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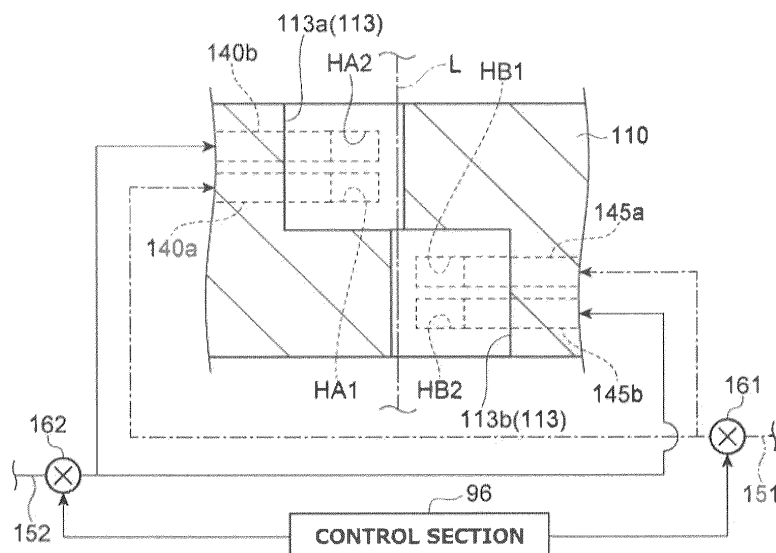
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(54) **YARN JOINING DEVICE, YARN JOINING NOZZLE STRUCTURE, AND WINDING DEVICE**

(57) A yarn joining device (26) includes a yarn joining part (50) in which yarn joining is performed by injection of compressed air. The yarn joining part (50) includes a downstream-side yarn joining chamber (113a) and an upstream-side yarn joining chamber (113b) that are arranged adjacent to each other in a yarn running direction and communicate with each other, a first downstream-side injection hole (HA1) and a second downstream-side injection hole (HA2) for injecting compressed air into the downstream-side yarn joining chamber (113a), and a first upstream-side injection hole (HB1)

and a second upstream-side injection hole (HB2) for injecting compressed air into the upstream-side yarn joining chamber (113b). A control section (96) is operable of changing injection start timing for injecting the compressed air from one of the first downstream-side injection hole (HA1) and the second downstream-side injection hole (HA2) and / or injection start timing for injecting the compressed air from the first upstream-side injection hole (HB1) and the second upstream-side injection hole (HB2).

FIG.5B



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn joining device, a yarn joining nozzle structure, and a winding device.

2. Description of the Related Art

[0002] A conventional yarn joining device is disclosed, for example, in Japanese Patent No. 2590565. In the yarn joining device disclosed in Japanese Patent No. 2590565, air current is jetted from a first outlet and a second outlet arranged on an upstream side and a downstream side, respectively, of a yarn path of the first outlet in a yarn joining chamber of a yarn joining part (splicing nozzle block).

[0003] In this yarn joining device, there are situations where a yarn joint having insufficient strength or appearance quality is produced depending on the yarn type and the yarn count.

[0004] Consequently, in the recent years, there has been a need for developing a yarn joining device that is capable of handling a variety of yarns (yarn of various types and having different yarn counts).

SUMMARY OF THE INVENTION

[0005] The present invention has been made in view of the above circumstances. It is an object of the present invention to provide a yarn joining device capable of handling variety of yarns, a yarn joining nozzle structure, and a winding device.

[0006] According to one aspect of the present invention, a yarn joining device includes a yarn joining part that performs yarn joining by twisting overlapping yarn ends by the action of compressed air, and a control section that controls injection of the compressed air in the yarn joining part. The yarn joining part includes an upstream-side yarn joining chamber and a downstream-side yarn joining chamber that are arranged adjacent to each other in a yarn running direction and communicate with each other; a plurality of upstream-side injection holes from which the compressed air is injected into the upstream-side yarn joining chamber, and a plurality of downstream-side injection holes from which the compressed air is injected into the downstream-side yarn joining chamber. The control section is operable or capable of changing injection start timing for injecting the compressed air from one or more of the plurality of the upstream-side injection holes, and changing injection start timing for injecting the compressed air from one or more of the plurality of the downstream-side injection holes.

[0007] According to another aspect of the present invention, a winding device includes the above yarn joining

device.

[0008] According to still another aspect of the present invention, a yarn joining nozzle structure in which yarn joining is performed by injection of compressed air includes a nozzle in which an upstream-side yarn joining chamber and a downstream-side yarn joining chamber are formed adjacent to each other in a yarn running direction and communicate with each other, and a supporting block that accommodates the nozzle. The nozzle includes a first upstream-side injection hole and a second upstream-side injection hole for injecting compressed air into the upstream-side yarn joining chamber, and a first downstream-side injection hole and a second downstream-side injection hole that inject compressed air to the downstream-side yarn joining chamber, the first upstream-side injection hole and the second upstream-side injection hole have different shapes, and the first downstream-side injection hole and the second downstream-side injection hole have different shapes.

[0009] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is a front view of an automatic winder.

FIG. 2 is a side view of a winder unit shown in FIG. 1.

FIG. 3 is a front view of a yarn joining device according to a first embodiment.

FIG. 4A is a perspective view showing a front side of a yarn joining nozzle structure according to the first embodiment.

FIG. 4B is a perspective view showing a back side of the yarn joining nozzle structure according to the first embodiment.

FIG. 5A is a cross-sectional view along a line V(a)-V(a) shown in FIG. 4A.

FIG. 5B is a cross-sectional view along a line V(b)-V(b) shown in FIG. 5A.

FIG. 6 is a cross-sectional view corresponding to FIG. 5A for explaining injection of compressed air in the yarn joining device according to the first embodiment.

FIG. 7 is a graph showing a relation between a blowing time of compressed air and a winding force.

FIG. 8 is a diagram showing an example of injection timing conditions based on which compressed air is injected in the yarn joining device according to the first embodiment.

FIG. 9A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device according to a second embodiment.

FIG. 9B is a cross-sectional view along a line

IX(b)-IX(b) shown in FIG. 9A.

FIG. 10 is a cross-sectional view corresponding to FIG. 9A for explaining injection of compressed air in the yarn joining device according to the second embodiment.

FIG. 11A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device according to a third embodiment.

FIG. 11B is a cross-sectional view along a line XI(b)-XI(b) shown in FIG. 11A.

FIG. 12 is a cross-sectional view corresponding to FIG. 11A for explaining injection of compressed air in the yarn joining device according to the third embodiment.

FIG. 13A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device according to a fourth embodiment.

FIG. 13B is a cross-sectional view along a line XIII (b)-XIII (b) shown in FIG. 13A.

DETAILED DESCRIPTION

[0011] Exemplary embodiments of the present invention are explained in detail below with reference to the accompanying drawings. Identical elements or corresponding elements are indicated by the same reference symbols in the drawings and redundant explanation thereof is omitted.

First Embodiment

[0012] As shown in FIG. 1, an automatic winder 1 includes a plurality of winder units 3 arranged side-by-side, a main control device 5, and a doffing device 7. The main control device 5 is operable or capable of communicating with a plurality of the winder units (winding device) 3. An operator of the automatic winder 1 can collectively control a plurality of the winder units 3 by appropriately operating the main control device 5. Each winder unit 3 forms a package P by unwinding a yarn Y from a yarn supplying bobbin SB and winding the yarn Y onto a winding bobbin WB while traversing the yarn Y. When the package P in a certain winder unit 3 is fully wound (a state in which a specific amount of the yarn Y is wound), the doffing device 7 travels to a position of this winder unit 3, removes the fully wound package P, and sets an empty winding bobbin WB in the winder unit 3.

[0013] As shown in FIG. 2, the winder unit 3 includes a unit controller 10, a yarn supplying device 12, and a winding device 14. The unit controller 10 includes, for example, a CPU (Central Processing Unit) and a ROM (Read Only Memory). A computer program to control various components of the winder unit 3 is stored in the ROM. The CPU executes the computer program stored in the ROM. The unit controller 10 includes a later-explained control section 96.

[0014] The yarn supplying device 12 supports the yarn supplying bobbin SB, which has been set in a not-shown

transport tray, at a certain position. The yarn supplying device 12 unwinds the yarn Y from the yarn supplying bobbin SB and pulls the yarn Y from the yarn supplying bobbin SB. The yarn supplying device 12 supplies the yarn Y. The yarn supplying device 12 is not limited to a transport tray-type device and can be, for example, a magazine-type device.

[0015] The winding device 14 includes a cradle 16 and a winding drum 18. The cradle 16 rotatably supports the winding bobbin WB (or package P) by pinching the winding bobbin WB. The winding drum 18 causes the package P to rotate while causing the yarn Y to traverse on the surface of the package P. The winding drum 18 is rotatably driven by a not-shown drum driving motor. An outer periphery of the package P is in contact with the winding drum 18; therefore, the package P rotates following the rotation of the winding drum 18. A helical traverse groove is formed on an outer peripheral surface of the winding drum 18. The yarn Y unwound from the yarn supplying bobbin SB is wound onto the surface of the package P at a fixed width while being traversed via the traverse groove. Accordingly, the package P having a fixed winding width can be formed.

[0016] Each winder unit 3 includes, sequentially from the yarn supplying device 12, on a yarn path between the yarn supplying device 12 and the winding device 14, a yarn unwinding assisting device 20, a tension applying device 22, a tension detecting device 24, a yarn joining device 26, and a yarn monitoring device 28. A first catching and guiding device 30 and a second catching and guiding device 32 are arranged near the yarn joining device 26.

[0017] The yarn unwinding assisting device 20 prevents excessive swinging of the yarn Y due to the centrifugal force of the yarn Y that is being unwound from the yarn supplying bobbin SB thereby appropriately unwinding the yarn Y from the yarn supplying bobbin SB. The tension applying device 22 applies a predetermined tension to the running yarn Y. In the present embodiment, the tension applying device 22 is a gate-type device in which movable comb teeth are arranged with respect to fixed comb teeth.

[0018] The tension detecting device 24 detects the tension of the yarn Y running between the yarn supplying device 12 and the winding device 14. When the yarn Y is disconnected between the yarn supplying device 12 and the winding device 14 due to some reason, the yarn joining device 26 joins the yarn Y on the yarn supplying device 12 side and the yarn Y on the winding device 14 side.

[0019] The yarn monitoring device 28 monitors the state of the yarn Y running on the yarn path and detects whether there is a yarn defect. The yarn defect includes, for example, thickness defects of the yarn Y, foreign matter stuck to the yarn Y, and / or yarn breakage and the like.

[0020] The first catching and guiding device 30 is pivotable from a waiting position on the yarn supplying device 12 side to a catching position on the winding device

14 side. The first catching and guiding device 30 catches the yarn Y at the catching position and guides the yarn Y to the yarn joining device 26. The second catching and guiding device 32 is pivotable from a waiting position on the yarn supplying device 12 side to the catching position on the winding device 14 side. The second catching and guiding device 32 catches the yarn Y at the catching position and guides the yarn Y to the yarn joining device 26.

[0021] Next, the yarn joining device 26 will be explained in detail.

[0022] FIG. 3 is a front view of the yarn joining device 26. In the following explanation, for the sake of convenience, the winding device 14 side is referred to as a downstream side, the yarn supplying device 12 side is referred to as an upstream side, the running path of the yarn Y (yarn path) side with respect to the yarn joining device 26 is referred to as a front side, and an opposite side thereof is called a back side. A direction perpendicular to an up-down direction and a front-back direction is referred to as a left-right direction. Moreover, a yarn end of the yarn Y positioned on the winding device 14 side is referred to as a first yarn end and a yarn end of the yarn Y positioned on the yarn supplying device 12 side is referred to as a second yarn end.

[0023] As shown in FIG. 3, the yarn joining device 26 includes a front plate (contact member) 90, an untwisting part 40 that includes a first untwisting pipe member 41A and a second untwisting pipe member 41B, a yarn joining part 50 that performs yarn joining by using compressed air, a not-shown pair of yarn shifting levers capable of pivoting so as to pinch the untwisting part 40, a yarn pressing member 80 that includes a first yarn pressing lever 82 and a second yarn pressing lever 83 capable of pivoting so as to pinch the yarn joining part 50, an air guide 94, and the control section 96 that controls injection of the compressed air in the yarn joining part 50 (see FIG. 5B).

[0024] The front plate 90 is a plate-shaped member having a thickness direction thereof in the front-back direction. A front surface (contact surface) 90a of the front plate 90 is flat and extends in a direction parallel to a yarn running direction. The yarn joining part 50 is arranged on the front surface 90a of the front plate 90. On the front surface 90a of the front plate 90, a first yarn end introducing port, which is an opening port of the first untwisting pipe member 41A, is provided on the upstream side of the yarn joining part 50, and a second yarn end introducing port, which is an opening port of the second untwisting pipe member 41B, is provided on the downstream side of the yarn joining part 50.

[0025] On the front surface 90a of the front plate 90, a first guide member 45A is provided on the downstream side of the first untwisting pipe member 41A, and a second guide member 45B is provided on the upstream side of the second untwisting pipe member 41B. The first guide member 45A and the second guide member 45B are arranged so as to face each other with the yarn joining part 50 interposed therebetween. The first guide member

45A guides the yarn Y guided by the first catching and guiding device 30 and the second guide member 45B guides the yarn Y guided by the second catching and guiding device 32.

[0026] The first untwisting pipe member 41A untwists the first yarn end by the action of the compressed air. The second untwisting pipe member 41B untwists the second yarn end by the action of the compressed air. The yarn joining part 50 twists and joins the first yarn end untwisted in the first untwisting pipe member 41A and the second yarn end untwisted in the second untwisting pipe member 41B by the action of the compressed air. When twisting the yarn ends in the yarn joining part 50, the first yarn end and the second yarn end are pulled, while being held by a not-shown clamp, from the first untwisting pipe member 41A and the second untwisting pipe member 41B by a not-shown yarn shifting lever and pressed near the yarn joining part 50 by the first yarn pressing lever 82 and the second yarn pressing lever 83.

[0027] The yarn pressing member 80 is connected to, for example, a not-shown driving source, such as stepping motor, via a cam-link mechanism 95. The yarn pressing member 80 is arranged movable so as to approach and separate from the front surface 90a of the front plate 90 by a driving force of the driving source. In other words, the first yarn pressing lever 82 and the second yarn pressing lever 83 of the yarn pressing member 80 are pivoted (rotated) by the driving force of the driving source such that tip end sides thereof approach and separate from the front surface 90a of the front plate 90. The yarn pressing member 80 presses the first yarn end and the second yarn end in cooperation with the front surface 90a when in contact with the front surface 90a of the front plate 90. The first yarn pressing lever 82 and the second yarn pressing lever 83 can be biased, for example, by a not-shown helical torsion coil spring, such that the tip ends thereof approach the front plate 90 side. The air guide 94 is a member that guides the compressed air injected in the yarn joining part 50. The air guide 94 is arranged so as to cover a part of opening ports positioned above and below a yarn joining chamber 113 of the yarn joining part 50 to which the first yarn end and the second yarn end are guided.

[0028] In the yarn joining device 26 having such a configuration, first, the not-shown first yarn shifting lever and the second yarn shifting lever, the first yarn pressing lever 82, and the second yarn pressing lever 83 pivot to the front plate 90 side. Accordingly, the yarn Y on the downstream side and the yarn Y on the upstream side caught by the first catching and guiding device 30 and the second catching and guiding device 32 are pulled to the untwisting part 40 side. Subsequently, the yarn Y on an upper side and the yarn Y on a lower side are held by the clamp and then cut in this state by a cutter. The first yarn end is fed to the inside of the first untwisting pipe member 41A and the second yarn end is fed to the inside of the second untwisting pipe member 41B. When the compressed air is injected in the first untwisting pipe member

41A and the second untwisting pipe member 41B, the first yarn end and the second yarn end are untwisted by the action of the compressed air.

[0029] Subsequently, the not-shown first yarn shifting lever and the second yarn shifting lever are further pivoted. Accordingly, the first yarn end and the second yarn end are pressed near the yarn joining part 50 by the first yarn pressing lever 82 and the second yarn pressing lever 83 while being pulled from the first untwisting pipe member 41A and the second untwisting pipe member 41B. After this, injection of the compressed air is started in the yarn joining part 50, whereby the untwisted first yarn end and the second yarn end are twisted by the action of the compressed air. Then, the first yarn pressing lever 82 and the second yarn pressing lever 83 are pivoted, along with the not-shown first yarn shifting lever and the second yarn shifting lever, in the opposite direction. Accordingly, the yarn Y on the upper side and the yarn Y on the lower side held by the clamp are released. As a result, the connected yarn Y returns to the running path on the front side of the yarn joining device 26.

[0030] FIG. 4A is a perspective view showing a front side of a yarn joining nozzle structure 100. FIG. 4B is a perspective view showing a back side of the yarn joining nozzle structure 100. FIG. 5A is a cross-sectional view along a line V(a)-V(a) shown in FIG. 4A. FIG. 5B is a cross-sectional view along a line V(b)-V(b) shown in FIG. 5A. The yarn joining part 50 performs yarn joining by using the compressed air, and includes the yarn joining nozzle structure 100. The yarn joining nozzle structure 100 includes a nozzle 110 and a supporting block 120.

[0031] As shown in FIGS. 4A, 4B, and 5A, the nozzle 110 is fixed to the supporting block 120. The nozzle 110 is made of, for example, ceramic. A groove 111 having a V-shaped cross-section and that extends from an upper end to a lower end is formed on a front side of the nozzle 110. The yarn joining chamber 113 that communicates with the groove 111 via a passage portion 112 is formed on a bottom portion of the groove 111. The yarn joining chamber 113 is a space in which yarn joining is performed by the action of the compressed air. The yarn joining chamber 113 includes a downstream-side yarn joining chamber 113a and an upstream-side yarn joining chamber 113b.

[0032] The downstream-side yarn joining chamber 113a is provided on a lower side from the center of the up-down direction (yarn running direction) of the nozzle 110, and opens on the downstream side. When viewed from the downstream side, the downstream-side yarn joining chamber 113a is circular and inclined to one side from the center of the left-right direction. The upstream-side yarn joining chamber 113b is provided on the upstream side from the center of the up-down direction (yarn running direction) of the nozzle 110, and opens on the upstream side. When viewed from the upstream side, the upstream-side yarn joining chamber 113b is circular and inclined to the other side from the center of the left-right direction. The downstream-side yarn joining cham-

ber 113a and the upstream-side yarn joining chamber 113b are adjacent to each other in the up-down direction and communicate with each other at a central portion in the up-down direction of the nozzle 110.

[0033] As shown in FIGS. 5A and 5B, a first passage 140a and a second passage 140b via which the compressed air is supplied to the downstream-side yarn joining chamber 113a is formed on the nozzle 110. The first passage 140a and the second passage 140b are through holes that communicate with the downstream-side yarn joining chamber 113a. The first passage 140a and the second passage 140b extend in an inclined manner inside the nozzle 110 following the V-shape of the groove 111. When viewed from the front side (from a direction perpendicular to the yarn running direction and a predetermined direction), the first passage 140a and the second passage 140b are positioned parallel to the up-down direction and are on one side of the left-right direction with respect to a yarn running path L. When viewed from the front side, the first passage 140a is positioned on the upstream side of the second passage 140b (inner side of the nozzle 110). An opening of the first passage 140a on the downstream-side yarn joining chamber 113a constitutes a first downstream-side injection hole HA1 and an opening of the second passage 140b on the downstream-side yarn joining chamber 113a constitutes a second downstream-side injection hole HA2.

[0034] The compressed air is injected inside the downstream-side yarn joining chamber 113a from the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 in a twisting direction of the first yarn end. When viewed from the front side, the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 are positioned on one side of the left-right direction with respect to the yarn running path L. When viewed from the front side, the first downstream-side injection hole HA1 is positioned more on the upstream side (inner side of the nozzle 110, side near to an upstream-side injection hole) than the second downstream-side injection hole HA2. When viewed from the up-down direction, a compressed air P1 is injected from the first downstream-side injection hole HA1 and a compressed air P2 is injected from the second downstream-side injection hole HA2 towards an edge part of the downstream-side yarn joining chamber 113a (that is, along a tangential direction) (see FIG. 6). A cross-section of the first passage 140a and the second passage 140b is rectangular and the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 are rectangular.

[0035] Moreover, a first passage 145a and a second passage 145b via which the compressed air is supplied to the upstream-side yarn joining chamber 113b are formed on the nozzle 110. The first passage 145a and the second passage 145b are through holes that communicate with the upstream-side yarn joining chamber 113b. The first passage 145a and the second passage 145b extend in an inclined manner inside the nozzle 110

following the V-shape of the groove 111. When viewed from the front side, the first passage 145a and the second passage 145b are positioned parallel to the up-down direction and are on the other side of the left-right direction with respect to the yarn running path L. When viewed from the front side, the first passage 145a is positioned on the downstream side of the second passage 145b (inner side of the nozzle 110). An opening of the first passage 145a on the upstream-side yarn joining chamber 113b constitutes a first upstream-side injection hole HB1 and an opening of the second passage 145b on the upstream-side yarn joining chamber 113b constitutes a second upstream-side injection hole HB2.

[0036] The compressed air is injected inside the upstream-side yarn joining chamber 113b from the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 in a twisting direction of the second yarn end. When viewed from the front side, the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 are positioned on the other side of the left-right direction with respect to the yarn running path L. When viewed from the front side, the first upstream-side injection hole HB1 is positioned more on the downstream side (inner side of the nozzle 110, a side near to a downstream-side injection hole) of the second upstream-side injection hole HB2. When viewed from the up-down direction, the compressed air is injected from the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 towards an edge part of the upstream-side yarn joining chamber 113b (that is, along the tangential direction). A cross-section of the first passage 145a and the second passage 145b is rectangular, and the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 are rectangular.

[0037] The supporting block 120 is made of metal such as aluminum, or resin, and has a substantially rectangular parallelepiped shape. A U-shaped opening 121 that accommodates the nozzle 110 is formed in the supporting block 120. A first block passage 125a and a second block passage 125b are formed in the supporting block 120. The first block passage 125a is a passage for supplying the compressed air from outside the supporting block 120 to the first passages 140a and 145a of the nozzle 110, and the first block passage 125a communicates with the first passages 140a and 145a. The second block passage 125b is a passage for supplying the compressed air from outside the supporting block 120 to the second passages 140b and 145b of the nozzle 110, and the second block passage 125b communicates with the second passages 140b and 145b.

[0038] The control section 96 is a computer constituted by CPU, ROM, RAM, and the like. The control section 96 performs control of various operations, for example, by loading a computer program stored in the ROM into the RAM and executing the computer program by using the CPU. The control section 96 can be configured as hardware based on plural electronic circuits and the like.

The control section 96 is constituted by a part of the unit controller 10. In the present invention, the control section 96 constituted by a part of the unit controller 10 is explained as a part of the yarn joining device 26.

[0039] The control section 96 controls opening / closing of a first solenoid valve 161 provided on a first airflow path (airflow path) 151 that guides the compressed air to the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. The first airflow path 151 is formed of, for example, a tube and the like, and communicates with the first block passage 125a. The control section 96 controls opening / closing of a second solenoid valve 162 provided on a second airflow path (airflow path) 152 that guides the compressed air to the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. The second airflow path 152 is formed of, for example, a tube and the like, and communicates with the second block passage 125b. By controlling the timing from closing to opening of the first solenoid valve 161 and / or the second solenoid valve 162, the control section 96 is operable or capable of changing an injection start timing of compressed air injected from the first downstream-side injection hole HA1 and / or the second downstream-side injection hole HA2, and the first upstream-side injection hole HB1 and / or the second upstream-side injection hole HB2.

[0040] Specifically, because the control section 96 controls the opening / closing of the first solenoid valve 161 of the first airflow path 151 that communicates with the first downstream-side injection hole HA1 and the second upstream-side injection hole HB1, the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 is set to the same timing. Moreover, because the control section 96 controls the opening / closing of the second solenoid valve 162 of the second airflow path 152 that communicates to the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2, the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is set to the same timing. In this case, the control section 96 performs control such that the timing of opening / closing of the first solenoid valve 161 differs from that of opening / closing of the second solenoid valve 162, and causes the injection start timing of the first downstream-side injection hole HA1 to differ from the injection start timing of the second downstream-side injection hole HA2 and causes the injection start timing of the first upstream-side injection hole HB1 to differ from the injection start timing of the second upstream-side injection hole HB2.

[0041] In the above explanation, in the yarn joining device 26, at an appropriate injection start timing, the compressed air can be injected from the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 into the downstream-side yarn joining chamber 113a, and the compressed air can be injected from the first upstream-side injection hole HB1 and the

second upstream-side injection hole HB2 to the upstream-side yarn joining chamber 113b. Accordingly, the compressed air can be caused to act in various ways on the first yarn end and the second yarn end that are to be joined, which allows handling of various types of the yarn Y. Moreover, strength and appearance quality of the joint of the yarn Y on which yarn joining is performed can be improved.

[0042] FIG. 7 is a graph showing a relation between a blowing time of compressed air and a winding force. The blowing time is a time during which injection of the compressed air continues. The winding force is a force at which one of the untwisted first yarn end and the untwisted second yarn end winds around the other yarn end, also referred to as turning force. In FIG. 7, a line M1 represents the winding force when compressed air is injected from the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. A line M2 represents the winding force when compressed air is injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. The injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is delayed than the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. A line M3 represents the winding force ($=M1+M2$) when compressed air is injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 after the compressed air is injected after the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1.

[0043] By setting the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 and the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 in a staggered manner as shown in FIG. 7, the action of the compressed air injected later acts before the winding force generated by the compressed air injected earlier reduces significantly. As a result, because the action of the compressed air injected earlier is effectively superimposed on the action of the compressed air injected later, it is considered that a significant winding force can be obtained.

[0044] In the yarn joining device 26, the control section 96 can appropriately set the injection start timings of the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 so as to be different from each other, and can appropriately set the injection start timings of the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 so as to be different from each other. Accordingly, compressed air can be applied in various ways to the first yarn end and the second yarn end that are the targets of yarn joining.

[0045] In the yarn joining device 26, the first downstream-side injection hole HA1, the second downstream-side injection hole HA2, the first upstream-side injection

hole HB1, and the second upstream-side injection hole HB2 are rectangular. Accordingly, injection area of the first downstream-side injection hole HA1, the second downstream-side injection hole HA2, the first upstream-side injection hole HB1, and the second upstream-side injection hole HB2 can be effectively increased. As a result, the winding force can be improved.

[0046] In the yarn joining device 26, the downstream-side yarn joining chamber 113a is inclined to one side of the left-right direction with respect to the yarn running path L, and the upstream-side yarn joining chamber 113b is inclined to the other side of the left-right direction with respect to the yarn running path L. When viewed from the front side, the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 are positioned on one side of the left-right direction with respect to the yarn running path L, and when viewed from the front side, the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 are positioned on the other side of the left-right direction with respect to the yarn running path L. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarn Y becomes possible can be concretely realized.

[0047] In the yarn joining device 26, when viewed from the up-down direction, the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 inject compressed air toward the edge part of the downstream-side yarn joining chamber 113a (blow compressed air in a tangential direction). When viewed from the up-down direction, the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 inject compressed air toward the edge part of the upstream-side yarn joining chamber 113b (blow compressed air in a tangential direction). In such a configuration, at the time of the yarn joining, the compressed air injected from the first downstream-side injection hole HA1 and the compressed air injected from the second downstream-side injection hole HA2 interact effectively, and the compressed air injected from the first upstream-side injection hole HB1 and the compressed air injected from the second upstream-side injection hole HB2 interact effectively, making it possible to obtain a strong winding force (see FIG. 7). Incidentally, the yarn joining device 26 is suitable for yarn joining of yarn Y having short fibers such as cotton.

[0048] In the yarn joining device 26, the control section 96 controls opening / closing of the first solenoid valve 161 provided on the first airflow path 151 and the second solenoid valve 162 provided on the second airflow path 152. In such a configuration, by using the first solenoid valve 161 and the second solenoid valve 162, the injection start timings of the compressed air can be controlled.

[0049] In the yarn joining device 26, the yarn joining part 50 includes the yarn joining nozzle structure 100 that includes the nozzle 110 in which the downstream-side yarn joining chamber 113a and the upstream-side yarn joining chamber 113b are formed, and the supporting

block 120 that accommodates the nozzle 110. In such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarn Y becomes possible can be concretely realized.

[0050] The winder unit 3 includes the yarn joining device 26. Because the winder unit 3 includes the yarn joining device 26, various types of yarn Y can be handled in the winder unit 3.

[0051] Furthermore, in the present embodiment, the injection start timings of the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2, as well as the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 can be set separately and as desired. Moreover, it is allowable to configure so that the duration of injection of the compressed air from the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2, as well as the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 can be set separately and as desired. Moreover, it is allowable to configure so that the injection pressure at which compressed air is injected from the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2, as well as the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 can be set separately and as desired. Moreover, the stop timing of the compressed air injected in the untwisting part 40 can be set freely. Such a configuration can be realized by using, for example, known technology, such as by using a solenoid valve or a pressure reducing valve.

[0052] FIG. 8 is a diagram showing an example of injection timing conditions based on which the compressed air is injected in the yarn joining device 26. Time shown in FIG. 8 indicates the time elapsed as it progresses to the right side. In FIG. 8, presence of a horizontal bar of "untwisting part" indicates that the compressed air is being injected in the untwisting part 40; presence of the horizontal bar of "first injection hole" indicates that the compressed air is being injected from the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1; and presence of the horizontal bar of "second injection hole" indicates that the compressed air is being injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. Numerals 1 to 4 shown in the figure indicate condition numbers. As shown in FIG. 8, in the yarn joining device 26, the compressed air can be injected in the untwisting part 40 and the yarn joining part 50 based on first to fourth injection timing conditions relating to condition numbers 1 to 4.

[0053] In the first injection timing condition, injection stop timing of the untwisting part 40 is the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. In the first injection timing condition, the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is delayed than

the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. In the first injection timing condition, the injection stop timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 and the injection stop timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 are the same.

[0054] In the second injection timing condition, the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 is delayed than the injection stop timing of the untwisting part 40. In the second injection timing condition, the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is delayed than the injection stop timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1.

[0055] In a third injection timing condition, the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is delayed than the injection stop timing of the untwisting part 40. In the third injection timing condition, the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 is delayed than the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. In the third injection timing condition, the injection stop timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 is delayed than the injection stop timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2.

[0056] In a fourth injection timing condition, the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 is delayed than the injection stop timing of the untwisting part 40. In the fourth injection timing condition, the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 is delayed than the injection stop timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2.

[0057] In the yarn joining device 26, it is found that the yarn joining of the yarn Y that is a cotton denim yarn can be handled by setting the first injection timing condition. In other words, when the yarn joining device 26 is used to perform yarn joining of the cotton denim yarn, the control section 96 can set the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 earlier than the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. In such a case, the yarn joining is performed in a cotton denim yarn joining mode for handling the cotton denim yarn. In this yarn joining mode, a first pressure of the compressed air injected from the first downstream-side injection hole HA1 and the first upstream-side injection

hole HB1 can be set lower than a second pressure of the compressed air injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 (for example, first pressure: 5.0 kg/cm²; second pressure: 5.0 kg/cm²).

[0058] In the yarn joining device 26, it is found that the yarn joining of the yarn Y that is a blended yarn of polyester and cotton can be handled by setting the second injection timing condition or the fourth injection timing condition explained above. In this case, the first pressure of the compressed air injected from the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 can be set higher than the second pressure of the compressed air injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 (for example, the first pressure: 5.5 kg/cm²; the second pressure: 4.5 kg/cm²).

[0059] In the yarn joining device 26, it is found that the yarn joining of the yarn Y that is a purified cellulose fiber can be handled by setting the third injection timing condition. In other words, when the yarn joining device 26 is used to perform yarn joining of the purified cellulose fibers, the control section 96 can set the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 earlier than the injection start timing of the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1. In this case, the yarn joining is performed in a purified cellulose fibers yarn joining mode for handling the purified cellulose fibers. In this yarn joining mode, the first pressure of the compressed air injected from the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 can be set the same as the second pressure of the compressed air injected from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2 (for example, the first pressure: 3.0 kg/cm²; the second pressure: 3.0 kg/cm²).

Second Embodiment

[0060] Next, a second embodiment is explained below. In the present embodiment, contents that are different from that of the first embodiment are only explained and redundant explanation is omitted.

[0061] FIG. 9A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device 226 according to the present embodiment. FIG. 9B is a cross-sectional view along a line IX(b)-IX(b) shown in FIG. 9A. As shown in FIGS. 9A and 9B, the second embodiment differs from the first embodiment in that the yarn joining device 226 according to the second embodiment includes a first passage 240a and a first downstream-side injection hole HA3 instead of the first passage 140a and the first downstream-side injection hole HA1, and includes a first passage 245a and a first upstream-side injection hole HB3 instead of the first passage 145a and the first upstream-side injection hole HB1.

[0062] The first passage 240a is a through hole that supplies the compressed air to the downstream-side yarn joining chamber 113a, and communicates with the downstream-side yarn joining chamber 113a. When viewed from the front side, the first passage 240a is positioned on the other side of the left-right direction with respect to the yarn running path L. The first passage 240a extends in an inclined manner inside the nozzle 110 following the V-shape of the groove 111. An opening of the first passage 240a on the downstream-side yarn joining chamber 113a side constitutes the first downstream-side injection hole HA3.

[0063] The compressed air is injected from the first downstream-side injection hole HA3 into the downstream-side yarn joining chamber 113a. When viewed from the front side, the first downstream-side injection hole HA3 is positioned on the other side of the left-right direction with respect to the yarn running path L. When viewed from the up-down direction, the compressed air P1 is injected from the first downstream-side injection hole HA3 toward the center of the downstream-side yarn joining chamber 113a (see FIG. 10). In other words, when viewed from the up-down direction, the first downstream-side injection hole HA3 is formed in a direction perpendicular to the downstream-side yarn joining chamber 113a. A cross-section of the first passage 240a and the first downstream-side injection hole HA3 are rectangular.

[0064] The first passage 245a is a through hole that supplies the compressed air to the upstream-side yarn joining chamber 113b, and communicates with the upstream-side yarn joining chamber 113b. When viewed from the front side, the first passage 245a is positioned on one side of the left-right direction with respect to the yarn running path L. The first passage 245a extends in an inclined manner inside the nozzle 110 following the V-shape of the groove 111. An opening of the first passage 245a on the upstream-side yarn joining chamber 113b side constitutes the first upstream-side injection hole HB3.

[0065] The compressed air is injected from the first upstream-side injection hole HB3 into the upstream-side yarn joining chamber 113b. When viewed from the front side, the first upstream-side injection hole HB3 is positioned on one side of the left-right direction with respect to the yarn running path L. When viewed from the up-down direction, the compressed air is injected from the first upstream-side injection hole HB3 toward the center of the upstream-side yarn joining chamber 113b. In other words, when viewed from the up-down direction, the first upstream-side injection hole HB3 is formed in a direction perpendicular to the upstream-side yarn joining chamber 113b. A cross-section of the first passage 245a and the first upstream-side injection hole HB3 are rectangular.

[0066] As explained above, even in the yarn joining device 226, various types of yarns can be handled. Strength and appearance quality of the joint of the yarn Y on which yarn joining was performed can be improved. Incidentally, the yarn joining device 226 is suitable for

yarn joining of the long and thick fibers such as wool or hemp.

[0067] In the yarn joining device 226, the downstream-side yarn joining chamber 113a is inclined on one side of the left-right direction with respect to the yarn running path L, and the upstream-side yarn joining chamber 113b is inclined on the other side of the left-right direction with respect to the yarn running path L. When viewed from the front side, the second downstream-side injection hole HA2 and the first upstream-side injection hole HB3 are positioned on one side of the left-right direction with respect to the yarn running path L, and when viewed from the front side, the first downstream-side injection hole HA3 and the second upstream-side injection hole HB2 is positioned on the other side of the left-right direction with respect to the yarn running path L. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarn Y becomes possible can be concretely realized.

[0068] In the yarn joining device 226, when viewed from the up-down direction, the compressed air is injected from the first downstream-side injection hole HA3 toward the center of the downstream-side yarn joining chamber 113a (blows the compressed air to the center). In other words, when viewed from the up-down direction, the first downstream-side injection hole HA3 is formed in a direction perpendicular to the downstream-side yarn joining chamber 113a. When viewed from the up-down direction, the compressed air is injected from the second downstream-side injection hole HA2 toward the edge part of the downstream-side yarn joining chamber 113a (blows the compressed air in a tangential direction). In other words, when viewed from the up-down direction, the second downstream-side injection hole HA2 is formed in the tangential direction of the downstream-side yarn joining chamber 113a. When viewed from the up-down direction, the compressed air is injected from the first upstream-side injection hole HB3 toward the center of the upstream-side yarn joining chamber 113b (blows the compressed air to the center). In other words, when viewed from the up-down direction, the first upstream-side injection hole HB3 is formed in a direction perpendicular to the upstream-side yarn joining chamber 113b. When viewed from the yarn running direction, the compressed air is injected from the second upstream-side injection hole HB2 toward the edge part of the upstream-side yarn joining chamber 113b (blows the compressed air in the tangential direction). In other words, when viewed from the yarn running direction, the second upstream-side injection hole HB2 is formed in the tangential direction of the upstream-side yarn joining chamber 113b. Accordingly, fibers of the first yarn end and the second yarn end can be intertwined by the action of the compressed air injected from the first downstream-side injection hole HA3 and the first upstream-side injection hole HB3, and the first yarn end and the second yarn end can be wound and a joint thereof can be prepared (formed) by the action of the compressed air injected

from the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2.

[0069] In the yarn joining device 226, the control section 96 can set the injection start timing of the first downstream-side injection hole HA3 and the first upstream-side injection hole HB3 earlier than the injection start timing of the second downstream-side injection hole HA2 and the second upstream-side injection hole HB2. In such a case, the effect in which fibers of the first yarn end and the second yarn end are intertwined and the first yarn end and the second yarn end are wound explained above can be effectively exhibited.

Third Embodiment

[0070] A third embodiment is explained below. In the present embodiment, contents that are different from that of the second embodiment are only explained and redundant explanation is omitted.

[0071] FIG. 11A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device 326 according to the present embodiment. FIG. 11B is a cross-sectional view along a line XI(b)-XI(b) shown in FIG. 11A. As shown in FIGS. 11A and 11B, the third embodiment differs from the second embodiment in that the yarn joining device 326 further includes a downstream-side injection receiving wall 331 and an upstream-side injection receiving wall 332.

[0072] The downstream-side injection receiving wall 331 is provided on the inside of the downstream-side yarn joining chamber 113a. The downstream-side injection receiving wall 331 is provided such that a part of the inner surface of the downstream-side yarn joining chamber 113a is raised. Specifically, the downstream-side injection receiving wall 331 is provided on a part on the inner surface of the downstream-side yarn joining chamber 113a on which compressed air is blown from the first downstream-side injection hole HA3. The downstream-side injection receiving wall 331 includes a flat wall surface 331a that faces the first downstream-side injection hole HA3.

[0073] The upstream-side injection receiving wall 332 is provided on the inside of the upstream-side yarn joining chamber 113b. The upstream-side injection receiving wall 332 is provided such that a part of the inner surface of the upstream-side yarn joining chamber 113b is raised. Specifically, the upstream-side injection receiving wall 332 is provided on a part on the inner surface of the upstream-side yarn joining chamber 113b on which compressed air is blown from the first upstream-side injection hole HB3. The upstream-side injection receiving wall 332 includes a flat wall surface 332a that faces the first upstream-side injection hole HB3.

[0074] Various types of yarns can be handled even in the yarn joining device 326. Strength and appearance quality of the joint of the yarn Y on which yarn joining is performed can be improved. Moreover, because the yarn joining device 326 includes the downstream-side injection

tion receiving wall 331 and the upstream-side injection receiving wall 332, the compressed air injected from the first downstream-side injection hole HA1 and the first upstream-side injection hole HB1 diffuses after hitting the downstream-side injection receiving wall 331 and the upstream-side injection receiving wall 332 (see FIG. 12). Accordingly, an action in which fibers of the first yarn end and the second yarn end are intertwined by the action of the compressed air injected toward the center of the downstream-side yarn joining chamber 113a and the upstream-side yarn joining chamber 113b from the first downstream-side injection hole HA3 and the first upstream-side injection hole HB3 (blown to the center) explained above becomes remarkable.

Fourth Embodiment

[0075] A fourth embodiment is explained below. In the present embodiment, contents that are different from that of the third embodiment are only explained and redundant explanation is omitted.

[0076] FIG. 13A is a cross-sectional view corresponding to FIG. 5A of a yarn joining device 426 according to the present embodiment. FIG. 13B is a cross-sectional view along a line XIII(b)-XIII(b) shown in FIG. 13A. As shown in FIGS. 13A and 13B, the yarn joining device 426 differs from the yarn joining device 326 explained in the third embodiment in that, instead of the second passage 140b that supplies compressed air to the downstream-side yarn joining chamber 113a and the second downstream-side injection hole HA2 (see FIG. 11), the yarn joining device 426 includes a second passage 440b and a second downstream-side injection hole HA4. The yarn joining device 426 differs from the yarn joining device 326 of the third embodiment in that the yarn joining device 426 includes a second passage 445b and a second upstream-side injection hole HB4, instead of the second passage 145b that supplies the compressed air to the upstream-side yarn joining chamber 113b and the second upstream-side injection hole HB2 (see FIG. 11). Moreover, the yarn joining device 426 differs from that of the third embodiment on the point that the yarn joining device 426 includes a downstream-side injection receiving wall 431 and an upstream-side injection receiving wall 432, instead of the downstream-side injection receiving wall 331 and the upstream-side injection receiving wall 332 (see FIG. 11).

[0077] The second passage 440b is a through hole that supplies compressed air to the downstream-side yarn joining chamber 113a and communicates with the downstream-side yarn joining chamber 113a. When viewed from the front side, the second passage 440b is positioned on the other side (right side in the figure) of the left-right direction with respect to the yarn running path L. The second passage 440b extends in an inclined manner inside the nozzle 110 following the V-shape of the groove 111. When viewed from the front side, the second passage 440b is arranged on the downstream side of the

first passage 240a. An opening of the second passage 440b on the downstream-side yarn joining chamber 113a constitutes the second downstream-side injection hole HA4.

[0078] The compressed air is injected from the second downstream-side injection hole HA4 into the downstream-side yarn joining chamber 113a. When viewed from the front side, the second downstream-side injection hole HA4 is positioned on the other side of the left-right direction with respect to the yarn running path L. When viewed from the up-down direction, the compressed air is injected from the second downstream-side injection hole HA4 toward the center of the downstream-side yarn joining chamber 113a. A cross section of the second passage 440b and the second downstream-side injection hole HA4 are rectangular. The second passage 440b and the second downstream-side injection hole HA4 communicate with the second airflow path 152 via the second solenoid valve 162.

[0079] The second passage 445b is a through hole that supplies compressed air to the upstream-side yarn joining chamber 113b and communicates with the upstream-side yarn joining chamber 113b. When viewed from the front side, the second passage 445b is positioned on one side (left side shown in the figure) of the left-right direction in the direction of the yarn running path L. The second passage 445b extends in an inclined manner inside the nozzle 110 following the V-shape of the groove 111. When viewed from the front side, the second passage 445b is arranged upstream of the first passage 245a. An opening of the second passage 445b on the upstream-side yarn joining chamber 113b side constitutes the second upstream-side injection hole HB4.

[0080] The compressed air is injected from the second upstream-side injection hole HB4 into the upstream-side yarn joining chamber 113b. When viewed from the front side, the second upstream-side injection hole HB4 is positioned on one side of the left-right direction with respect to the yarn running path L. When viewed from the up-down direction, the compressed air is injected from the second upstream-side injection hole HB4 toward the center of the upstream-side yarn joining chamber 113b. A cross-section of the second passage 445b and the second upstream-side injection hole HB4 are rectangular. The second passage 445b and the second upstream-side injection hole HB4 communicate with the second airflow path 152 via the second solenoid valve 162.

[0081] The downstream-side injection receiving wall 431 is provided on the inside of the downstream-side yarn joining chamber 113a. The downstream-side injection receiving wall 431 is provided on a portion inside the downstream-side yarn joining chamber 113a on which compressed air is blown from the first downstream-side injection hole HA3 and the second downstream-side injection hole HA2. The downstream-side injection receiving wall 431 is provided such that a region that extends from an upper end of the inner side of the downstream-side yarn joining chamber 113a to the lower end thereof

is raised. The downstream-side injection receiving wall 431 includes a flat wall surface 431a that faces the first downstream-side injection hole HA3 and the second downstream-side injection hole HA2.

[0082] The upstream-side injection receiving wall 432 is provided on the inside of the upstream-side yarn joining chamber 113b. The upstream-side injection receiving wall 432 is provided on a portion on the inside of the upstream-side yarn joining chamber 113b on which compressed air is blown from the first upstream-side injection hole HB3 and the second upstream-side injection hole HB4. The upstream-side injection receiving wall 432 is provided such that a region that extends from an upper end of the inner side of the upstream-side yarn joining chamber 113b to the lower end thereof is raised. The upstream-side injection receiving wall 432 includes a flat wall surface 432a that faces the first upstream-side injection hole HB3 and the second upstream-side injection hole HB4.

[0083] Various types of yarn Y can be handled even in the yarn joining device 426. Moreover, strength and appearance quality of the joint of the yarn Y on which yarn joining is performed can be improved. Especially, the yarn joining device 426 is effective for handling the yarn Y that is a long-fiber single yarn and a long-fiber twin yarn.

Modifications

[0084] Various embodiments of the present invention are explained above; however, one aspect of the present invention is not limited to the embodiments explained above.

[0085] The above embodiments include the first downstream-side injection holes HA1 and HA3, and the second downstream-side injection hole HA2 as a plurality of the downstream-side injection holes. However, the number of the downstream-side injection holes can be three or more. The above embodiments include the first upstream-side injection holes HB1 and HB3, and the second upstream-side injection hole HB2 as a plurality of the upstream-side injection holes. However, the number of the upstream-side injection holes can be three or more.

[0086] In the above embodiments, the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 can have different shapes. Moreover, in the embodiments explained above, the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 can have different shapes. In such a configuration, according to the difference in the hole shapes, various types of the yarn Y can be handled.

[0087] In the above embodiments, one of the first downstream-side injection hole HA1 and the second downstream-side injection hole HA2 can be polygonal, and the other can be circular. In the above embodiments, one of the first upstream-side injection hole HB1 and the second upstream-side injection hole HB2 can be polygonal, and the other can be circular. In such a configura-

tion, one aspect that exhibits the effect explained above via which handling of various types of yarn Y becomes possible can be concretely realized.

[0088] In the above embodiments, the yarn joining nozzle structure 100 performs yarn joining by injecting compressed air, and includes the nozzle 110 formed by the downstream-side yarn joining chamber 113a and the upstream-side yarn joining chamber 113b, and the supporting block 120 that accommodates the nozzle 110. The nozzle 110 includes the first downstream-side injection hole and the second downstream-side injection hole that inject compressed air to the downstream-side yarn joining chamber 113a and the first upstream-side injection hole and the second upstream-side injection hole that inject compressed air to the upstream-side yarn joining chamber 113b. The first downstream-side injection hole and the second downstream-side injection hole can have different shapes, and the first upstream-side injection hole and the second upstream-side injection hole can have different shapes.

[0089] In such a configuration, the compressed air is injected from the first downstream-side injection hole and the second downstream-side injection hole into the downstream-side yarn joining chamber 113a, and the compressed air is injected from the first upstream-side injection hole and the second upstream-side injection hole into the upstream-side yarn joining chamber 113b. Because the shape of the first downstream-side injection hole differs from that of the second downstream-side injection hole and the shape of the first upstream-side injection hole differs from that of the second upstream-side injection hole, various types of the yarn Y can be handled according to the difference in the shape holes.

[0090] In the above embodiments, the yarn joining device according to one aspect of the present invention is applied to the winder unit 3. However, the yarn joining device according to one aspect of the present invention can be applied to a winding unit of a spinning machine, or a work carrier that moves between a plurality of winding units and the like.

[0091] According to one aspect of the present invention, a yarn joining device includes a yarn joining part that performs yarn joining by twisting overlapping yarn ends by the action of compressed air, and a control section that controls injection of the compressed air in the yarn joining part, characterized in that the yarn joining part includes an upstream-side yarn joining chamber and a downstream-side yarn joining chamber that are arranged adjacent to each other in a yarn running direction and communicate with each other; a plurality of upstream-side injection holes from which the compressed air is injected into the upstream-side yarn joining chamber, and a plurality of downstream-side injection holes from which the compressed air is injected into the downstream-side yarn joining chamber, wherein the control section is operable or capable of changing injection start timing for injecting the compressed air from one or more of the plurality of the upstream-side injection holes, and changing

injection start timing for injecting the compressed air from one or more of the plurality of the downstream-side injection holes.

[0092] In the above yarn joining device, at an appropriate injection start timing, the compressed air can be injected from a plurality of upstream-side injection holes into the upstream-side yarn joining chamber, and the compressed air can be injected from a plurality of downstream-side injection holes into the downstream-side yarn joining chamber. Accordingly, the compressed air can be caused to act in a variety of ways to yarn ends to be joined and various types of yarns can be handled.

[0093] In the above yarn joining device, the plurality of the upstream-side injection holes includes a first upstream-side injection hole that is arranged near the downstream-side injection hole and a second upstream-side injection hole that is arranged away from the downstream-side injection hole, the plurality of the downstream-side injection holes includes a first downstream-side injection hole that is arranged near the upstream-side injection hole and a second downstream-side injection hole that is arranged away from the upstream-side injection hole, and the control section performs settings such that the injection start timing for injecting the compressed air from the first upstream-side injection hole differs from the injection start timing for injecting the compressed air from the second upstream-side injection hole, and the injection start timing for injecting the compressed air from the first downstream-side injection hole differs from the injection start timing for injecting the compressed air from the second downstream-side injection hole. With such a configuration, by performing a control in which the injection start timing for injecting the compressed air from the first upstream-side injection hole and the second upstream-side injection hole differs from each other, and the injection start timing for injecting the compressed air from the first downstream-side injection hole and the second downstream-side injection hole differs from each other, various types of yarns can be handled.

[0094] In the above yarn joining device, the first upstream-side injection hole and the second upstream-side injection hole have different shapes, and the first downstream-side injection hole and the second downstream-side injection hole have different shapes. With such a configuration, because the first upstream-side injection hole and the second upstream-side injection hole have different shapes, and the first downstream-side injection hole and the second downstream-side injection hole have different shapes, according to the shapes of the holes, various types of yarns can be handled.

[0095] In the above yarn joining device, one of the first upstream-side injection hole and the second upstream-side injection hole is polygonal and the remaining of the first upstream-side injection hole and the second upstream-side injection hole is circular, and one of the first downstream-side injection hole and the second downstream-side injection hole is polygonal and the remaining of the first downstream-side injection hole and the second

downstream-side injection hole is circular. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarns becomes possible can be concretely realized.

[0096] In the above yarn joining device, the upstream-side yarn joining chamber is inclined to one side of a predetermined direction that is perpendicular to a yarn running direction with respect to a yarn running path, the downstream-side yarn joining chamber is inclined to the other side of the predetermined direction that is perpendicular to the yarn running direction with respect to the yarn running path, when viewed from the yarn running direction and a direction that is perpendicular to the predetermined direction, the first upstream-side injection hole and the second upstream-side injection hole are positioned on one side of the predetermined direction with respect to the yarn running path, and when viewed from the yarn running direction and a direction that is perpendicular to the predetermined direction, the first downstream-side injection hole and the second downstream-side injection hole are positioned on the other side of the predetermined direction with respect to the yarn running path. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarns becomes possible can be concretely realized.

[0097] In the above yarn joining device, when viewed from the yarn running direction, the first upstream-side injection hole and the second upstream-side injection hole are formed in a tangential direction of the upstream-side yarn joining chamber such that the compressed air is injected toward an edge part of the upstream-side yarn joining chamber, and when viewed from the yarn running direction, the first downstream-side injection hole and the second downstream-side injection hole are formed in a tangential direction of the downstream-side yarn joining chamber such that the compressed air is injected toward an edge part of the downstream-side yarn joining chamber. In such a configuration, at the time of yarn joining, a significant winding force can be obtained.

[0098] In the above yarn joining device, the control section is operable in a cotton denim yarn joining mode in which, at the time of performing yarn joining, the injection start timing for injecting the compressed air from the first upstream-side injection hole and the injection start timing for injecting the compressed air from the first downstream-side injection hole is set earlier than the injection start timing for injecting the compressed air from the second upstream-side injection hole and the injection start timing for injecting the compressed air from the second downstream-side injection hole. In such a configuration, a cotton denim yarn can be handled.

[0099] In the above yarn joining device, the control section is operable in a purified cellulose fibers yarn joining mode in which, at the time of performing yarn joining, the injection start timing for injecting the compressed air from the second upstream-side injection hole and the injection start timing for injecting the compressed air from the sec-

ond and downstream-side injection hole is set earlier than the injection start timing for injecting the compressed air from the first upstream-side injection hole and the injection start timing for injecting the compressed air from the first downstream-side injection hole. In such a configuration, the purified cellulose fibers can be handled.

[0100] In the above yarn joining device, the upstream-side yarn joining chamber is inclined on one side of a predetermined direction that is perpendicular to the yarn running direction with respect to the yarn running path, the downstream-side yarn joining chamber is inclined on the other side of the predetermined direction with respect to the yarn running path, when viewed from a direction that is perpendicular to the yarn running direction and the predetermined direction, the second upstream-side injection hole and the first downstream-side injection hole are positioned on one side of the predetermined direction with respect to the yarn running path, and when viewed from a direction that is perpendicular to the yarn running direction and the predetermined direction, the first upstream-side injection hole and the second downstream-side injection hole are positioned on the other side of the predetermined direction with respect to the yarn running path. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarns becomes possible can be concretely realized.

[0101] In the above yarn joining device, when viewed from the yarn running direction, the first upstream-side injection hole is formed in a direction perpendicular to the upstream-side yarn joining chamber such that the compressed air is injected toward the center of the upstream-side yarn joining chamber, when viewed from the yarn running direction, the second upstream-side injection hole is formed in a tangential direction of the upstream-side yarn joining chamber such that the compressed air is injected toward an edge part of the upstream-side yarn joining chamber, when viewed from the yarn running direction, the first downstream-side injection hole is formed in a direction perpendicular to the downstream-side yarn joining chamber such that the compressed air is injected toward the center of the downstream-side yarn joining chamber, and when viewed from the yarn running direction, the second downstream-side injection hole is formed in a tangential direction of the downstream-side yarn joining chamber such that the compressed air is injected toward an edge part of the downstream-side yarn joining chamber. In such a configuration, fibers of the yarn ends can be intertwined by the action of the compressed air injected from the first upstream-side injection hole and the first downstream-side injection hole, and the yarn ends can be wound by the action of the compressed air injected from the second upstream-side injection hole and the second downstream-side injection hole.

[0102] In the above yarn joining device, the upstream-side yarn joining chamber is arranged such that a part on the inner surface thereof is raised, and includes an

upstream-side injection receiving wall that includes a wall surface that faces the first upstream-side injection hole, and the downstream-side yarn joining chamber is arranged such that a part of the inner surface thereof is raised, and includes a downstream-side injection receiving wall that includes a wall surface that faces the first downstream-side injection hole. In such a configuration, the compressed air injected from the first upstream-side injection hole and the first downstream-side injection hole diffuses after hitting the upstream-side injection receiving wall and the downstream-side injection receiving wall. Accordingly, the action of the intertwining the fibers of the yarn ends explained above becomes remarkable.

[0103] In the above yarn joining device, the control section sets the injection start timing of the first upstream-side injection hole and the first downstream-side injection hole earlier than the injection timing of the second upstream-side injection hole and the second downstream-side injection hole. In such a configuration, the effect in which fibers of the yarn ends are intertwined and the yarn ends are wound explained above can be effectively exhibited.

[0104] In the above yarn joining device, the control section controls opening / closing of solenoid valves provided on airflow paths that guide compressed air to a plurality of the upstream-side injection holes and a plurality of the downstream-side injection holes. With such a configuration, injection start timing of compressed air can be controlled by using the solenoid valves.

[0105] In the above yarn joining device, the yarn joining part includes a yarn joining nozzle structure that includes a nozzle in which the upstream-side yarn joining chamber and the downstream-side yarn joining chamber are formed and a supporting block that accommodates the nozzle. With such a configuration, one aspect that exhibits the effect explained above via which handling of various types of yarns becomes possible can be concretely realized.

[0106] According to another aspect of the present invention, a winding device includes the above yarn joining device. Because the winding device includes the yarn joining device explained above, various types of yarns can be handled in this winding device.

[0107] According to still another aspect of the present invention, a yarn joining nozzle structure in which yarn joining is performed by injection of compressed air includes a nozzle in which an upstream-side yarn joining chamber and a downstream-side yarn joining chamber are formed adjacent to each other in a yarn running direction and communicate with each other, and a supporting block that accommodates the nozzle, wherein the nozzle includes a first upstream-side injection hole and a second upstream-side injection hole for injecting compressed air into the upstream-side yarn joining chamber, and a first downstream-side injection hole and a second downstream-side injection hole that inject compressed air to the downstream-side yarn joining chamber, the first upstream-side injection hole and the second upstream-

side injection hole have different shapes, and the first downstream-side injection hole and the second downstream-side injection hole have different shapes.

[0108] In the above yarn joining nozzle structure, the first upstream-side injection hole and the second upstream-side injection hole can inject compressed air in the upstream-side yarn joining chamber, and the first downstream-side injection hole and the second downstream-side injection hole can inject compressed air in the downstream-side yarn joining chamber. Because the first upstream-side injection hole and the second upstream-side injection hole have different shapes, as well as the first downstream-side injection hole and the second downstream-side injection hole have different shapes, various types of yarns can be handled according to the difference in the shapes of the holes.

[0109] According to the present invention, a yarn joining device capable of handling various types of yarn, a yarn joining nozzle structure, and a winding device can be provided.

[0110] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

[0111] Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the scope of the claims.

Claims

1. A yarn joining device (26; 226; 326; 426) comprising:

a yarn joining part (50) configured to perform yarn joining by twisting overlapping yarn ends by the action of compressed air, and
a control section (96) configured to control injection of the compressed air in the yarn joining part (50), **characterized in that**

the yarn joining part (50) includes,
an upstream-side yarn joining chamber (113b) and a downstream-side yarn joining chamber (113a) that are arranged adjacent to each other in a yarn running direction and communicate with each other;
a plurality of upstream-side injection holes (HB1, HB2; HB3, HB4) from which the compressed air is injected into the upstream-side yarn joining chamber (113b), the plurality of the upstream-side injection holes (HB1, HB2; HB3, HB4) including at least a first upstream-side injection hole (HB1; HB3) and a second upstream-side injection hole (HB2; HB4), and
a plurality of downstream-side injection

holes (HA1, HA2; HA3, HA4) from which the compressed air is injected into the downstream-side yarn joining chamber (113a), the plurality of the downstream-side injection holes (HA1, HA2; HA3, HA4) including at least a first downstream-side injection hole (HA1; HA3) and a second downstream-side injection hole (HA2; HA4), wherein

the control section (96) is operable of changing injection start timing for injecting the compressed air from one or more of the plurality of the upstream-side injection holes (HB1, HB2; HB3, HB4), and changing injection start timing for injecting the compressed air from one or more of the plurality of the downstream-side injection holes (HA1, HA2; HA3, HA4).

2. The yarn joining device (26; 226; 326; 426) as claimed in Claim 1, wherein
the first upstream-side injection hole (HB1; HB3) is arranged nearer to the plurality of downstream-side injection holes (HA1; HA3) than the second upstream-side injection hole (HB2; HB4),
the first downstream-side injection hole (HA1; HA3) is arranged nearer to the plurality of upstream-side injection holes (HB1; HB3) than the second downstream-side injection hole (HA2; HA4), and
the control section (96) is configured to perform settings such that the injection start timing for injecting the compressed air from the first upstream-side injection hole (HB1; HB3) differs from the injection start timing for injecting the compressed air from the second upstream-side injection hole (HB2; HB4), and the injection start timing for injecting the compressed air from the first downstream-side injection hole (HA1; HA3) differs the injection start timing for injecting the compressed air from the second downstream-side injection hole (HA2; HA4) .
3. The yarn joining device (26; 226; 326; 426) as claimed in Claim 1 or 2, wherein the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) have different shapes, and the first downstream-side injection hole (HA1; HA3) and the second downstream-side injection hole (HA2; HA4) have different shapes.
4. The yarn joining device (26; 226; 326; 426) as claimed in Claim 3, wherein
one of the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) is polygonal and the remaining of the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) is circular, and
one of the first downstream-side injection hole (HA1;

HA3) and the second downstream-side injection hole (HA2; HA4) is polygonal and the remaining of the first downstream-side injection hole (HA1; HA3) and the second downstream-side injection hole (HA2; HA4) is circular.

5. The yarn joining device (26; 426) as claimed in any one of Claims 1 to 4, wherein the upstream-side yarn joining chamber (113b) is inclined to one side of a predetermined direction that is perpendicular to the yarn running direction with respect to a yarn running path (L), the downstream-side yarn joining chamber (113a) is inclined to the other side of the predetermined direction that is perpendicular to the yarn running direction with respect to the yarn running path (L), when viewed from the yarn running direction and a direction that is perpendicular to the predetermined direction, the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) are positioned on one side of the predetermined direction with respect to the yarn running path (L), and when viewed from the yarn running direction and a direction that is perpendicular to the predetermined direction, the first downstream-side injection hole (HA1; HA3) and the second downstream-side injection hole (HA2; HA4) are positioned on the other side of the predetermined direction with respect to the yarn running path (L).
6. The yarn joining device (26) as claimed in Claim 5, wherein when viewed from the yarn running direction, the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) are formed in a tangential direction of the upstream-side yarn joining chamber (113b) such that the compressed air is injected toward an edge part of the upstream-side yarn joining chamber (113b), and when viewed from the yarn running direction, the first downstream-side injection hole (HA1; HA3) and the second downstream-side injection hole (HA2; HA4) are formed in a tangential direction of the downstream-side yarn joining chamber (113a) such that the compressed air is injected toward an edge part of the downstream-side yarn joining chamber (113a).
7. The yarn joining device (26; 426) as claimed in Claim 5 or 6, wherein, the control section (96) is operable in a cotton denim yarn joining mode in which, at the time of performing yarn joining, the injection start timing for injecting the compressed air from the first upstream-side injection hole (HB1; HB3) and the injection start timing for injecting the compressed air from the first downstream-side injection hole (HA1; HA3) is set earlier than the injection start timing for injecting

the compressed air from the second upstream-side injection hole (HB2; HB4) and the injection start timing for injecting the compressed air from the second downstream-side injection hole (HA2; HA4) .

8. The yarn joining device (26; 426) as claimed in Claim 5 or 6, wherein, the control section (96) is operable in a purified cellulose fibers yarn joining mode in which, at the time of performing yarn joining, the injection start timing for injecting the compressed air from the second upstream-side injection hole (HB2; HB4) and the injection start timing for injecting the compressed air from the second downstream-side injection hole (HA2; HA4) is set earlier than the injection start timing for injecting the compressed air from the first upstream-side injection hole (HB1; HB3) and the injection start timing for injecting the compressed air from the first downstream-side injection hole (HA1; HA3) .
9. The yarn joining device (226; 326) as claimed in any one of Claims 1 to 4, wherein the upstream-side yarn joining chamber (113b) is inclined on one side of a predetermined direction that is perpendicular to the yarn running direction with respect to the yarn running path (L), the downstream-side yarn joining chamber (113a) is inclined on the other side of the predetermined direction with respect to the yarn running path (L), when viewed from a direction that is perpendicular to the yarn running direction and the predetermined direction, the second upstream-side injection hole (HB2) and the first downstream-side injection hole (HA3) are positioned on one side of the predetermined direction with respect to the yarn running path (L), and when viewed from a direction that is perpendicular to the yarn running direction and the predetermined direction, the first upstream-side injection hole (HB3) and the second downstream-side injection hole (HA2) are positioned on the other side of the predetermined direction with respect to the yarn running path (L).
10. The yarn joining device (326) as claimed in Claim 9, wherein when viewed from the yarn running direction, the first upstream-side injection hole (HB1; HB3) is formed in a direction perpendicular to the upstream-side yarn joining chamber (113b) such that the compressed air is injected toward the center of the upstream-side yarn joining chamber (113b), when viewed from the yarn running direction, the second upstream-side injection hole (HB2; HB4) is formed in a tangential direction of the upstream-side yarn joining chamber (113b) such that the compressed air is injected toward an edge part of the upstream-side yarn joining chamber (113b),

when viewed from the yarn running direction, the first downstream-side injection hole (HA1; HA3) is formed in a direction perpendicular to the downstream-side yarn joining chamber (113a) such that the compressed air is injected toward the center of the downstream-side yarn joining chamber (113a), and

when viewed from the yarn running direction, the second downstream-side injection hole (HA2; HA4) is formed in a tangential direction of the downstream-side yarn joining chamber (113a) such that the compressed air is injected toward an edge part of the downstream-side yarn joining chamber (113a).

11. The yarn joining device (326) as claimed in Claim 10, wherein
the upstream-side yarn joining chamber (113b) is arranged such that a part on the inner surface thereof is raised, and includes an upstream-side injection receiving wall (332) that includes a wall surface that faces the first upstream-side injection hole (HB1; HB3), and
the downstream-side yarn joining chamber (113a) is arranged such that a part of the inner surface thereof is raised, and includes a downstream-side injection receiving wall (331) that includes a wall surface that faces the first downstream-side injection hole (HA1; HA3).
12. The yarn joining device (326) as claimed in Claim 10 or 11, wherein the control section (96) is configured to set the injection start timing of the first upstream-side injection hole (HB1; HB3) and the first downstream-side injection hole (HA1; HA3) earlier than the injection timing of the second upstream-side injection hole (HB2; HB4) and the second downstream-side injection hole (HA2; HA4).
13. The yarn joining device (26; 226; 326; 426) as claimed in any one of Claims 1 to 12, wherein the control section (96) is configured to control opening / closing of solenoid valves (161, 162) provided on airflow paths that guide compressed air to the plurality of the upstream-side injection holes and the plurality of the downstream-side injection holes.
14. The yarn joining device (26; 226; 326; 426) as claimed in any one of Claims 1 to 13, wherein the yarn joining part (50) includes a yarn joining nozzle structure (100) that includes a nozzle (110) in which the upstream-side yarn joining chamber (113b) and the downstream-side yarn joining chamber (113b) are formed and a supporting block (120) that accommodates the nozzle (110).
15. A winding device (3) comprising the yarn joining device (26; 226; 326; 426) as claimed in any one of Claims 1 to 14.

16. A yarn joining nozzle structure (100) in which yarn joining is performed by injection of compressed air, comprising:

a nozzle (110) in which an upstream-side yarn joining chamber (113b) and a downstream-side yarn joining chamber (113a) are formed adjacent to each other in a yarn running direction and communicate with each other, and a supporting block (120) that accommodates the nozzle (110), wherein
the nozzle (110) includes a first upstream-side injection hole (HB1; HB3) and a second upstream-side injection hole (HB2; HB4) for injecting compressed air into the upstream-side yarn joining chamber (113b), and a first downstream-side injection hole (HA1; HA3) and a second downstream-side injection hole (HA2; HA4) that inject compressed air to the downstream-side yarn joining chamber (113a),
the first upstream-side injection hole (HB1; HB3) and the second upstream-side injection hole (HB2; HB4) have different shapes, and
the first downstream-side injection hole (HA1; HA3) and the second downstream-side injection hole (HA2; HA4) have different shapes.

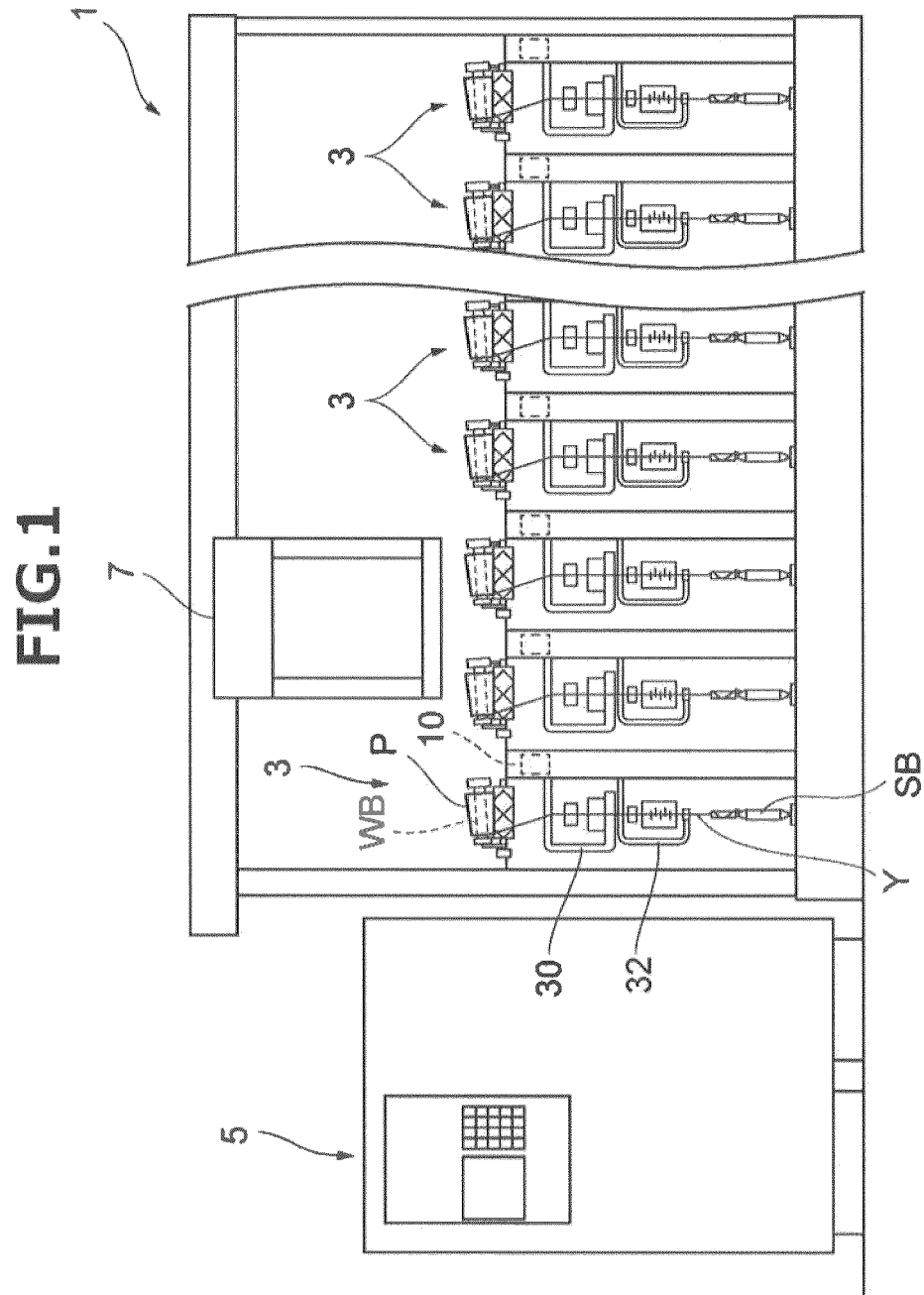
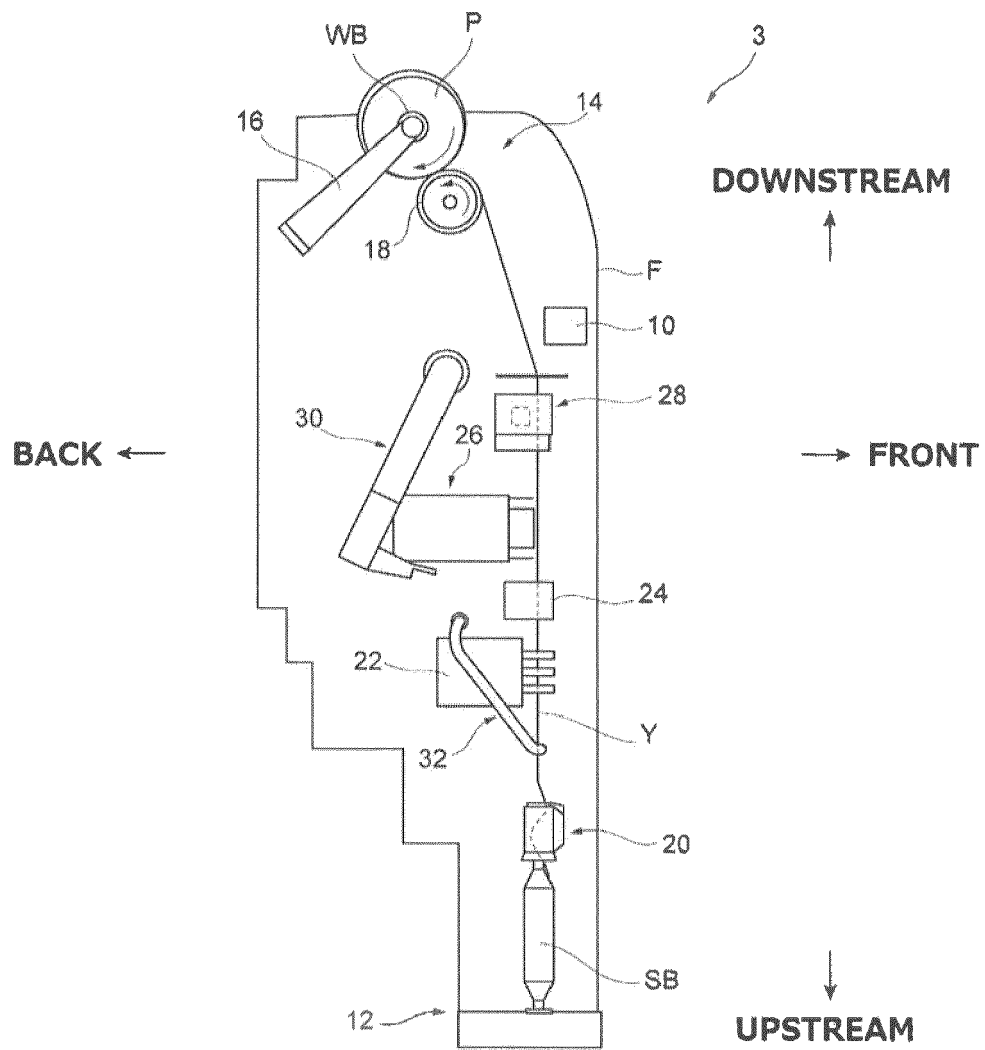


FIG.2



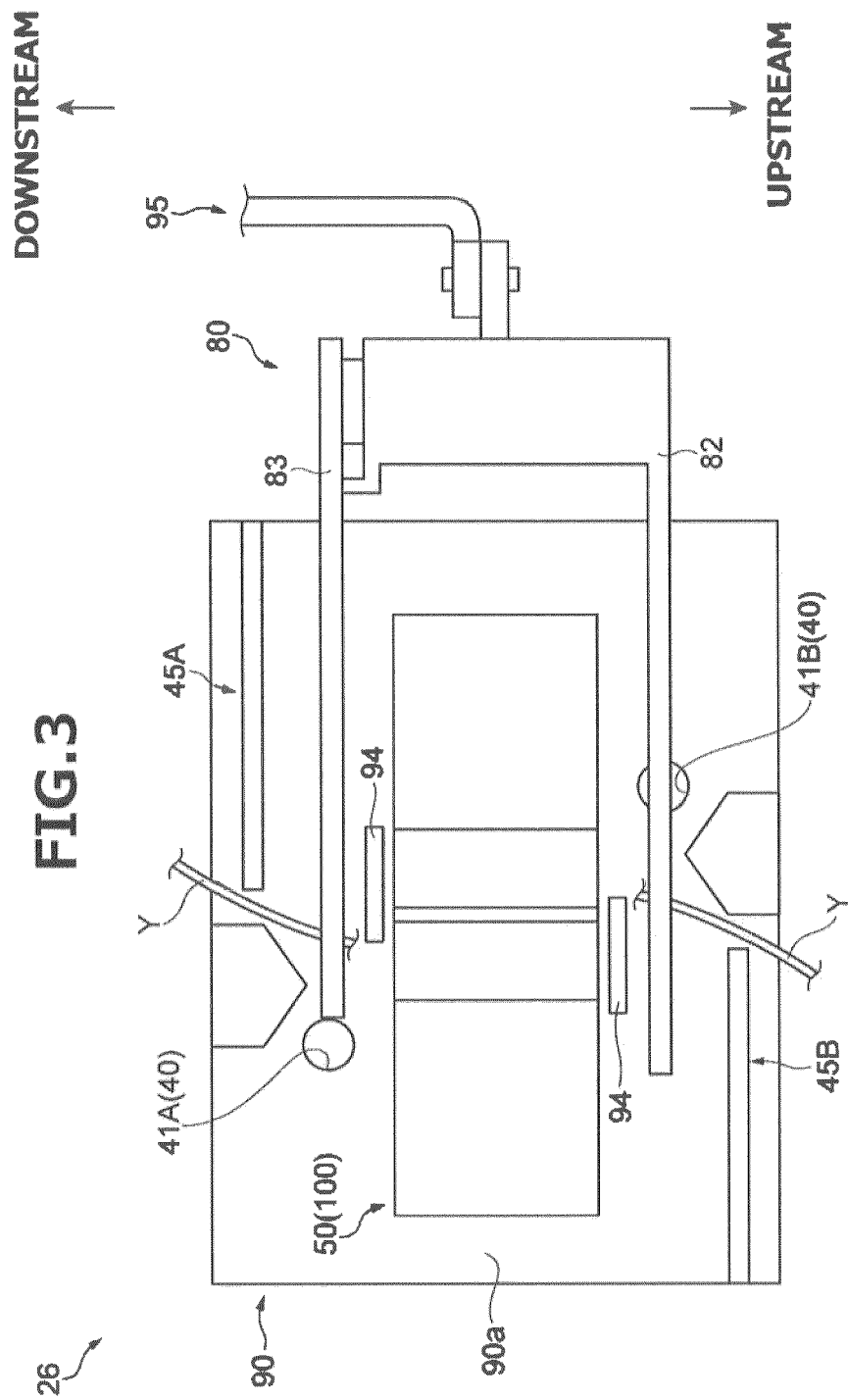


FIG.4A

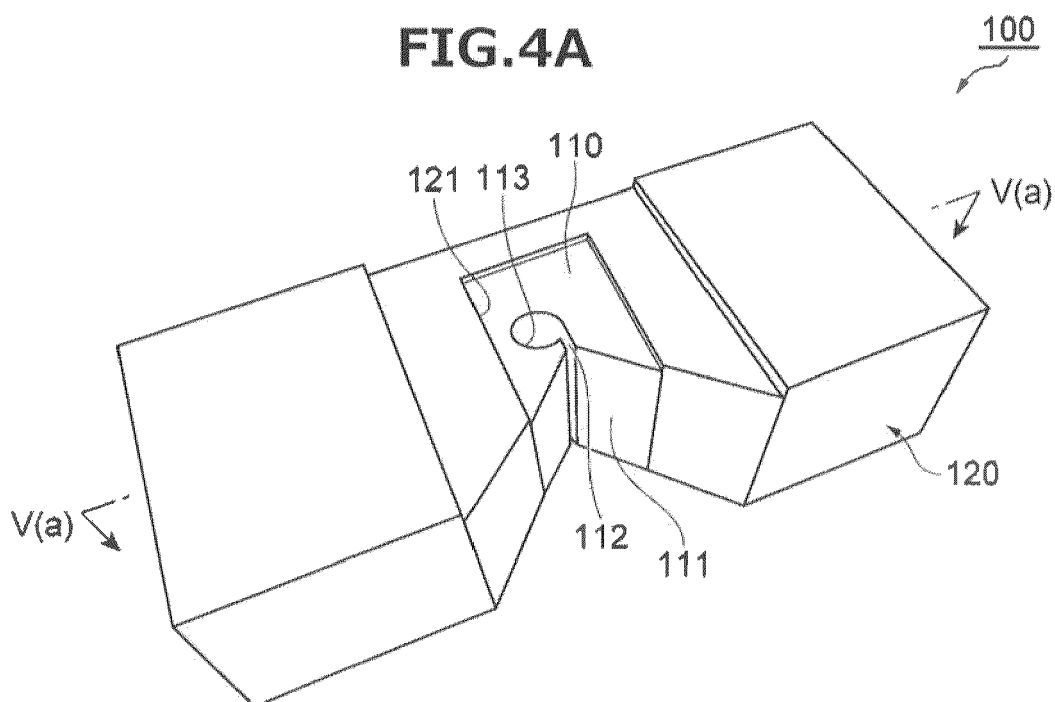


FIG.4B

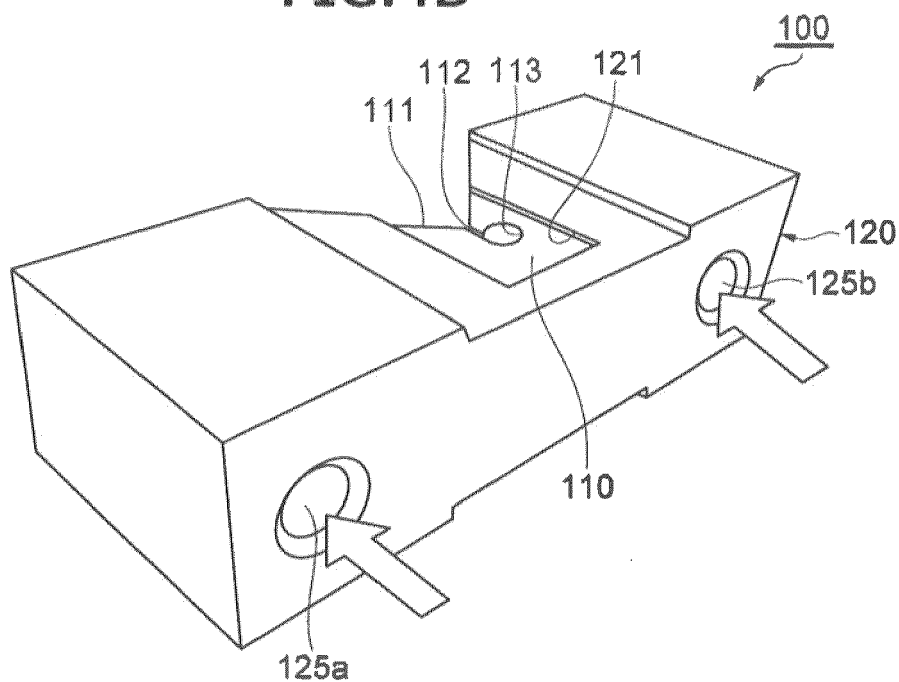


FIG.5A

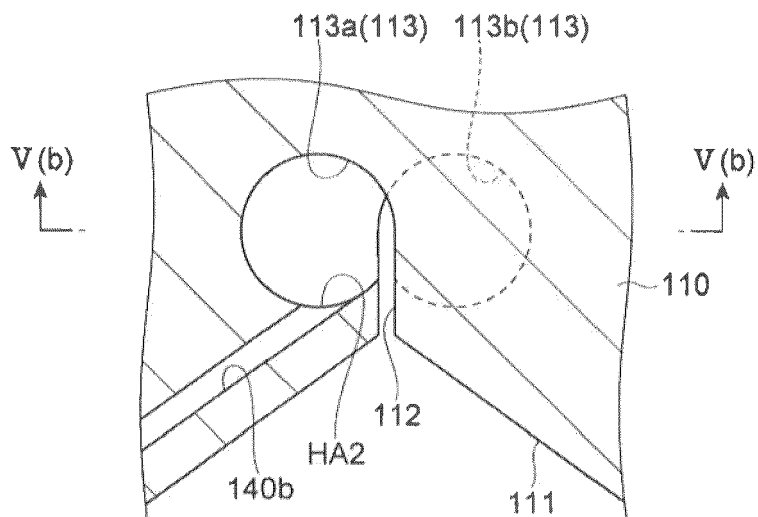


FIG.5B

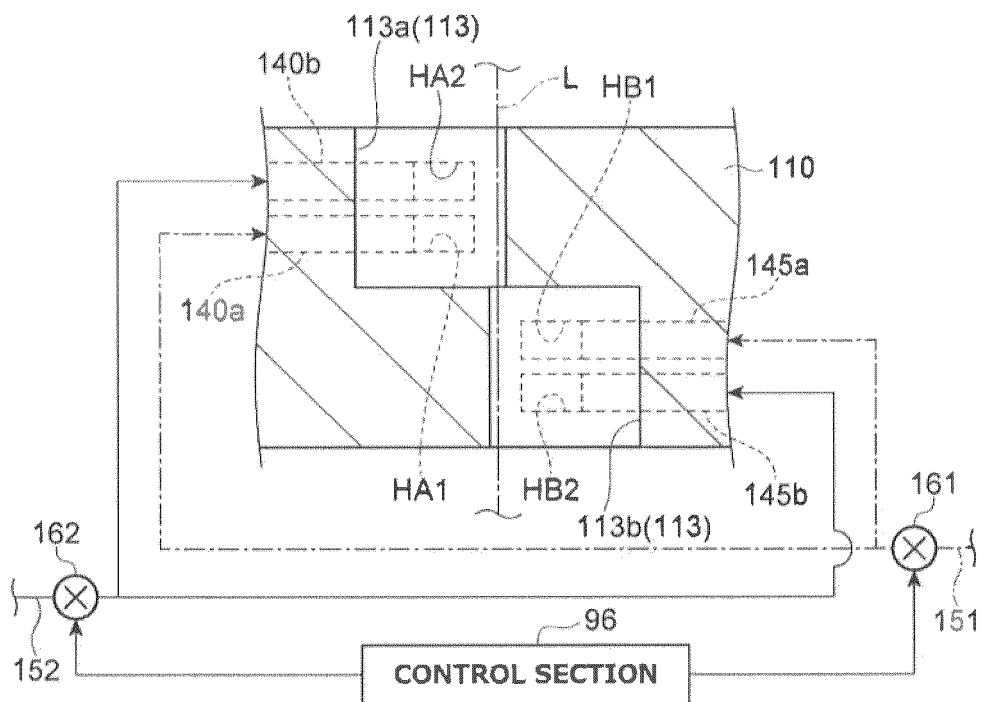


FIG.6

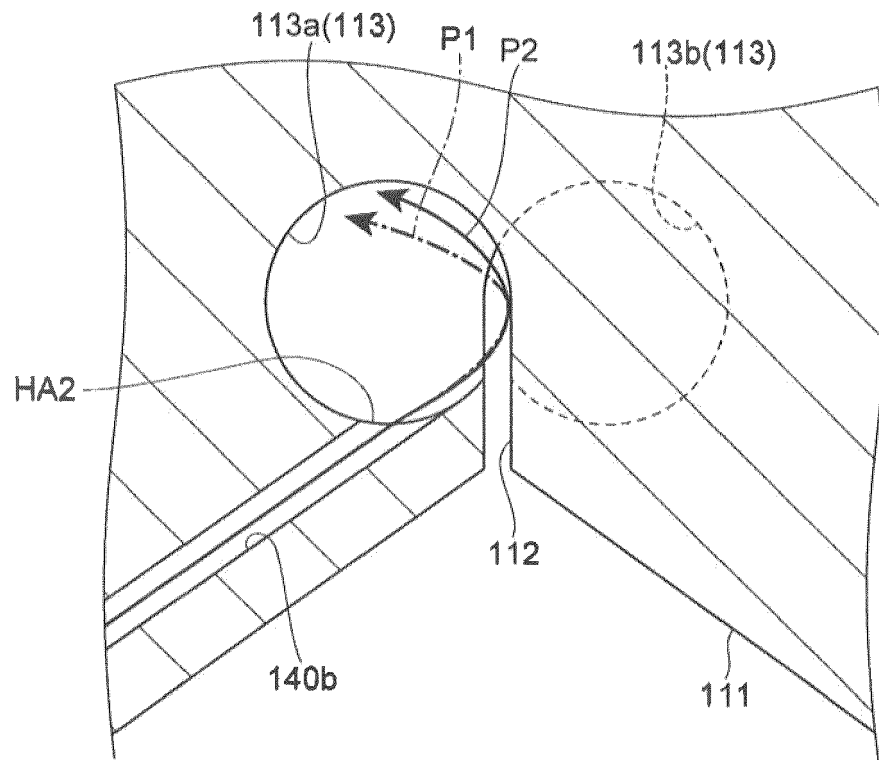


FIG.7

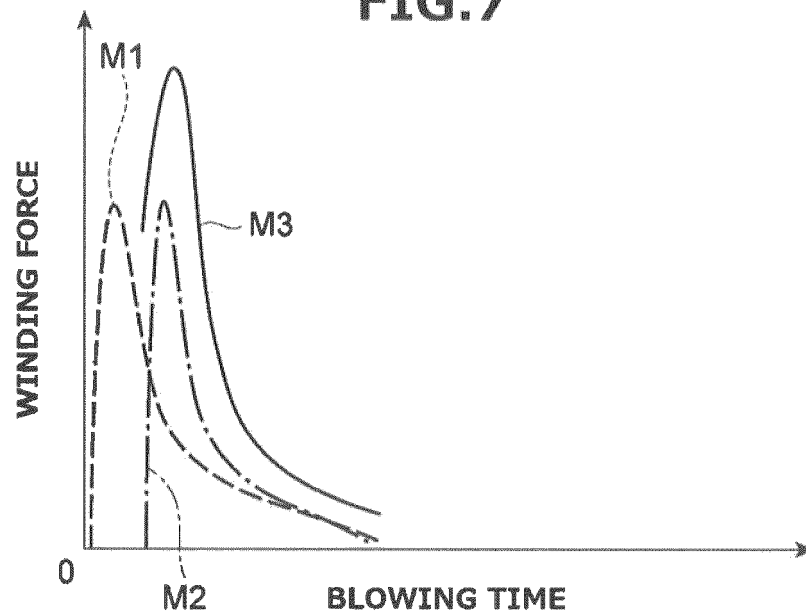


FIG.8

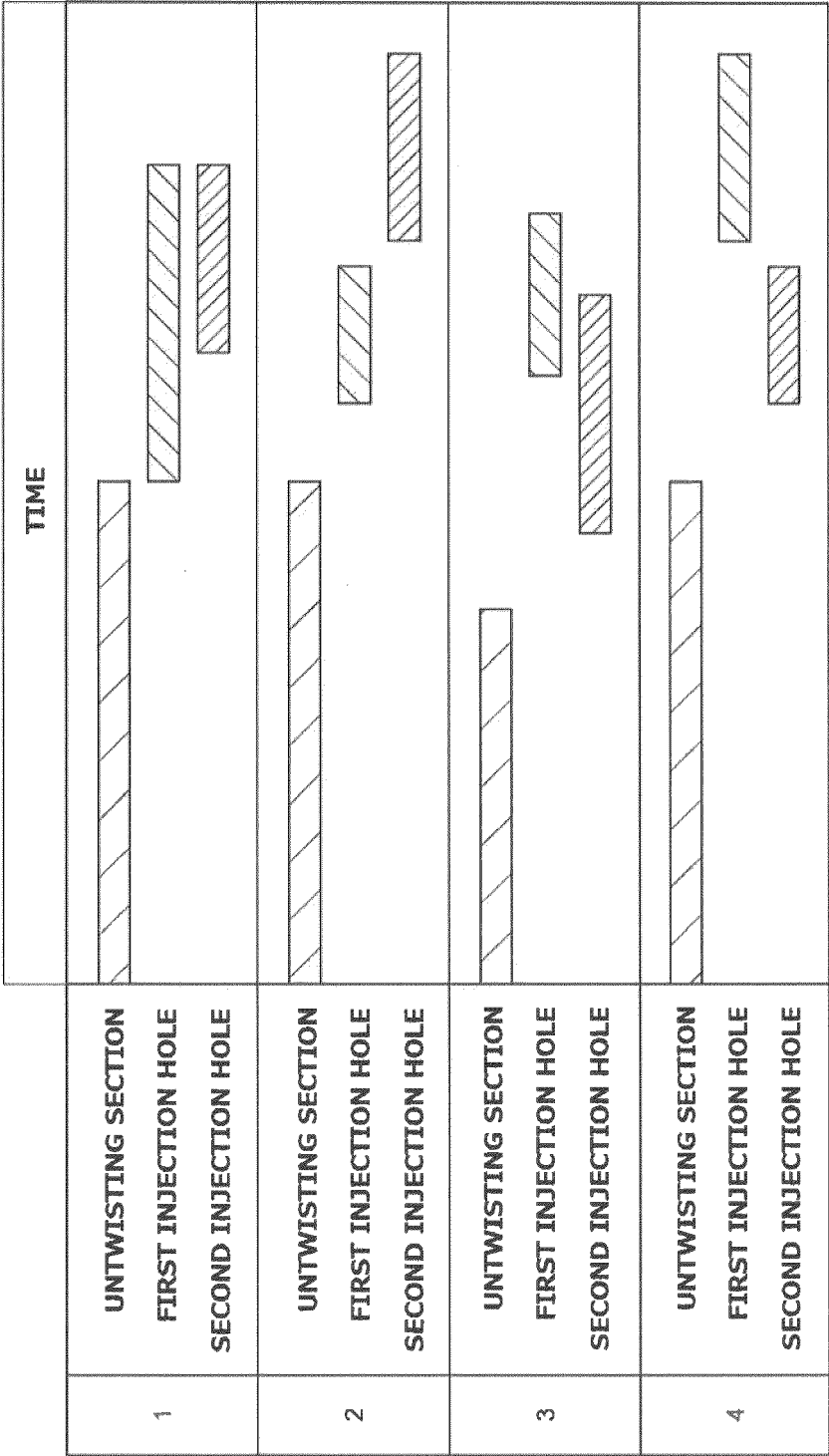


FIG. 9A

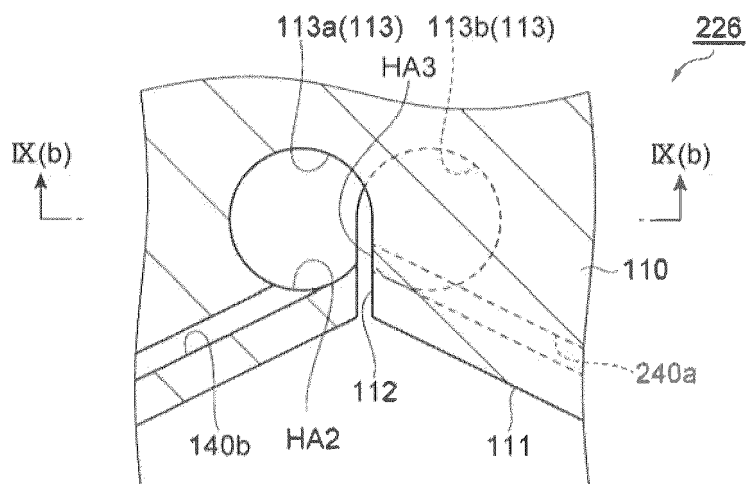


FIG. 9B

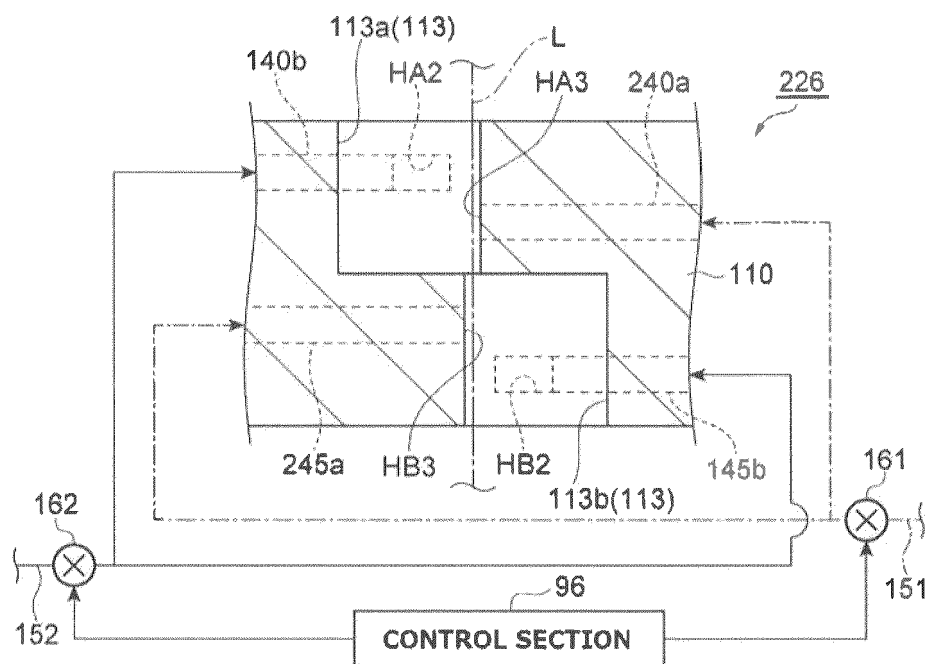


FIG.10

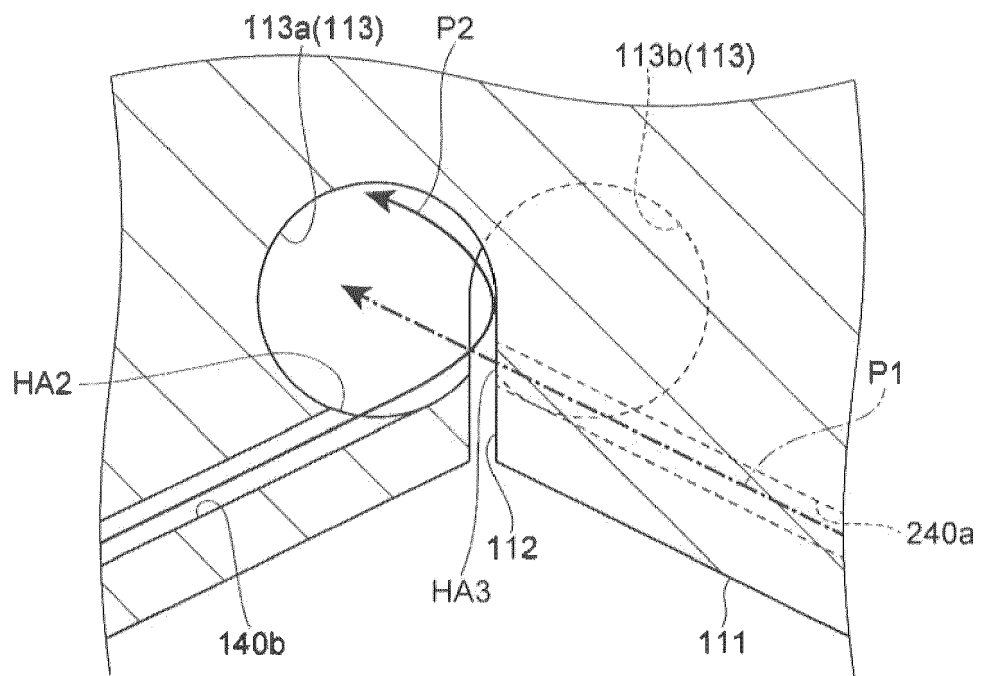


FIG.11A

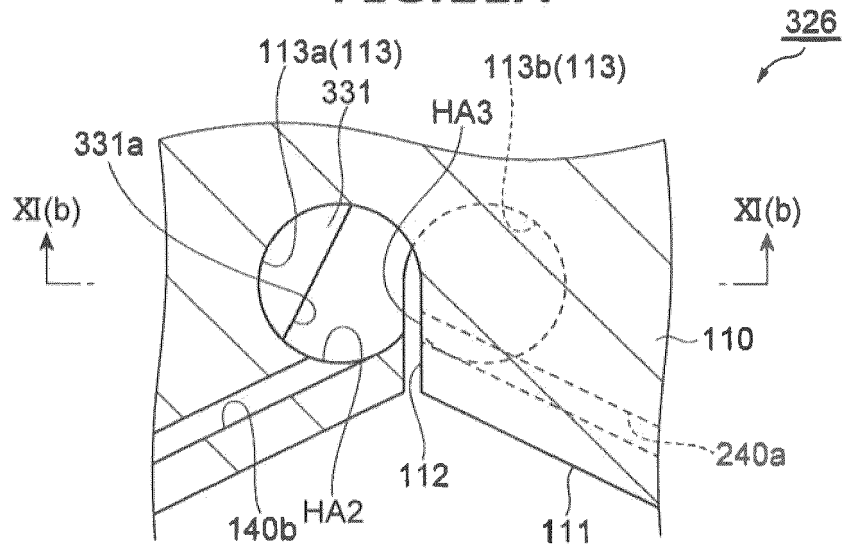


FIG.11B

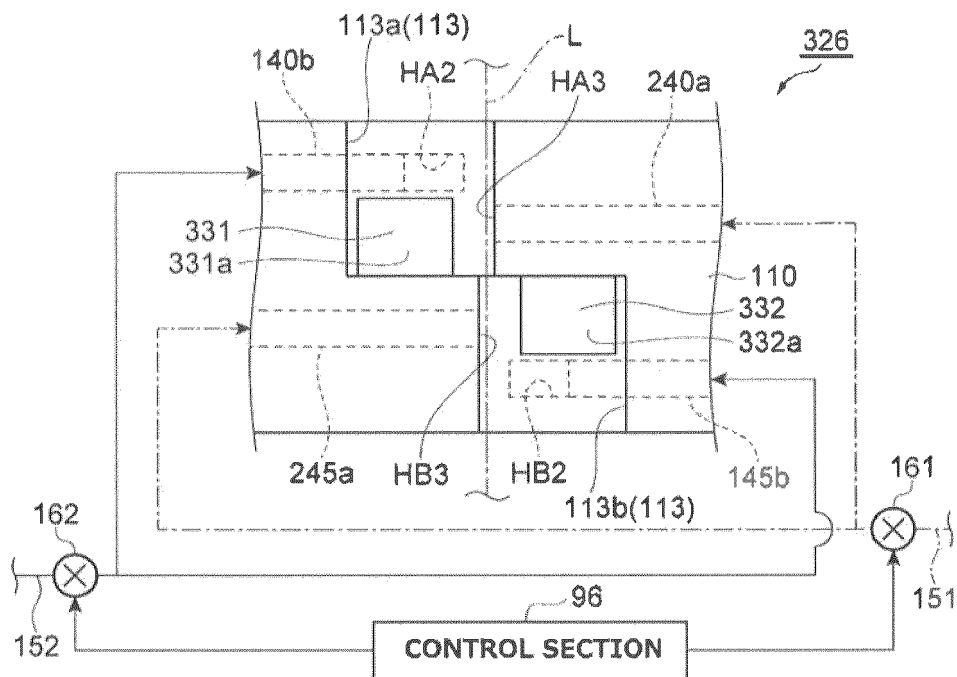


FIG.12

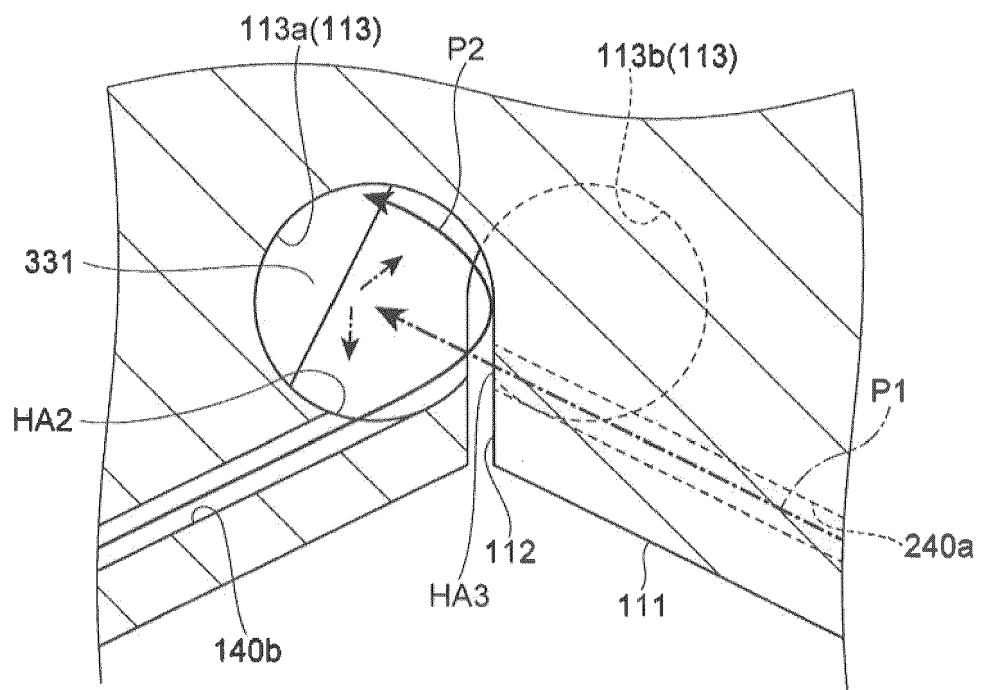


FIG.13A

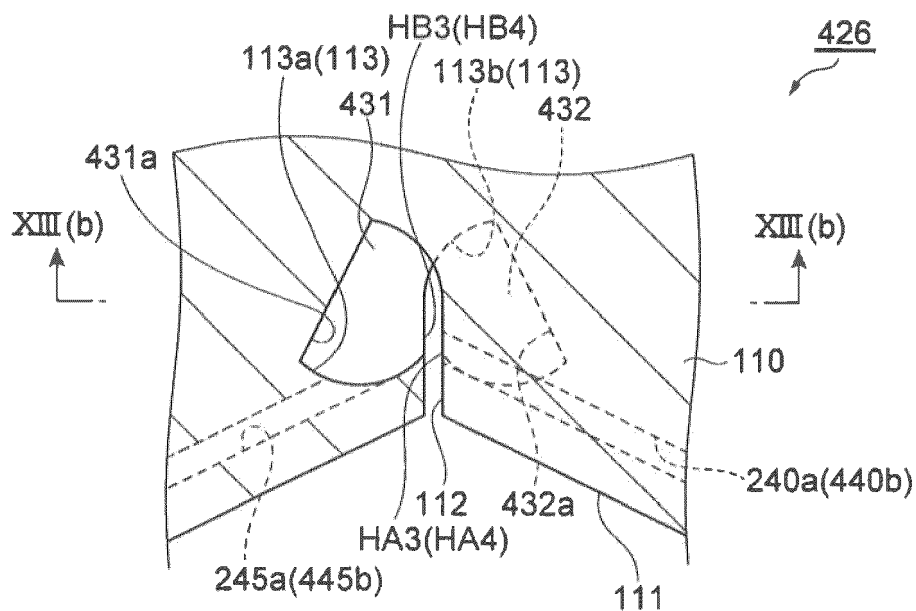
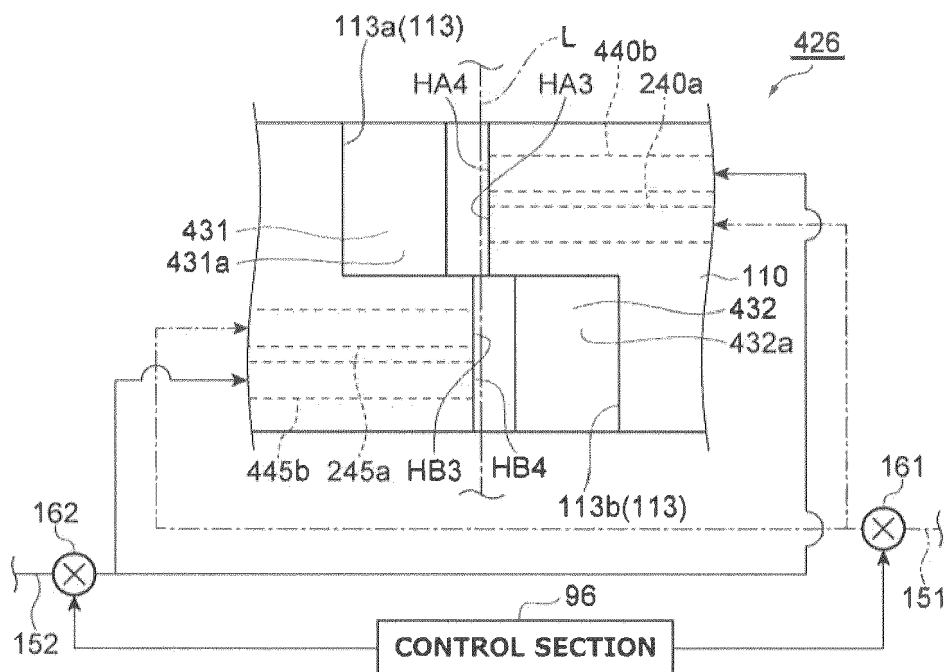


FIG.13B





EUROPEAN SEARCH REPORT

Application Number
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A	* paragraphs [0022] - [0027], [0095] - [0129], [0131], [0132], [0134]; figures 7-11B *	4,7,8,12	
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			TECHNICAL FIELDS SEARCHED (IPC)
			B65H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		6 April 2021	Pussemier, Bart
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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06-04-2021

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