are detected by a selvage warp yarn sensor 16 (a light projector 16a and an optical receiver 16b). In the case of this example, the selvage warp yarn sensor 16 (the light projector 16a and the optical receiver 16b) is disposed in the vicinity of locations where the yarn guides 11 are rotated and shifted, respectively. The effect of a break occurring to the respective selvage warp yarns 2, occurring between the respective yarn packages 3 and the cloth cell 14, ripples through respective portions of the selvage warp yarns 2, located at the position of the selvage warp yarn sensor 16 (the light projector 16a and the optical receiver 16b), and are thereby detected by the selvage warp yarn sensor 16 (the light projector 16a and the optical receiver 16b). Accordingly,

with this example, yarn feed sensors 9a, 9b become unnecessary, and are therefore omitted.

[0043] Further, in Fig. 12, during the orbital motions of a pair of planet gears, respectively, the pair of the yarn guides 11 are rotated on their own axes in a direction reverse to the direction of the orbital motions of the pair of the planet gears by a planetary gear mechanism 33.

[0044] In Fig. 12, a drive motor 15 is mounted on a base 34, and a drive gear 35 of the drive motor 15 is engaged with a large slave gear 36. The slave gear 36 is freely rotatable around a support shaft 37 mounted on the base 34 by the agency of bearings 38, supporting a pair of relay gears 41, the pair of the planet gears 42, and both a pair of yarn feed bobbins 43 and the pair of the yarn guides 11, integral with the pair of the planet gears 42, respectively, with shafts 39, 40, four in total, disposed at the side of the slave gear 36, respectively.

[0045] A sun gear 44 fixedly attached to the support shaft 37 is sequentially engaged with the relay gears 41, and the planet gears 42. The numbers of teeth of the sun gear 44, the relay gears 41, and the planet gears 42, respectively, are set such that the respective planet gears 42, and both the yarn feed bobbins 43 and the pair of the yarn guides 11, integral with the respective planet gears 42, are rotated a full-turn on respective axes while the slave gear 36 is revolved a half-turn around the sun gear 44. The drive motor 15 is continuously rotated, thereby causing the slave gear 36 to revolve in the same direction by a half-turn in every weaving cycle. As a result, the pair of the yarn guides 11 causes selvage warp yarns 2 to open and close a shed at the time of every picking, and to grip an end of a weft yarn 19, thereby forming a selvage weave.

[0046] Now, the effects of the invention are described hereinafter.

[0047] In accordance with the first aspect of the invention, with the selvage warp yarn break detection system incorporated in the selvage device, the pair of the selvage warp yarns that are caused to vertically move accompanying the weaving operation are detected, respectively, by a selvage warp yarn sensor, and the detection signal from the selvage warp yarn sensor is delivered to the selvage warp yarn fault detection circuit, whereupon the selvage warp yarn fault detection circuit compares the generation pattern of the detection signal from the selvage warp yarn sensor at the time of the normal weaving operation with the generation pattern of the detection signal from the selvage warp yarn sensor at the time of the faulty weaving operation, and when these operation patterns differ from each other, the selvage warp yarn fault detection circuit outputs the selvage warp yarn fault signal. With such a configuration as described, the detection regions of the selvage warp yarn sensor are always fixed at positions including those of a predetermined height, so that even if the detection regions of the selvage warp yarn sensor become narrower due to vertical movement of the selvage warp yarns, the respective selvage warp yarns can be detect-

ed with certainty. More specifically, at the time of the normal weaving operation, it is possible to detect the respective selvage warp yarns that vertically move in linkage with operation of the loom, and at the time of a yarn break, it is possible to detect only an unbroken selvage warp yarn at the position of the predetermined height with certainty. Accordingly, at the time of the yarn break, the selvage warp yarn fault detection circuit that receives the detection signal from the selvage warp yarn sensor can detect with certainty the generation pattern differing from the generation pattern at the time of the normal weaving operation, thereby accurately outputting the selvage warp yarn fault signal. Further, because the respective selvage warp yarns are detected without interposition of constituent members of the selvage warp yarn sensor, which displacement is restrained by being always in contact with the respective selvage warp yarns while being shifted in conjunction with the yarn guides, restraint on the displacement, imposed by the selvage warp yarns, being eliminated upon occurrence of a yarn break, it is possible to prevent erroneous detection due to faulty action or malfunction of the constituent members of the selvage warp yarn sensor.

[0048] In accordance with the second aspect of the invention, the selvage warp yarn break detection system incorporated in the selvage device, comprises the selvage warp yarn sensor provided at the predetermined position, having detection regions extending in upper and lower directions, respectively, and the selvage warp yarn fault detection circuit with the input terminal thereof, connected to the output terminal of the selvage warp yarn sensor, wherein the pair of selvage warp yarns that are caused to vertically move accompanying the weaving operation are detected, respectively, by the selvage warp yarn sensor, and the detection signal from the selvage warp yarn sensor is delivered to the selvage warp yarn fault detection circuit, whereupon the selvage warp yarn fault detection circuit outputs the selvage warp yarn fault signal when the generation pattern of the detection signal from the selvage warp yarn sensor in the time period to detect the respective selvage warp yarns differs from the generation pattern of the detection signal from the selvage warp yarn sensor at the time of the normal weaving operation. With such a configuration as described, since the selvage warp yarn sensor is fixedly mounted on the loom base, and provided at the predetermined position, the detection regions of the selvage warp yarn sensor are fixed, thereby enabling stable detection to be implemented. Further, in the preset time period to detect the respective selvage warp yarns, or in the case of the detection regions containing entire upper and lower movement regions of the respective selvage warp yarns, the generation pattern, such as a signal level etc., of the detection signal is always monitored, and when the generation pattern differs from that at the time of the normal weaving operation, the selvage warp yarn fault signal is sent out.

[0049] With these features, the selvage device may

form the selvage of the leno weave, the pair of the yarn guides may be disposed so as to oppose each other with the warp line interjacent therebetween, centering substantially around the warp line, and the selvage warp yarns may be inserted through the yarn guides, respectively, from the yarn feeder fixedly attached to the loom base. With such a configuration as described, since the yarn feeder is not rotated in conjunction with the yarn guides, the yarn feeder can be provided at a position away from the yarn guides, and also away from warp yarns without any need for taking into consideration interference between the yarn guides and the warp yarns or rotation balance of the yarn guides. Consequently, it is possible to increase respective yarn amounts of the selvage warp yarn packages or to connect the terminating end of a selvage warp yarn of a selvage warp yarn package with the leading end of a selvage warp yarn of a succeeding selvage warp yarn package, thereby making use of a plurality of the selvage warp yarn packages. As a result, a state of yarn consumption at the respective selvage warp yarn packages can be easily observed, and in addition, it is possible to replenish the respective selvage warp yarn packages with selvage warp yarns without stopping the operation of the loom.

[0050] With the selvage warp yarn break detection system of the selvage device, according to the first or second aspect of the invention, the selvage device may be the leno selvage device provided with the planet gears, the pair of the yarn guides may be rotated substantially around the warp line and shifted by the planetary gear mechanism, and may be disposed so as to oppose each other with the warp line interjacent therebetween while the yarn feeder may be shifted in conjunction with the respective yarn guides. With such a configuration as described, since the yarn feeder and the respective yarn guides are integrally rotated, the selvage warp yarn between the respective yarn guides and the yarn feeder will not be twisted, so that there is no need for reverse rotation of the respective yarn guides in order to eliminate twist.

[0051] With those features described above, the selvage warp yarn sensor preferably detects the respective portions of the selvage warp yarns, located between the respective yarn guides and the cloth fell. Accordingly, the detection regions are in respective traveling-paths of the selvage warp yarns between the respective yarn guides and the cloth fell, and consequently, in case of the selvage warp yarn being broken between the respective yarn guides and the cloth fell, the selvage warp yarn as broken is immediately prevented from entering the respective detection regions, thereby enabling a yarn break to be quickly detected.

[0052] With the selvage warp yarn break detection system of the selvage device, according to the first aspect of the invention, when the number of selvage warp yarn detections by the selvage warp yarn sensor during the predetermined time period in the weaving cycle or within the predetermined time from the predetermined

time in the weaving cycle is less than that at the time of the normal weaving operation, the selvage warp yarn fault detection circuit preferably outputs the selvage warp yarn fault signal, so that an incidence of malfunction in the course of signal processing (counting) can be reduced.

[0053] Further, the selvage warp yarn fault detection circuit may detect the interval between the selvage warp yarn detections, and when the respective selvage warp yarns are not detected by the selvage warp yarn sensor within the predetermined time or within a predetermined time period in the weaving cycle, the selvage warp yarn fault detection circuit may output the selvage warp yarn fault signal, so that a yarn break can be quickly detected by adjusting the predetermined time or the predetermined time period.

[0054] With the selvage warp yarn break detection system of the selvage device, according to the second aspect of the invention, the time period to detect the respective selvage warp yarns may be the whole period of one weaving cycle, and the detection regions may contain each upper and lower movement regions of the selvage warp yarns, respectively. Accordingly, it is possible to cope with respective breaks of the respective selvage warp yarns, in any pattern, and in addition, there is no need for setting timing for detection, so that detection is rendered easier.

[0055] Further, the selvage warp yarn sensor may be made up of the photoelectric non-contact sensor, thereby enabling a yarn break to be detected without causing force to act on the selvage warp yarns. Alternatively, the selvage warp yarn sensor may be made up of the piezoelectric contact sensor, thereby enabling a yarn break to be detected in linkage with tension of the respective selvage warp yarns.

[0056] 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. A selvage warp yarn break detection system (30) incorporated in a selvage device (1) for vertically moving a pair of selvage warp yarns (2), fed from a yarn feeder (7) and connected to a cloth fell (14), by motion of yarn guides (11) to thereby open and close a shed, and for holding an end of a weft yarn (19), said selvage warp yarn break detection system comprising:

a selvage warp yarn sensor (16) provided at a predetermined position where the pair of the selvage warp yarns (2) can be detected, respectively; and
a selvage warp yarn fault detection circuit (31)

with an input terminal thereof, connected to an output terminal of the selvage warp yarn sensor (16), wherein the pair of the selvage warp yarns (2) that are caused to vertically move accompanying a weaving operation are detected, respectively, by the selvage warp yarn sensor (16), and a detection signal from the selvage warp yarn sensor (16) is delivered to the selvage warp yarn fault detection circuit (31), whereupon the selvage warp yarn fault detection circuit (31) outputs a selvage warp yarn fault signal when a generation pattern of the detection signal from the selvage warp yarn sensor (16) differs from a generation pattern of the detection signal from the selvage warp yarn sensor (16) at the time of a normal weaving operation.

2. A selvage warp yarn break detection system (30) incorporated in a selvage device (1) for vertically moving a pair of selvage warp yarns (2), fed from a yarn feeder (7) and connected to a cloth fell (14), by motion of yarn guides (11) to thereby open and close a shed, and for holding an end of a weft yarn (19), said selvage warp yarn break detection system comprising:

a selvage warp yarn sensor (16) provided at a predetermined position, having detection regions extending in upper and lower directions, respectively; and

a selvage warp yarn fault detection circuit (31) with an input terminal thereof, connected to an output terminal of the selvage warp yarn sensor (16), wherein the pair of the selvage warp yarns (2) that are caused to vertically move accompanying a weaving operation are detected, respectively, by the selvage warp yarn sensor (16), and a detection signal from the selvage warp yarn sensor (16) is delivered to the selvage warp yarn fault detection circuit (31), whereupon the selvage warp yarn fault detection circuit (31) outputs a selvage warp yarn fault signal when a generation pattern of the detection signal from the selvage warp yarn sensor (16) in a time period to detect the respective selvage warp yarns (2) differs from a generation pattern of the detection signal from the selvage warp yarn sensor (16) at the time of a normal weaving operation.

3. A selvage warp yarn break detection system (30) according to claim 1 or claim 2, wherein the selvage device (1) forms a selvage of a leno weave, a pair of yarn guides (11) are disposed so as to oppose each other with a warp line interjacent therebetween, centering substantially around the warp line, and the selvage warp yarns (2) are inserted through

the yarn guides (11), respectively, from the yarn feeder (7) fixedly attached to a loom base (18).

4. A selvage warp yarn break detection system (30) according to claim 1 or claim 2, wherein the selvage device (1) is a leno selvage device provided with planet gears, a pair of yarn guides (11) are rotated substantially around a warp line and shifted by a planetary gear mechanism (33), and are disposed so as to oppose each other with the warp line interjacent therebetween, while the yarn feeder (7) is shifted in conjunction with the respective yarn guides (11).
5. A selvage warp yarn break detection system (30) according to any of claims 1 to 4, wherein the selvage warp yarn sensor (16) detects respective portions of the selvage warp yarns (2), located between the respective yarn guides (11) and the cloth fell 14.
6. A selvage warp yarn break detection system (30) according to claim 1, wherein the selvage warp yarn fault detection circuit (31) outputs the selvage warp yarn fault signal when the number of selvage warp yarn detections by the selvage warp yarn sensor (16) during a predetermined time period in a weaving cycle or within predetermined time from a predetermined time in the weaving cycle is less than that at the time of the normal weaving operation.
7. A selvage warp yarn break detection system (30) according to claim 1, wherein the selvage warp yarn fault detection circuit (31) detects an interval between selvage warp yarn detections, and when the respective selvage warp yarns (2) are not detected by the selvage warp yarn sensor (16) within predetermined time or during a predetermined time period in a weaving cycle, the selvage warp yarn fault detection circuit (31) outputs the selvage warp yarn fault signal.
8. A selvage warp yarn break detection system (30) according to claim 2, wherein the time period to detect the respective selvage warp yarns (2) is a whole period of one weaving cycle, and the detection regions contain each upper and lower movement regions of the respective selvage warp yarns (2).
9. A selvage warp yarn break detection system (30) according to claim 1 or claim 2, wherein the selvage warp yarn sensor (16) is made up of a photoelectric non-contact sensor.
10. A selvage warp yarn break detection system (30) according to claim 1 or claim 2, wherein the selvage warp yarn sensor (16) is made up of a piezoelectric contact sensor.

FIG.1

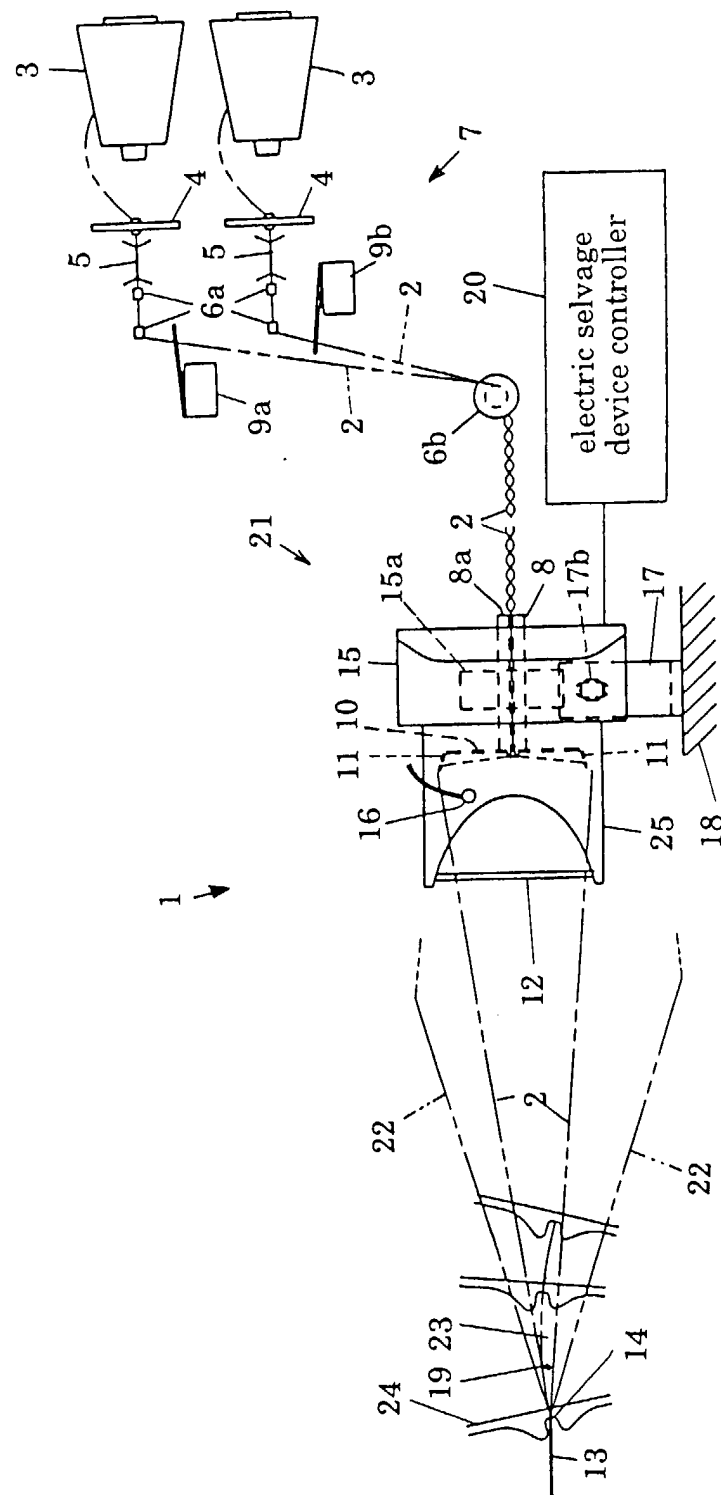


FIG.2

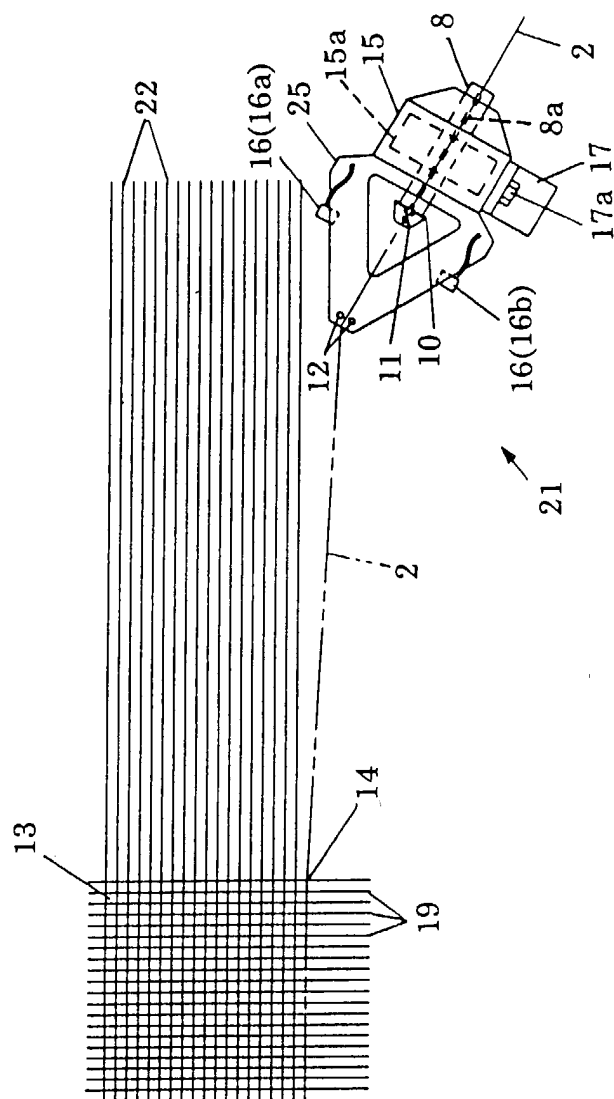


FIG.3

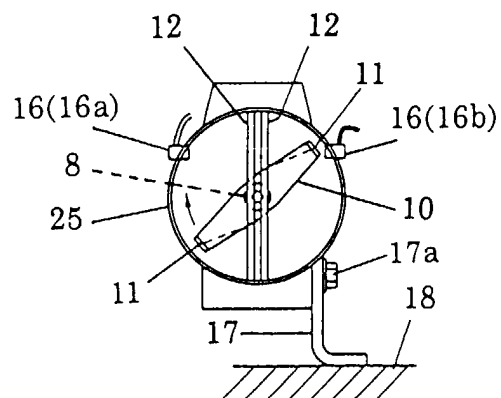


FIG. 4

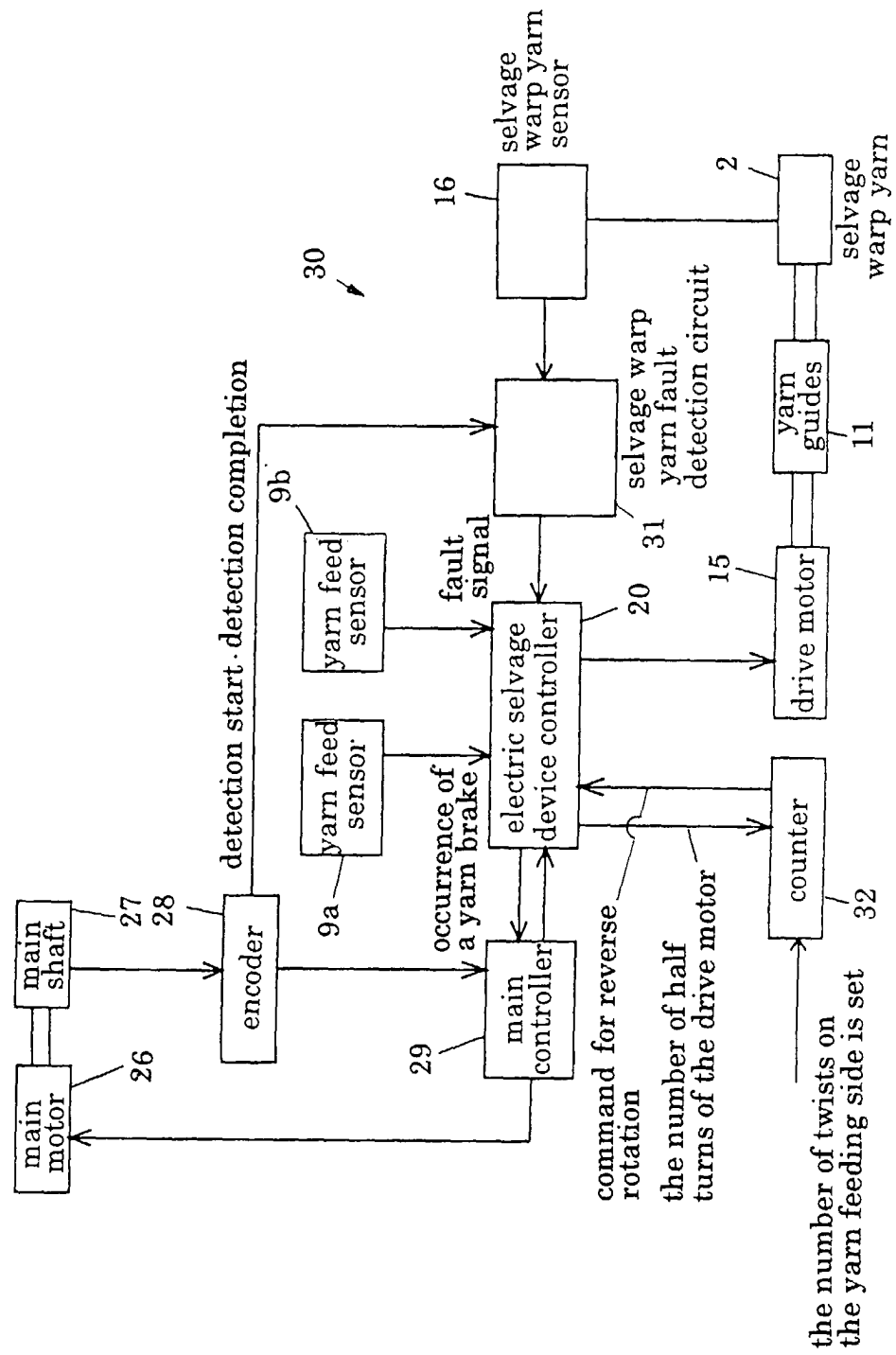


FIG.5

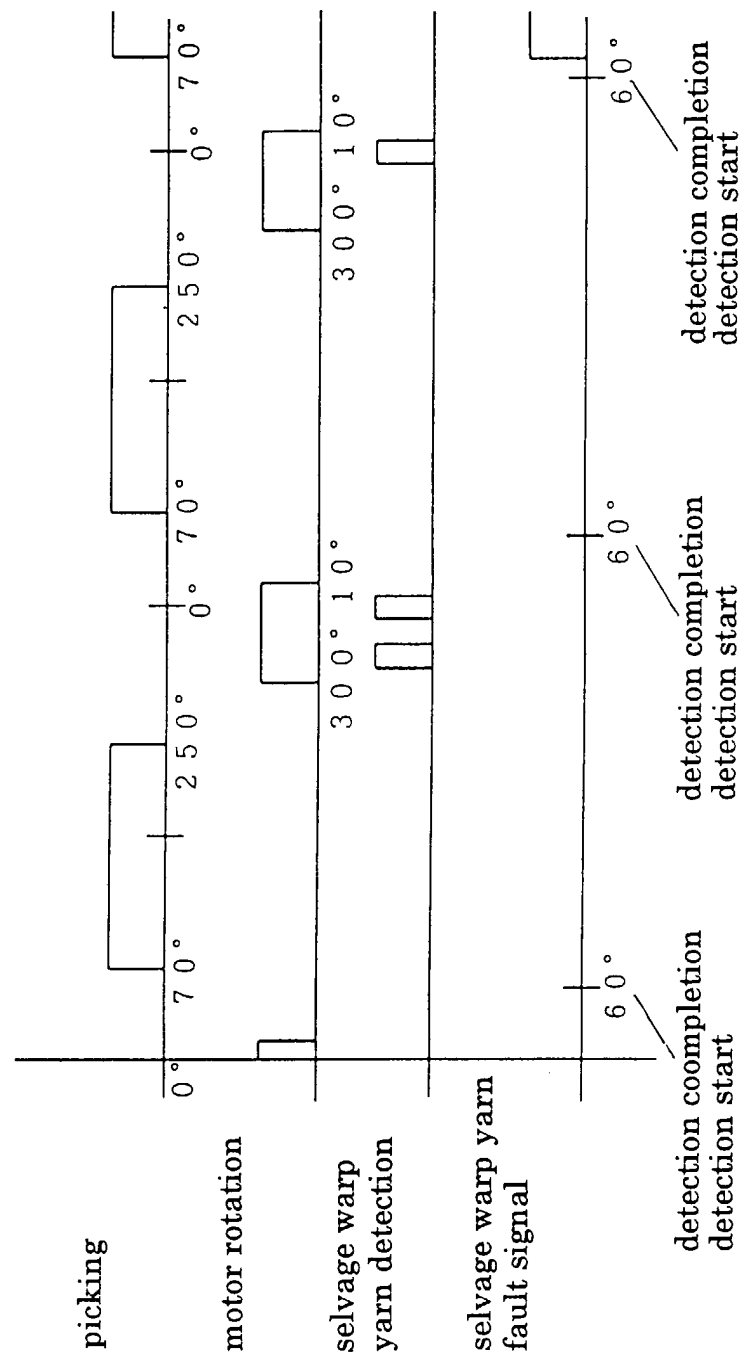


FIG.6

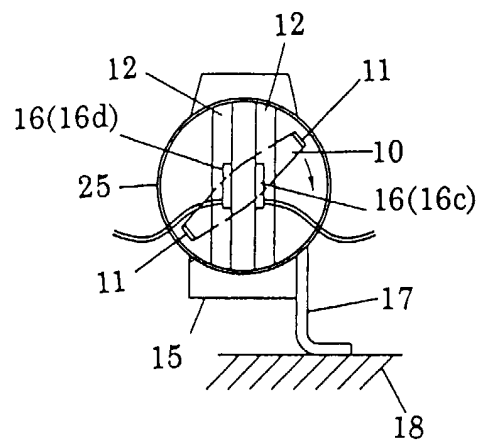


FIG. 7

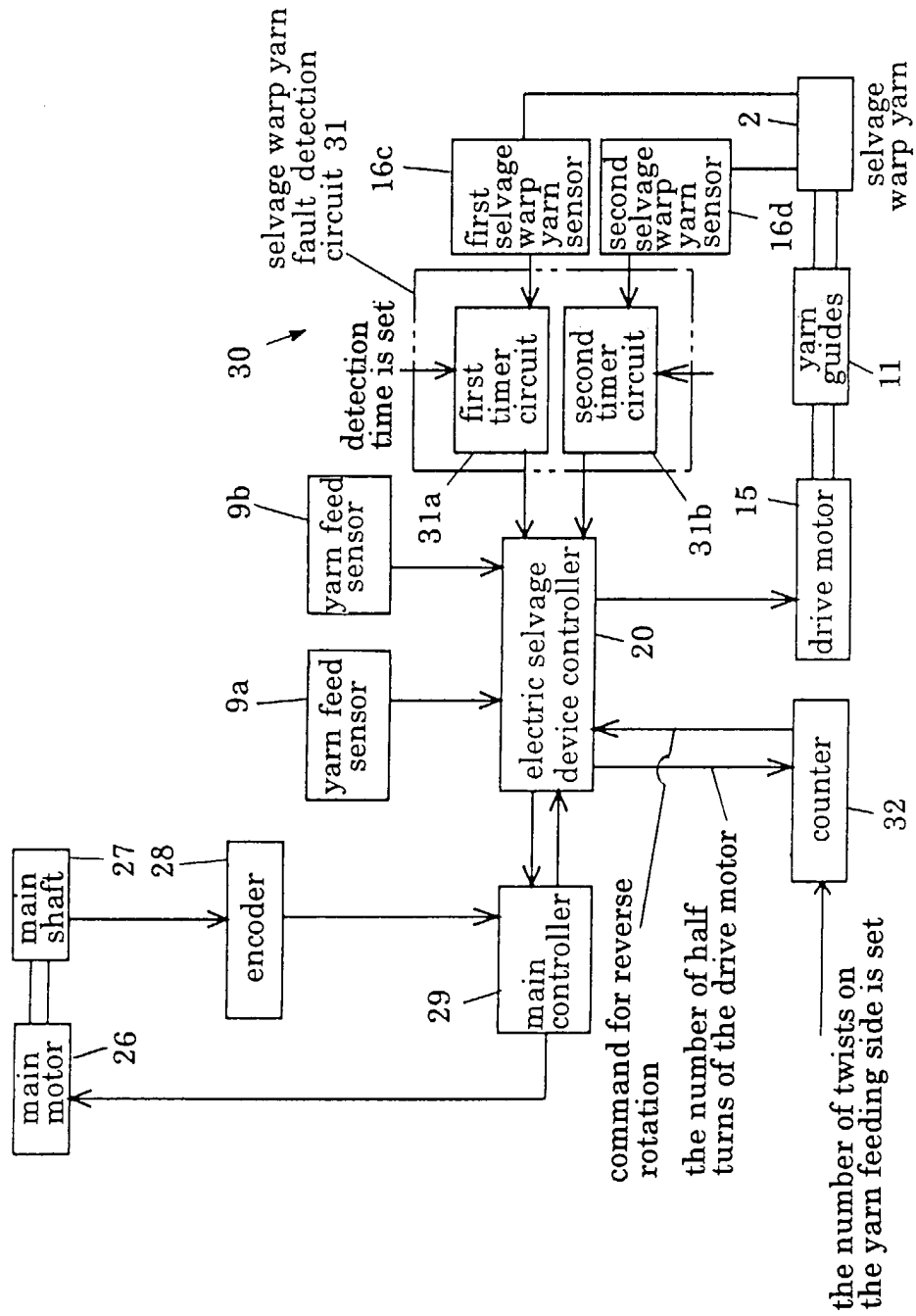


FIG.8

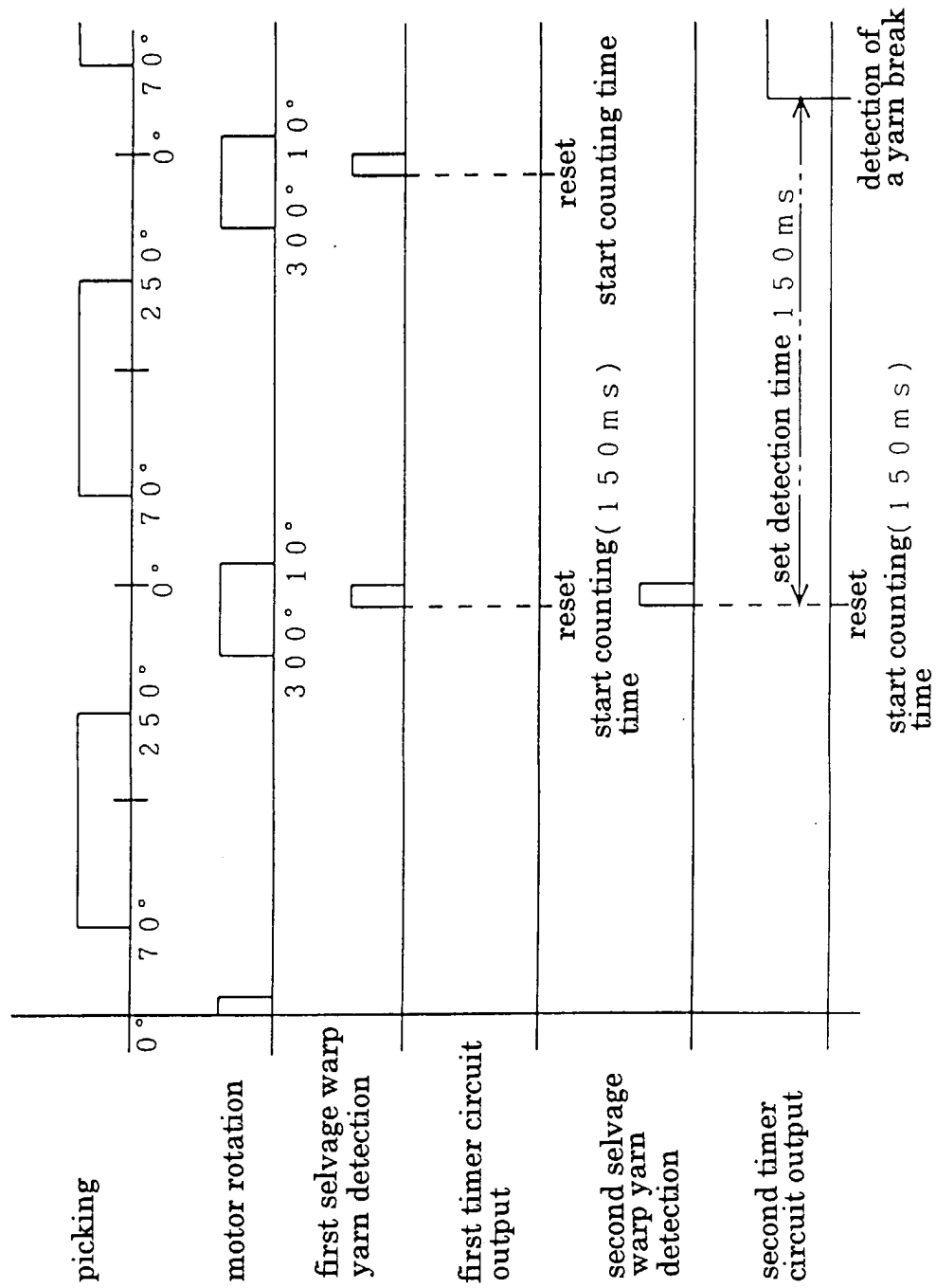


FIG.9

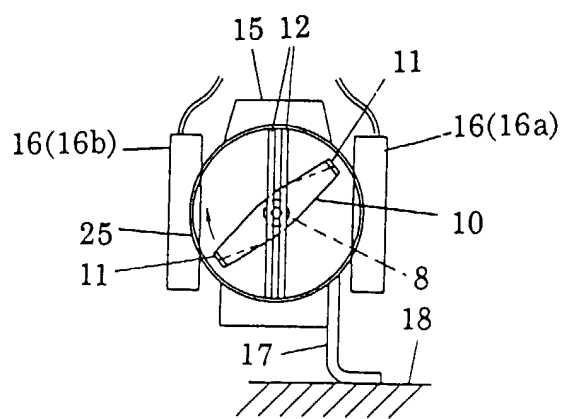


FIG.10

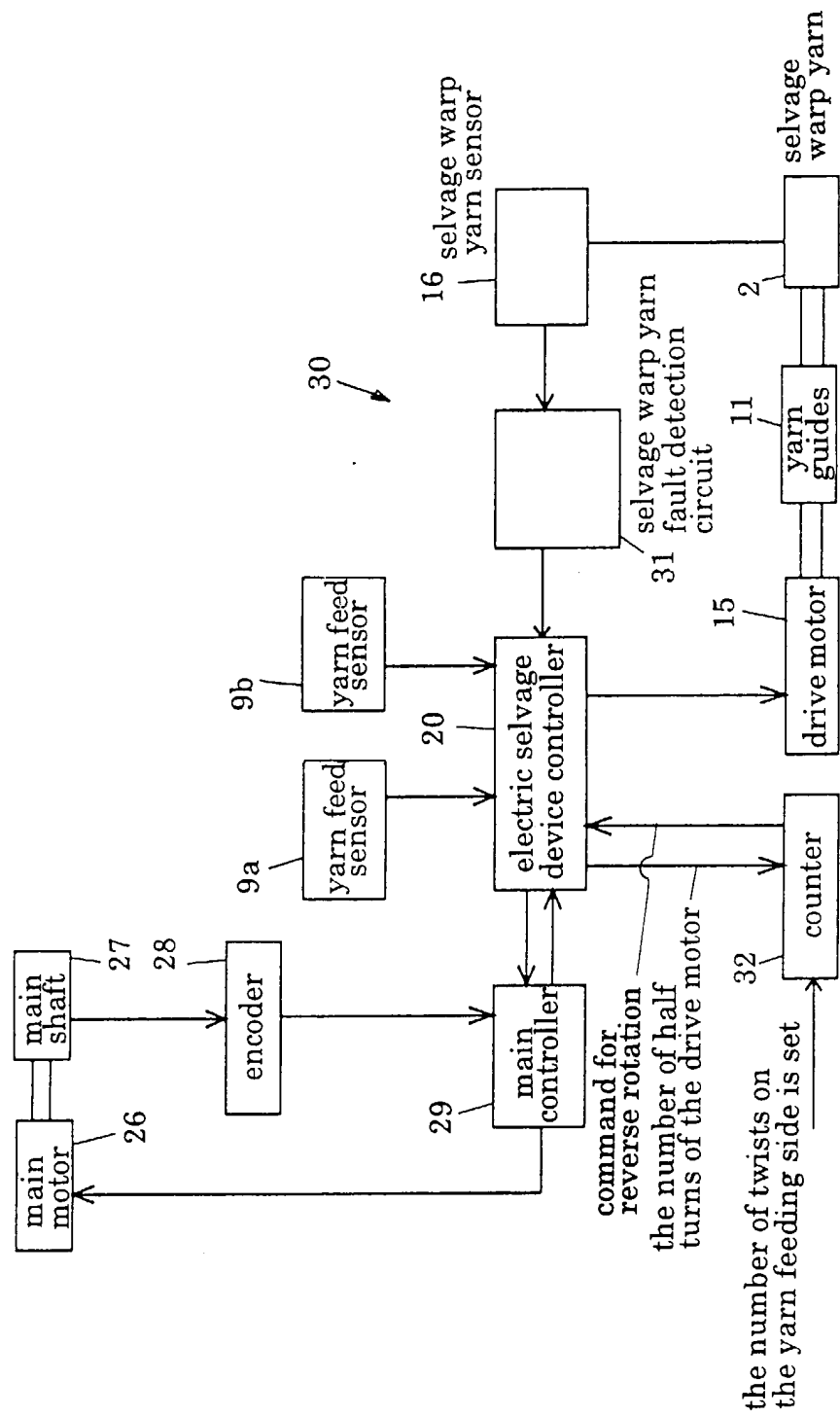


FIG. 11

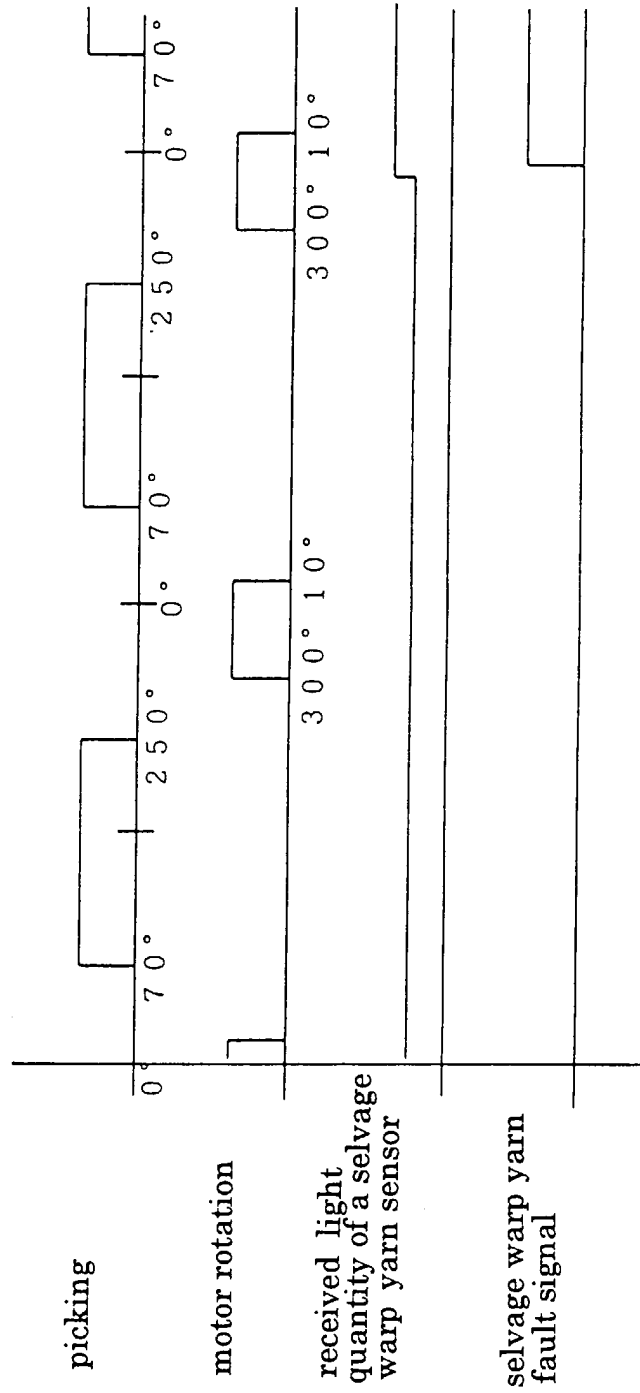


FIG.12

