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(54) **YARN SPLICING NOZZLE AND WINDING DEVICE**

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(56) References cited:
EP-A2- 2 666 741
DE-A1- 102018 108 151
JP-A- 2010 030 705

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a yarn splicing nozzle and a winding device.

BACKGROUND

[0002] For example, a splicer nozzle disclosed in Japanese Unexamined Patent Publication No. 2010-30705 is known as a technique related to yarn splicing nozzles. The splicer nozzle disclosed in Japanese Unexamined Patent Publication No. 2010-30705 has a splicing chamber that accommodates two yarn ends and in which yarns are spliced. A fluid injection passage for injecting compressed air into the splicing chamber is open on the inner wall surface of the splicing chamber. The inner wall surface of the yarn splicing chamber has a planar flat surface against which the injected compressed air directly collides.

[0003] Another document is DE 10 2018 108 151 A1, which refers to a yarn splicing device for a workstation of a textile machine and discloses a yarn splicing nozzle according to the preamble of claim 1.

SUMMARY

[0004] In the above-mentioned yarn splicing device, the strength of a spliced point may be insufficient, for example, depending on the yarn types of yarns to be spliced. In recent years, therefore, there has been a demand for developing yarn splicing devices that can handle a variety of yarns.

[0005] An object of the present disclosure is to provide a yarn splicing nozzle and a winding device that can handle a variety of yarns.

[0006] A yarn splicing nozzle according to an aspect of the present disclosure is configured to splice yarns by injection of compressed air. The yarn splicing nozzle includes a nozzle body, an upstream splicing chamber formed in the nozzle body and having a planar flat wall at a part of an inner wall, a downstream splicing chamber formed in the nozzle body, communicatively connected to the upstream splicing chamber, and having a planar flat wall at a part of an inner wall, a first upstream injection hole and a second upstream injection hole formed in the nozzle body and configured to inject compressed air toward the upstream splicing chamber, and a first downstream injection hole and a second downstream injection hole formed in the nozzle body and configured to inject compressed air toward the downstream splicing chamber. The first upstream injection hole injects compressed air along the flat wall of the upstream splicing chamber. The first downstream injection hole injects compressed air along the flat wall of the downstream splicing chamber.

[0007] In this yarn splicing nozzle, the first upstream injection hole injects compressed air along the flat wall of the upstream splicing chamber. Two yarns to form a spliced point are swept in an aligned state along the flat wall by the flow of compressed air, bounce off, and approach the first upstream injection hole. The two yarns approaching the first upstream injection hole are swept again along the flat wall and bounce off. This process is repeated so that the yarns are swung around. This is applicable to the first downstream injection hole. With this configuration, two yarns are entangled effectively to form a spliced point, and a sufficient strength of the spliced point can be ensured even when a variety of yarns are spliced. A variety of yarns can be handled.

[0008] In the yarn splicing nozzle according to an aspect of the present disclosure, as viewed from a yarn traveling direction, the flat wall of the upstream splicing chamber may be inclined at 15° to 30° relative to an injection direction of compressed air from the first upstream injection hole, and as viewed from the yarn traveling direction, the flat wall of the downstream splicing chamber may be inclined at 15° to 30° relative to an injection direction of compressed air from the first downstream injection hole. In this case, compressed air is injected from the first upstream injection hole and the first downstream injection hole to entangle the two yarns more effectively to form a spliced point.

[0009] In the yarn splicing nozzle according to an aspect of the present disclosure, as viewed from the yarn traveling direction, the flat wall of the upstream splicing chamber may be inclined at 20° to 25° relative to an injection direction of compressed air from the first upstream injection hole, and as viewed from the yarn traveling direction, the flat wall of the downstream splicing chamber may be inclined at 20° to 25° relative to an injection direction of compressed air from the first downstream injection hole. In this case, compressed air is injected from the first upstream injection hole and the first downstream injection hole to entangle the two yarns even more effectively to form a spliced point.

[0010] In the yarn splicing nozzle according to an aspect of the present disclosure, a boundary line formed between the flat wall and the remainder of the inner wall of the upstream splicing chamber may be continuous to at least a part of an edge of the first upstream injection hole, and a boundary line formed between the flat wall and the remainder of the inner wall of the downstream splicing chamber may be continuous to at least a part of an edge of the first downstream injection hole. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns. Since the air injected from the first upstream injection hole and the first downstream injection hole flows continuously along the flat walls, the air flow is not easily disturbed and the action on the yarn is also not disturbed.

[0011] In the yarn splicing nozzle according to an aspect of the present disclosure, the first upstream injection hole may have a circular shape, the first downstream injection hole may have a circular shape, the boundary line of the inner wall of the upstream splicing chamber may overlap with a tangent to the circular shape of the first upstream injection hole, and the boundary line of the inner wall of the downstream splicing chamber may overlap with a tangent to the circular shape of the first downstream injection hole. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns.

[0012] In the yarn splicing nozzle according to an aspect of the present disclosure, the first upstream injection hole and the first downstream injection hole may have a polygonal shape, the boundary line of the inner wall of the upstream splicing chamber may overlap with one side of the polygonal shape of the first upstream injection hole, and the boundary line of the inner wall of the downstream splicing chamber may overlap with one side of the polygonal shape of the first downstream injection hole. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns.

[0013] In the yarn splicing nozzle according to an aspect of the present disclosure, an inner surface of the first upstream injection hole may be continuous to the flat wall of the upstream splicing chamber, and an inner surface of the first downstream injection hole may be continuous to the flat wall of the downstream splicing chamber. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns.

[0014] In the yarn splicing nozzle according to an aspect of the present disclosure, as viewed from the yarn traveling direction, the upstream splicing chamber and the downstream splicing chamber may be disposed such that centers are deviated away from each other in a predetermined direction, and as viewed from the yarn traveling direction, respective injection directions of compressed air from the first upstream injection hole and the first downstream injection hole may be along the predetermined direction and opposite to each other. With this configuration, the first upstream injection hole and the first downstream injection hole can be formed symmetrically in the predetermined direction when viewed from the yarn traveling direction.

[0015] In the yarn splicing nozzle according to an aspect of the present disclosure, each of the upstream splicing chamber and the downstream splicing chamber may have a curved wall having an arc shape at a part of the inner wall as viewed from the yarn traveling direction, the second upstream injection hole may inject compressed air along a tangential direction of the curved wall of the upstream splicing chamber as viewed from the yarn traveling direction, and the second downstream injection hole may inject compressed air along a tangential direction of the curved wall of the downstream splicing chamber as viewed from the yarn traveling direction. In this case, the compressed air injected along the tangential direction from the second upstream injection hole and the second downstream injection hole mainly transmits rotational force to the yarn and effectively twins the fibers at the yarn ends of two yarns. With this configuration, a sufficient strength of the spliced point can be ensured even when a variety of yarns are spliced.

[0016] The yarn splicing nozzle according to an aspect of the present disclosure may further include a groove disposed in the nozzle body and extending in the yarn traveling direction, the groove having a bottom side communicatively connected to the upstream splicing chamber and the downstream splicing chamber. The second upstream injection hole and the second downstream injection hole may be open to the bottom side of the groove. In this case, in the configuration with the groove, slipping of the yarn out of the upstream splicing chamber and the downstream splicing chamber through the groove can be suppressed by the injection of compressed air from the second upstream injection hole and the second downstream injection hole.

[0017] In the yarn splicing nozzle according to an aspect of the present disclosure, as viewed from the yarn traveling direction, the flat wall of the upstream splicing chamber may be disposed closer to the groove than the center of the upstream splicing chamber, and as viewed from the yarn traveling direction, the flat wall of the downstream splicing chamber may be disposed closer to the groove than the center of the downstream splicing chamber. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns. Furthermore, this configuration can prevent the yarn from escaping to the outside of the yarn splicing nozzle through the groove.

[0018] In the yarn splicing nozzle according to an aspect of the present disclosure, in the yarn traveling direction, the second upstream injection hole and the second downstream injection hole may be located between the first upstream injection hole and the first downstream injection hole. In this case, slipping of the yarn out of the upstream splicing chamber and the downstream splicing chamber can be suppressed, compared with when the first upstream injection hole and the first downstream injection hole are located between the second upstream injection hole and the second downstream injection hole in the yarn traveling direction.

[0019] A winding device according to an aspect of the present disclosure includes the yarn splicing nozzle described above, a support supporting the yarn splicing nozzle, and a controller configured to control injection of compressed air in the yarn splicing nozzle. In this yarn splicing device, the yarn splicing nozzle also achieves the effect described above, such as the effect of handling a variety of yarns.

[0020] The winding device according to an aspect of the present disclosure may have a control mode of splicing yarns of a first yarn type and a second yarn type. The controller may be configured to perform a control mode of starting injection of compressed air from the first upstream injection hole and the first downstream injection hole, starting injection of compressed air from the second upstream injection hole and the second downstream injection hole, and simultaneously stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole and injection of compressed air from the second upstream injection hole and the second downstream injection hole. In this case, the first yarn type and the second yarn type can be handled.

[0021] The winding device according to an aspect of the present disclosure may have a control mode of splicing yarns of a third yarn type. The controller may be configured to perform a control mode of starting injection of compressed air from the first upstream injection hole and the first downstream injection hole, starting injection of compressed air from the second upstream injection hole and the second downstream injection hole, stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole, starting injection of compressed air from the first upstream injection hole and the first downstream injection hole again, stopping injection of compressed air from the second upstream injection hole and the second downstream injection hole, and stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole. In this case, the third yarn type can be handled.

[0022] The winding device according to an aspect of the present disclosure may have a control mode of splicing yarns of a fourth yarn type. The controller may be configured to perform a control mode of starting injection of compressed air from the second upstream injection hole and the second downstream injection hole, starting injection of compressed air from the first upstream injection hole and the first downstream injection hole, stopping injection of compressed air from the second upstream injection hole and the second downstream injection hole, starting injection of compressed air from the second upstream injection hole and the second downstream injection hole again, stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole, and stopping injection of compressed air from the second upstream injection hole and the second downstream injection hole. In this case, the fourth yarn type can be handled.

[0023] The winding device according to an aspect of the present disclosure may have a control mode of splicing yarns of a fifth yarn type. The winding device may further include a yarn shrinkage suppressing lever configured to grip the fifth yarn type by holding the fifth yarn type to the support. The controller may be configured to perform a control mode of, with the fifth yarn type being held and gripped by the yarn shrinkage suppressing lever, starting injection of compressed air from the first upstream injection hole and the first downstream injection hole and stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole, and with the gripping by the yarn shrinkage suppressing lever being released, starting injection of compressed air from the first upstream injection hole and the first downstream injection hole, starting injection of compressed air from the second upstream injection hole and the second downstream injection hole, and thereafter simultaneously stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole and injection of compressed air from the second upstream injection hole and the second downstream injection hole. In this case, the fifth yarn type can be handled.

[0024] The winding device according to an aspect of the present disclosure may have a control mode of splicing yarns of a sixth yarn type. The controller may be configured to perform a control mode of starting injection of compressed air from the first upstream injection hole and the first downstream injection hole, stopping injection of compressed air from the first upstream injection hole and the first downstream injection hole, starting injection of compressed air from the second upstream injection hole and the second downstream injection hole, and stopping injection of compressed air from the second upstream injection hole and the second downstream injection hole. In this case, the sixth yarn type can be handled.

[0025] The winding device according to an aspect of the present disclosure may further include a pressure regulator configured to regulate an injection pressure from at least one of the first upstream injection hole, the second upstream injection hole, the first downstream injection hole, and the second downstream injection hole. In this case, the pressure regulator can control, for example, entanglement of two yarns according to the yarn types of yarns.

[0026] According to the present disclosure, a yarn splicing nozzle and a winding device that can handle a variety of yarns can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a front view of an automatic winder according to embodiments.

FIG. 2 is a side view of a winder unit according to embodiments.

FIG. 3 is a front view of a yarn splicing device according to embodiments.

FIG. 4A is a perspective view of the front side of a yarn splicing unit according to embodiments. FIG. 4B is a perspective view of the rear side of the yarn splicing unit according to embodiments.

FIG. 5 is a partial cross-sectional view of the yarn splicing nozzle according to embodiments along A-A in FIG. 4A.

FIG. 6 is a diagram illustrating an overall configuration of the yarn splicing device according to embodiments.

FIG. 7 is an enlarged cross-sectional view of the yarn splicing nozzle according to embodiments along line C-C in FIG. 6.

FIG. 8 is a cross-sectional view corresponding to FIG. 7, illustrating injection of compressed air from a first upstream injection hole.

FIG. 9 is a cross-sectional view corresponding to FIG. 7, illustrating injection of compressed air from a second upstream injection hole.

FIG. 10A is a diagram illustrating an example of a compressed air injection timing condition for splicing cotton combed yarn. FIG. 10B is a diagram illustrating an example of a compressed air injection timing condition for splicing polyester yarn.

FIG. 11A is a diagram illustrating an example of a compressed air injection timing condition for splicing acrylic yarn. FIG. 11B is a diagram illustrating an example of a compressed air injection timing condition for splicing worsted yarn.

FIG. 12A is a diagram illustrating an example of a compressed air injection timing condition for splicing core yarn. FIG. 12B is a diagram illustrating an example of a compressed air injection timing condition for splicing lyocell fiber yarn.

DETAILED DESCRIPTION

[0028] Embodiments will be described in detail below with reference to the attached drawings. In the description of the drawings, like or corresponding elements are denoted by the same reference signs and an overlapping description is omitted.

[0029] As illustrated in FIG. 1, an automatic winder 1 includes a plurality of winder units 3 arranged in a row, a machine control device 5, and a doffer 7. The machine control device 5 can communicate with a plurality of winder units (winding devices) 3. The operator of the automatic winder 1 can collectively control a plurality of winder units 3 by operating the machine control device 5 as appropriate. Each of the winder units 3 unwinds yarn Y from a yarn supply bobbin SB while traversing the yarn Y and winds the yarn Y onto a winding bobbin WB to form a package P. When the package P becomes full (a state in which a predetermined amount of yarn is wound) in each winder unit 3, the doffer 7 travels to the position of the winder unit 3, removes the full package, and sets an empty winding bobbin WB.

[0030] As illustrated in FIG. 2, the winder unit 3 includes a unit controller 10, a yarn supply device 12, and a winding device 14. The unit controller 10 includes, for example, a central processing unit (CPU) and a read only memory (ROM). The ROM stores a program for controlling each component of the winder unit 3. The CPU executes the program stored in the ROM.

[0031] The yarn supply device 12 supports a yarn supply bobbin SB placed on a not-illustrated transportation tray at a predetermined position. The yarn supply device 12 unwinds yarn Y from the yarn supply bobbin SB and pulls out the yarn Y from the yarn supply bobbin SB. The yarn supply device 12 supplies yarn Y. The yarn supply device 12 is not limited to a transportation tray-type device and may be, for example, a magazine-type device.

[0032] The winding device 14 includes a cradle 16 and a winding drum 18. The cradle 16 sandwiches a winding bobbin WB and thereby rotatably supports the winding bobbin WB (or package P). The winding drum 18 traverses yarn Y on the surface of the package P and rotates the package P. The winding drum 18 is driven to rotate by a not-illustrated drum drive motor. With the outer periphery of the package P in contact with the winding drum 18, the winding drum 18 is driven to rotate so that the package P follows the rotation. The outer peripheral surface of the winding drum 18 has a spiral traverse groove. The yarn Y unwound from the yarn supply bobbin SB is wound onto the surface of the package P while being traversed in a constant width with the traverse groove. The package P having a constant winding width thus can be formed.

[0033] Each winder unit 3 includes an unwinding assisting device 20, a tension applying device 22, a tension detecting device 24, a yarn splicing device 26, and a yarn monitoring device 28 in this order from the yarn supply device 12, in a yarn path between the yarn supply device 12 and the winding device 14. A first catch guide device 30 and a second catch guide device 32 are disposed in the vicinity of the yarn splicing device 26.

[0034] The unwinding assisting device 20 prevents the yarn Y unwound from the yarn supply bobbin SB from being swung excessively by centrifugal force and assists in unwinding the yarn Y from the yarn supply bobbin SB appropriately. The tension applying device 22 applies a predetermined tension to the traveling yarn Y. In the present embodiment, the tension applying device 22 is a gate-type device in which movable comb teeth are disposed for fixed comb teeth. The tension detecting device 24 detects the tension of the traveling yarn Y between the yarn supply device 12 and the winding device 14. The yarn splicing device 26 splices the yarn Y on the yarn supply device 12 side and the yarn Y on the winding device 14 side when the yarn Y is broken between the yarn supply device 12 and the winding device 14 for some reason.

[0035] The yarn monitoring device 28 monitors a state of the yarn Y traveling on the yarn path and detects whether there is a yarn defect, based on the monitored information. The yarn defect is, for example, at least one of abnormal thickness of yarn Y, a foreign matter contained in yarn Y, yarn breakage, and the like. The first catch guide device 30 can turn from a standby position on the yarn supply device 12 side to a catch position on the winding device 14 side. The first catch guide device 30 catches the yarn Y at the catch position and guides the caught yarn Y to the yarn splicing device 26. The second catch guide device 32 can turn from a standby position on the yarn supply device 12 side to a catch position on the winding device 14 side. The second catch guide device 32 catches the yarn Y at the catch position and guides the caught yarn to the yarn splicing device 26.

[0036] The yarn splicing device 26 described above will now be described in more detail.

[0037] FIG. 3 is a front view of the yarn splicing device 26. In the following description, the winding device 14 side is referred to as the downstream side, the yarn supply device 12 side is referred to as the upstream side, the yarn Y traveling path (yarn path) side of the yarn splicing device 26 is referred to as the front side, and the opposite side is referred to as the rear side, for convenience sake. The direction orthogonal to the vertical direction and the front-back direction is referred to as the left-right direction. The yarn end of the yarn Y on the yarn supply device 12 side is referred to as a first yarn end, and the yarn end of the yarn Y on the winding device 14 side is referred to as a second yarn end.

[0038] As illustrated in FIG. 3, the yarn splicing device 26 includes a front plate (support) 90, an untwisting unit 40 including a first untwisting pipe member 41A and a second untwisting pipe member 41B, a yarn splicing unit 50 configured to splice yarns by injection of compressed air, a pair of yarn gathering levers (not illustrated) capable of turning such that the untwisting unit 40 is sandwiched, a yarn holding member 80 including first and second yarn holding levers 82 and 83 capable of turning such that the yarn splicing unit 50 is sandwiched, hold-down levers (yarn shrinkage suppressing lever) 85 configured to grip the yarn Y by holding the yarn Y to the front plate 90, nozzle guides 94, and a controller 96 (see FIG. 6) configured to control injection of compressed air in the yarn splicing unit 50.

[0039] The front plate 90 has a plate shape having a thickness direction in the front-to-back direction. A front surface 90a of the front plate 90 is planar along the yarn traveling direction. The yarn splicing unit 50 is provided on the front surface 90a of the front plate 90. The front plate 90 supports the yarn splicing unit 50. The front surface 90a of the front plate 90 has a first yarn end entry that is an opening of the first untwisting pipe member 41A on the downstream side of the yarn splicing unit 50 and has a second yarn end entry that is an opening of the second untwisting pipe member 41B on the upstream side of the yarn splicing unit 50.

[0040] The front surface 90a of the front plate 90 has a first guide 45A on the downstream side of the first untwisting pipe member 41A and a second guide 45B on the upstream side of the second untwisting pipe member 41B. The first and second guides 45A and 45B are disposed to face each other with the yarn splicing unit 50 interposed therebetween. The first and second guides 45A and 45B guide the yarns Y guided by the first and second catch guide devices 30 and 32, respectively.

[0041] The first untwisting pipe member 41A takes in and untwists the first yarn end by the action of compressed air. The second untwisting pipe member 41B takes in and untwists the second yarn end by the action of compressed air. The yarn splicing unit 50 twists and splices the first yarn end untwisted by the first untwisting pipe member 41A and the second yarn end untwisted by the second untwisting pipe member 41B, by the action of compressed air. When the yarn ends are twisted together in the yarn splicing unit 50, the first and second yarn ends are pulled out of the first and second untwisting pipe members 41A and 41B by the yarn gathering levers (not illustrated) while being retained by a clamp (not illustrated) and are held in the vicinity of the yarn splicing unit 50 by the first and second yarn holding levers 82 and 83.

[0042] The yarn holding member 80 is connected to a drive source (not illustrated) such as a stepping motor through a cam link mechanism 95. The yarn holding member 80 is movable in directions closer to and away from the front surface 90a of the front plate 90 by the driving force of the driving source. That is, the first and second yarn holding levers 82 and 83 of the yarn holding member 80 turn (rotate) such that the distal ends thereof move closer to and away from the front surface 90a of the front plate 90 by the driving force of the driving source. The yarn holding member 80 comes into abutment with the front surface 90a of the front plate 90 to hold the first and second yarn ends in cooperation with the front surface 90a. The distal ends of the first and second yarn holding levers 82 and 83 may be biased closer to the front plate 90, for example, by a torsion coil spring (not illustrated).

[0043] A pair of hold-down levers 85 are disposed to be aligned vertically with the yarn splicing unit 50 interposed therebetween. The pair of hold-down levers 85 integrally swing about a shaft 86 extending in the vertical direction. The hold-down levers 85 are swung into abutment with the front surface 90a of the front plate 90 and hold the yarn Y to the front plate 90 with an appropriate gripping force.

[0044] The nozzle guides 94 are members configured to guide the compressed air injected in the yarn splicing unit 50. The nozzle guides 94 are used for controlling the direction of the injected compressed air and for stabilizing the positional retention of two yarns Y to be spliced. The nozzle guides 94 have a plate shape. The nozzle guides 94 are fixed to the upper side and the lower side of the yarn splicing unit 50 with spacers 94S interposed. The nozzle guides 94 are provided to close a part of an opening on the upstream side of an upstream splicing chamber 113U described later in the yarn splicing unit 50 and a part of an opening on the downstream side of a downstream splicing chamber 113D described later in the yarn splicing unit 50. The end portions of the nozzle guides 94 that close the openings of the upstream splicing chamber 113U and the downstream splicing chamber 113D have corners not chamfered on either the top surface or the back surface.

[0045] In the yarn splicing device 26 configured as described above, first, the first and second yarn gathering levers (not illustrated) and the first and second yarn holding levers 82 and 83 turn toward the front plate 90. As a result, the yarn Y on the downstream side and the yarn Y on the upstream side that are guided by the first and second catch guide devices 30 and 32 are drawn toward the untwisting unit 40. These yarns Y are then retained by the clamp and cut by a cutter in this state. The first yarn end is fed into the first untwisting pipe member 41A, and the second yarn end is fed into the second untwisting pipe member 41B. In doing so, the yarn Y is gripped to the front plate 90 by the hold-down levers 85 so that shrinkage of the yarn Y during cutting yarn Y is suppressed. Injection of compressed air is started in the first and second untwisting pipe members 41A and 41B, and the first and second yarn ends are untwisted by the action of compressed air.

[0046] Subsequently, the first and second yarn gathering levers (not illustrated) further turn. As a result, the first yarn end and the second yarn end are held in the vicinity of the yarn splicing unit 50 by the first and second yarn holding levers 82 and 83 while being pulled out of the first and second untwisting pipe members 41A and 41B, respectively. The hold-down levers 85 are returned to the initial position, and the gripping of the yarn Y by the hold-down levers 85 is released. The injection of compressed air is started in the yarn splicing unit 50, and the first yarn end and the second yarn end untwisted are twisted together by the action of compressed air. Subsequently, the first and second yarn gathering levers (not illustrated) and the first and second yarn holding levers 82 and 83 turn in the opposite direction. Then, the retention of the yarn Y on the upper side and the yarn Y on the lower side by the clamp is released. As a result, the joined yarn Y returns onto the traveling path on the front side of the yarn splicing device 26.

[0047] FIG. 4A is a perspective view of the front side of the yarn splicing unit 50. FIG. 4B is a perspective view of the rear side of the yarn splicing unit 50. FIG. 5 is a partial cross-sectional view of a yarn splicing nozzle 100 along A-A in FIG. 4A. FIG. 6 is a diagram illustrating an overall configuration of the yarn splicing device 26. FIG. 6 includes a partial cross-sectional view of the yarn splicing nozzle 100 along B-B in FIG. 5. FIG. 7 is an enlarged cross-sectional view of the yarn splicing nozzle 100 along line C-C in FIG. 6. The yarn splicing unit 50 is a part that splices yarns by injection of compressed air and includes the yarn splicing nozzle 100 and a support block 120.

[0048] As illustrated in FIG. 4A, FIG. 4B, and FIG. 5, the yarn splicing nozzle 100 is fixed to the support block 120. The yarn splicing nozzle 100 is a yarn splicing nozzle that splices yarns by injection of compressed air. The yarn splicing nozzle 100 includes a nozzle body 110 that is a block made of ceramic, for example, a slit (groove) 112 extending along the vertical direction that is the yarn traveling direction, the upstream splicing chamber 113U and the downstream splicing chamber 113D that are spaces where yarns are spliced by the action of compressed air, a first upstream injection hole HU1 and a second upstream injection hole HU2 configured to inject compressed air toward the upstream splicing chamber 113U, and a first downstream injection hole HD1 and a second downstream injection hole HD2 configured to inject compressed air toward the downstream splicing chamber 113D.

[0049] The front side of the nozzle body 110 has a V groove 111 extending in the shape of V in cross section between the upper end and the lower end. The slit 112 is formed on the bottom side of the V groove 111 in the nozzle body 110. The slit 112 extends along the vertical direction between the upper end and the lower end of the nozzle body 110. The bottom side (rear side) of the slit 112 is communicatively connected to the upstream splicing chamber 113U and the downstream splicing chamber 113D.

[0050] The upstream splicing chamber 113U is provided on the upstream side from the center in the vertical direction in the yarn splicing nozzle 100 and is open to the upstream side. The downstream splicing chamber 113D is provided on the lower side from the center in the vertical direction in the yarn splicing nozzle 100 and is open to the downstream side. These upstream splicing chamber 113U and downstream splicing chamber 113D are adjacent to each other in the vertical direction and are communicatively connected to each other at the center in the vertical direction in the yarn splicing nozzle 100. As viewed from the vertical direction, the upstream splicing chamber 113U and the downstream splicing chamber 113D are disposed such that their centers are deviated away from each other in the left-right direction (predetermined direction).

[0051] The upstream splicing chamber 113U has a planar flat wall 114U and a rounded curved wall 115U at a part of its inner wall. The flat wall 114U is provided closer to the slit 112 than the center of the upstream splicing chamber 113U as viewed from the vertical direction. The flat wall 114U has a linear shape that is inclined rearward relative to the left-right direction toward the inside in the left-right direction as viewed from the vertical direction. The curved wall 115U has an arc shape as viewed from the vertical direction. The curved wall 115U forms a wall surface other than the flat wall 114U in the inner wall of the upstream splicing chamber 113U. The upstream splicing chamber 113U defined by the flat wall 114U and the curved wall 115U has the shape of a major segment of a circle in which a part of the front side and the inside in the left-right direction of a circle is cut off as viewed from the vertical direction.

[0052] The downstream splicing chamber 113D has a planar flat wall 114D and a rounded curved wall 115D at a part of its inner wall. The flat wall 114D is provided closer to the slit 112 than the center of the downstream splicing chamber 113D as viewed from the vertical direction. The flat wall 114D has a linear shape that is inclined rearward relative to the left-right direction toward the inside in the left-right direction as viewed from the vertical direction. The curved wall 115D has an arc shape as viewed from the vertical direction. The curved wall 115D forms a wall surface other than the flat wall 114D in the inner wall of the downstream splicing chamber 113D. The downstream splicing chamber 113D defined by the flat wall 114D and the curved wall 115D has the shape of a major segment of a circle in which a part of the front side and the inside in the left-right direction of a circle is cut off as viewed from the vertical direction.

[0053] As illustrated in FIG. 5, FIG. 6, and FIG. 7, the nozzle body 110 has a first passage 140U1 and a second passage 140U2 for supplying compressed air to the upstream splicing chamber 113U. The first passage 140U1 is a through hole leading to the upstream splicing chamber 113U. The first passage 140U1 extends in the left-right direction. The second passage 140U2 is a through hole leading to the bottom side of the slit 112. The second passage 140U2 extends at an angle relative to the left-right direction. The first passage 140U1 and the second passage 140U2 are aligned in the vertical direction and are located on one side in the left-right direction relative to the yarn traveling path L, as viewed from the front. The first passage 140U1 is located on the upstream side of the second passage 140U2 as viewed from the front. The openings of the first passage 140U1 and the second passage 140U2 form the first upstream injection hole HU1 and the second upstream injection hole HU2, respectively. The cross-sectional shape of the first passage 140U1 and the second passage 140U2 is rectangular. In other words, the first upstream injection hole HU1 and the second upstream injection hole HU2 input, pass, output, or supply the compressed air toward the upstream splicing chamber 113U.

[0054] The nozzle body 110 also has a first passage 140D1 and a second passage 140D2 for supplying compressed air to the downstream splicing chamber 113D. The first passage 140D1 is a through hole leading to the downstream splicing chamber 113D. The first passage 140D1 extends in the left-right direction. The second passage 140D2 is a through hole leading to the bottom side of the slit 112. The second passage 140D2 extends at an angle relative to the left-right direction. The first passage 140D1 and the second passage 140D2 are aligned in the vertical direction and are located on the other side in the left-right direction relative to the yarn traveling path L, as viewed from the front. The first passage 140D1 is located on the downstream side of the second passage 140D2 as viewed from the front. The openings of the first passage 140D1 and the second passage 140D2 form the first downstream injection hole HD1 and the second downstream injection hole HD2, respectively. The cross-sectional shape of the first passage 140D1 and the second passage 140D2 is rectangular. In other words, the first downstream injection hole HD1 and the second downstream injection hole HD input, pass, output, or supply the compressed air toward the downstream splicing chamber 113D.

[0055] The first upstream injection hole HU1 and the second upstream injection hole HU2 are injection holes formed in the nozzle body 110 to inject compressed air toward the upstream splicing chamber 113U. The first upstream injection hole HU1 and the second upstream injection hole HU2 inject compressed air in the direction in which the twisting of the second yarn end is applied. The first upstream injection hole HU1 and the second upstream injection hole HU2 are located on one side in the left-right direction relative to the yarn traveling path L, as viewed from the front. The first upstream injection hole HU1 and the second upstream injection hole HU2 have a rectangular shape.

[0056] The first upstream injection hole HU1 injects compressed air along the flat wall 114U of the upstream splicing chamber 113U. The first upstream injection hole HU1 is open to the inside of the upstream splicing chamber 113U. As viewed from the vertical direction, the flat wall 114U of the upstream splicing chamber 113U is inclined at 15° to 30° relative to the injection direction of compressed air from the first upstream injection hole HU1. Specifically, as viewed from the vertical direction, the flat wall 114U is inclined at 20° to 25° relative to the injection direction of compressed air from the first upstream injection hole HU1. In the example illustrated in the drawings, the flat wall 114U is provided such that the angle α to the injection direction of compressed air from the first upstream injection hole HU1 is 25°. The flat wall 114U is continuous to the edge of the first upstream injection hole HU1. As described above, injecting compressed air along the flat wall 114U includes the extending direction of the flat wall 114U not only in parallel to but also at an angle to the injection direction.

[0057] For example, the injection direction of compressed air from the first upstream injection hole HU1 corresponds to the direction in which the first upstream injection hole HU1 is oriented. For example, the injection direction of compressed air from the first upstream injection hole HU1 is the main direction of streamline of the compressed air through the first upstream injection hole HU1. This is applicable to the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2.

[0058] The second upstream injection hole HU2 is provided on the bottom side of the slit 112. The second upstream injection hole HU2 is open to the bottom side of the slit 112. The second upstream injection hole HU2 injects compressed air along the tangential direction of the curved wall 115U of the upstream splicing chamber 113U, as viewed from the vertical direction. The second upstream injection hole HU2 injects compressed air from the bottom side of the slit 112 toward the edge of the upstream splicing chamber 113U.

[0059] The first downstream injection hole HD1 and the second downstream injection hole HD2 are injection holes formed in the nozzle body 110 to inject compressed air toward the downstream splicing chamber 113D. The first downstream injection hole HD1 and the second downstream injection hole HD2 inject compressed air in the direction in which the twisting of the first yarn end is applied. The first downstream injection hole HD1 and the second downstream injection hole HD2 are located on the other side in the left-right direction relative to the yarn traveling path L, as viewed from the front. The first downstream injection hole HD1 and the second downstream injection hole HD2 have a rectangular shape.

[0060] The first downstream injection hole HD1 injects compressed air along the flat wall 114D of the downstream splicing chamber 113D. The first downstream injection hole HD1 is open to the inside of the downstream splicing chamber 113D. As viewed from the vertical direction, the flat wall 114D of the downstream splicing chamber 113D is inclined at 15° to 30° relative to the injection direction of compressed air from the first downstream injection hole HD1. Specifically, as viewed from the vertical direction, the flat wall 114D is inclined at 20° to 25° relative to the injection direction of compressed air from the first downstream injection hole HD1. In the example illustrated in the drawings, the flat wall 114D is provided such that the angle β to the injection direction of compressed air from the first downstream injection hole HD1 is 25°. The flat wall 114D is continuous to the edge of the first downstream injection hole HD1. As described above, injecting compressed air along the flat wall 114D includes the extending direction of the flat wall 114D not only in parallel to but also at an angle to the injection direction.

[0061] The second downstream injection hole HD2 is provided on the bottom side of the slit 112. The second downstream injection hole HD2 is open to the bottom side of the slit 112. The second downstream injection hole HD2 injects compressed air along the tangential direction of the curved wall 115D of the downstream splicing chamber 113D, as viewed from the vertical direction. The second downstream injection hole HD2 injects compressed air from the bottom side of the slit 112 toward the edge of the downstream splicing chamber 113D.

[0062] The respective injection directions of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 are along the left-right direction and opposite to each other. In the vertical direction, the second upstream injection hole HU2 and the second downstream injection hole HD2 are located between the first upstream injection hole HU1 and the first downstream injection hole HD1 (see FIG. 6). In other words, in the vertical direction, the first upstream injection hole HU1 and the first downstream injection hole HD1 are disposed on the outside of the nozzle body 110, and the second upstream injection hole HU2 and the second downstream injection hole HD2 are disposed on the inside of the nozzle body 110.

[0063] A boundary line formed between the flat wall 114U and the remainder (curved wall 115U) of the inner wall of the upstream splicing chamber 113U is continuous to at least a part of the edge of the first upstream injection hole HU1. A boundary line formed between the flat wall 114D and the remainder (curved wall 115D) of the inner wall of the downstream splicing chamber 113D is continuous to at least a part of the edge of the first downstream injection hole HD1. The boundary line of the inner wall of the upstream splicing chamber 113U forms a corner (ridge) formed at a place where the flat wall 114U and the curved wall 115U meet. The boundary line of the inner wall of the downstream splicing chamber 113D forms a corner (ridge) formed at a place where the flat wall 114D and the curved wall 115D meet. The boundary line of the inner wall of the upstream splicing chamber 113U overlaps with one side of the polygonal shape of the first upstream injection hole HU1. The boundary line of the inner wall of the downstream splicing chamber 113D overlaps with one side of the polygonal shape of the first downstream injection hole HD1. The inner surface of the first upstream injection hole HU1 connects to the flat wall 114U of the upstream splicing chamber 113U. The inner surface of the first downstream injection hole HD1 connects to the flat wall 114D of the downstream splicing chamber 113D. The boundary line may be a line that actually appears or may be a virtual line.

[0064] Returning to FIG. 3 and FIG. 4, the support block 120 is formed of, for example, a metal such as aluminum or a resin and substantially shaped like a rectangular parallelepiped. The support block 120 has a U-shaped opening 121 that accommodates the yarn splicing nozzle 100. The support block 120 has a first block passage 125A and a second block passage 125B. The first block passage 125A is a passage for circulating compressed air from the outside of the support block 120 to the first passage 140U1 and the first passage 140D1 (see FIG. 6) of the yarn splicing nozzle 100. The second block passage 125B is a passage for circulating compressed air from the outside of the support block 120 to the second passage 140U2 and the second passage 140D2 (see FIG. 6) of the yarn splicing nozzle 100.

[0065] As illustrated in FIG. 6, the controller 96 is a computer configured with a CPU, a ROM, a RAM, and the like. The control of various operations in the controller 96 is performed, for example, by a program stored in the ROM, loaded into the RAM, and executed by the CPU. The controller 96 may be configured as hardware by an electronic circuit or the like. The controller 96 may be configured with a part of the unit controller 10 (see FIG. 2). The controller 96 may be configured separately from the unit controller 10.

[0066] The controller 96 controls the injection of compressed air in the yarn splicing nozzle 100. Specifically, the controller 96 controls opening and closing of a first solenoid valve 161 provided in a first air channel 151 that guides compressed air to the first upstream injection hole HU1 and the first downstream injection hole HD1. The first air channel 151 is formed of, for example, a tube and communicatively connected to the first block passage 125A. The controller 96 controls opening and closing of a second solenoid valve 162 provided in a second air channel 152 that guides compressed air to the second upstream injection hole HU2 and the second downstream injection hole HD2. The second air channel 152 is formed of, for example, a tube and communicatively connected to the second block passage 125B. The controller 96 can control opening and closing of at least one of the first solenoid valve 161 and the second solenoid valve 162 to change the injection start timing and the injection stop timing of compressed air from the first upstream injection hole HU1, the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2.

[0067] The first air channel 151 has a first pressure regulating valve 171 configured to regulate an injection pressure from the first upstream injection hole HU1 and the first downstream injection hole HD1. The second air channel 152 has a second pressure regulating valve 172 configured to regulate an injection pressure from the second upstream injection hole HU2 and the second downstream injection hole HD2. That is, the yarn splicing device 26 includes the first pressure regulating valve 171 and the second pressure regulating valve 172 as a pressure regulator.

[0068] As described above, in the yarn splicing nozzle 100, the first upstream injection hole HU1 injects compressed air along the flat wall 114U of the upstream splicing chamber 113U. As illustrated in FIG. 8, two yarns Y and Y to form a spliced point are swept in an aligned state along the flat wall 114U by the flow of compressed air in the upstream splicing chamber 113U, collide and bounce off, and approach the first upstream injection hole HU1. The two yarns Y and Y approaching the first upstream injection hole HU1 are swept along the flat wall 114U again, and collide and bounce off. This process is repeated so that the yarns Y and Y are swung around. As a result, the fibers of the two yarns Y and Y are entangled to form a spliced point. The formation of entanglement at a spliced point is performed through such behavior of the yarns Y in the upstream splicing chamber 113U. The compressed air from the first upstream injection hole HU1 has an element of twining at the outer edge of the upstream splicing chamber 113U but mainly has an element of entanglement in the upstream splicing chamber 113U, which contributes to the spliced point strength. This is applicable to the first downstream injection hole HD1. The spliced point strength in a manner of the present invention is the maximum tensile strength measured until yarn is broken in a yarn tenacity and elongation test described below.

[0069] The yarn splicing nozzle 100 therefore can effectively entangle two yarns Y and Y and form a spliced point. As a result, a sufficient strength of the spliced point can be ensured even when a variety of yarns Y are spliced. A variety of yarns Y can be handled. Any kinds of yarns can be handled by a single kind of yarn splicing nozzle 100. The spliced point can be formed in a clean shape with no whiskers at both ends. It is unnecessary to apply heat or water to change the stiffness of yarn Y during splicing and modify the yarn for the quality suitable for splicing.

[0070] In the yarn splicing nozzle 100, as viewed from the vertical direction, the flat wall 114U of the upstream splicing chamber 113U is inclined at 15° to 30° relative to the injection direction of compressed air from the first upstream injection hole HU1. As viewed from the vertical direction, the flat wall 114D of the downstream splicing chamber 113D is inclined at 15° to 30° relative to the injection direction of compressed air from the first downstream injection hole HD1. In this case, compressed air is injected from the first upstream injection hole HU1 and the first downstream injection hole HD1 to entangle the two yarns Y and Y more effectively to form a spliced point.

[0071] If the flat wall 114U is disposed at an angle smaller than 15° relative to the injection direction of compressed air from the first upstream injection hole HU1, the proportion of air flowing to the outside through the slit 112 is larger and the yarns Y and Y may escape to the outside through the slit 112. If the flat wall 114U is disposed at an angle larger than 30° relative to the injection direction of compressed air from the first upstream injection hole HU1, the volume of the upstream splicing chamber 113U is smaller and the air may fail to swirl sufficiently. This is also applicable to the flat wall 114D.

[0072] In the yarn splicing nozzle 100, as viewed from the vertical direction, the flat wall 114U of the upstream splicing chamber 113U is inclined at 20° to 25° relative to the injection direction of compressed air from the first upstream injection hole HU1. As viewed from the vertical direction, the flat wall 114D of the downstream splicing chamber 113D is inclined at 20° to 25° relative to the injection direction of compressed air from the first downstream injection hole HD1. In this case, compressed air is injected from the first upstream injection hole HU1 and the first downstream injection hole HD1 to entangle the two yarns Y and Y even more effectively to form a spliced point.

[0073] In the yarn splicing nozzle 100, the boundary line formed between the flat wall 114U and the remainder (curved wall 115U) of the inner wall of the upstream splicing chamber 113U is continuous to at least a part of the edge of the first upstream injection hole HU1. The boundary line formed between the flat wall 114D and the remainder (curved wall 115D) of the inner wall of the downstream splicing chamber 113D is continuous to at least a part of the edge of the first downstream injection hole HD1. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns Y. Since the air injected from the first upstream injection hole HU1 and the first downstream injection hole HD1 flows continuously along the flat walls 114U and 114D, the air flow is not easily disturbed and the action on the yarn Y is also not disturbed.

[0074] In the yarn splicing nozzle 100, the first upstream injection hole HU1 and the first downstream injection hole HD1 have a polygonal shape, the boundary line of the inner wall of the upstream splicing chamber 113U overlaps with one side of the polygonal shape of the first upstream injection hole HU1, and the boundary line of the inner wall of the downstream splicing chamber 113D overlaps with one side of the polygonal shape of the first downstream injection hole HD1. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns Y.

[0075] In the yarn splicing nozzle 100, the first upstream injection hole HU1 and the first downstream injection hole HD1 may have a circular shape, the boundary line of the inner wall of the upstream splicing chamber

113U may overlap with a tangent to the circular shape of the first upstream injection hole HU1, and the boundary line of the inner wall of the downstream splicing chamber 113D may overlap with a tangent to the circular shape of the first downstream injection hole HD1. This configuration can also specifically provide a manner that achieves the effect of handling a variety of yarns Y.

[0076] In the yarn splicing nozzle 100, the inner surface of the first upstream injection hole HU1 is continuous to the flat wall 114U of the upstream splicing chamber 113U, and the inner surface of the first downstream injection hole HD1 is continuous to the flat wall 114D of the downstream splicing chamber 113D. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns Y.

[0077] In the yarn splicing nozzle 100, as viewed from the vertical direction, the upstream splicing chamber 113U and the downstream splicing chamber 113D are disposed such that their centers are deviated away from each other in the left-right direction. As viewed from the vertical direction, the respective injection directions of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 are along the left-right direction and opposite to each other. With this configuration, the first upstream injection hole HU1 and the first downstream injection hole HD1 can be formed symmetrically in the left-right direction when viewed from the vertical direction. The center is the center of a circle when the upstream splicing chamber 113U and the downstream splicing chamber 113D have a circular shape as viewed from the vertical direction, as in the present embodiment. The center may be the intersection of the major axis and the minor axis, for example, when the upstream splicing chamber 113U and the downstream splicing chamber 113D have an elongated shape (such as an oval shape and an elliptic shape) as viewed from the vertical direction. The center may be the center of rotation, for example, when the upstream splicing chamber 113U and the downstream splicing chamber 113D have a rotationally symmetric shape as viewed from the vertical direction.

[0078] In the yarn splicing nozzle 100, the upstream splicing chamber 113U has the curved wall 115U, and the downstream splicing chamber 113D has the curved wall 115D. As viewed from the vertical direction, the second upstream injection hole HU2 injects compressed air along the tangential direction of the curved wall 115U (see FIG. 9). As viewed from the vertical direction, the second downstream injection hole HD2 injects compressed air along the tangential direction of the curved wall 115D. In this case, the compressed air injected along the tangential direction from the second upstream injection hole HU2 and the second downstream injection hole HD2 mainly transmits rotational force to the yarn Y and effectively twins the fibers of the first yarn end and the second yarn end. The compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 has an element of entanglement formed in the upstream splicing chamber 113U and the downstream splicing chamber 113D but mainly has an element of twining of the fibers at the outer edges of the upstream splicing chamber 113U and the downstream splicing chamber 113D, which contributes to formation of a spliced point. With this configuration, a sufficient strength of the spliced point can be ensured even when a variety of yarns Y are spliced.

[0079] The yarn splicing nozzle 100 has the slit 112 communicatively connected to the upstream splicing chamber 113U and the downstream splicing chamber 113D, and the second upstream injection hole HU2 and the second downstream injection hole HD2 are open to the bottom side of the slit 112. In this case, in the configuration with the slit 112, slipping of the yarn Y out of the upstream splicing chamber 113U and the downstream splicing chamber 113D through the slit 112 can be suppressed by the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2.

[0080] In the yarn splicing nozzle 100, the flat wall 114U is provided closer to the slit 112 than the center of the upstream splicing chamber 113U, and the flat wall 114D is provided closer to the slit 112 than the center of the downstream splicing chamber 113D, as viewed from the vertical direction. This configuration can specifically provide a manner that achieves the effect of handling a variety of yarns Y.

[0081] In the yarn splicing nozzle 100, in the vertical direction, the second upstream injection hole HU2 and the second downstream injection hole HD2 are located between the first upstream injection hole HU1 and the first downstream injection hole HD1. In this case, slipping of the yarn Y out of the upstream splicing chamber 113U and the downstream splicing chamber 113D can be suppressed, compared with when the first upstream injection hole HU1 and the first downstream injection hole HD1 are located between the second upstream injection hole HU2 and the second downstream injection hole HD2 in the vertical direction.

[0082] The winder unit 3 includes the yarn splicing nozzle 100, the front plate 90 supporting the yarn splicing nozzle 100, and the controller 96 configured to control the injection of compressed air in the yarn splicing nozzle 100. In the yarn splicing device 26, the yarn splicing nozzle 100 also achieves the effect described above, such as the effect of handling a variety of yarns Y.

[0083] The winder unit 3 includes the first pressure regulating valve 171 and the second pressure regulating valve 172 configured to regulate the injection pressure at the first upstream injection hole HU1, the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2. In this configuration, for example, when the yarn Y is cotton denim yarn, the first pressure regulating valve 171 and the second pressure regulating valve 172 are controlled such that the injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is larger than the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2, thereby enhancing the entanglement of two yarns Y and Y to be spliced and achieving the strength of a spliced point suitable for denim yarn. That is, the strength of a spliced point according to the yarn types of yarn Y can be achieved.

[0084] In the yarn splicing device 26, the controller 96 controls opening and closing of the first solenoid valve 161 provided in the first air channel 151 and opening and closing of the second solenoid valve 162 provided in the second air channel 152. In this case, the injection timing of compressed air can be controlled using the first solenoid valve 161 and the second solenoid valve 162.

[0085] FIG. 10A, FIG. 10B, FIG. 11A, FIG. 11B, FIG. 12A, and FIG. 12B are diagrams illustrating an example of a compressed air injection timing condition in the winder unit 3. The time in each figure represents the passage of time in the direction of the arrow. In each figure, the presence of a horizontal bar labeled "untwisting unit" indicates that compressed air is being injected in the untwisting unit 40. The presence of a horizontal bar labeled "first injection hole" indicates that compressed air is being injected from the first upstream injection hole HU1 and the first downstream injection hole HD1. The presence of a horizontal bar labeled "second injection hole" indicates that compressed air is being injected from the second upstream injection hole HU2 and the second downstream injection hole HD2. In the winder unit 3, compressed air may be injected in the untwisting unit 40 and the yarn splicing unit 50, based on the injection timing condition, for example, according to the yarn types of yarn Y.

[0086] For example, the winder unit 3 has a control mode of splicing yarn Y that is cotton combed yarn (first yarn type). In the control mode of splicing yarn Y that is cotton combed yarn, it is found that the injection timing condition illustrated in FIG. 10A can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started under the control of the controller 96. After the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started after some delay, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped simultaneously, under the control of the controller 96. In this case, cotton combed yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.5 MPa).

[0087] A tenacity and elongation measurement test performed for the cotton combed yarn spliced under the injection timing condition illustrated in FIG. 10A showed that the retention (%) was 80% to 90% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed. The retention (%) is the ratio of the strength of the yarn Y spliced to the strength of the yarn Y not spliced. Here, the result of the tenacity and elongation measurement test is the average value of 30 test results. Common measurement conditions can be employed as the other measurement conditions in the tenacity and elongation measurement test. These are applicable to the following tenacity and elongation measurement tests.

[0088] For example, the winder unit 3 has a control mode of splicing yarn Y that is polyester yarn (second yarn type). In the control mode of splicing yarn Y that is polyester yarn, it is found that the injection timing condition illustrated in FIG. 10B can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started under the control of the controller 96. After the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started after some delay, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped simultaneously, under the control of the controller 96. The injection period of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 illustrated in FIG. 10B is longer than that illustrated in FIG. 10A. The injection period of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 illustrated in FIG. 10B is longer than that illustrated in FIG. 10A. In this case, polyester yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.4 MPa).

[0089] A tenacity and elongation measurement test performed for the polyester yarn spliced under the injection timing condition illustrated in FIG. 10B showed that the retention (%) was 80% to 90% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed.

[0090] For example, the winder unit 3 has a control mode of splicing yarn Y that is acrylic yarn (third yarn type). In the control mode of splicing yarn Y that is acrylic yarn, it is found that the injection timing condition illustrated in FIG. 11A can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started under the control of the controller 96. The injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started after some delay under the control of the controller 96. Subsequently, during the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is stopped, and the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started again, under the control of the controller 96. Then, the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped, and the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be stopped after some delay, under the control of the controller 96. In this case, acrylic yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.4 MPa).

[0091] A tenacity and elongation measurement test performed for the acrylic yarn spliced under the injection timing condition illustrated in FIG. 11A showed that the retention (%) was 80% to 90% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed.

[0092] For example, the winder unit 3 has a control mode of splicing yarn Y that is worsted yarn (fourth yarn type). In the control mode of splicing yarn Y that is worsted yarn, it is found that the injection timing condition illustrated in FIG. 11B can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started under the control of the controller 96. The injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started after some delay under the control of the controller 96. Subsequently, during the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1, the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is stopped, and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started again, under the control of the controller 96. Then, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be stopped, and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped after some delay, under the control of the controller 96. In this case, worsted yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.65 MPa).

[0093] A tenacity and elongation measurement test performed for the worsted yarn spliced under the injection timing condition illustrated in FIG. 11B showed that the retention (%) was 85% to 95% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed.

[0094] For example, the winder unit 3 has a control mode of splicing yarn Y that is core yarn (fifth yarn type). In the control mode of splicing yarn Y that is core yarn, it is found that the injection timing condition illustrated in FIG. 12A can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, with the yarn Y held and gripped by the hold-down levers 85, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started, and thereafter the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is stopped, under the control of the controller 96. Subsequently, with the gripping by the hold-down levers 85 being released, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started, the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 is started after some delay, and thereafter the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped simultaneously, under the control of the controller 96. In this case, core yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.6 MPa).

[0095] A tenacity and elongation measurement test performed for the core yarn spliced under the injection timing condition illustrated in FIG. 12A showed that the retention (%) was 80% to 90% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed.

[0096] For example, the winder unit 3 has a control mode of splicing yarn Y that is lyocell fiber yarn (sixth yarn type). In the control mode of splicing yarn Y that is lyocell fiber yarn, it is found that the injection timing condition illustrated in FIG. 12B can be adopted. The controller 96 of the winder unit 3 is configured to perform the following control mode. That is, in the winder unit 3, after the injection of compressed air is stopped in the untwisting unit 40, the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is started, and the injection of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 is stopped, under the control of the controller 96. Subsequently, the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be started, and the injection of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 may be stopped, under the control of the controller 96. In this case, lyocell fiber yarn can be handled. The injection pressure of compressed air from the first upstream injection hole HU1 and the first downstream injection hole HD1 may be the same as the injection pressure of compressed air from the second upstream injection hole HU2 and the second downstream injection hole HD2 (for example, injection pressure: 0.55 MPa).

[0097] A tenacity and elongation measurement test performed for the lyocell fiber yarn spliced under the injection timing condition illustrated in FIG. 12B showed that the retention (%) was 80% to 90% and the strength of a spliced point was sufficient. It was also shown that a spliced point with a clean shape was formed.

Modifications

[0098] Although the embodiment has been described above, a manner of the present invention is not limited to the foregoing embodiment.

[0099] In the foregoing embodiment, the deviation in the left-right direction of the upstream splicing chamber 113U and the downstream splicing chamber 113D may be opposite. That is, instead of the arrangement of the upstream splicing chamber 113U deviated to one side and the downstream splicing chamber 113D deviated to the other side in the left-right direction, the upstream splicing chamber 113U may be deviated to the other side and the downstream splicing chamber 113D may be deviated to one side in the left-right direction. Such a modification is used when the direction of twisting in splicing is reversed in the foregoing embodiment. In such a modification, the nozzle guides 94 are turned upside down and fixed in a position opposite to that in the foregoing embodiment in the left-right direction with the yarn traveling path L of the yarn splicing unit 50 interposed. The nozzle guides 94 can be used, independently of the positional relation in the left-right direction of the upstream splicing chamber 113U and the downstream splicing chamber 113D.

[0100] In the foregoing embodiment, the injection start timings of the first upstream injection hole HU1, the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2 can be separately set freely. The blowing periods of compressed air from the first upstream injection hole HU1, the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2 may be separately set freely. The injection pressures of compressed air from the first upstream injection hole HU1, the second upstream injection hole HU2, the first downstream injection hole HD1, and the second downstream injection hole HD2 may be separately set freely. The timing of stopping the compressed air injected in the untwisting unit 40 may be set freely. Such a configuration can be implemented, for example, using known techniques such as solenoid valves or pressure-reducing valves.

[0101] In the foregoing embodiment, the yarn splicing device according to a manner of the invention is applied to the winder unit 3. However, the yarn splicing device according to an aspect of the present invention may be applied to the winding unit of a spinning machine or a work vehicle moving between a plurality of winding units.

[0102] In the foregoing embodiment, the nozzle body 110 is formed of ceramic but is not limited thereto. For example, the nozzle body 110 may be formed of metal. When the material of the nozzle body 110 is made of metal, a powder injection molding process (metal injection process) can also be used. Unlike ceramics, metal is not broken, and in addition, there is no need for machining for forming a complicated shape. Iron or stainless steel can be used as the metal material when the powder injection molding process is used.

Claims

1. A yarn splicing nozzle (100) configured to splice yarns (Y) by injection of compressed air, the yarn splicing nozzle (100) comprising:

   a nozzle body (110);
   an upstream splicing chamber (113U) formed in the nozzle body (110) and having a planar flat wall (114U) at a part of an inner wall;
   a downstream splicing chamber (113D) formed in the nozzle body (110), communicatively connected to the upstream splicing chamber (113U), and having a planar flat wall (114D) at

a part of an inner wall;
a first upstream injection hole (HU1) and a second upstream injection hole (HU2) formed in the nozzle body (110) and configured to inject compressed air toward the upstream splicing chamber (113U); and
a first downstream injection hole (HD1) and a second downstream injection hole (HD2) formed in the nozzle body (110) and configured to inject compressed air toward the downstream splicing chamber (113D), **characterized in that** the first upstream injection hole (HU1) injects compressed air along the flat wall (114U) of the upstream splicing chamber (113U), and
the first downstream injection hole (HD1) injects compressed air along the flat wall (114D) of the downstream splicing chamber (113D).

2. The yarn splicing nozzle (100) according to claim 1, wherein

as viewed from a yarn (Y) traveling direction, the flat wall (114U) of the upstream splicing chamber (113U) is inclined at 15° to 30° relative to an injection direction of compressed air from the first upstream injection hole (HU1), and
as viewed from the yarn (Y) traveling direction, the flat wall (114D) of the downstream splicing chamber (113D) is inclined at 15° to 30° relative to an injection direction of compressed air from the first downstream injection hole (HD1).

3. The yarn splicing nozzle (100) according to claim 2, wherein

as viewed from the yarn (Y) traveling direction, the flat wall (114U) of the upstream splicing chamber (113U) is inclined at 20° to 25° relative to an injection direction of compressed air from the first upstream injection hole (HU1), and
as viewed from the yarn (Y) traveling direction, the flat wall (114D) of the downstream splicing chamber (113D) is inclined at 20° to 25° relative to an injection direction of compressed air from the first downstream injection hole (HD1).

4. The yarn splicing nozzle (100) according to any one of claims 1 to 3, wherein

a boundary line formed between the flat wall (114U) and the remainder of the inner wall of the upstream splicing chamber (113U) is continuous to at least a part of an edge of the first upstream injection hole (HU1), and
a boundary line formed between the flat wall (114D) and the remainder of the inner wall of the downstream splicing chamber (113D) is continuous to at least a part of an edge of the first downstream injection hole (HD1).

5. The yarn splicing nozzle (100) according to claim 4, wherein

the first upstream injection hole (HU1) has a circular shape,
the first downstream injection hole (HD1) has a circular shape,
the boundary line of the inner wall of the upstream splicing chamber (113U) overlaps with a tangent to the circular shape of the first upstream injection hole (HU1), and
the boundary line of the inner wall of the downstream splicing chamber (113D) overlaps with a tangent to the circular shape of the first downstream injection hole (HD1).

6. The yarn splicing nozzle (100) according to claim 4, wherein

the first upstream injection hole (HU1) and the first downstream injection hole (HD1) have a polygonal shape,
the boundary line of the inner wall of the upstream splicing chamber (113U) overlaps with one side of the polygonal shape of the first upstream injection hole (HU1), and
the boundary line of the inner wall of the downstream splicing chamber (113D) overlaps with one side of the polygonal shape of the first downstream injection hole (HD1).

7. The yarn splicing nozzle (100) according to any one of claims 1 to 6, wherein

an inner surface of the first upstream injection hole (HU1) is continuous to the flat wall (114U) of the upstream splicing chamber (113U), and
an inner surface of the first downstream injection hole (HD1) is continuous to the flat wall (114D) of the downstream splicing chamber (113D).

8. The yarn splicing nozzle (100) according to any one of claims 1 to 7, wherein

as viewed from the yarn (Y) traveling direction, the upstream splicing chamber (113U) and the downstream splicing chamber (113D) are disposed such that centers are deviated away from each other in a predetermined direction, and
as viewed from the yarn (Y) traveling direction, respective injection directions of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1) are along the predetermined direction and opposite to each other.

9. The yarn splicing nozzle (100) according to any one of claims 1 to 8, wherein

each of the upstream splicing chamber (113U) and the downstream splicing chamber (113D) has a curved wall (115U; 115D) having an arc shape at a part of the inner wall as viewed from the yarn (Y) traveling direction,
the second upstream injection hole (HU2) injects compressed air along a tangential direction of the curved wall (115U) of the upstream splicing chamber (113U) as viewed from the yarn (Y) traveling direction, and
the second downstream injection hole (HD2) injects compressed air along a tangential direction of the curved wall (115D) of the downstream splicing chamber (113D) as viewed from the yarn (Y) traveling direction.

10. The yarn splicing nozzle (100) according to any one of claims 1 to 9, further comprising a groove (111) disposed in the nozzle body (110) and extending in the yarn (Y) traveling direction, the groove (111) having a bottom side communicatively connected to the upstream splicing chamber (113U) and the downstream splicing chamber (113D), wherein

the second upstream injection hole (HU2) and the second downstream injection hole (HD2) are open to the bottom side of the groove (111),
as viewed from the yarn (Y) traveling direction, the flat wall (114U) of the upstream splicing chamber (113U) is disposed closer to the groove (111) than the center of the upstream splicing chamber (113U), and
as viewed from the yarn (Y) traveling direction, the flat wall (114D) of the downstream splicing chamber (113D) is disposed closer to the groove (111) than the center of the downstream splicing chamber (113D).

11. The yarn splicing nozzle (100) according to claim 9 or 10, wherein in the yarn (Y) traveling direction, the second upstream injection hole (HU2) and the second downstream injection hole (HD2) are located between the first upstream injection hole (HU1) and the first downstream injection hole (HD1).

12. A winding device (14) comprising:

the yarn splicing nozzle (100) according to any one of claims 1 to 11;
a support (120) supporting the yarn splicing nozzle (100); and
a controller (96) configured to control injection of compressed air in the yarn splicing nozzle (100).

13. The winding device (14) according to claim 12, wherein

the winding device (14) has a control mode of splicing yarns (Y) of a first yarn type and a second yarn type,
the controller (96) is configured to perform a control mode of
starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), and simultaneously stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1) and injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2).

14. The winding device (14) according to claim 12, wherein

the winding device (14) has a control mode of splicing yarns (Y) of a third yarn type,
the controller (96) is configured to perform a control mode of
starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1) again, stopping injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), and stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1).

15. The winding device (14) according to claim 12, wherein

the winding device (14) has a control mode of splicing yarns (Y) of a fourth yarn type,
the controller (96) is configured to perform a control mode of
starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), starting injection of compressed air from the first up-

stream injection hole (HU1) and the first downstream injection hole (HD1), stopping injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2) again, stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), and stopping injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2).

16. The winding device (14) according to claim 12, wherein

the winding device (14) has a control mode of splicing yarns (Y) of a fifth yarn type,
the winding device (14) further comprises a yarn shrinkage suppressing lever (85) configured to grip the fifth yarn type by holding the fifth yarn type to the support (120),
the controller (96) is configured to perform a control mode of
with the fifth yarn type being held and gripped by the yarn shrinkage suppressing lever (85), starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1) and stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), and
with the gripping by the yarn shrinkage suppressing lever (85) being released, starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), and thereafter simultaneously stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1) and injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2).

17. The winding device (14) according to claim 12, wherein

the winding device (14) has a control mode of splicing yarns of a sixth yarn type,
the controller (96) is configured to perform a control mode of
starting injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), stopping injection of compressed air from the first upstream injection hole (HU1) and the first downstream injection hole (HD1), starting injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2), and stopping injection of compressed air from the second upstream injection hole (HU2) and the second downstream injection hole (HD2) .

18. The winding device (14) according to any one of claims 12 to 17, further comprising a pressure regulator configured to regulate an injection pressure from at least one of the first upstream injection hole (HU1), the second upstream injection hole (HU2), the first downstream injection hole (HD1), and the second downstream injection hole (HD2).

Patentansprüche

1. Fadenspleißdüse (100), die zum Spleißen von Fäden (Y) durch Einblasen von Druckluft konfiguriert ist, wobei die Fadenspleißdüse (100) Folgendes umfasst:

einen Düsenkörper (110);
eine stromaufwärtige Spleißkammer (113U), die in dem Düsenkörper (110) gebildet ist und eine ebene flache Wand (114U) an einem Teil einer Innenwand aufweist;
eine stromabwärtige Spleißkammer (113D), die in dem Düsenkörper (110) gebildet ist, mit der stromaufwärtigen Spleißkammer (113U) kommunikativ verbunden ist und eine ebene flache Wand (114D) an einem Teil einer Innenwand aufweist;
ein erstes stromaufwärtiges Einblasloch (HU1) und ein zweites stromaufwärtiges Einblasloch (HU2), die in dem Düsenkörper (110) gebildet und dazu konfiguriert sind, Druckluft hin zu der stromaufwärtigen Spleißkammer (113U) einzublasen; und
ein erstes stromabwärtiges Einblasloch (HD1) und ein zweites stromabwärtiges Einblasloch (HD2), die in dem Düsenkörper (110) gebildet und dazu konfiguriert sind, Druckluft hin zu der stromabwärtigen Spleißkammer (113D) einzublasen, **dadurch gekennzeichnet, dass**
das erste stromaufwärtige Einblasloch (HU1) Druckluft entlang der flachen Wand (114U) der stromaufwärtigen Spleißkammer (113U) einbläst und
das erste stromabwärtige Einblasloch (HD1) Druckluft entlang der flachen Wand (114D) der stromabwärtigen Spleißkammer (113D) einbläst.

2. Fadenspleißdüse (100) nach Anspruch 1, wobei

die flache Wand (114U) der stromaufwärtigen Spleißkammer (113U), wie von einer Laufrichtung eines Fadens (Y) aus gesehen, um 15° bis 30° relativ zu einer Einblasrichtung von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) geneigt ist und
die flache Wand (114D) der stromabwärtigen Spleißkammer (113D), wie von der Laufrichtung des Fadens (Y) aus gesehen, um 15° bis 30° relativ zu einer Einblasrichtung von Druckluft aus dem ersten stromabwärtigen Einblasloch (HD1) geneigt ist.

3. Fadenspleißdüse (100) nach Anspruch 2, wobei

die flache Wand (114U) der stromaufwärtigen Spleißkammer (113U), wie von der Laufrichtung des Fadens (Y) aus gesehen, um 20° bis 25° relativ zu einer Einblasrichtung von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) geneigt ist und
die flache Wand (114D) der stromabwärtigen Spleißkammer (113D), wie von der Laufrichtung des Fadens (Y) aus gesehen, um 20° bis 25° relativ zu einer Einblasrichtung von Druckluft aus dem ersten stromabwärtigen Einblasloch (HD1) geneigt ist.

4. Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 3, wobei

eine zwischen der flachen Wand (114U) und dem Rest der Innenwand der stromaufwärtigen Spleißkammer (113U) gebildete Begrenzungslinie bis zu mindestens einem Teil einer Kante des ersten stromaufwärtigen Einblaslochs (HU1) durchgehend ist und
eine zwischen der flachen Wand (114D) und dem Rest der Innenwand der stromabwärtigen Spleißkammer (113D) gebildete Begrenzungslinie bis zu mindestens einem Teil einer Kante des ersten stromabwärtigen Einblaslochs (HD1) durchgehend ist.

5. Fadenspleißdüse (100) nach Anspruch 4, wobei

das erste stromaufwärtige Einblasloch (HU1) eine kreisförmige Form aufweist, das
erste stromabwärtige Einblasloch (HD1) eine kreisförmige Form aufweist,
die Begrenzungslinie der Innenwand der stromaufwärtigen Spleißkammer (113U) sich mit einer Tangente an die kreisförmige Form des ersten stromaufwärtigen Einblaslochs (HU1) überschneidet und
die Begrenzungslinie der Innenwand der stromabwärtigen Spleißkammer (113D) sich mit einer Tangente an die kreisförmige Form des ersten stromabwärtigen Einblaslochs (HD1) überschneidet.

6. Fadenspleißdüse (100) nach Anspruch 4, wobei

das erste stromaufwärtige Einblasloch (HU1) und das erste stromabwärtige Einblasloch (HD1) eine polygonale Form aufweisen,
die Begrenzungslinie der Innenwand der stromaufwärtigen Spleißkammer (113U) sich mit einer Seite der polygonalen Form des ersten stromaufwärtigen Einblaslochs (HU1) überschneidet und
die Begrenzungslinie der Innenwand der stromabwärtigen Spleißkammer (113D) sich mit einer Seite der polygonalen Form des ersten stromabwärtigen Einblaslochs (HD1) überschneidet.

7. Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 6, wobei

eine Innenfläche des ersten stromaufwärtigen Einblaslochs (HU1) durchgehend bis zu der flachen Wand (114U) der stromaufwärtigen Spleißkammer (113U) ist und
eine Innenfläche des ersten stromabwärtigen Einblaslochs (HD1) durchgehend bis zu der flachen Wand (114D) der stromabwärtigen Spleißkammer (113D) ist.

8. Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 7, wobei

die stromaufwärtige Spleißkammer (113U) und die stromabwärtige Spleißkammer (113D), wie von der Laufrichtung des Fadens (Y) aus gesehen, derart angeordnet sind, dass Zentren in einer vorbestimmten Richtung voneinander abweichen, und
jeweilige Einblasrichtungen von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), wie von der Laufrichtung des Fadens (Y) aus gesehen, entlang der vorgegebenen Richtung und entgegengesetzt zueinander sind.

9. Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 8, wobei

sowohl die stromaufwärtige Spleißkammer (113U) als auch die stromabwärtige Spleißkammer (113D) eine gekrümmte Wand (115U; 115D) aufweisen, die an einem Teil der Innenwand, wie von der Laufrichtung des Fadens (Y) aus gesehen, eine Bogenform aufweist,

das zweite stromaufwärtige Einblasloch (HU2) Druckluft entlang einer tangentialen Richtung der gekrümmten Wand (115U) der stromaufwärtigen Spleißkammer (113U) einbläst, wie von der Laufrichtung des Fadens (Y) aus gesehen, und
das zweite stromabwärtige Einblasloch (HD2) Druckluft entlang einer tangentialen Richtung der gekrümmten Wand (115D) der stromabwärtigen Spleißkammer (113D) einbläst, wie von der Laufrichtung des Fadens (Y) aus gesehen.

10. Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 9, weiter umfassend eine Nut (111), die in dem Düsenkörper (110) angeordnet ist und sich in der Laufrichtung des Fadens (Y) erstreckt, wobei die Nut (111) eine Unterseite aufweist, die mit der stromaufwärtigen Spleißkammer (113U) und der stromabwärtigen Spleißkammer (113D) kommunikativ verbunden ist, wobei

das zweite stromaufwärtige Einblasloch (HU2) und das zweite stromabwärtige Einblasloch (HD2) zu der Unterseite der Nut (111) hin offen sind,
die flache Wand (114U) der stromaufwärtigen Spleißkammer (113U), wie von der Laufrichtung des Fadens (Y) aus gesehen, näher an der Nut (111) angeordnet ist als das Zentrum der stromaufwärtigen Spleißkammer (113U), und
die flache Wand (114D) der stromabwärtigen Spleißkammer (113D), wie von der Laufrichtung des Fadens (Y) aus gesehen, näher an der Nut (111) angeordnet ist als das Zentrum der stromabwärtigen Spleißkammer (113D).

11. Fadenspleißdüse (100) nach Anspruch 9 oder 10, wobei sich in der Laufrichtung des Fadens (Y) das zweite stromaufwärtige Einblasloch (HU2) und das zweite stromabwärtige Einblasloch (HD2) zwischen dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1) befinden.

12. Aufwickelvorrichtung (14), umfassend:

die Fadenspleißdüse (100) nach einem der Ansprüche 1 bis 11;
eine Stütze (120), die die Fadenspleißdüse (100) stützt; und
eine Steuereinheit (96), die dazu konfiguriert ist, ein Einblasen von Druckluft in die Fadenspleißdüse (100) zu steuern.

13. Aufwickelvorrichtung (14) nach Anspruch 12, wobei

die Aufwickelvorrichtung (14) einen Steuermodus zum Spleißen von Fäden (Y) eines ersten Fadentyps und eines zweiten Fadentyps aufweist,
wobei die Steuereinheit (96) konfiguriert ist zum Durchführen eines Steuermodus eines
Beginnens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2) und gleichzeitigen Stoppens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1) und eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2).

14. Aufwickelvorrichtung (14) nach Anspruch 12, wobei

die Aufwickelvorrichtung (14) einen Steuermodus zum Spleißen von Fäden (Y) eines dritten Fadentyps aufweist,
wobei die Steuereinheit (96) konfiguriert ist zum Durchführen eines Steuermodus eines
Beginnens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2), Stoppens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), erneuten Startens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Stoppens des Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2), und Stoppens des Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1).

15. Aufwickelvorrichtung (14) nach Anspruch 12, wobei

die Aufwickelvorrichtung (14) einen Steuermodus zum Spleißen von Fäden (Y) eines vierten Fadentyps aufweist,
wobei die Steuereinheit (96) konfiguriert ist zum Durchführen eines Steuermodus eines
Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2), Beginnens eines Einblasens

von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Stoppens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2), erneuten Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2), Stoppens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), und Stoppens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2).

16. Aufwickelvorrichtung (14) nach Anspruch 12, wobei

die Aufwickelvorrichtung (14) einen Steuermodus zum Spleißen von Fäden (Y) eines fünften Fadentyps aufweist,
wobei die Aufwickelvorrichtung (14) weiter einen Fadenschrumpfungsunterdrückungshebel (85) umfasst, der dazu konfiguriert ist, den fünften Fadentyp zu ergreifen, indem er den fünften Fadentyp an der Stütze (120) hält,
wobei die Steuereinheit (96) konfiguriert ist zum Durchführen eines Steuermodus eines
Beginnens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1) und Stoppens des Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), wobei der fünfte Fadentyp durch den Fadenschrumpfungsunterdrückungshebel (85) gehalten und ergriffen ist, und
Beginnens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), wobei das Ergreifen durch den Fadenschrumpfungsunterdrückungshebel (85) gelöst ist, Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2) und danach gleichzeitigen Stoppens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1) und eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2).

17. Aufwickelvorrichtung (14) nach Anspruch 12, wobei

die Aufwickelvorrichtung (14) einen Steuermodus zum Spleißen von Fäden eines sechsten Fadentyps aufweist,
wobei die Steuereinheit (96) konfiguriert ist zum Durchführen eines Steuermodus eines
Beginnens eines Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Stoppens des Einblasens von Druckluft aus dem ersten stromaufwärtigen Einblasloch (HU1) und dem ersten stromabwärtigen Einblasloch (HD1), Beginnens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2) und Stoppens eines Einblasens von Druckluft aus dem zweiten stromaufwärtigen Einblasloch (HU2) und dem zweiten stromabwärtigen Einblasloch (HD2).

18. Aufwickelvorrichtung (14) nach einem der Ansprüche 12 bis 17, weiter umfassend einen Druckregler, der dazu konfiguriert ist, einen Einblasdruck von mindestens einem des ersten stromaufwärtigen Einblaslochs (HU1), des zweiten stromaufwärtigen Einblaslochs (HU2), des ersten stromabwärtigen Einblaslochs (HD1) und des zweiten stromabwärtigen Einblaslochs (HD2) zu regulieren.

Revendications

1. Buse (100) d'épissage de fil configurée pour épisser des fils (Y) par injection d'air comprimé, la buse (100) d'épissage de fil comprenant :

un corps de buse (110) ;
une chambre d'épissage amont (113U) formée dans le corps de buse (110) et présentant une paroi plate (114U) planaire au niveau d'une partie d'une paroi interne ;
une chambre d'épissage aval (113D) formée dans le corps de buse (110), reliée de façon communicante à la chambre d'épissage amont (113U) et présentant une paroi plate (114D) planaire au niveau d'une partie d'une paroi interne ;
un premier trou d'injection amont (HU1) et un deuxième trou d'injection amont (HU2) formés dans le corps de buse (110) et configurés pour injecter de l'air comprimé vers la chambre d'épissage amont (113U) ; et
un premier trou d'injection aval (HD1) et un deuxième trou d'injection aval (HD2) formés dans le corps de buse (110) et configurés pour injecter de l'air comprimé vers la chambre d'épissage aval (113D), **caractérisée en ce que**
le premier trou d'injection amont (HU1) injecte

de l'air comprimé le long de la paroi plate (114U) de la chambre d'épissage amont (113U), et
le premier trou d'injection aval (HD1) injecte de l'air comprimé le long de la paroi plate (114D) de la chambre d'épissage aval (113D).

2. Buse (100) d'épissage de fil selon la revendication 1, dans laquelle

telle que vue depuis une direction de déplacement de fil (Y), la paroi plate (114U) de la chambre d'épissage amont (113U) est inclinée à 15° à 30° par rapport à une direction d'injection d'air comprimé depuis le premier trou d'injection amont (HU1), et
telle que vue depuis la direction de déplacement de fil (Y), la paroi plate (114D) de la chambre d'épissage aval (113D) est inclinée à 15° à 30° par rapport à une direction d'injection d'air comprimé depuis le premier trou d'injection aval (HD1).

3. Buse (100) d'épissage de fil selon la revendication 2, dans laquelle

telle que vue depuis la direction de déplacement de fil (Y), la paroi plate (114U) de la chambre d'épissage amont (113U) est inclinée à 20° à 25° par rapport à une direction d'injection d'air comprimé depuis le premier trou d'injection amont (HU1), et
telle que vue depuis la direction de déplacement de fil (Y), la paroi plate (114D) de la chambre d'épissage aval (113D) est inclinée à 20° à 25° par rapport à une direction d'injection d'air comprimé depuis le premier trou d'injection aval (HD1).

4. Buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 3, dans laquelle

une ligne de frontière formée entre la paroi plate (114U) et le reste de la paroi interne de la chambre d'épissage amont (113U) est continue jusqu'à au moins une partie d'un bord du premier trou d'injection amont (HU1), et
une ligne de frontière formée entre la paroi plate (114D) et le reste de la paroi interne de la chambre d'épissage aval (113D) est continue jusqu'à au moins une partie d'un bord du premier trou d'injection aval (HD1).

5. Buse (100) d'épissage de fil selon la revendication 4, dans laquelle

le premier trou d'injection amont (HU1) présente une forme circulaire, le
premier trou d'injection aval (HD1) présente une forme circulaire,
la ligne de frontière de la paroi interne de la chambre d'épissage amont (113U) chevauche une tangente à la forme circulaire du premier trou d'injection amont (HU1), et
la ligne de frontière de la paroi interne de la chambre d'épissage aval (113D) chevauche une tangente à la forme circulaire du premier trou d'injection aval (HD1).

6. Buse (100) d'épissage de fil selon la revendication 4, dans laquelle

le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) présentent une forme polygonale,
la ligne de frontière de la paroi interne de la chambre d'épissage amont (113U) chevauche un côté de la forme polygonale du premier trou d'injection amont (HU1), et
la ligne de frontière de la paroi interne de la chambre d'épissage aval (113D) chevauche un côté de la forme polygonale du premier trou d'injection aval (HD1).

7. Buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 6, dans laquelle

une surface interne du premier trou d'injection amont (HU1) est continue jusqu'à la paroi plate (114U) de la chambre d'épissage amont (113U), et
une surface interne du premier trou d'injection aval (HD1) est continue jusqu'à la paroi plate (114D) de la chambre d'épissage aval (113D).

8. Buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 7, dans laquelle

telle que vue depuis la direction de déplacement de fil (Y), la chambre d'épissage amont (113U) et la chambre d'épissage aval (113D) sont disposées de telle sorte que les centres sont déviés loin l'un de l'autre dans une direction prédéterminée, et
telle que vues depuis la direction de déplacement de fil (Y), des directions d'injection respectives d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) se trouvent le long de la direction prédéterminée et à l'opposé l'une de l'autre.

9. Buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 8, dans laquelle

chacune parmi la chambre d'épissage amont (113U) et la chambre d'épissage aval (113D) présente une paroi incurvée (115U ; 115D) pré-

sentant une forme d'arc au niveau d'une partie de la paroi interne telle que vue depuis la direction de déplacement de fil (Y),
le deuxième trou d'injection amont (HU2) injecte de l'air comprimé le long d'une direction tangentielle de la paroi incurvée (115U) de la chambre d'épissage amont (113U) telle que vue depuis la direction de déplacement de fil (Y), et
le deuxième trou d'injection aval (HD2) injecte de l'air comprimé le long d'une direction tangentielle de la paroi incurvée (115D) de la chambre d'épissage aval (113D) telle que vue depuis la direction de déplacement de fil (Y).

10. Buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 9, comprenant en outre une rainure (111) disposée dans le corps de buse (110) et s'étendant dans la direction de déplacement de fil (Y), la rainure (111) présentant un côté inférieur relié de façon communicante à la chambre d'épissage amont (113U) et à la chambre d'épissage aval (113D), dans laquelle

le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2) sont ouverts sur le côté inférieur de la rainure (111),
telle que vue depuis la direction de déplacement de fil (Y), la paroi plate (114U) de la chambre d'épissage amont (113U) est disposée plus près de la rainure (111) que le centre de la chambre d'épissage amont (113U), et
telle que vue depuis la direction de déplacement de fil (Y), la paroi plate (114D) de la chambre d'épissage aval (113D) est disposée plus près de la rainure (111) que le centre de la chambre d'épissage aval (113D).

11. Buse (100) d'épissage de fil selon la revendication 9 ou la revendication 10, dans laquelle dans la direction de déplacement de fil (Y), le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2) sont situés entre le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1).

12. Dispositif d'enroulement (14) comprenant :

la buse (100) d'épissage de fil selon l'une quelconque des revendications 1 à 11 ;
un support (120) supportant la buse (100) d'épissage de fil ; et
un dispositif de commande (96) configuré pour commander l'injection d'air comprimé dans la buse (100) d'épissage de fil.

13. Dispositif d'enroulement (14) selon la revendication 12, dans lequel

le dispositif d'enroulement (14) présente un mode de commande d'épissage de fils (Y) d'un premier type de fil et d'un deuxième type de fil,
le dispositif de commande (96) est configuré pour mettre en oeuvre un mode de commande de
démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2), et simultanément d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) et d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2).

14. Dispositif d'enroulement (14) selon la revendication 12, dans lequel

le dispositif d'enroulement (14) présente un mode de commande d'épissage de fils (Y) d'un troisième type de fil,
le dispositif de commande (96) est configuré pour mettre en oeuvre un mode de commande de
démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), de démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection amont (HD2), d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection amont (HD1), démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) de nouveau, d'arrêt d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection amont (HD2), et d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection amont (HD1).

15. Dispositif d'enroulement (14) selon la revendication 12, dans lequel

le dispositif d'enroulement (14) présente un mode de commande d'épissage de fils (Y) d'un quatrième type de fil,
le dispositif de commande (96) est configuré pour mettre en oeuvre un mode de commande de
démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2), de démarrage d'injection d'air comprimé depuis le pre-

mier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), d'arrêt d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection amont (HD2), démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2) de nouveau, d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), et d'arrêt d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection amont (HD2).

16. Dispositif d'enroulement (14) selon la revendication 12, dans lequel

le dispositif d'enroulement (14) présente un mode de commande d'épissage de fils (Y) d'un cinquième type de fil,
le dispositif d'enroulement (14) comprend en outre un levier (85) de suppression de rétrécissement de fil configuré pour saisir le cinquième type de fil en maintenant le cinquième type de fil sur le support (120),
le dispositif de commande (96) est configuré pour mettre en oeuvre un mode de commande de
avec le cinquième type de fil maintenu et saisi par le levier (85) de suppression de rétrécissement de fil, démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) et d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), et
avec la libération de la saisie par le levier (85) de suppression de rétrécissement de fil, démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2), et ensuite simultanément d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1) et d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2).

17. Dispositif d'enroulement (14) selon la revendication 12, dans lequel

le dispositif d'enroulement (14) présente un mode de commande d'épissage de fils d'un sixième type de fil,
le dispositif de commande (96) est configuré pour mettre en oeuvre un mode de commande de
démarrage d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), d'arrêt d'injection d'air comprimé depuis le premier trou d'injection amont (HU1) et le premier trou d'injection aval (HD1), démarrage d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection aval (HD2), et d'arrêt d'injection d'air comprimé depuis le deuxième trou d'injection amont (HU2) et le deuxième trou d'injection amont (HD2).

18. Dispositif d'enroulement (14) selon l'une quelconque des revendications 12 à 17, comprenant en outre un régulateur de pression configuré pour réguler une pression d'injection depuis au moins l'un parmi le premier trou d'injection amont (HU1), le deuxième trou d'injection amont (HU2), le premier trou d'injection aval (HD1) et le deuxième trou d'injection aval (HD2).

Fig.1

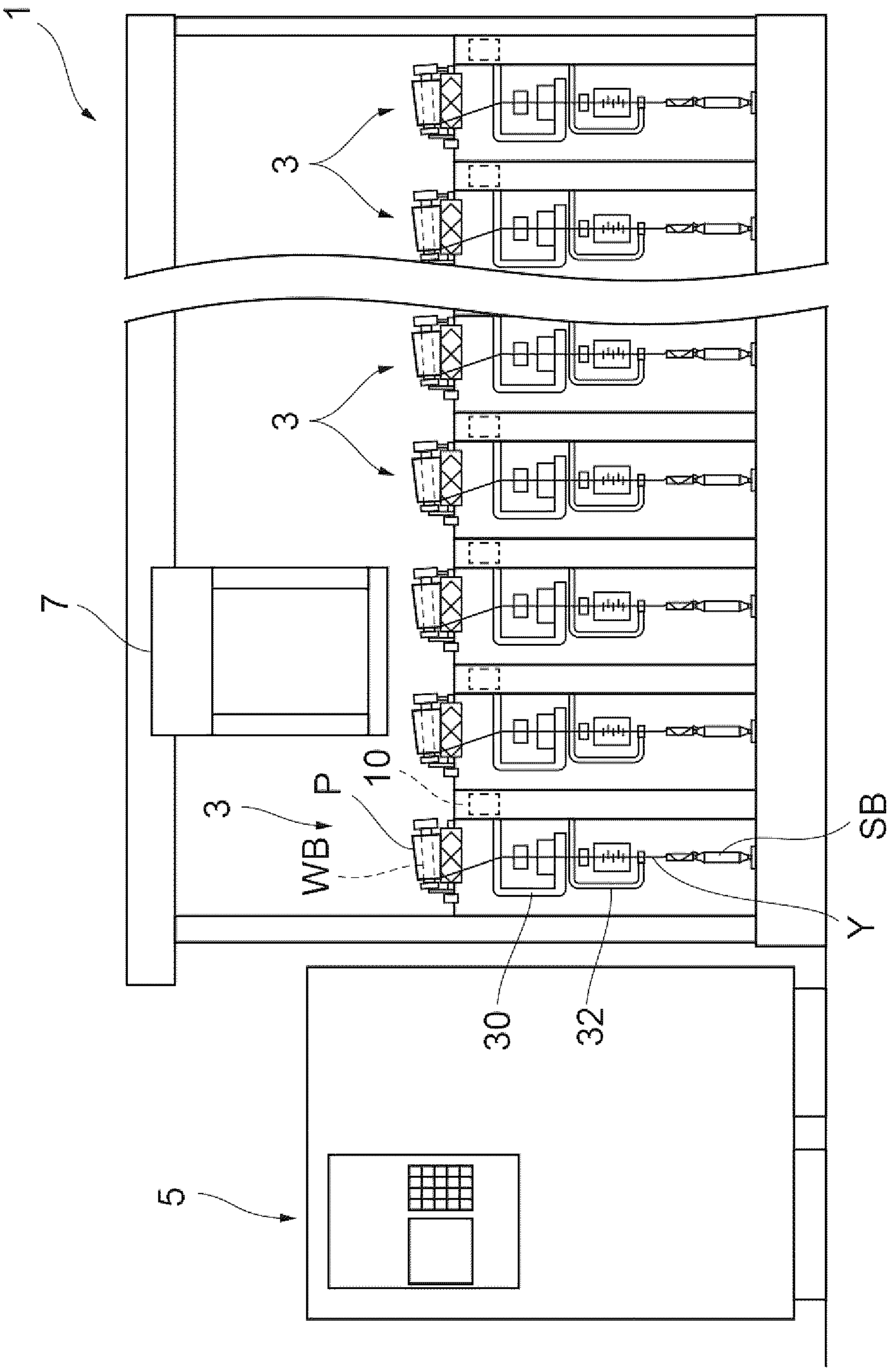
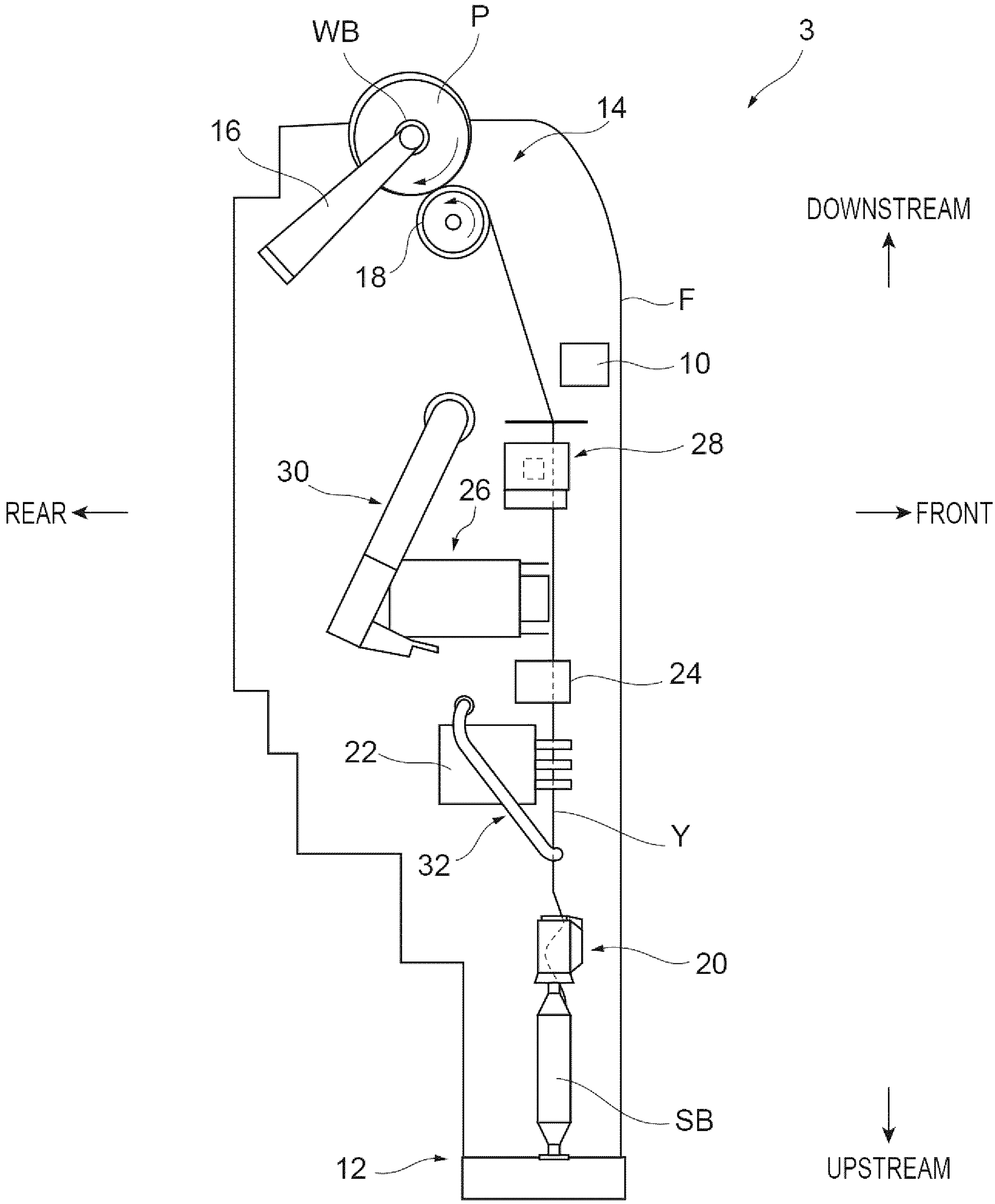


Fig.2


WB
P
3
16
14
DOWNSTREAM
18
F
10
28
30
26
REAR
FRONT
24
22
Y
32
20
SB
12
UPSTREAM

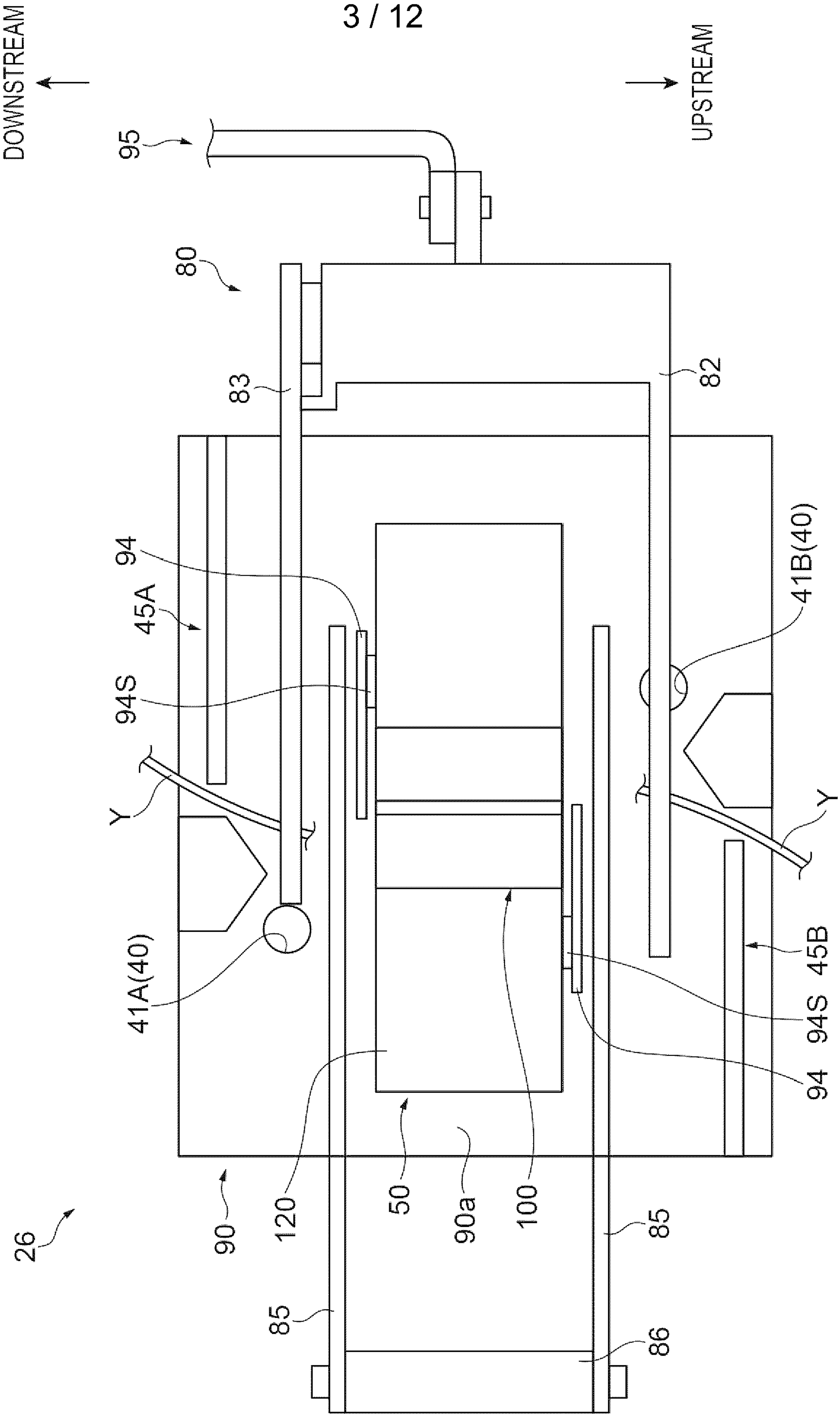

DOWNSTREAM
UPSTREAM
95
80
83
82
94
45A
94S
Y
41A(40)
41B(40)
Y
45B
94S
94
26
90
120
50
90a
100
85
85
86

Fig.3

Fig.4A

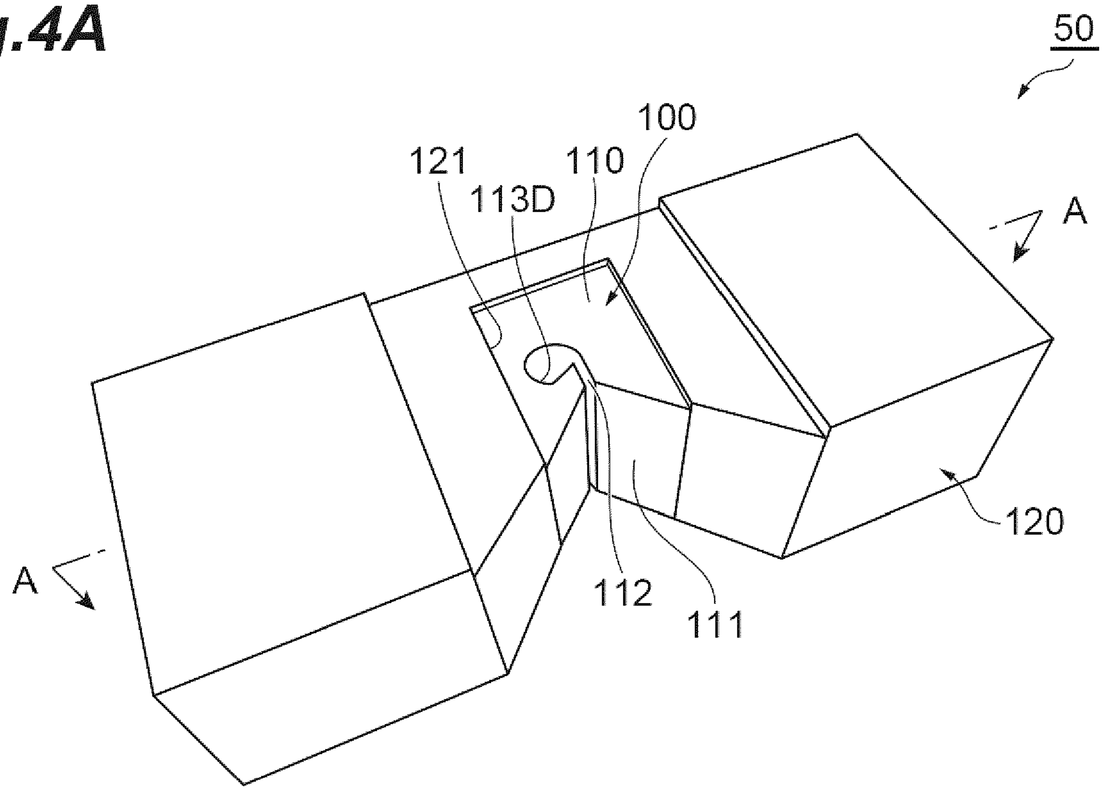

50
100
121
110
113D
A
A
120
112
111

Fig.4B

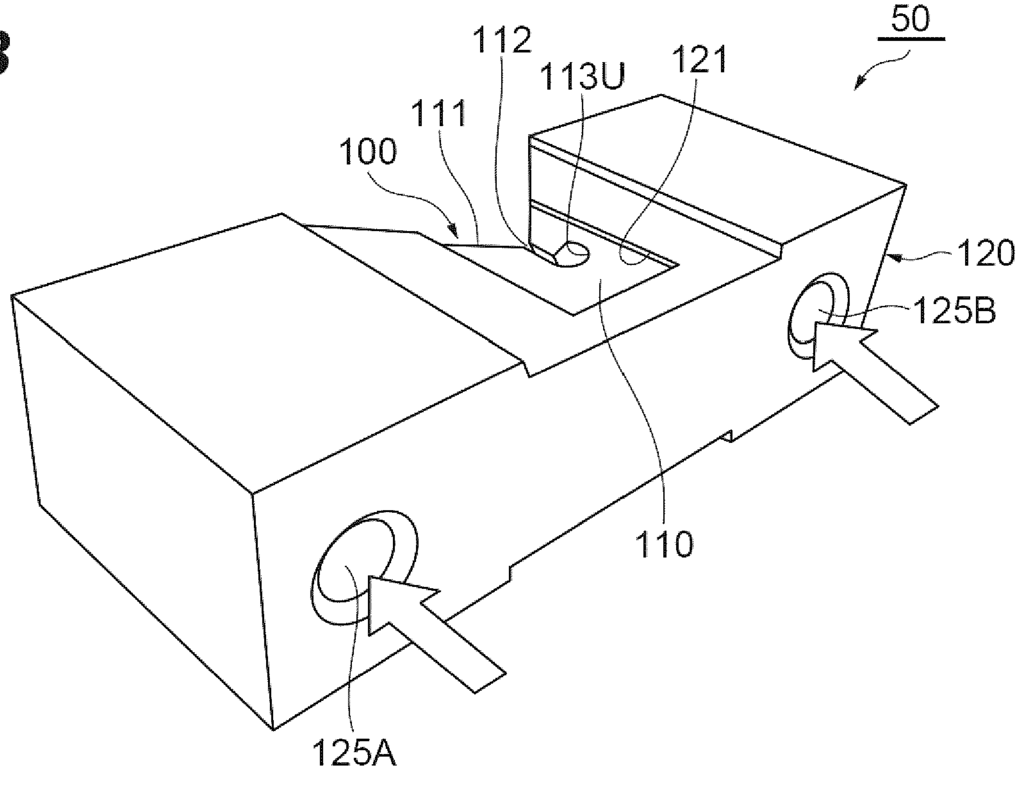

50
112
121
113U
111
100
120
125B
110
125A

Fig.5

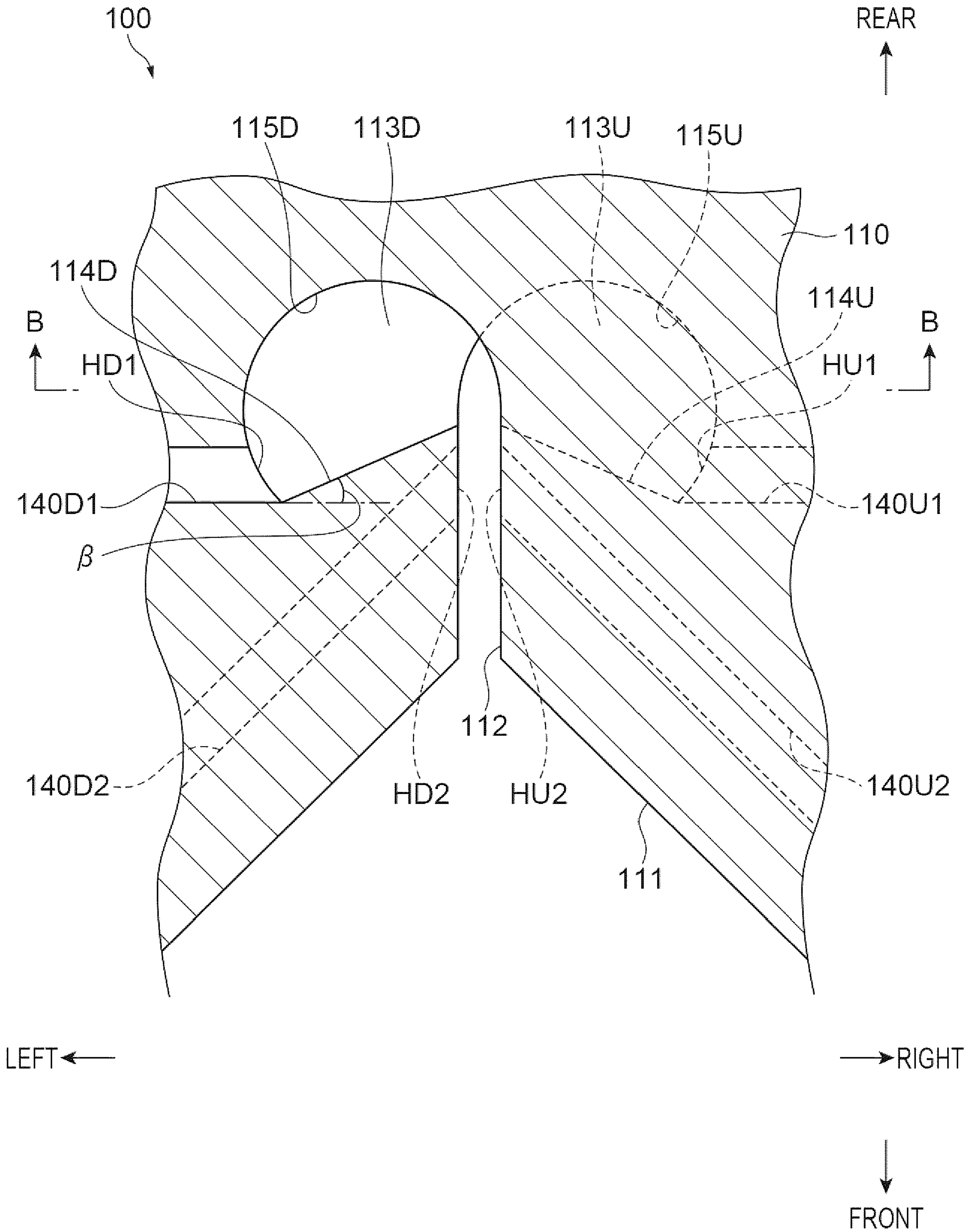
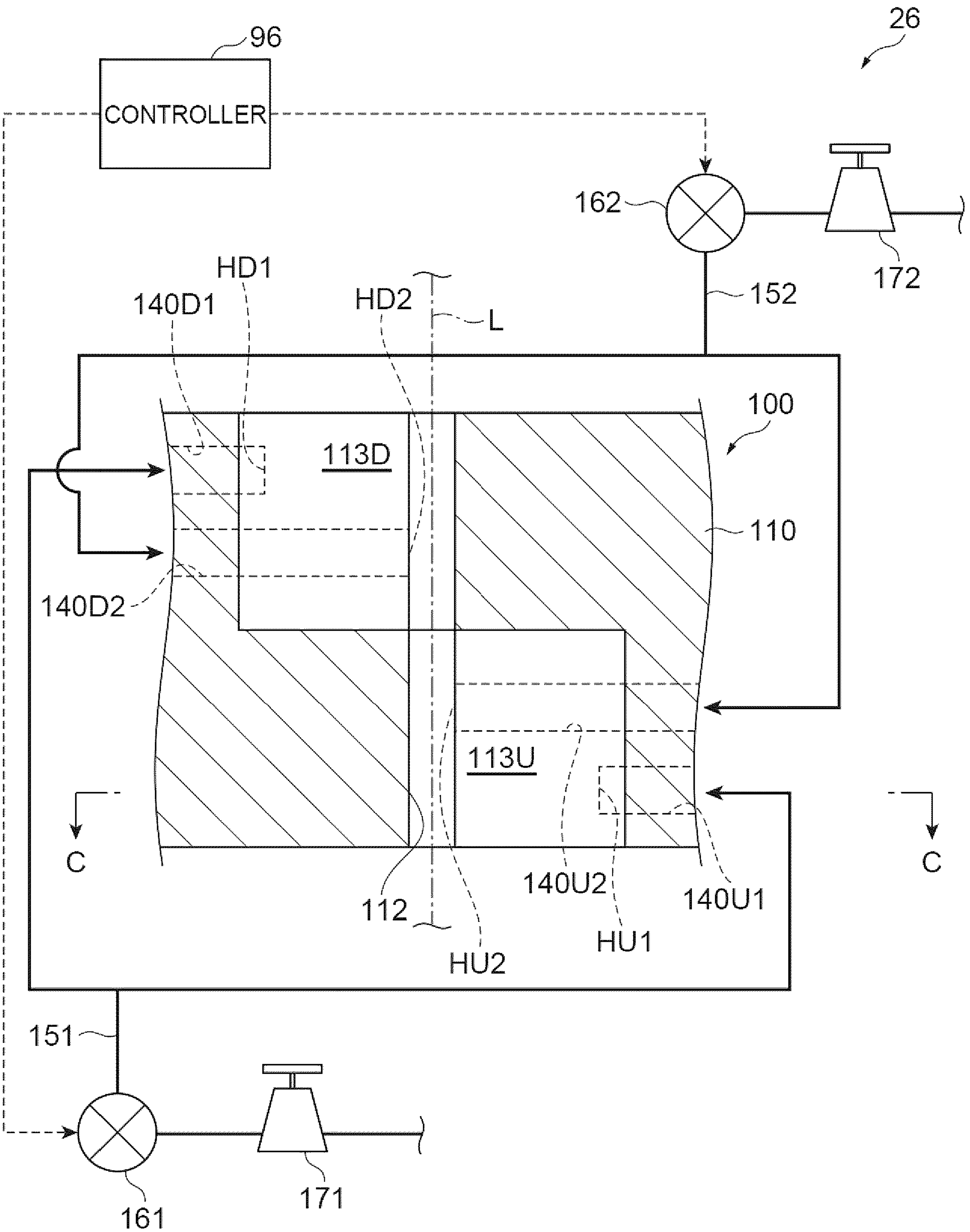

100
REAR
115D
113D
113U
115U
110
114D
114U
B
B
HD1
HU1
140D1
140U1
β
112
140D2
HD2
HU2
140U2
111
LEFT
RIGHT
FRONT

Fig.6



96
CONTROLLER
26
162
172
152
HD1
140D1
HD2
L
100
113D
110
140D2
113U
C
C
140U2
140U1
112
HU1
HU2
151
161
171

Fig.7

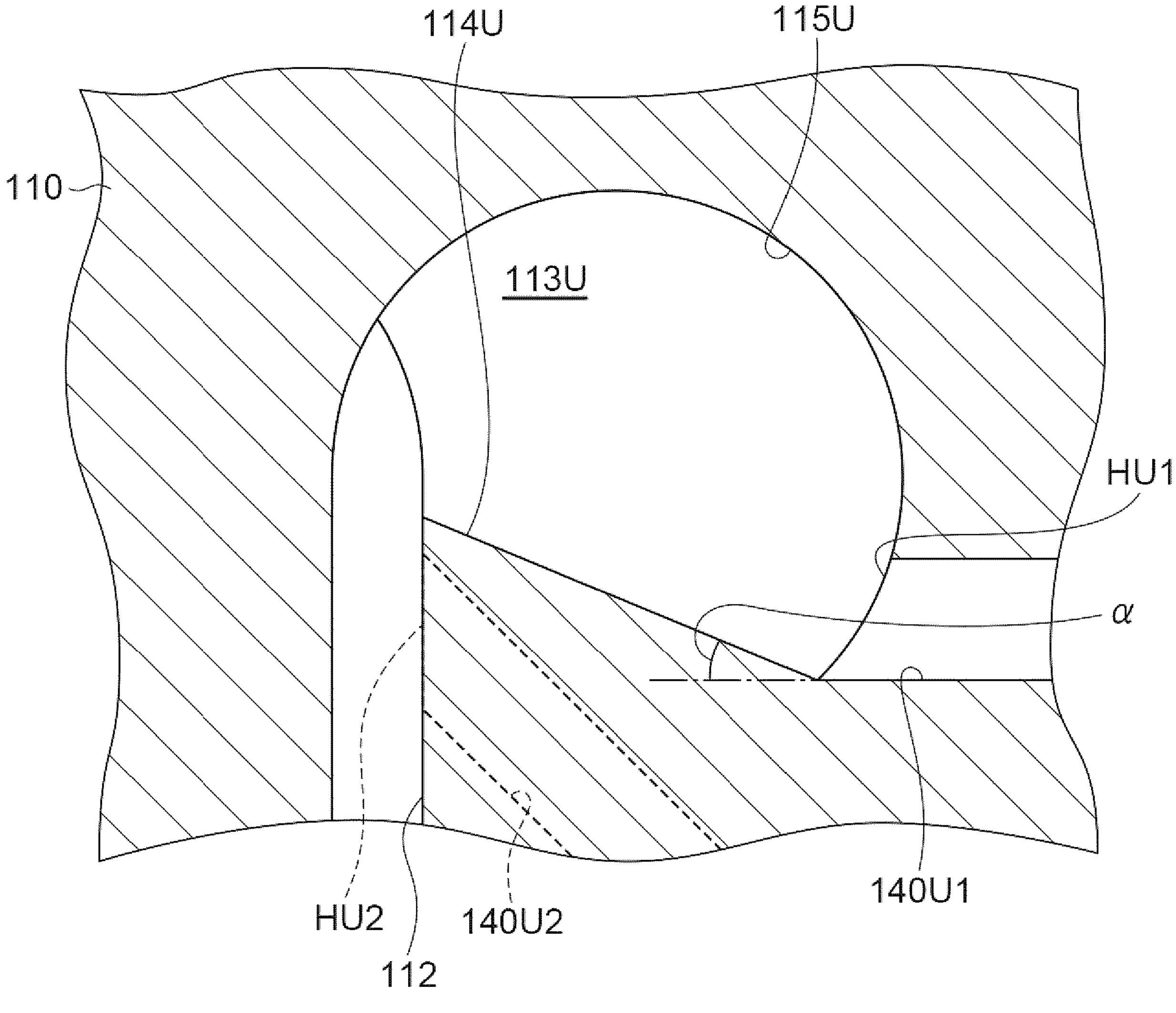


Fig.8

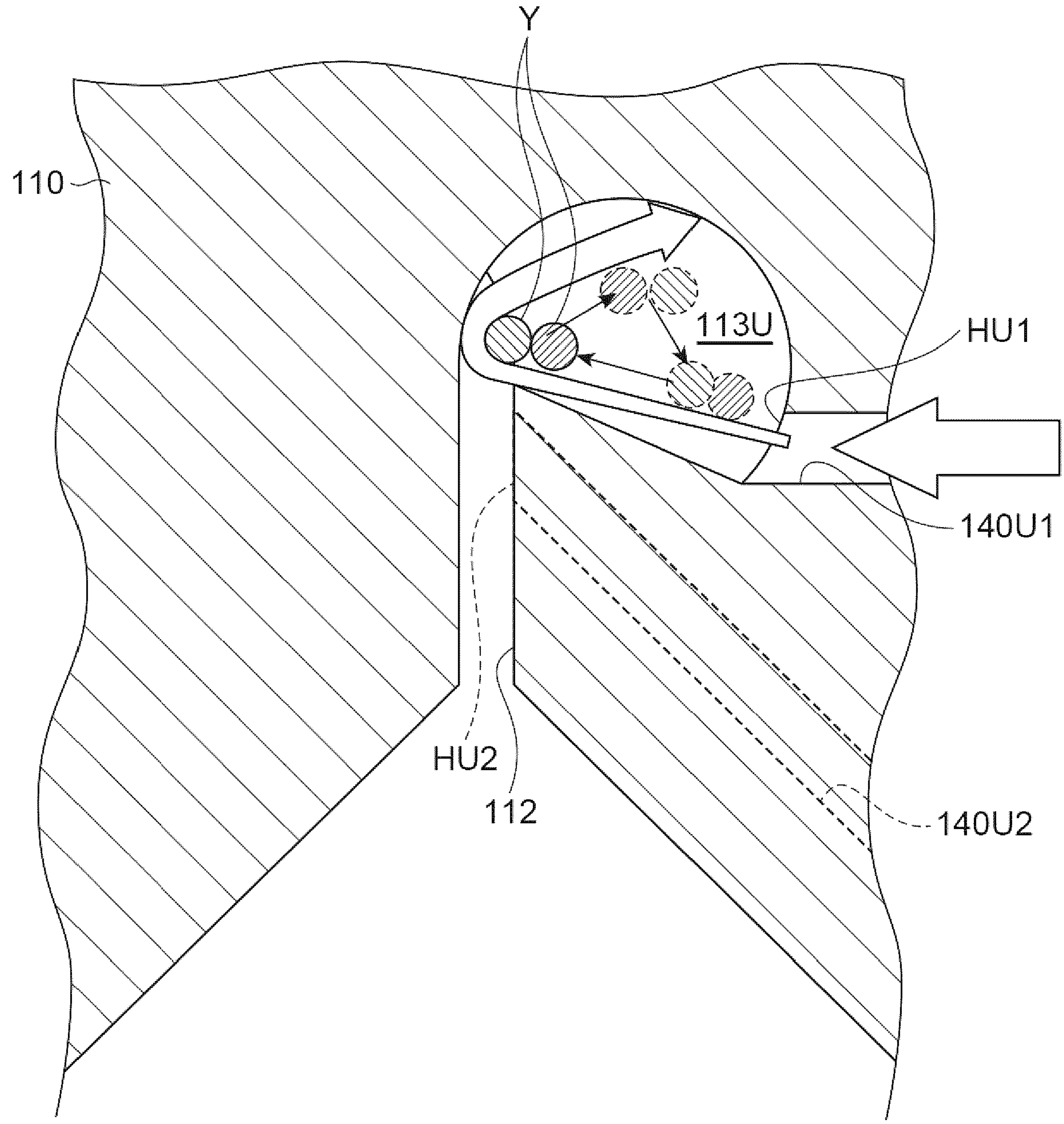


Fig.9

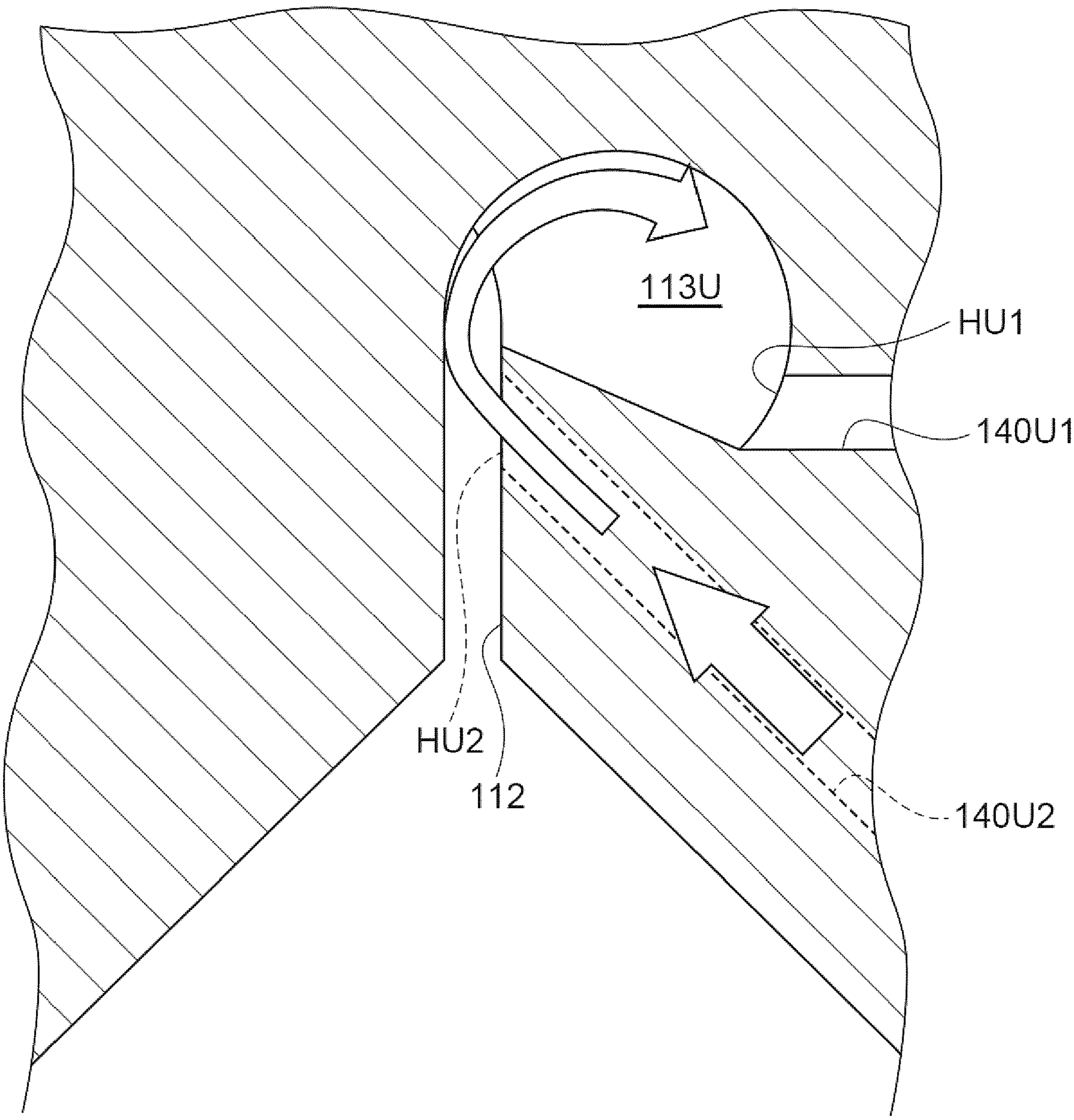


Fig.10A

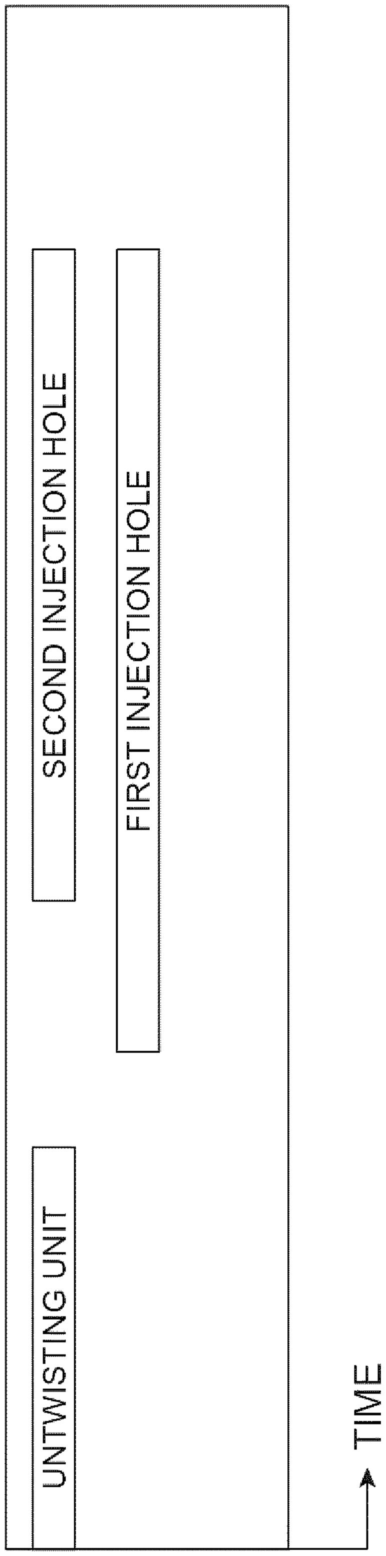
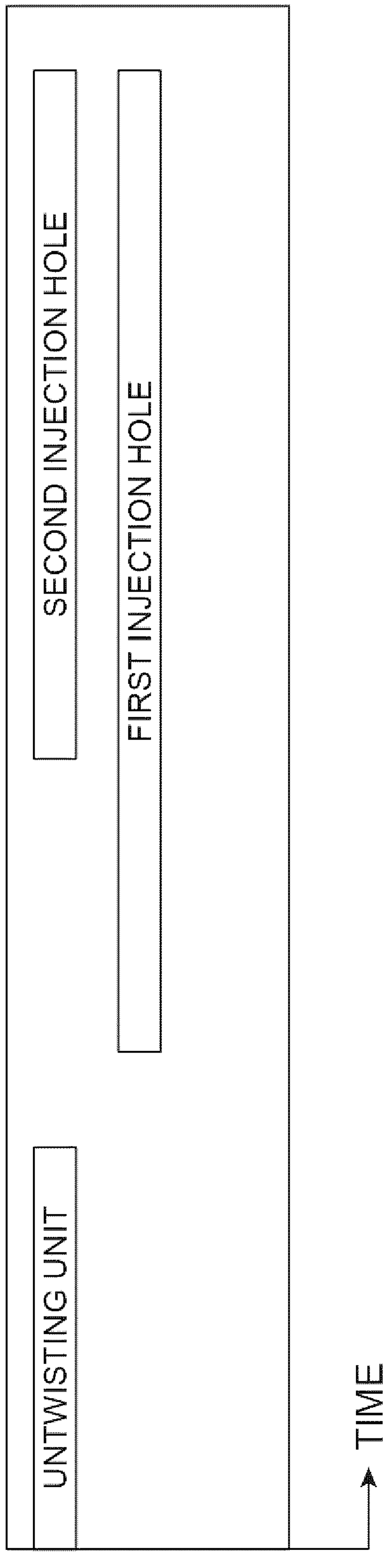


Fig.10B



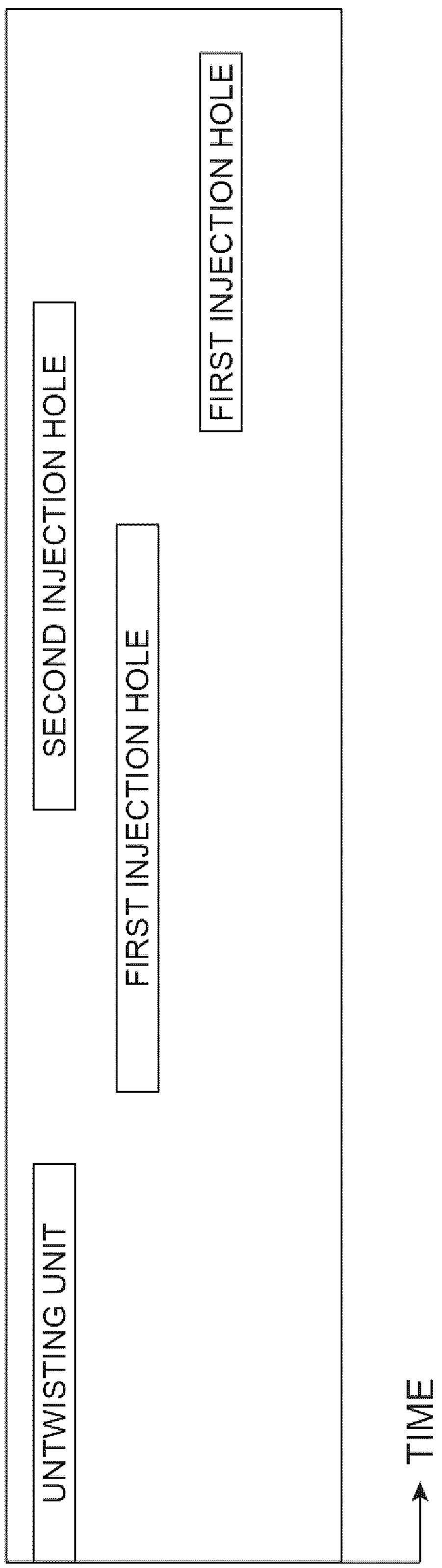


Fig.11A

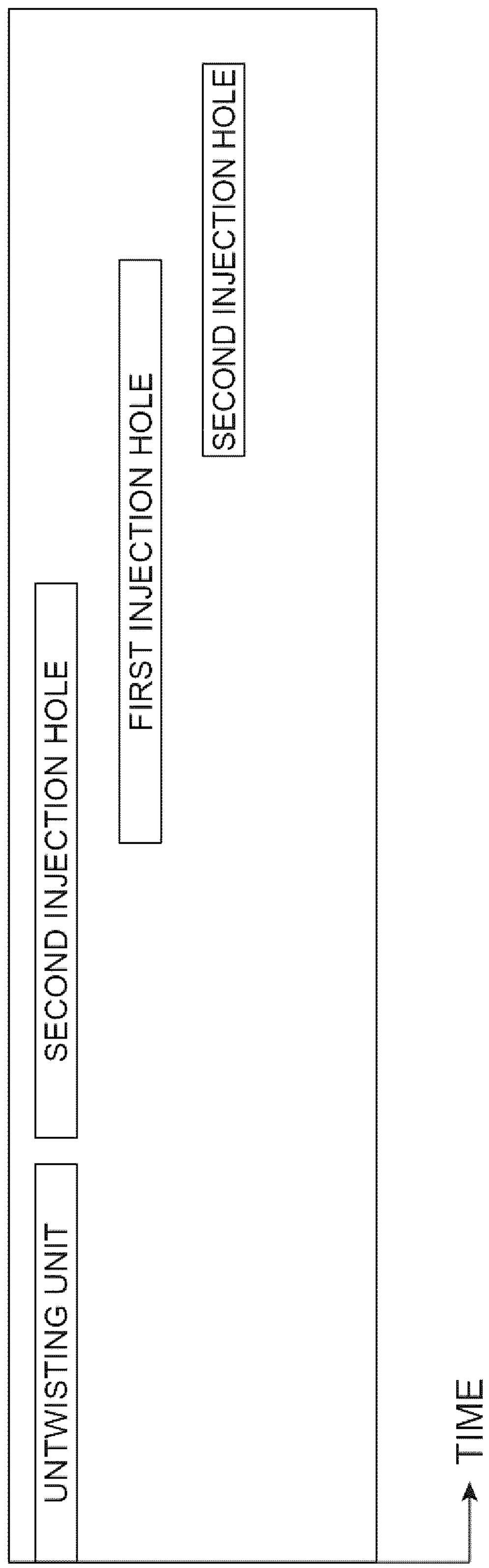


Fig.11B

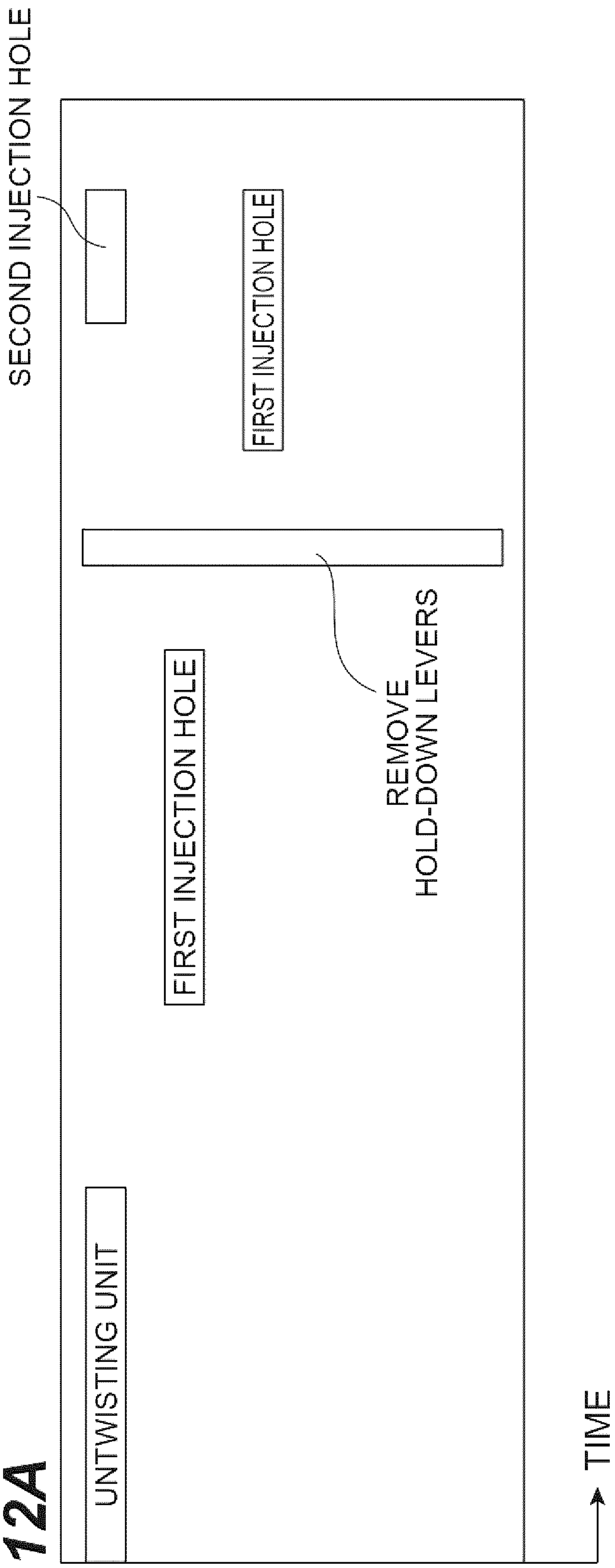


Fig.12A

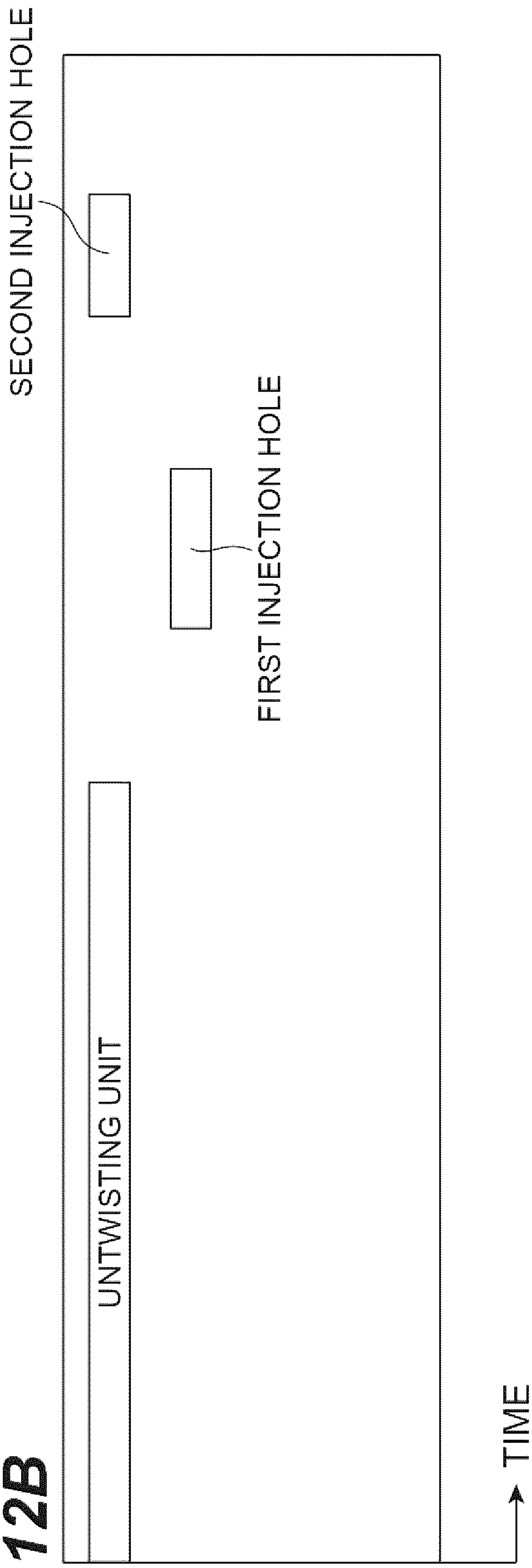


Fig.12B

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010030705 A **[0002]**
- DE 102018108151 A1 **[0003]**