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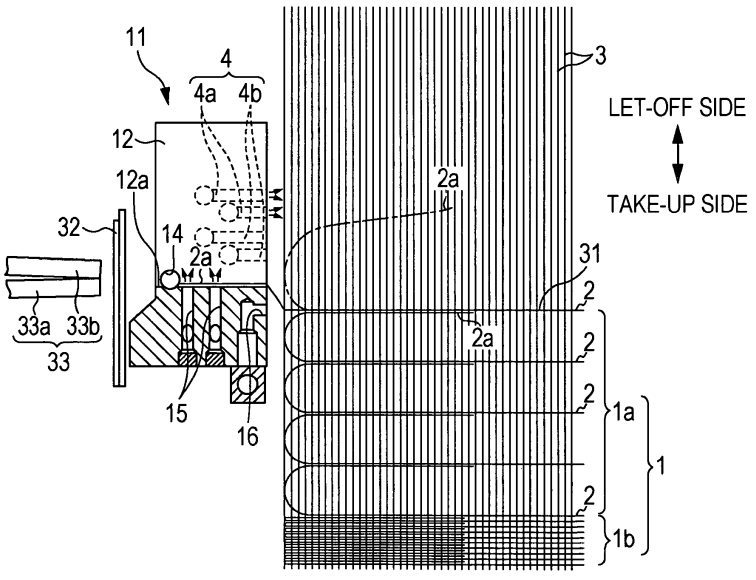
(54) Tuck-in method and tuck-in device for shuttleless loom

(57) An air jet tuck-in device for use in a shuttleless loom for weaving a fabric (1) including a plurality of weave sections having different weft densities includes one or more tuck-in nozzles (4) disposed at a side of a row of warp yarns for tucking an end portion (2a) of a weft yarn into a warp shedding (30) after weft insertion; switching means (5) that switches an ejection position of the tuck-in nozzles (4) between a first ejection position that corresponds to a first weave section (1a) and a second ejection position that corresponds to a second weave section (1b); and control means (6) that selects the ejection position of the tuck-in nozzles (4) and operates the switching means (5) on the basis of a result of the selection, the selection being performed on the basis of a signal related to an input weft density or a weaving condition associated with the weft density.

FIG. 2



EP 2 330 239 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a tuck-in method and a tuck-in device for use in a shuttleless loom.

2. Description of the Related Art

[0002] A tuck-in selvage is an example of a selvage structure of a fabric woven by a shuttleless loom. The tuck-in selvage is formed by bending an end portion of a weft yarn after weft insertion such that the end portion of the weft yarn is inserted into a shedding into which the subsequent weft yarn is to be inserted and weaving the end portion of the weft yarn into the fabric together with the subsequent weft yarn. An air jet tuck-in device disclosed in, for example, Japanese Unexamined Patent Application Publication No. 2003-166148 (hereinafter referred to as Patent Document 1) is known as a device for forming the tuck-in selvage. An operation of bending the end portion of the weft yarn after the weft insertion such that the end portion of the weft yarn is inserted into the shedding into which the subsequent weft yarn is to be inserted is called a tuck-in operation, and the tuck-in device is also called an air tucker.

[0003] Air jet tuck-in devices are generally disposed at either side of a row of warp yarns, and each air jet tuck-in device includes a tuck-in nozzle for bending the weft yarn. The tuck-in nozzles eject air so that the weft yarn after the weft insertion is bent into the shedding at each end of the weft yarn by the ejected air. Thus, the tuck-in operation is performed.

[0004] The operation of an air jet tuck-in device having substantially the same structure as that of the device disclosed in Patent Document 1 will now be described with reference to Figs. 5 and 6. Although only a tuck-in device disposed at a weft-insertion side is illustrated in Fig. 5, another tuck-in device having a similar structure is also disposed at a side opposite to the weft-insertion side. A weft yarn 42 is inserted into a warp shedding 30 by one of weft insertion nozzles 33, and is beaten up against a cloth fell 31 when a reed (not shown) is moved forward. At this time, an end portion 42a of the weft yarn at the weft-insertion side moves into a slit 52 in a tuck-in head 51. The end portion 42a is cut off from the weft yarn in the corresponding weft insertion nozzle 33 by a cutter 32, is blown into a weft-yarn-end holding hole 54 by air ejected from a weft-yarn-end holding nozzle 53, and is retained in the weft-yarn-end holding hole 54.

[0005] Then, when the reed is moved backward, the weft-yarn-end holding nozzle 53 stops ejecting the air and a weft-yarn releasing nozzle 55 starts to eject air. Accordingly, the end portion 42a of the weft yarn is pushed out of the weft-yarn-end holding hole 54 by the air ejected from the weft-yarn releasing nozzle 55, and is blown out from the slit 52. Subsequently, a tuck-in nozzle 44 starts to eject air, so that the end portion 42a of the weft yarn is blown into the warp shedding 30 by the air ejected from the tuck-in nozzle 44 and is bent in a looped shape. The end portion 42a of the weft yarn in the bent state is beaten up together with the subsequent weft yarn and is woven into a fabric 41 together with the subsequent weft yarn.

[0006] In general fabrics, to form a fast tuck-in selvage with a good appearance, it is preferable that the end portion 42a of the weft yarn that has been tucked in be sharply bent at a weft insertion position and be beaten up while a loop formed at the bent portion is very small. Therefore, in the air jet tuck-in device according to the related art, the tuck-in nozzle 44 is positioned near the cloth fell 31 so that a small loop can be formed by the end portion 42a of the weft yarn when the end portion 42a is bent. In addition, a selvage fastening nozzle 56 is disposed near the cloth fell (start point of the warp shedding) so that the end portion 42a of the weft yarn that has been tucked in can be blown and urged toward the center of the warp shedding 30 and be prevented from becoming loose.

[0007] Some fabrics woven by shuttleless looms include two weave sections having largely different weft densities. An example of such a fabric is a fabric for reinforcing rubber (hereinafter referred to as a "rubber reinforcing fabric"). The rubber reinforcing fabric is used as a core for reinforcing a rubber material, and includes two weave sections: a tire fabric section in which a weft density is extremely low and a tabby section in which a weft density is higher than that in the tire fabric section.

[0008] The tire fabric section serves as the main body of the rubber reinforcing fabric. The tabby section is formed so as to extend a predetermined length in a warp direction before weaving of the tire fabric section is started, and is also formed so as to extend a predetermined length in the warp direction after weaving of the tire fabric section is finished. The tabby section serves to prevent the tire fabric section in which the weft density is low from breaking apart and maintain the form of the rubber reinforcing fabric.

[0009] A tire cord fabric is an example of the rubber reinforcing fabric. The tire cord fabric is a type of rubber reinforcing fabric used to manufacture a carcass layer which serves as a framework of a rubber tire. The carcass layer is manufactured by coating the tire fabric section of the tire cord fabric with a rubber material.

[0010] In the tabby section in which the weft density is high, from the viewpoint of maintaining the form of the rubber reinforcing fabric, it is preferable that the end portion of the weft yarn be sharply bent at the weft insertion position and be tightly fastened, similar to general fabrics.

[0011] In contrast, in the tire fabric section in which the weft density is low, from the viewpoint of ensuring the quality of the rubber reinforcing fabric, it is preferable that the end portion of the weft yarn be bent along a large, gentle curve in accordance with a weft interval (weft density), as illustrated in Fig. 2, and extend along the sub-

sequent weft yarn that is to be beaten up.

[0012] However, in the tuck-in device according to the related art, the tuck-in nozzle ejects the air at a constant position in the warp direction. Therefore, in the case where a fabric, such as the rubber reinforcing fabric, which includes a weave section with a high weft density and a weave section with a low weft density is woven, the following problem occurs. That is, if the position of the tuck-in nozzle is set to a position suitable for one of the weave sections, it is difficult to form an appropriate tuck-in selvage at the other weave section.

[0013] For example, a case is considered in which a tuck-in operation similar to that suitable for the tabby section with a high weft density, that is, a tuck-in operation using the tuck-in nozzle positioned near the cloth fell, is performed in the process of weaving the tire fabric section with a very low weft density. In this case, there is a risk that the end portion of the weft yarn will be bent at a position on a take-up side, which is opposite to a let-off side, in the warp direction relative to a position at which the subsequent weft yarn is beaten up, and the end portion of the weft yarn that has been tucked in will be bent in the fabric without being beaten up (see Fig. 7). This degrades the quality of the rubber reinforcing fabric, such as the tire cord fabric.

[0014] As described above, with regard to the preferred state of the end portion of the weft yarn that has been tucked in, there is a conflict between the states suitable for the tabby section and the tire fabric section. The tuck-in device according to the related art is not capable of establishing both of the states that conflict each other.

[0015] Another example of an air jet tuck-in device that has a structure similar to that of the above-described tuck-in device according to the related art includes a plurality of tuck-in nozzles arranged in the warp direction. In this device, the tuck-in nozzles are operated in cooperation with each other to tuck in (bend) the end portion of the weft yarn. However, also in this tuck-in device, each of the tuck-in nozzles ejects air each time the tuck-in operation is performed, and all of the tuck-in nozzles operate in cooperation with each other to perform a single tuck-in operation. Therefore, it is not possible to establish both of the above-described tuck-in states that conflict each other.

SUMMARY OF THE INVENTION

[0016] Accordingly, an object of the present invention is to provide a tuck-in method and a tuck-in device for a shuttleless loom that weaves a fabric, such as a rubber reinforcing fabric, which includes at least a first weave section and a second weave section having a weft density that differs from a weft density of the first weave section, the tuck-in method and the tuck-in device allowing an appropriate tuck-in selvage to be formed in each of the first weave section and the second weave section.

[0017] To achieve the above-described object, the present invention provides the following tuck-in method.

[0018] That is, the present invention provides a tuck-in method for a shuttleless loom including an air jet tuck-in device including one or more tuck-in nozzles disposed at a side of a row of warp yarns for tucking an end portion of a weft yarn into a warp shedding after weft insertion, the shuttleless loom weaving a fabric including at least a first weave section and a second weave section having a weft density that differs from a weft density of the first weave section. The tuck-in method includes the step of performing an ejecting operation of ejecting air from the tuck-in nozzles for tucking the end portion of the weft yarn into the warp shedding, an ejection position at which the tuck-in nozzles perform the ejecting operation during weaving of the first weave section being different, in a warp direction, from an ejection position at which the tuck-in nozzles perform the ejecting operation during weaving of the second weave section.

[0019] The shuttleless loom may be a loom for weaving a rubber reinforcing fabric in which the first weave section is a tire fabric section and the second weave section is a tabby section. The ejection position of the tuck-in nozzles during weaving of the tire fabric section may be on a let-off side in the warp direction relative to the ejection position of the tuck-in nozzles during weaving of the tabby section.

[0020] The tuck-in device may include one or more first tuck-in nozzles and one or more second tuck-in nozzles, the first tuck-in nozzles being on the let-off side in the warp direction relative to the second tuck-in nozzles. The first tuck-in nozzles perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the second tuck-in nozzles do not perform the ejecting operation during weaving of the first weave section, and the second tuck-in nozzles perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the first tuck-in nozzles do not perform the ejecting operation during weaving of the second weave section.

[0021] In addition, the present invention provides the following tuck-in device.

[0022] That is, the present invention provides an air jet tuck-in device for use in a shuttleless loom for weaving a fabric including at least a first weave section and a second weave section having a weft density that differs from a weft density of the first weave section, the tuck-in device including one or more tuck-in nozzles disposed at a side of a row of warp yarns for tucking an end portion of a weft yarn into a warp shedding after weft insertion. The tuck-in device includes switching means that switches an ejection position at which an ejecting operation is performed between a first ejection position that corresponds to the first weave section and a second ejection position that corresponds to the second weave section, the first ejection position and the second ejection position being different from each other in a warp direction; and control means that selects one of the first ejection position and the second ejection position as the ejection position

at which the ejecting operation is to be performed by the tuck-in nozzles for tucking the end portion of the weft yarn into the warp shedding and operates the switching means on the basis of a result of the selection, the selection being performed on the basis of a signal related to an input weft density or a weaving condition associated with the weft density.

[0023] With the above-described structure, the tuck-in device according to the present invention is capable of performing the tuck-in operation appropriately for each of the weave sections having different densities by selectively switching the ejection position of the tuck-in nozzles for each of the weave sections.

[0024] The structure for selectively switching the ejection position of the tuck-in nozzles may be a structure in which a plurality of tuck-in nozzles are arranged in the tuck-in device at different positions in the warp direction. The tuck-in nozzle caused to perform the ejecting operation can be selected from the tuck-in nozzles by on-off valves, which function as switching means, in accordance with each weave section.

[0025] Instead of selectively using a plurality of tuck-in nozzles disposed at different positions in the warp direction, the ejection position can be changed by moving the tuck-in nozzle themselves to another position along the warp direction. In this case, means for moving the tuck-in nozzles serves as the switching means.

[0026] The control means may include a setting unit in which the weft density or the weaving condition associated with the weft density is set for each of the first weave section and the second weave section and in which information regarding the first or second ejection position is set in association with the weft density or the weaving condition, a selecting unit that performs the selection on the basis of the signal related to the input weft density or the weaving condition, and a controller that controls the operation of the switching means on the basis of the result of the selection performed by the selecting unit.

[0027] The shuttleless loom may be a loom for weaving a rubber reinforcing fabric in which the first weave section is a tire fabric section and the second weave section is a tabby section, and the first ejection position may be on a let-off side in the warp direction relative to the second ejection position.

[0028] The tuck-in device may include one or more first tuck-in nozzles that perform the ejecting operation at the first ejection position and one or more second tuck-in nozzles that perform the ejecting operation at the second ejection position, the first tuck-in nozzles and the second tuck-in nozzles being arranged next to each other in the warp direction. The controller in the control means may control the operation of the switching means such that the first tuck-in nozzles or the second tuck-in nozzles perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding.

[0029] In the shuttleless loom that weaves a fabric including at least the first weave section and the second weave section having a weft density that differs from the weft density of the first weave section, the ejecting operation of ejecting air from the tuck-in nozzles is performed at a position corresponding to each of the weave sections. Accordingly, the tuck-in operation can be appropriately performed for each of the weave sections having different densities.

[0030] In particular, in a loom for weaving a rubber reinforcing fabric, the ejection position of the tuck-in nozzles during weaving of the tire fabric section is on the let-off side in the warp direction relative to the ejection position of the tuck-in nozzles during weaving of the tabby section. Accordingly, a tuck-in selvage can be normally formed in both the tire fabric section and the tabby section that have largely different weft densities. The ejection position of the tuck-in nozzles during weaving of the tabby section is preferably near the cloth fell. In such a case, the end portion of the weft yarn that has been tucked in can be sharply bent at a weft insertion position and a fast tuck-in selvage can be formed. The ejection position of the tuck-in nozzles during weaving of the tire fabric section is preferably set such that the end portion of the weft yarn can be tucked in at a position separated from the cloth fell by a distance greater than or equal to a weft interval. In such a case, the end portion of the weft yarn that has been tucked in can be beaten up by a reed together with the subsequent weft yarn so that the end portion of the weft yarn that has been tucked extends along the subsequent weft yarn.

[0031] The tuck-in device may include one or more first tuck-in nozzles corresponding to the tire fabric section and one or more second tuck-in nozzles corresponding to the tabby section. The first tuck-in nozzles perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the second tuck-in nozzles do not perform the ejecting operation during weaving of the tire fabric section, and the second tuck-in nozzles perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the first tuck-in nozzles do not perform the ejecting operation during weaving of the tire fabric section. In such a case, the tuck-in selvage can be appropriately formed in both the tire fabric section and the tabby section. In particular, in the process of weaving the tire fabric section, the end portion of the weft yarn can be tucked in so as to as to extend along a large, gentle curve in accordance with the weft interval. Therefore, the end portion of the weft yarn that has been tucked extends along the subsequent weft yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

Fig. 1 is a perspective view of an area around a tuck-in head included in a tuck-in device according to an embodiment of the present invention;

Fig. 2 is a partially sectioned plan view of the area around the tuck-in head included in the tuck-in device

according to the embodiment of the present invention;

Figs. 3A, 3B, and 3C are orthographic views of the tuck-in head according to the embodiment of the present invention;

Fig. 4 is a block diagram of a pneumatic system and a control system in the tuck-in device according to the embodiment of the present invention;

Fig. 5 is a plan view of an area around a tuck-in head included in a tuck-in device according to the related art;

Fig. 6 is a side view of the tuck-in head according to the related art; and

Fig. 7 is a plan view of an area around the tuck-in head included in the tuck-in device according to the related art.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] A tuck-in method and a tuck-in device in which the tuck-in method is implemented according to an embodiment of the present invention will be described with reference to Figs. 1 to 4. In the present embodiment, the present invention is applied to a shuttleless loom for weaving a tire cord fabric, which is a type of rubber reinforcing fabric. As described above, the tire cord fabric includes two weave sections having largely different weft densities. The two weave sections are a tire fabric section that serves as a first weave section 1a and a tabby section that serves as a second weave section 1b.

[0034] The shuttleless loom in which the tuck-in device according to the present embodiment is mounted includes two weft insertion systems: a first weft insertion system (a first weft insertion nozzle 33a, a measuring-and-storing device (not shown), etc.) and a second weft insertion system (a second weft insertion nozzle 33b, etc.). The first weft insertion system is used to insert a weft yarn in a process of weaving the tire fabric section (hereinafter referred to as "tire fabric weaving"). The second weft insertion system is used to insert a weft yarn in a process of weaving the tabby section (hereinafter referred to as "tabby weaving"). In the actual loom, so-called mixed weaving is performed in which three weft insertion systems are provided for tire fabric weaving and the three weft insertion systems are operated in sequence. However, in the present embodiment, a single weft insertion system is illustrated as the weft insertion system for tire fabric weaving and the other two weft insertion systems are omitted.

[0035] In the tuck-in device according to the present invention, the tuck-in operation can be appropriately performed for each of tire fabric weaving and tabby weaving by selectively switching an ejection position of tuck-in nozzles between tire fabric weaving and tabby weaving. A tuck-in device 10 according to the present embodiment includes a group of first tuck-in nozzles 4a and a group of second tuck-in nozzles 4b which eject air at different ejection positions. The tuck-in operation is performed by ejecting the air from the group of first tuck-in nozzles 4a during tire fabric weaving and from the group of second tuck-in nozzles 4b during tabby weaving, thereby selectively switching the ejection position of the tuck-in nozzles. The tuck-in device according to the present invention will now be described in detail.

[0036] The air jet tuck-in device 10 according to the embodiment of the present invention mainly includes tuck-in heads (11) which each include a plurality of tuck-in nozzles 4 illustrated in Figs. 1 to 3C, switching means 5 illustrated in Fig. 4 that selectively switches the ejection position of the tuck-in nozzles 4, and control means 6 illustrated in Fig. 4 that controls the operation of the switching means 5.

[0037] The tuck-in heads (11) are block-shaped components and are disposed at either side of a row of warp yarns, that is, at a weft-insertion side and a side opposite to the weft-insertion side of the row of warp yarns. The tuck-in head 11 disposed at the weft-insertion side and the tuck-in head (not shown) disposed at the side opposite to the weft-insertion side are horizontally symmetrical to each other. Therefore, in the following description, only the tuck-in head 11 at the weft-insertion side will be explained and explanations and illustrations of the tuck-in head at the side opposite to the weft-insertion side will be omitted.

[0038] As illustrated in Fig. 1, the tuck-in head 11 is disposed adjacent to a warp shedding 30 formed in the row of warp yarns. The tuck-in head 11 is fixed to a temple bracket (not shown) or the like of a loom using attachment holes 18. As illustrated in Fig. 2, a cutter 32 for cutting a weft yarn 2 is provided near the tuck-in head 11 at a side opposite to the row of warp yarns. Fig. 2 illustrates a state after the weft yarn has been beaten up by a reed (not shown) and the weft yarn connected to the cloth fell 31 has been cut off from the weft yarn in the corresponding weft insertion nozzle 33 by the cutter 32.

[0039] As illustrated in Fig. 3B, the tuck-in head 11 has a slit 12 for receiving an end portion 2a of the weft yarn that has been beaten up. Fig. 2 illustrates a sectional view of the tuck-in head 11 in Fig. 3B taken along line II-II to facilitate understanding of the positional relationship between nozzles, which will be described below. The slit 12 is open at three sides: a warp let-off side (hereinafter referred to simply as a "let-off side"), a side facing the row of warp yarns, and a side facing the cutter 32. As illustrated in Fig. 2, the tuck-in head 11 is disposed such that a bottom surface 12a of the slit 12 is positioned in front of the cloth fell 31 when viewed from the let-off side. In addition, as illustrated in Fig. 3B, the tuck-in head 11 is provided with guide surfaces 17 in a section that is on the let-off side of the slit 12 and that continues from the slit 12. The guide surfaces 17 are formed such that the distance therebetween gradually increases in the vertical direction. Owing to the guide surfaces 17, the end portion 2a of the weft yarn can smoothly enter the slit 12.

[0040] According to the present embodiment, the tuck-in head 11 includes a weft-yarn-end holding nozzle 13,

weft-yarn releasing nozzles 15, the tuck-in nozzles 4 (4a and 4b), and a selvage fastening nozzle 16. The weft-yarn-end holding nozzle 13 temporarily retains the end portion 2a of the weft yarn that enters the slit 12 in the slit 12. The weft-yarn releasing nozzles 15 blow out the end portion 2a of the weft yarn from the slit 12. The tuck-in nozzles 4 (4a and 4b) blow the end portion 2a of the weft yarn that has been blown out of the slit 12 into the warp shedding 30, thereby bending the end portion 2a of the weft yarn in a looped shape. The selvage fastening nozzle 16 urges the end portion 2a of the weft yarn that has been tucked in toward the center of the warp shedding 30 to prevent the end portion 2a of the weft yarn from becoming loose.

[0041] The weft-yarn-end holding nozzle 13 is formed in a portion of the tuck-in head 11 that is positioned above the slit 12, and opens at an upper inner wall of the slit 12, which has the upper inner wall and a lower inner wall, at a position near the cutter 32 in a width direction. A weft-yarn-end holding hole 14 opens at the lower inner wall of the slit 12 at a position corresponding to the weft-yarn-end holding nozzle 13. The weft-yarn-end holding hole 14 is a through hole formed in a portion of the tuck-in head 11 that is positioned below the slit 12, and is formed such that the axial center line of the weft-yarn-end holding hole 14 coincides with the axial center line of the weft-yarn-end holding nozzle 13. As illustrated in Fig. 4, the weft-yarn-end holding nozzle 13 receives pressurized air from a pressurized air source 24 through an on-off valve 5c, a surge tank 37, and a pressure control valve 38. A joint 19 that is connected to the weft-yarn-end holding nozzle 13 is attached to a top surface of the tuck-in head 11. The joint 19 is connected to the on-off valve 5c through a tube (not shown).

[0042] The weft-yarn releasing nozzles 15 are formed so as to extend from a side surface of the tuck-in head 11 at a take-up side, which is opposite to the let-off side, to the bottom surface 12a of the slit 12, and open at the bottom surface 12a of the slit 12. In the illustrated example, two weft-yarn releasing nozzles 15 are provided and are arranged next to each other in a cloth width direction. The weft-yarn releasing nozzles 15 are connected to joints 20 that are positioned obliquely below the weft-yarn releasing nozzles 15. The weft-yarn releasing nozzles 15 are connected to on-off valves (not shown) through tubes (not shown), and receive pressurized air from the pressurized air source 24. The pneumatic circuit of the weft-yarn releasing nozzles 15 is not illustrated in Fig. 4.

[0043] In the present embodiment, the tuck-in nozzles 4, which are characteristic elements of the present invention, include the tuck-in nozzles 4a that are disposed at a first ejection position and perform an ejecting operation during tire fabric weaving (during weaving of the first weave section 1a) and the tuck-in nozzles 4b that are disposed at a second ejection position and that perform an ejecting operation during tabby weaving (during weaving of the second weave section 1b).

[0044] The tuck-in nozzles 4a disposed at the first ejection position open at a side surface of the tuck-in head 11 that faces the fabric. Two tuck-in nozzles 4a are disposed at each side of the slit 12 (four tuck-in nozzles 4a are provided in total) to form the group of first tuck-in nozzles 4a. The first ejection position is on the let-off side relative to the second ejection position, which will be described below, in the warp direction. In the present embodiment, the first ejection position is separated from the cloth fell 31 in the warp direction by a distance greater than or equal to a weft interval in tire fabric weaving. The end portion 2a of the weft yarn that has been tucked in by the group of first tuck-in nozzles 4a is bent along a large, gentle curve from the weft insertion position to a position separated from the cloth fell 31 by a distance greater than or equal to the weft interval in tire fabric weaving (see, for example, the two-dot chain line in Fig. 2).

[0045] The tuck-in nozzles 4b disposed at the second ejection position also open at the side surface of the tuck-in head 11 that faces the fabric. Two tuck-in nozzles 4b are disposed at each side of the slit 12 (four tuck-in nozzles 4b are provided in total) to form the group of second tuck-in nozzles 4b. The second ejection position is on the take-up side relative to the above-described first ejection position in the warp direction. In other words, the second ejection position is closer to the cloth fell 31 than the first ejection position. The end portion 2a of the weft yarn that has been tucked in by the group of second tuck-in nozzles 4b is sharply bent from the weft insertion position (see, for example, the two-dot chain line in Fig. 5).

[0046] As illustrated in Fig. 4, the first tuck-in nozzles 4a and the second tuck-in nozzles 4b receive pressurized air from the pressurized air source 24 through on-off valves 5a and 5b that are connected to the tuck-in nozzles 4a and 4b, respectively, a common surge tank 39, and a common pressure control valve 40. Joints 21 and 22 that are connected to the tuck-in nozzles 4a and 4b, respectively, are attached to the top and bottom surfaces of the tuck-in head 11. The joints 21 and 22 are connected to the on-off valves 5a and 5b, respectively, through tubes (not shown). The on-off valves 5a and 5b are, for example, solenoid valves, and function as the above-described switching means 5.

[0047] The selvage fastening nozzle 16 opens at the side surface of the tuck-in head 11 that faces the fabric, and is directed toward the cloth fell 31 (warp shedding). The selvage fastening nozzle 16 is connected to a joint 23 that is attached to a side surface of the tuck-in head 11 at the take-up side. The selvage fastening nozzle 16 is connected to an on-off valve (not shown) through a tube (not shown), and receives pressurized air from the pressurized air source 24. The pneumatic circuit of the selvage fastening nozzle 16 is not illustrated in Fig. 4.

[0048] A control system of the tuck-in device will now be described with reference to Fig. 4. In the illustrated example, the "control means 6" according to the present invention includes a loom controller 27 and a tuck-in operation setter 29 in a loom control device 25 and a timing

controller 9 in a tuck-in control device 26. As described above, the shuttleless loom illustrated in the figures includes two weft insertion systems, which are the first weft insertion system operated for performing weft insertion during tire fabric weaving and the second weft insertion system operated for performing weft insertion during tabby weaving. In the following description, the first weft insertion system is also called "color 1" and the second weft insertion system is also called "color 2".

[0049] The loom control device 25 controls the operations of a weft insertion device 36 and other devices during weaving processes. A weave pattern, a color used to weave the weave pattern, a weft density, etc., are set for each of tire fabric weaving and tabby weaving in the loom controller 27 included in the loom control device 25. In addition, weaving conditions, such as the weaving order, weaving length, etc., for each weave pattern are also set in the loom controller 27 included in the loom control device 25. Therefore, the loom controller 27 also functions as a part of a "setting unit 7" according to the present invention.

[0050] The loom controller 27 measures a weaving length on the basis of a signal from an encoder 34 that detects an amount of rotation of a main shaft 35, and selects the weave pattern (tire fabric weaving or tabby weaving) corresponding to the weaving length. The loom controller 27 outputs a signal (hereinafter referred to as a "color signal") S1 that represents the color (color 1 or 2) used to weave the selected weave pattern to the weft insertion device 36. Accordingly, one of the weft insertion nozzles 33 for colors 1 and 2 is caused to perform the weft insertion operation. Thus, the weft insertion operation corresponding to tire fabric weaving or tabby weaving is performed.

[0051] The loom controller 27 also outputs the color signal S1 to the tuck-in operation setter 29. In the tuck-in operation setter 29, the groups of tuck-in nozzles to be used and ejection conditions (timing and pressure) are set in association with colors 1 and 2. Therefore, the tuck-in operation setter 29 also functions as the "setting unit 7" according to the present invention. The above-described settings are made by a display-setter device (not shown) having a display screen provided on the loom.

[0052] When the tuck-in operation setter 29 receives the color signal S1 from the loom controller 27, the tuck-in operation setter 29 selects the group of tuck-in nozzles and the ejection conditions that are set in association with color 1 or 2 on the basis of the color signal S1. Then, the tuck-in operation setter 29 outputs a signal S2 representing the selected group of tuck-in nozzles and the ejection timing, which is one of the ejection conditions, to the timing controller 9. Therefore, the tuck-in operation setter 29 also functions as a "selecting unit 8" according to the present invention. In the illustrated example, the tuck-in operation setter 29 provides the functions of both the "setting unit 7" and the "selecting unit 8". However, the functions may instead be provided by separate components.

[0053] The tuck-in operation setter 29 also selects a pressure value, which is another one of the ejection conditions, set in association with color 1 or 2 on the basis of the color signal S1 from the loom controller 27, and outputs a signal S3 representing the selected pressure value to a pressure regulator 28. Accordingly, the pressure regulator 28 controls the pressure control valve (electro-pneumatic proportional valve) 40 and adjusts the pressure of the air supplied from the pressurized air source 24 to the tuck-in nozzles 4 to a pressure corresponding to the tuck-in operation for the weaving process using the selected color.

[0054] The on-off solenoid valves 5a and 5b, the operations of which are controlled by the timing controller 9, are respectively connected to the group of first tuck-in nozzles 4a for tire fabric weaving and the group of second tuck-in nozzles 4b for tabby weaving. More specifically, in the illustrated example, the tuck-in device 10 includes the on-off valve 5a connected to the tuck-in nozzles 4a corresponding to tire fabric weaving and the on-off valve 5b connected to the tuck-in nozzles 4b corresponding to tabby weaving, and operates one of the on-off valves 5a and 5b to switch the ejection position of the tuck-in nozzles that perform the ejecting operation. Therefore, in the illustrated example, the pair of on-off valves correspond to the "switching means 5" according to the present invention.

[0055] The timing controller 9 controls the operation of the on-off valve 5a or 5b that is connected to the selected group of tuck-in nozzles on the basis of the signal S2 from the tuck-in operation setter 29. More specifically, the timing controller 9 receives the signal from the encoder 34, and controls the on-off valve connected to the selected group of tuck-in nozzles by exciting and demagnetizing the on-off valve at the set ejection timing in synchronization with the rotation of the main shaft 35. Accordingly, one of the group of tuck-in nozzles 4a and the group of tuck-in nozzles 4b that corresponds to the signal S2 from the tuck-in operation setter 29 performs the ejecting operation at the set ejection timing.

[0056] The operation of the tuck-in device 10 during tire fabric weaving and tabby weaving will now be described with reference to Figs. 2 to 4.

[0057] In tire fabric weaving, the loom controller 27 causes the weft insertion nozzle 33a for color 1 (first weft insertion system) to insert the weft yarn 2 into the warp shedding 30, and outputs a color signal $S1_1$ that represents color 1 to the tuck-in operation setter 29.

[0058] As illustrated in Fig. 2, the inserted weft yarn 2 is beaten up against the cloth fell 31 when a reed (not shown) is moved forward. At this time, the end portion 2a of the weft yarn moves into the slit 12 in the tuck-in head 11. The end portion 2a is cut off from the weft yarn in the weft insertion nozzle 33a by the cutter 32, is blown into the weft-yarn-end holding hole 14 by the air ejected from the weft-yarn-end holding nozzle 13, and is retained in the weft-yarn-end holding hole 14.

[0059] Then, when the reed (not shown) is moved backward, the timing controller 9 controls the on-off valves 5a and 5c on the basis of a signal $S2_1$ that is received from the tuck-in operation setter 29 and that represents the group of tuck-in nozzles corresponding to color 1 and the ejection condition thereof, so that the end portion 2a of the weft yarn is bent into the warp shedding 30. More specifically, first, the timing controller 9 causes the weft-yarn-end holding nozzle 13 to stop ejecting the air and causes the weft-yarn releasing nozzles 15 to start ejecting the air. The end portion 2a of the weft yarn is pushed out of the weft-yarn-end holding hole 14 by the air ejected from the weft-yarn releasing nozzles 15, and is blown out of the slit 12.

[0060] Then, the timing controller 9 opens the on-off valve 5a corresponding to tire fabric weaving on the basis of the signal $S2_1$, and causes only the group of first tuck-in nozzles 4a included in the tuck-in nozzles 4 to eject the air. At this time, the group of first tuck-in nozzles 4a eject the air at a pressure adjusted for tire fabric weaving by the pressure control valve 40. The pressure control valve 40 adjusts the pressure of the air under the control of the pressure regulator 28 that receives a signal $S3_1$ that is output from the tuck-in operation setter 29 and that represents the pressure value corresponding to color 1.

[0061] When the air is ejected from the group of tuck-in nozzles 4a, the end portion 2a of the weft yarn is blown into the warp shedding 30 at a position separated from the cloth fell 31, and is bent along a gentle, loop-shaped curve as shown by the two-dot chain line in Fig. 2. The end portion 2a of the weft yarn that has been bent is beaten up together with the subsequent weft yarn and is woven into the fabric 1 together with the subsequent weft yarn. In tire fabric weaving, the selvage fastening nozzle 16 is deactivated to maintain the gentle, loop-shaped curve of the tuck-in selvage.

[0062] In tabby weaving, the loom controller 27 causes the weft insertion nozzle 33b for color 2 (second weft insertion system) to insert the weft yarn 2 into the warp shedding 30, and outputs a color signal $S1_2$ that represents color 2 to the tuck-in operation setter 29.

[0063] When the color signal $S1_2$ is input, the tuck-in operation setter 29 outputs a signal $S2_2$ that represents the group of tuck-in nozzles corresponding to color 2 and the ejection timing, which is one of the ejection conditions, to the timing controller 9. The timing controller 9 operates the on-off valve 5b corresponding to tabby weaving, and causes only the group of second tuck-in nozzles 4b included in the tuck-in nozzles 4 to eject the air. At this time, the group of second tuck-in nozzles 4b eject the air at a pressure adjusted for tabby weaving by the pressure control valve 40. The pressure control valve 40 adjusts the pressure of the air under the control of the pressure regulator 28 that receives a signal $S3_2$ that is output from the tuck-in operation setter 29 and that represents the pressure value corresponding to color 2.

[0064] When the air is ejected from the group of tuck-in nozzles 4b, the end portion 2a of the weft yarn is blown into the warp shedding 30 at a position close to the cloth fell 31, and is bent to as to form a small loop as shown by the two-dot chain line in Fig. 5 which illustrates the related art. The end portion 2a of the weft yarn that has been bent is beaten up together with the subsequent weft yarn and is woven into the fabric 1 together with the subsequent weft yarn. At this time, the air is ejected from the selvage fastening nozzle 16, so that the end portion 2a of the weft yarn that has been bent is blown and urged toward the center of the warp shedding 30 and is prevented from becoming loose. The operations of components other than the tuck-in nozzles 4 and the selvage fastening nozzle 16 in the tuck-in device 10 are basically similar to those in tire fabric weaving except that the ejection time, ejection pressure, etc. are set to values different from those in tire fabric weaving.

[0065] With the above-described structure, in the tuck-in device 10 according to the present embodiment, in tire fabric weaving, the tuck-in operation is performed by ejecting the air from the group of first tuck-in nozzles 4a, which is farther from the cloth fell 31 than the group of second tuck-in nozzles 4b in the warp direction. In tabby weaving, the tuck-in operation is performed by ejecting the air from the group of second tuck-in nozzles 4b. Thus, in the tuck-in device 10 according to the present embodiment, the tuck-in operation is performed by selectively ejecting the air from the tuck-in nozzles disposed at different positions in the warp direction between tire fabric weaving and tabby weaving in which the weft density is set to different values. Accordingly, the tuck-in selvage can be normally formed in both the tire fabric section and the tabby section that have largely different weft densities.

[0066] The structures of the tuck-in nozzles and the switching means according to the present invention are not limited to those in the above-described embodiment. In the tuck-in device according to the present invention, the tuck-in operation is appropriately performed for each of a plurality of weave sections having different densities by selectively switching the ejection position of the tuck-in nozzles for each of the weave sections. In the above-described example, the tuck-in device 10 includes two (groups of) tuck-in nozzles 4a and 4b which are disposed at different positions in the warp direction. The tuck-in nozzles caused to perform the ejecting operation are selectively switched by the on-off valves 5a and 5b, which function as the switching means 5, in accordance with each weave section. Thus, the ejection position of the tuck-in nozzles that perform the tuck-in operation is changed in the warp direction between the weave sections.

[0067] However, instead of selectively using a plurality of tuck-in nozzles disposed at different positions in the warp direction, the ejection position may be changed by moving the tuck-in nozzles themselves.

[0068] For example, the tuck-in head may be provided with a single (group of) tuck-in nozzle(s), and a structure for supporting the tuck-in head on a fixed member, such

as a temple bracket, of the loom may be switched from the above-described fixed-type structure to a support structure including a moving mechanism that can be moved in the warp direction by an actuator. Thus, the position of the tuck-in head in the warp direction can be switched between two or more positions in accordance with the weave structure of each weave section. Accordingly, the air can be ejected from a single (group of) tuck-in nozzle(s) at two or more positions that differ from each other in the warp direction. In this case, the moving mechanism corresponds to the "switching means" according to the present invention. The moving mechanism may be, for example, a ball screw mechanism driven by an electric motor.

[0069] In the above-described embodiment, the present invention is applied to a shuttleless loom for weaving a rubber reinforcing fabric such as a tire cord fabric. However, the present invention is not limited to shuttleless looms for weaving a rubber reinforcing fabric, and may also be applied to other types of shuttleless looms that weave a fabric including two weave sections with different densities. Here, the "fabric including two weave sections" is not limited to fabric including only two weave sections, but include fabric including other weave sections with different densities.

Claims

1. A tuck-in method for a shuttleless loom including an air jet tuck-in device including one or more tuck-in nozzles (4) disposed at a side of a row of warp yarns for tucking an end portion (2a) of a weft yarn into a warp shedding (30) after weft insertion, the shuttleless loom weaving a fabric (1) including at least a first weave section (1a) and a second weave section (1b) having a weft density that differs from a weft density of the first weave section, the tuck-in method comprising the step of:

performing an ejecting operation of ejecting air from the tuck-in nozzles for tucking the end portion of the weft yarn into the warp shedding, an ejection position at which the tuck-in nozzles perform the ejecting operation during weaving of the first weave section (1a) being different, in a warp direction, from an ejection position at which the tuck-in nozzles perform the ejecting operation during weaving of the second weave section (1b).

2. The tuck-in method according to claim 1,
wherein the shuttleless loom is a loom for weaving a rubber reinforcing fabric in which the first weave section (1a) is a tire fabric section and the second weave section (1b) is a tabby section, and
wherein the ejection position of the tuck-in nozzles during weaving of the tire fabric section is on a let-off side in the warp direction relative to the ejection position of the tuck-in nozzles during weaving of the tabby section.

3. The tuck-in method according to claim 2,
wherein the tuck-in device includes one or more first tuck-in nozzles (4a) and one or more second tuck-in nozzles (4b), the first tuck-in nozzles (4a) being on the let-off side in the warp direction relative to the second tuck-in nozzles (4b), and
wherein the first tuck-in nozzles (4a) perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the second tuck-in nozzles (4b) do not perform the ejecting operation during weaving of the first weave section (1a), and the second tuck-in nozzles (4b) perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding and the first tuck-in nozzles (4a) do not perform the ejecting operation during weaving of the second weave section (1b).

4. An air jet tuck-in device for use in a shuttleless loom for weaving a fabric (1) including at least a first weave section (1a) and a second weave section (1b) having a weft density that differs from a weft density of the first weave section, the tuck-in device including one or more tuck-in nozzles (4) disposed at a side of a row of warp yarns for tucking an end portion (2a) of a weft yarn into a warp shedding (30) after weft insertion, the tuck-in device comprising:

switching means (5) that switches an ejection position at which an ejecting operation is performed between a first ejection position that corresponds to the first weave section (1a) and a second ejection position that corresponds to the second weave section (1b), the first ejection position and the second ejection position being different from each other in a warp direction; and
control means (6) that selects one of the first ejection position and the second ejection position as the ejection position at which the ejecting operation is to be performed by the tuck-in nozzles for tucking the end portion of the weft yarn into the warp shedding and operates the switching means (5) on the basis of a result of the selection, the selection being performed on the basis of a signal (S1) related to an input weft density or a weaving condition associated with the weft density.

5. The tuck-in device according to claim 4,
wherein the control means (6) includes
a setting unit (7) in which the weft density or the weaving condition associated with the weft density is set for each of the first weave section (1a) and the second weave section (1b) and in which information re-

garding the first or second ejection position is set in association with the weft density or the weaving condition,
a selecting unit (8) that performs the selection on the basis of the signal (S1) related to the input weft density or the weaving condition, and
a controller (9) that controls the operation of the switching means (5) on the basis of the result of the selection performed by the selecting unit (8).

6. The tuck-in device according to claim 5,
wherein the shuttleless loom is a loom for weaving a rubber reinforcing fabric in which the first weave section (1a) is a tire fabric section and the second weave section (1b) is a tabby section, and
wherein the first ejection position is on a let-off side in the warp direction relative to the second ejection position.

7. The tuck-in device according to claim 6,
wherein the tuck-in device includes one or more first tuck-in nozzles (4a) that perform the ejecting operation at the first ejection position and one or more second tuck-in nozzles (4b) that perform the ejecting operation at the second ejection position, the first tuck-in nozzles (4a) and the second tuck-in nozzles (4b) being arranged next to each other in the warp direction, and
wherein the controller (9) in the control means (6) controls the operation of the switching means (5) such that the first tuck-in nozzles (4a) or the second tuck-in nozzles (4b) perform the ejecting operation for tucking the end portion of the weft yarn into the warp shedding.

FIG. 1

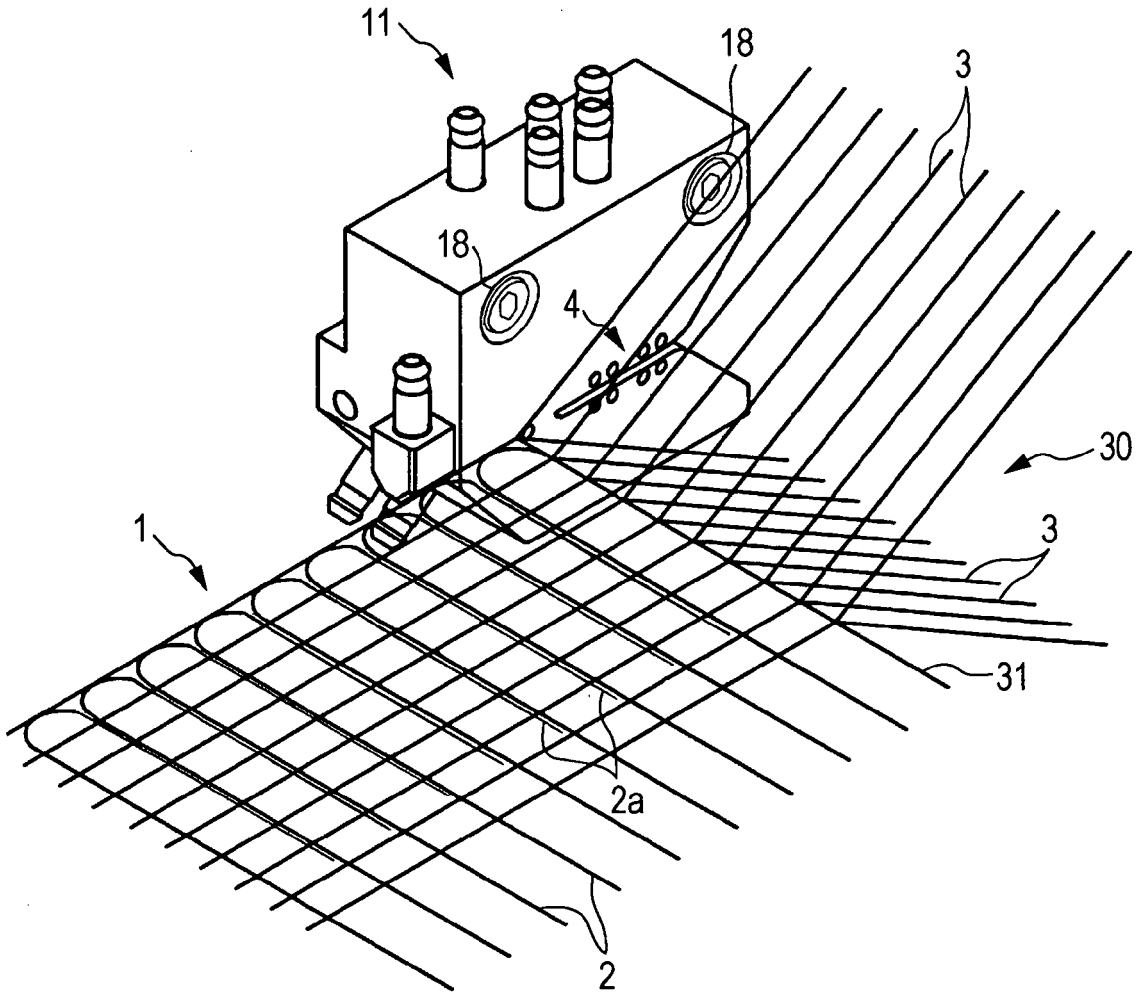


FIG. 2

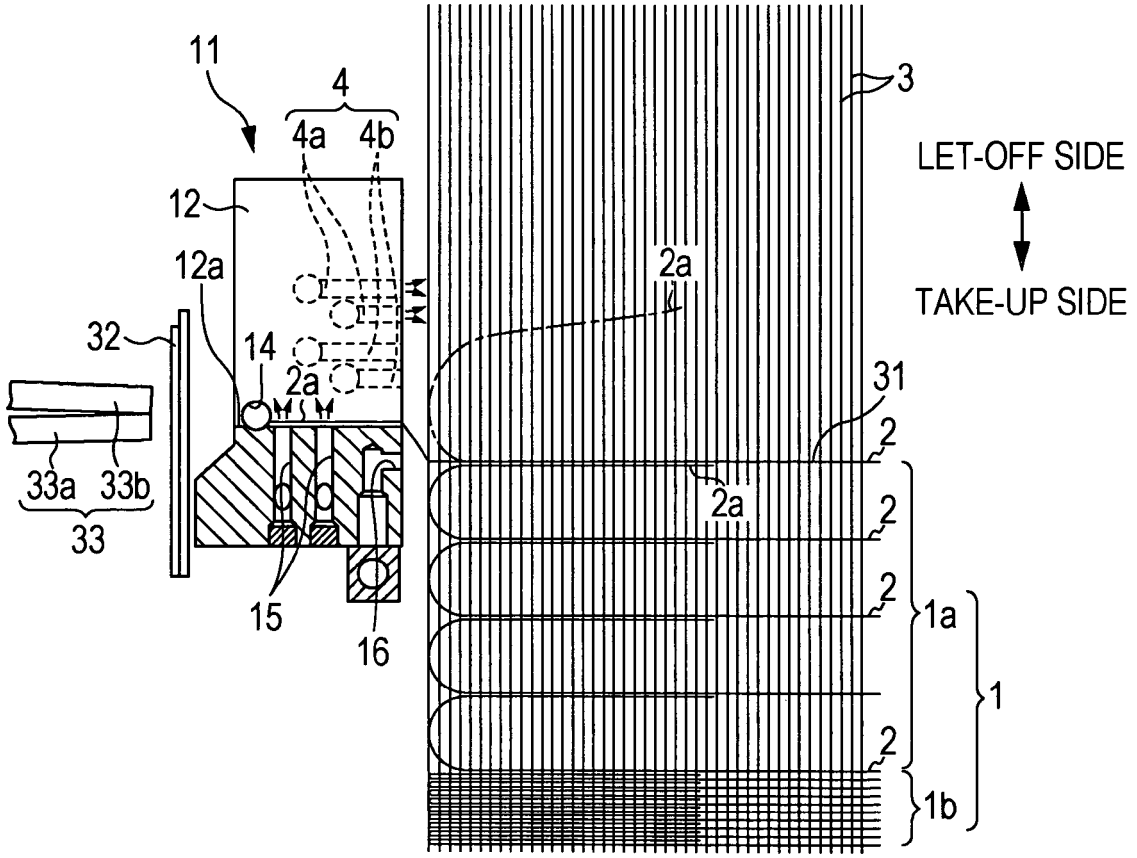

11
4
4a
4b
12
12a
32
14
2a
33a
33b
33
15
16
3
LET-OFF SIDE
TAKE-UP SIDE
2a
31
2
2a
2
2
1a
2
1
1b

FIG. 3A

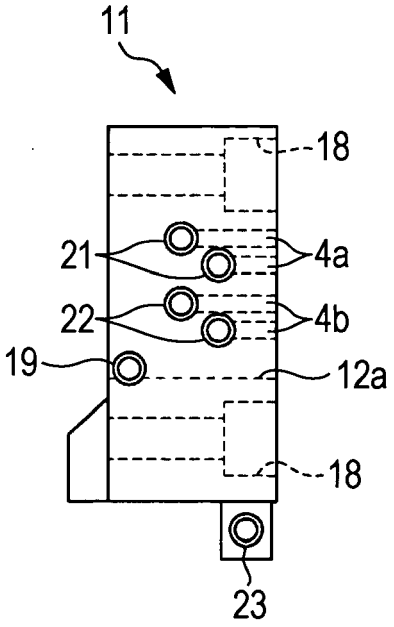


FIG. 3B

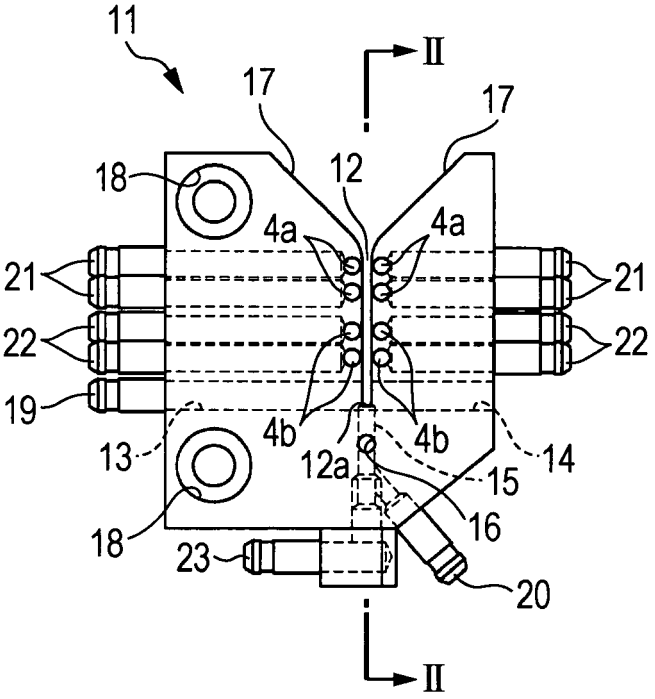


FIG. 3C

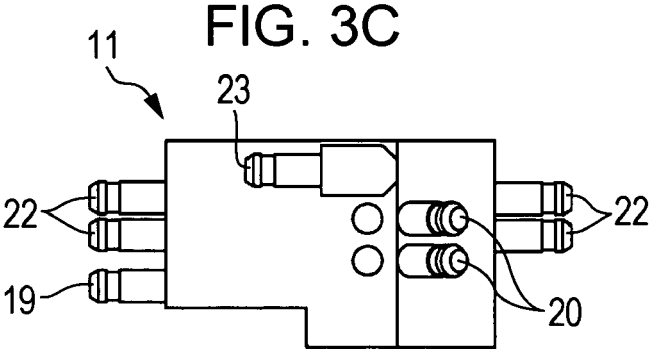


FIG. 4

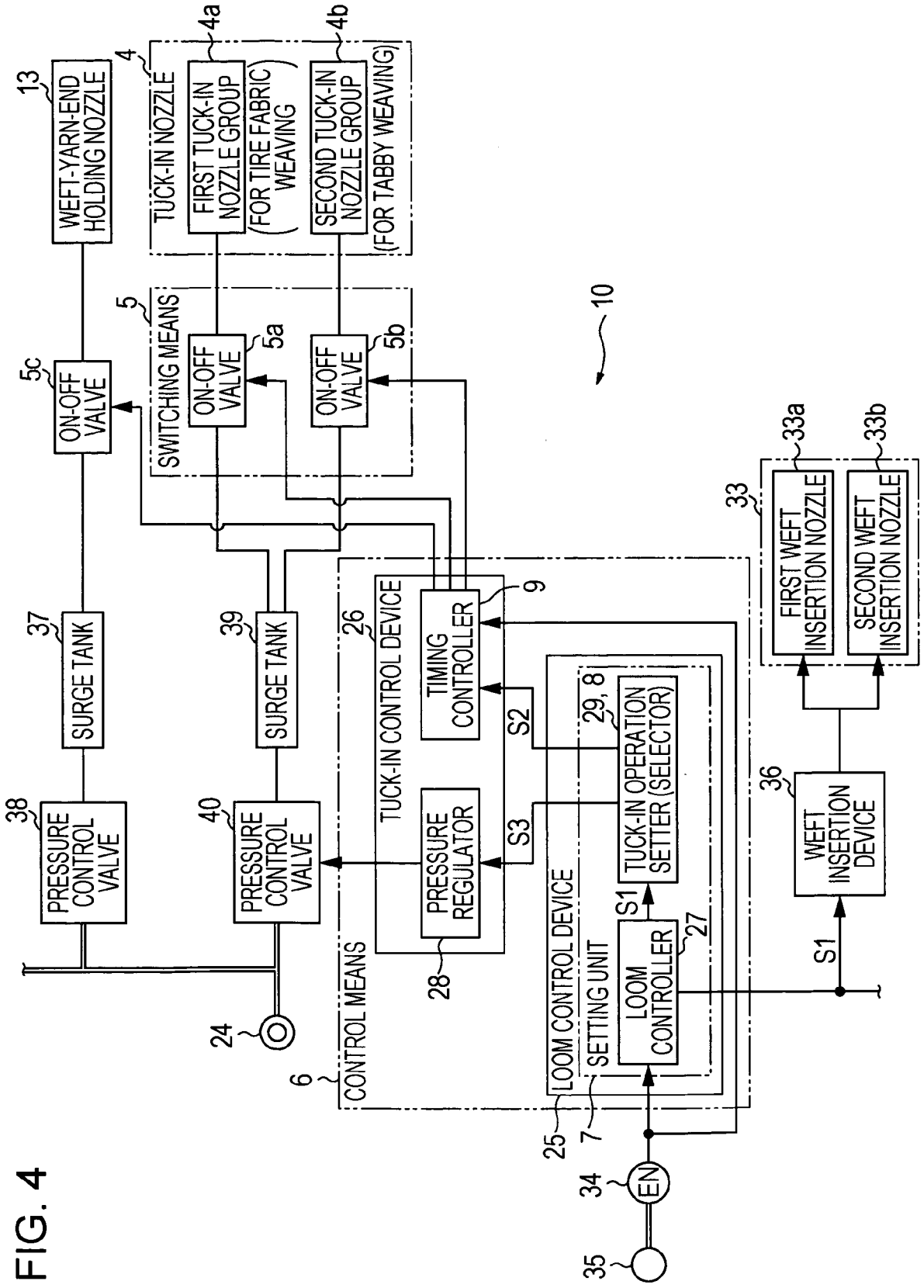

10
4
TUCK-IN NOZZLE
4a
FIRST TUCK-IN NOZZLE GROUP
(FOR TIRE FABRIC WEAVING)
4b
SECOND TUCK-IN NOZZLE GROUP
(FOR TABBY WEAVING)
13
WEFT-YARN-END HOLDING NOZZLE
5
SWITCHING MEANS
5a
ON-OFF VALVE
5b
ON-OFF VALVE
5c
ON-OFF VALVE
33
33a
FIRST WEFT INSERTION NOZZLE
33b
SECOND WEFT INSERTION NOZZLE
37
SURGE TANK
39
SURGE TANK
26
TUCK-IN CONTROL DEVICE
9
TIMING CONTROLLER
S2
29, 8
TUCK-IN OPERATION SETTER (SELECTOR)
38
PRESSURE CONTROL VALVE
40
PRESSURE CONTROL VALVE
S3
PRESSURE REGULATOR
28
36
WEFT INSERTION DEVICE
S1
S1
LOOM CONTROLLER
27
LOOM CONTROL DEVICE
SETTING UNIT
7
25
6
CONTROL MEANS
24
34
EN
35

FIG. 5

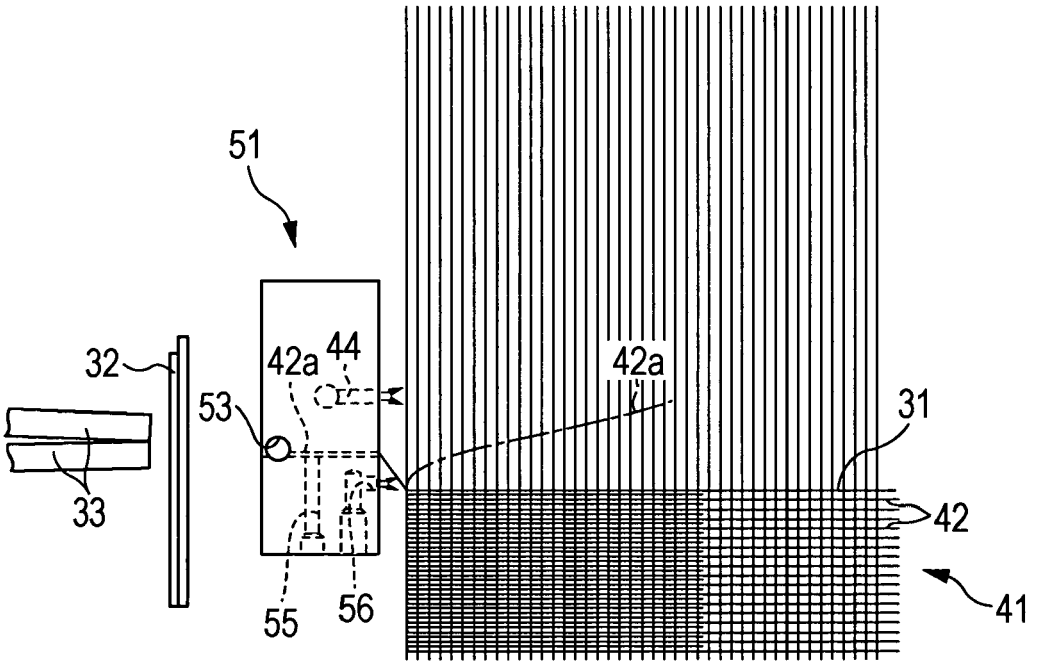


FIG. 6

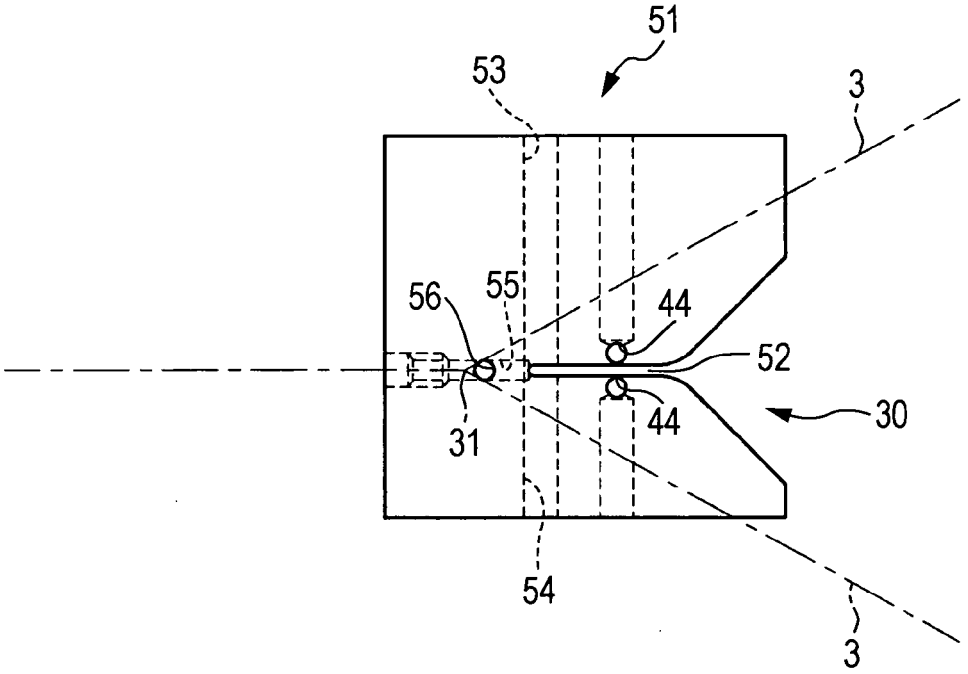
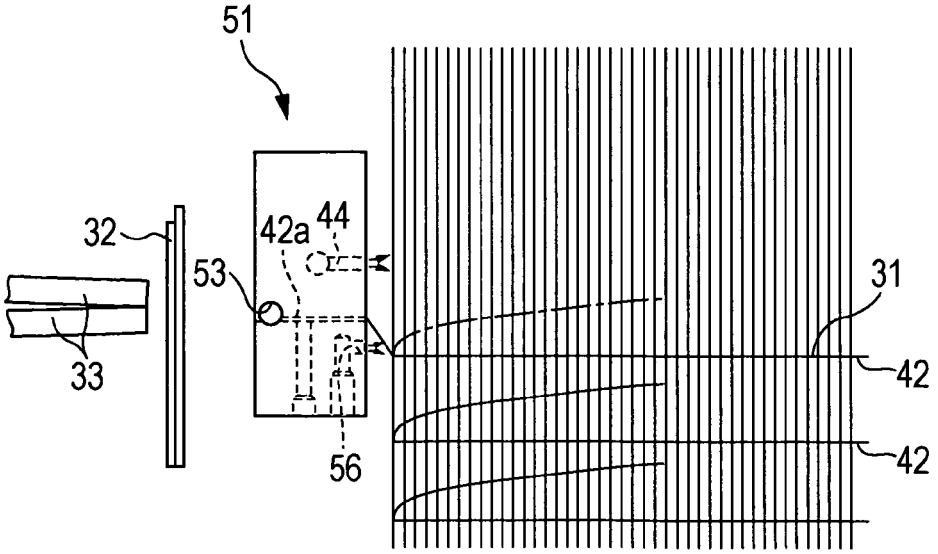


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 10 01 4846

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 314 807 A2 (TSUDAKOMA IND CO LTD [JP]) 28 May 2003 (2003-05-28) * paragraphs [0012] - [0025]; figures 1-8 *	1-7	INV. D03D47/48
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D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 January 2011	Iamandi, Daniela

CATEGORY OF CITED DOCUMENTS

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20-01-2011

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