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(54) **Yarn splicing device, yarn splicing system, and textile machine**

(57) A yarn splicing device comprising a twisting nozzle (73) adapted to twist yarn ends; and a twisting airflow supplying mechanism (42) adapted to supply compressed air to generate a twisting airflow with respect to the twisting nozzle (73) and to switch a whirling direction of the twisting airflow and/or to switch a generating region of the twisting airflow, wherein the twisting airflow for twisting the yarn ends is generated in the whirling direction and/or the generating region in accordance with a twisting condition of the yarn to be performed with a yarn splicing operation by a control on the twisting airflow supplying mechanism (42).

FIG. 3

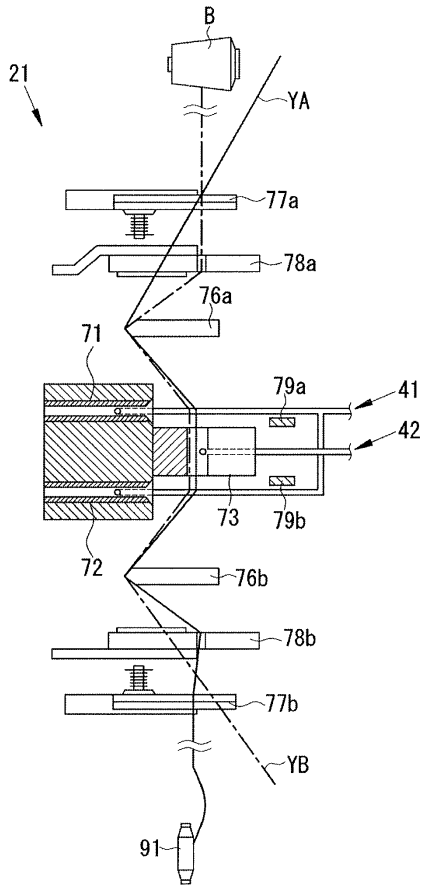

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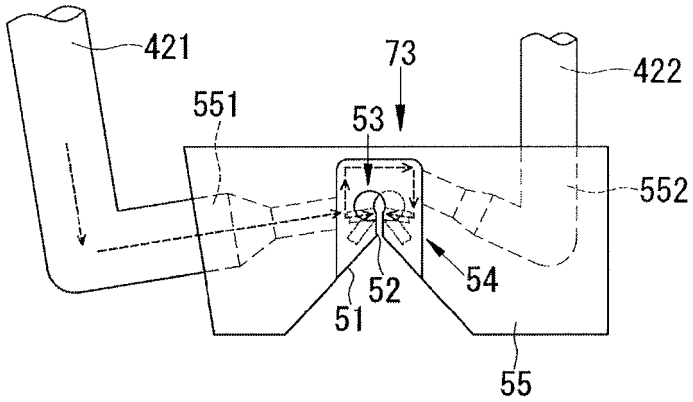
FIG. 5A



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn splicing device adapted to perform a yarn splicing operation, a yarn splicing system equipped with the yarn splicing device, and a textile machine equipped with the yarn splicing system.

2. Description of the Related Art

[0002] Conventionally, a yarn winding device such as an automatic winder adapted to wind a yarn unwound from a yarn supplying bobbin to a package is known. A plurality of such yarn winding devices are arranged in a line to configure yarn winding equipment. The yarn winding device includes a yarn splicing device adapted to perform a yarn splicing operation on a yarn end from the package and a yarn end from the yarn supplying side at the time of yarn breakage, yarn cut by a yarn defect detecting device, and the like.

[0003] A spinning device adapted to generate a spun yarn from a material such as sliver, spinning equipment configured by arranging a plurality of spinning devices in a line are also known. The yarn splicing device is arranged on a yarn splicing cart that travels along the spinning equipment, where the yarn splicing operation of the spinning device that requests the yarn splicing operation is performed.

[0004] A yarn splicing device that performs untwisting of the yarn ends to be spliced and twisting of the untwisted yarn ends using fluid such as compressed air, or the like (see e.g., Japanese Unexamined Patent Publication No. 59-211632) is known for the yarn splicing device. The yarn splicing device described in Japanese Unexamined Patent Publication No. 59-211632 includes an untwisting nozzle adapted to untwist the yarn ends, and a twisting nozzle adapted to twist the untwisted yarn ends. The yarn splicing device executes steps such as introduction, untwisting, twisting, and the like of the yarn ends to perform the yarn splicing operation.

Japanese Unexamined Patent Publication No. 3-64433 discloses a technique in which an opening facing an air chamber is formed and in which air of different whirling direction is alternately injected in the twisting of the yarn ends.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide a yarn splicing device, a yarn splicing system, and a textile machine capable of selecting and changing a whirling direction and a generating region of the airflow in accordance with the property of the yarn to be performed with the yarn splicing operation without changing the component even when the type of yarn is changed.

This object is achieved by a yarn splicing device according to claim 1, a yarn splicing system according to claim 3 or 4, and a textile machine according to claim 10.

[0006] The invention is based on the following findings. In a yarn splicing device described e. g. in Japanese Unexamined Patent Publication No. 59-211632, the compressed air is first supplied into each untwisting nozzle to generate an untwisting airflow including whirling airflow, and the yarn ends are suctioned into the untwisting nozzle by the untwisting airflow. In the untwisting nozzle, the yarn ends are untwisted by the action of the untwisting airflow thus raveling out a fiber bundle. The untwisted portions of the yarn ends are then moved into the twisting nozzle. The compressed air is also supplied into the twisting nozzle to generate a twisting airflow including the whirling airflow. The untwisted portions of the yarn ends are whirled by the twisting airflow to be entangled and twisted.

[0007] The yarn has various properties such as material, thickness, and twisting direction. For example, the twisting of the yarn includes an S twist (rightward twist) in which the twist is made in the clockwise direction and a Z twist (leftward twist) in which the twist is made in the counterclockwise direction, the S twist and the Z twist having opposite twisting directions. Thus, the untwisting direction is opposite and the twisting direction is also opposite in the S twist and the Z twist. For example, if the yarn applied up to the relevant point in the yarn winding device is the yarn of S twist and the newly applied yarn is the yarn of Z twist, the directions of untwisting and twisting are opposite, and hence the whirling direction of the airflow generated at the untwisting nozzle and the twisting nozzle needed to be changed as an initial setup operation of the yarn winding device. The nozzles needed to be changed to a different twisting nozzle and untwisting nozzle of a region for generating the airflow depending on the property of the yarn.

[0008] Thus, when the type of yarn to be applied changes, the property of such yarn also differs, whereby the twisting condition suited for the twisting of the yarn and the untwisting condition suited for the untwisting of the yarn such as the whirling direction of the airflow and the generating region of the airflow differ from each other. Thus, when the type of yarn is changed, the component of the yarn splicing device needed to be changed to change the whirling direction and the generating region of the airflow, which is inconvenient.

[0009] The technique described e.g. in Japanese Unexamined Patent Publication No. 3-64433, however, is a technique of alternately injecting air of different whirling direction in one twisting operation irrespective of the original twisting direction of the yarn to be performed with the yarn splicing operation. Thus, such technique is not a technique of selecting and changing the whirling direction and the generating region of the airflow according to the property of the yarn to be performed with the yarn splicing operation.

[0010] The problem to be solved by the present invention is as mentioned above, and now, the means for solving such problem will be described below.

[0011] In other words, the yarn splicing device of the present invention is a yarn splicing device adapted to perform a yarn splicing operation of yarn ends, and includes a twisting nozzle and a twisting airflow supplying mechanism. The twisting nozzle twists the yarn ends. The twisting airflow supplying mechanism is configured to supply compressed air to generate twisting airflow with respect to the twisting nozzle and to switch a whirling direction of the twisting airflow and/or switch a generating region of the twisting airflow. The twisting airflow for twisting the yarn ends is generated in the whirling direction and/or the generating region in accordance with a twisting condition of the yarn to be performed with the yarn splicing operation by a control on the twisting airflow supplying mechanism.

[0012] The yarn splicing device of the present invention relates to the yarn splicing device of a first invention, wherein the twisting nozzle includes a plurality of twisting injection holes corresponding to the whirling direction and/or the generating region to generate the twisting airflow for twisting the yarn ends in different whirling directions and/or different generating regions. The twisting airflow supplying mechanism includes a twisting flow path adapted to supply the compressed air for each of the whirling directions of the twisting airflow and/or for each of the generating regions of the twisting airflow to generate the twisting airflow with respect to the plurality of twisting injection holes, and a twisting valve adapted to open/close the twisting flow path for each of the whirling directions of the twisting airflow and/or for each of the generating regions of the twisting airflow. The twisting airflow for twisting the yarn ends is generated in the whirling direction and/or the generating region in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation by performing an open/close control on the twisting valve.

[0013] A yarn splicing system of the present invention includes the yarn splicing device of the first invention, a setting section, and a control section. The setting section is adapted to set a whirling direction of a twisting airflow for twisting yarn ends and/or a generating region of the twisting airflow in accordance with a twisting condition of the yarn to be performed with a yarn splicing operation as a set twisting condition. The control section is adapted to perform a control on the twisting airflow supplying mechanism based on the set twisting condition set by the setting section.

[0014] A yarn splicing system of the present invention includes the yarn splicing device of the second invention, a setting section, and a control section. The setting section is adapted to set a whirling direction of a twisting airflow for twisting yarn ends and/or a generating region of the twisting airflow in accordance with a twisting condition of the yarn to be performed with a yarn splicing operation as a set twisting condition. The control section is adapted to perform an open/close control on the twisting valve based on the set twisting condition set by the setting section.

[0015] The yarn splicing system of the present invention relates to the yarn splicing system of a fourth invention, wherein the twisting nozzle includes an air chamber in which the plurality of twisting injection holes are formed on a circumferential surface. The plurality of twisting injection holes include a main twisting injection hole and a sub-twisting injection hole adapted to generate the twisting airflow for twisting the yarn ends in different generating regions.

[0016] The yarn splicing system of the present invention relates to the yarn splicing system of a fifth invention, wherein the air chamber of the twisting nozzle is arranged with the yarn ends of two yarns to be performed with the yarn splicing operation overlapped from different directions, and is configured by a first air chamber adapted to whirl a yarn end of at least one yarn, and a second air chamber adapted to whirl a yarn end of at least the other yarn. The first air chamber and the second air chamber respectively have the main twisting injection hole and the sub-twisting injection hole formed side by side in an axial direction of the air chamber.

[0017] The yarn splicing system of the present invention relates to the yarn splicing system of a fourth invention, wherein the twisting nozzle includes an air chamber in which the plurality of twisting injection holes are formed on a circumferential surface. The plurality of twisting injection holes include an S twisting injection hole adapted to generate a twisting airflow for twisting the yarn ends of a yarn of S twist and a Z twisting injection hole adapted to generate a twisting airflow for twisting the yarn ends of a yarn of Z twist.

[0018] The yarn splicing system of the present invention relates to the yarn splicing system of a seventh invention, wherein the air chamber of the twisting nozzle is arranged with the yarn ends of two yarns to be performed with the yarn splicing operation overlapped from different directions and is configured by a first air chamber adapted to whirl a yarn end of at least one yarn, and a second air chamber adapted to whirl a yarn end of at least the other yarn. The first air chamber and the second air chamber respectively have an S twisting injection hole and a Z twisting injection hole formed side by side on the same circumference.

[0019] The yarn splicing system of the present invention relates to the yarn splicing system according to any one of the third to eighth inventions, wherein the yarn splicing device includes an untwisting nozzle and an untwisting airflow supplying mechanism. The untwisting nozzle is adapted to generate untwisting airflow for untwisting each yarn end at different positions to prepare for the twisting of the yarn ends by the twisting nozzle. The untwisting airflow supplying mechanism is configured to supply compressed air to the untwisting nozzle and to switch a generating position of the untwisting airflow. The untwisting airflow for untwisting the yarn ends

is generated at a position in accordance with untwisting condition of the yarn to be performed with the yarn splicing operation by a control on the untwisting airflow supplying mechanism.

[0020] A textile machine of the present invention includes the yarn splicing system according to any one of the third to ninth inventions, a plurality of yarn winding devices, and a main control section adapted to control the plurality of yarn winding devices. The yarn splicing device and the control section are installed in the yarn winding device. The main control section includes the setting section. The setting section includes an operation input unit operable by an operator.

[0021] The effects of the present invention include the following.

[0022] According to the yarn splicing device of the present invention, the twisting airflow for twisting the yarn ends can be generated in the whirling direction and/or the generating region in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation by a control on the twisting airflow supplying mechanism. Thus, even if the type of yarn is changed, the whirling direction and the generating region of the twisting airflow to be generated at the twisting nozzle can be selected and changed without replacing the component of the yarn splicing device.

[0023] According to the yarn splicing device of the present invention, a plurality of twisting injection holes are arranged, and the twisting airflow for twisting the yarn ends is generated in the whirling direction and/or the generating region in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation by performing an open/close control on the twisting valve. Thus, a simple configuration is obtained rather than a complex configuration of moving or opening/closing the injection hole itself.

[0024] According to the yarn splicing system of the present invention, the setting section for setting the set twisting condition, and the control section for performing the control on the twisting airflow supplying mechanism based on the setting are provided. The twisting airflow for twisting the yarn ends thus can be easily changed according to the setting. Thus, even if the type of yarn is changed, the whirling direction of the twisting airflow and the generating region of the twisting airflow can be selected and changed without performing a complicating operation or replacing the component of the yarn splicing device.

[0025] According to the yarn splicing system of the present invention, the setting section for setting the set twisting condition, and the control section for performing the open/close control on the twisting valve based on the setting are provided. The twisting airflow for twisting the yarn ends thus can be easily changed according to the setting. Thus, even if the type of yarn is changed, the whirling direction of the twisting airflow and the generating region of the twisting airflow can be changed without performing a complicating operation or replacing the component of the yarn splicing device.

[0026] According to the yarn splicing system of the present invention, the main twisting injection hole and the sub-twisting injection hole adapted to generate the twisting airflow for twisting the yarn ends at different generating regions when the type of yarn is changed are provided. Thus, even if the type of yarn is changed, the generating region of the twisting airflow can be selected and easily changed in accordance with the property of the yarn to be performed with the yarn splicing operation, whereby satisfactory twisting performance can be obtained.

[0027] According to the yarn splicing system of the present invention, the main twisting injection hole and the sub-twisting injection hole adapted to generate the twisting airflow for twisting the yarn ends at different generating regions when the type of yarn is changed are provided in the first air chamber and the second air chamber, respectively. Thus, even if the type of yarn is changed, the generating region of the twisting airflow can be selected and easily changed in accordance with the property of the yarn to be performed with the yarn splicing operation, whereby satisfactory twisting performance can be obtained.

[0028] According to the yarn splicing system of the present invention, the S twisting injection hole and the Z twisting injection hole adapted to generate the twisting airflow for twisting the yarn ends in different whirling directions when the type of yarn is changed are provided. Thus, when the twisting direction of the yarn is changed, the direction of the twisting airflow for twisting the yarn ends can be easily changed, and measures can be taken for the yarn of S twist and the yarn of Z twist without replacing the component.

[0029] According to the yarn splicing system of the present invention, the S twisting injection hole and the Z twisting injection hole adapted to generate the twisting airflow for twisting the yarn ends in different whirling directions when the type of yarn is changed are provided in the first air chamber and the second air chamber, respectively. Thus, when the twisting direction of the yarn is changed, the direction of the twisting airflow for twisting the yarn ends can be easily changed, and measures can be taken for the yarn of S twist and the yarn of Z twist without replacing the component.

[0030] According to the yarn splicing system of the present invention, the untwisting airflow for untwisting the yarn ends is generated at a position in accordance with untwisting condition of the yarn to be performed with the yarn splicing operation by a control on the untwisting airflow supplying mechanism. Thus, when the twisting direction of the yarn is changed, not only the whirling direction and the generating region of the twisting airflow for twisting the yarn ends, but also the generating position of the untwisting airflow for untwisting the yarn ends can be easily changed, and measures can be taken for the yarn Y of S twist and the yarn Y of Z twist without replacing the component.

[0031] According to the textile machine of the present invention, the main control section includes the operation input unit that can be operated by the operator. Thus, the whirling direction and the generating region of the twisting airflow and the generating position of the untwisting airflow can be collectively changed for the plurality of yarn winding units, which reduces the number of operations performed by the operator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIG. 1 is a front simplified view and a block diagram illustrating a yarn winding unit 11 applied with a yarn splicing device 21 according to a first example;

FIG. 2 is a perspective view of the yarn splicing device 21;
FIG. 3 is a simplified view of a structure of the yarn splicing device 21;
FIG. 4 is a simplified view illustrating a yarn splicing system 100 according to the first example;
FIG. 5A is a plan view of a twisting nozzle 73;
FIG. 5B is a plan enlarged view of the twisting nozzle 73;
FIG. 5C is a front enlarged view of the twisting nozzle 73;
FIG. 6A is a plan view of the twisting nozzle 73:
FIG. 6B is a plan enlarged view of the twisting nozzle 73;
FIG. 6C is a front enlarged view of the twisting nozzle 73;
FIG. 7 is a simplified view illustrating a yarn splicing system 100 according to a second example;
FIG. 8A is a plan view of the twisting nozzle 73:
FIG. 8B is a plan enlarged view of the twisting nozzle 73;
FIG. 8C is a front enlarged view of the twisting nozzle 73;
FIG. 9A is a plan view of the twisting nozzle 73:
FIG. 9B is a plan enlarged view of the twisting nozzle 73;
FIG. 9C is a front enlarged view of the twisting nozzle 73;
FIG. 10A is a plan view of the twisting nozzle 73:
FIG. 10B is a plan enlarged view of the twisting nozzle 73;
FIG. 10C is a front enlarged view of the twisting nozzle 73;
FIG. 11A is a variant of the twisting nozzle 73 according to the first example; and
FIG. 11B is a variant of the twisting nozzle 73 according to the second example.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0033] Embodiments of the present invention will be hereinafter described using the drawings.

[0034] A yarn splicing system applied with a yarn splicing device 21 according to a first example of the present invention, and an automatic winder serving as a textile machine equipped with the yarn splicing system 100 will be described using FIG. 1 to FIG. 6.

[0035] An outline of a yarn winding unit (yarn winding device) 11 that configures the automatic winder will be described first. As illustrated in FIG. 1, the yarn winding unit 11 is adapted to form a yarn layer on a winding tube 92 while traversing a yarn Y unwound from a yarn supplying bobbin 91 by a traverse device 12 to produce a package P. The travelling direction of the yarn Y is a direction from the yarn supplying bobbin 91 toward the package P. One yarn winding unit 11 is illustrated in FIG. 1, but the yarn winding unit 11 may be arranged in plurals to configure an automatic winder.

[0036] In the present specification, the winding tube 92 and the package P are sometimes collectively referred to as a winding bobbin B. In other words, the winding bobbin B in which the yarn layer is not formed is the winding tube 92, and the winding bobbin B in which the yarn layer is formed is the package P.

[0037] As illustrated in FIG. 1, the yarn winding unit 11 includes a winding section 2, a contact roller 14, the traverse device 12, and a yarn supplying section 3.

[0038] The winding section 2 is a section adapted to wind the yarn Y to the package P. The winding section 2 includes a cradle 13, a bearing (not illustrated), and a winding bobbin drive motor 18. The cradle 13 can freely swing about a swing shaft 15. The bearing is arranged on the cradle 13. The winding bobbin B is detachably attached to the bearing, and the cradle 13 rotatably grips both ends of the winding bobbin B. When the yarn Y is wound around the winding bobbin B thus increasing the diameter of the winding bobbin B, the cradle 13 swings. An appropriate contact between a peripheral surface of the winding bobbin B and the contact roller 14 is thereby maintained.

[0039] The winding bobbin drive motor 18 is a drive section adapted to directly and rotatably drive the winding bobbin B. A drive shaft of the winding bobbin drive motor 18 is coupled with the winding bobbin B in a relatively non-rotatable manner when the winding bobbin B is gripped by the bearing of the cradle 13 (so-called direct drive method). The winding section 2 winds the yarn Y by actively and rotatably driving the winding bobbin B by the winding bobbin drive motor 18.

[0040] The cradle 13 includes a winding bobbin rotation speed sensor 32 and a winding bobbin diameter sensor 33. The winding bobbin rotation speed sensor 32 detects the rotation speed of the winding bobbin B. The winding bobbin diameter sensor 33 detects the diameter of the winding bobbin B. The winding bobbin diameter sensor 33 is configured with a rotary encoder, or the like, and is adapted to detect the diameter of the winding bobbin B by detecting the swing angle of the cradle 13.

[0041] The contact roller 14 is a roller that rotates accompanying the rotation caused by being brought into

contact with the peripheral surface of the winding bobbin B. The contact roller 14 pushes the yarn Y against the surface of the winding bobbin B at an appropriate pressure and adjusts the shape of the winding bobbin B (package P).

[0042] The traverse device 12 is driven independent from the drive of the winding bobbin B to traverse the yarn Y to be wound around the winding bobbin B. The traverse device 12 includes a traverse guide 17 and a traverse guide drive motor 19.

[0043] The traverse guide 17 is a member adapted to traverse the yarn Y by engaging with the yarn Y. The traverse guide drive motor 19 drives the traverse guide 17 in a direction of a winding width of the winding bobbin B, as illustrated with an arrow in FIG. 1, that is, to reciprocate between both ends, a first end (illustrated end on left side) and a second end (illustrated end on right side), of the winding bobbin B. In the present example, the winding bobbin B is directly and rotatably driven, and the traverse device 12 is driven independent from the drive of the winding bobbin B, but the traverse device may be a traverse drum. The traverse drum is brought into contact with the outer peripheral surface of the winding bobbin B and rotates, thus causing the winding bobbin B to rotate accompanying the rotation of the traverse drum. A traverse groove is formed in the traverse drum, and the yarn Y is wound around the winding bobbin B while being traversed by the traverse groove.

[0044] The yarn supplying section 3 is a section adapted to supply the yarn Y to be wound around the winding bobbin B. The yarn supplying section 3 includes a yarn supplying bobbin holding peg (not illustrated), and the yarn supplying bobbin 91 is attached to the yarn supplying bobbin holding peg. A tension applying device 20, a yarn splicing device 21, and a yarn clearer 22 are arranged in order from the yarn supplying section 3 on a yarn travelling path between the yarn supplying section 3 and the contact roller 14.

[0045] The tension applying device 20 is adapted to apply an appropriate tension on the yarn Y. The yarn clearer 22 is adapted to detect a thickness of the yarn Y passing through the portion of the detecting section by a sensor and analyze a signal from the sensor by an analyzer 23 to detect a yarn defect such as a slub. The yarn clearer 22 may be configured to detect presence/absence of foreign substance contained in the yarn Y other than the thickness abnormality of the yarn Y. The yarn clearer 22 includes a cutter that cuts the yarn Y when the yarn defect is detected (clearer cut) , or that cuts the yarn Y to interrupt the winding due to traverse failure although the yarn defect is not present (additional cut) .

[0046] The yarn splicing device 21 is adapted to perform the yarn splicing operation on a yarn end YA of a lower yarn from the yarn supplying bobbin 91 and a yarn end YB of an upper yarn from the winding bobbin B (package P) when the yarn cut is performed by the yarn clearer 22 or when the yarn breakage of the yarn Y from the yarn supplying bobbin 91 occurs. The yarn splicing device 21 will be described in detail later.

[0047] A suction pipe 24 adapted to suction and catch the yarn end YA from the yarn supplying bobbin 91 and to guide the yarn end YA to the yarn splicing device 21 is arranged on a lower side of the yarn splicing device 21 (upstream in the travelling direction of the yarn Y). A suction mouth 27 adapted to suction and catch the yarn end YB from the winding bobbin B and to guide the yarn end YB to the yarn splicing device 21 is arranged on an upper side of the yarn splicing device 21 (downstream in the travelling direction of the yarn Y). The suction pipe 24 is configured to a pipe-shape and is arranged to vertically swing about a shaft 25, an opening 26 being formed at a distal end thereof. The suction mouth 27 is also configured to a pipe-shape and is arranged to vertically swing about a shaft 28, an opening 29 being formed at a distal end thereof. The suction pipe 24 and the suction mouth 27 are connected to a negative pressure source (not illustrated), and causes a suction action to be generated at the opening 26 and the opening 29 at the distal ends.

[0048] A configuration for controlling an operation of the yarn winding unit 11 will be described below. As illustrated in FIG. 1, the yarn winding unit 11 includes a unit control section (control section) 36 adapted to individually control the yarn winding unit 11. The unit control section 36 is connected with a winding bobbin drive control section 31 and a traverse control section 34. The yarn splicing device 21 is also connected to the unit control section 36 to control the operation of the yarn splicing device 21. The unit control section 36 is connected to the main control section 37. The main control section 37 comprehensively controls the plurality of yarn winding units 11 configuring the automatic winder.

[0049] The main control section 37 includes a setting section 38. The setting section 38 includes an operation input unit such as a touch panel that can be operated by an operator. The setting section 38 can collectively carry out the operation setting of each section for each yarn winding unit 11.

[0050] The unit control section 36, the main control section 37, the winding bobbin drive control section 31, and the traverse control section 34 include a CPU serving as a calculating section, a ROM, a RAM, or the like serving as a storing section, and the like.

[0051] The configuration of the yarn splicing device 21 will be described using FIG. 2 and FIG. 3. The yarn end YA from the yarn supplying bobbin 91 and the yarn end YB from the winding bobbin B are guided to the yarn splicing device 21 by the suction mouth 27 and the suction pipe 24 of the yarn winding unit 11. The untwisting step and the twisting step of the yarn ends YA, YB in the yarn splicing device 21 are carried out using compressed air. The overall configuration of the yarn splicing device 21 will be described, and then, the yarn splicing system 100 including the yarn splicing device 21 will be described.

[0052] The yarn splicing device 21 includes a first untwisting nozzle 71, a second untwisting nozzle 72, and a

twisting nozzle 73. The yarn splicing device 21 includes a yarn gathering lever 76, a yarn end cutter 77, a clamp section 78, and a yarn holding lever 79 for introducing the yarn ends YA, YB, and adjusting the positions of the yarn ends YA, YB.

[0053] The first untwisting nozzle 71 is a portion adapted to perform, on the yarn end YA, untwisting processing to prepare for the twisting of the yarn end YA. The first untwisting nozzle 71 suctions the yarn end YA from the yarn supplying bobbin 91, and performs untwisting. The first untwisting nozzle 71 is connected to an untwisting airflow supply mechanism 41. The untwisting airflow including spiral airflow is generated at the first untwisting nozzle 71 by injecting the compressed air for untwisting into the first untwisting nozzle 71. The yarn end YA from the yarn supplying bobbin 91 is suctioned into the first untwisting nozzle 71 by the untwisting airflow, whereby the fibers of the yarn end YA are raveled.

[0054] The second untwisting nozzle 72 is a portion adapted to perform, on the yarn end YB, untwisting processing to prepare for the twisting of the yarn end YB. The second untwisting nozzle 72 suctions the yarn end YB from the winding bobbin B, and performs untwisting. The second untwisting nozzle 72 is connected to the untwisting airflow supply mechanism 41. The untwisting airflow including spiral airflow is generated at the second untwisting nozzle 72 by injecting the compressed air for untwisting into the second untwisting nozzle 72. The yarn end YB from the winding bobbin B is suctioned into the second untwisting nozzle 72 by the untwisting airflow, whereby the fibers of the yarn end YB are raveled.

[0055] The twisting nozzle 73 is the portion that performs twisting of the yarn ends YA, YB. Specifically, the yarn ends YA, YB untwisted by the first untwisting nozzle 71 and the second untwisting nozzle 72 are entangled and connected. The twisting nozzle 73 is connected to a twisting airflow supply mechanism 42. The twisting airflow is generated by the compressed air for twisting injected into the twisting nozzle 73, whereby the untwisted yarn ends YA, YB are twisted and connected.

[0056] The yarn gathering lever 76 includes a first yarn gathering lever 76a and a second yarn gathering lever 76b. The first yarn gathering lever 76a and the second yarn gathering lever 76b adjust the positions of the yarn ends YA, YB.

[0057] The yarn end cutter 77 includes a first yarn end cutter 77a and a second yarn end cutter 77b. The first yarn end cutter 77a and the second yarn end cutter 77b cut the yarn ends YA, YB, respectively, to an appropriate length before the untwisting of the yarn ends YA, YB.

[0058] The clamp section 78 includes a first clamp plate 78a and a second clamp plate 78b. The first clamp plate 78a and the second clamp plate 78b clamp and fix the yarn ends YA, YB.

[0059] The yarn holding lever 79 includes a first fork 79a and a second fork 79b. The first fork 79a and a second fork 79b fix the positions of the untwisted portion of the yarn ends YA, YB such that the untwisted portions of the yarn ends YA, YB are positioned in the twisting nozzle 73.

[0060] The positions of the untwisted portions of the yarn ends YA, YB are fixed in the twisting nozzle 73 by the first fork 79a and the second fork 79b, and then the compressed air for twisting is injected by the twisting nozzle 73 to twist and connect the untwisted portions of the yarn ends YA, YB.

[0061] As illustrated in FIG. 4, the yarn splicing system 100 includes an air supplying device 61 common to the yarn splicing device 21 of each yarn winding unit 11. The air supplying device 61 is a device adapted to supply compressed air to the yarn splicing device 21. The air supplying device 61 is connected to an untwisting air piping 62 by way of a first depressurization valve 64. The first depressurization valve 64 is a valve adapted to adjust the compressed air from the air supplying device 61 to the pressure suited for the untwisting of the yarn ends YA, YB. The untwisting air piping 62 is a piping that supplies the compressed air for untwisting to the yarn splicing device 21 of each yarn winding unit 11. The air supplying device 61 is connected to a twisting air piping 63 by way of a second depressurization valve 65. The second depressurization valve 65 is a valve adapted to adjust the compressed air from the air supplying device 61 to the pressure suited for the twisting of the yarn ends YA, YB. The twisting air piping 63 is a piping that supplies the compressed air for twisting to the yarn splicing device 21 of each yarn winding unit 11.

[0062] The first untwisting nozzle 71, the second untwisting nozzle 72, and the twisting nozzle 73 will be described in detail below.

[0063] As illustrated in FIG. 3 and FIG. 4, the first untwisting nozzle 71 is configured to generate the untwisting airflow for untwisting the yarn end YA at different positions to prepare for the twisting of the yarn ends YA, YB by the twisting nozzle 73. The first untwisting nozzle 71 is formed with an S first untwisting injection hole 711 and a Z first untwisting injection hole 712. The S first untwisting injection hole 711 is an injection hole of the compressed air for generating the untwisting airflow for untwisting the yarn end YA of the yarn Y when the yarn Y is S twisted. The Z first untwisting injection hole 712 is an injection hole of the compressed air for generating the untwisting airflow for untwisting the yarn end YA of the yarn Y when the yarn Y is Z twisted. The whirling direction of the untwisting airflow for untwisting the yarn end YA is opposite for when the yarn Y is S twisted and for when the yarn Y is Z twisted. Thus, the S first untwisting injection hole 711 and the Z first untwisting injection hole 712 are arranged with being shifted by about 90 degrees to generate the untwisting airflow at different positions with respect to the yarn end YA. Specific arrangement is similar to the ejection holes 33, 34 described in FIG. 5 and FIG. 6 of Japanese Unexamined Patent Publication No. 62-3741.

[0064] The second untwisting nozzle 72 is configured to generate the untwisting airflow for untwisting the yarn

end YB at different positions to prepare for the twisting of the yarn ends YA, YB by the twisting nozzle 73. The second untwisting nozzle 72 is formed with an S second untwisting injection hole 721 and a Z second untwisting injection hole 722. The S second untwisting injection hole 721 is an injection hole of the compressed air for generating the untwisting airflow for untwisting the yarn end YB of the yarn Y when the yarn Y is S twisted. The Z second untwisting injection hole 722 is an injection hole of the compressed air for generating the untwisting airflow for untwisting the yarn end YB of the yarn Y when the yarn Y is Z twisted. The whirling direction of the untwisting airflow for untwisting the yarn end YB is opposite for when the yarn Y is S twisted and for when the yarn Y is Z twisted. Thus, the S second untwisting injection hole 721 and the Z second untwisting injection hole 722 are arranged with being shifted by about 90 degrees to generate the untwisting airflow at different positions with respect to the yarn end YB. Specific arrangement is similar to the ejection holes 33, 34 described in FIG. 5 and FIG. 6 of Japanese Unexamined Patent Publication No. 62-3741.

[0065] As illustrated in FIG. 4, FIG. 5, and FIG. 6, the twisting nozzle 73 of the present example is configured so that the twisting airflow for twisting the yarn ends YA, YB can be generated in different whirling directions. As illustrated in FIG. 5 and FIG. 6, the twisting nozzle 73 includes a guiding section 51, a slit 52, an air chamber 53, and a plurality of twisting injection holes 54. The guiding section 51 is a cutout opened to a V-shape in plan view. The guiding section 51 is a portion adapted to guide the yarn ends YA, YB to the slit 52. The slit 52 is a portion adapted to introduce the yarn ends YA, YB guided by the guiding section 51 to the air chamber 53.

[0066] The air chamber 53 is a portion arranged with the yarn ends YA, YB to be performed with the yarn splicing operation overlapped from different directions. In the air chamber 53, the twisting airflow for twisting the yarn ends YA, YB with the yarn ends YA, YB arranged is generated. The air chamber 53 is configured by a first air chamber 531 and second air chamber 532. In FIG. 5C, the first air chamber 531 illustrated on the upper side is formed with a cylindrical circumferential surface, and is adapted to whirl the yarn end YA. In FIG. 5C, the second air chamber 532 illustrated on the lower side is formed with a cylindrical circumferential surface, and is adapted to whirl the yarn end YB. The air chamber 53 of the present example is arranged with the center lines of the first air chamber 531 and the second air chamber 532 being offset.

[0067] The plurality of twisting injection holes 54 are injection holes of the compressed air formed on the respective circumferential surfaces of the first air chamber 531 and the second air chamber 532. The plurality of twisting injection holes 54 inject the compressed air in a tangential direction of the air chamber 53 to generate the twisting airflow in the first air chamber 531 and the second air chamber 532. The twisting injection hole 54 includes an S twisting injection hole 541 and a Z twisting injection hole 542. The S twisting injection hole 541 is an injection hole for generating the twisting airflow for twisting the yarn ends YA, YB of the yarn Y when the yarn Y is S twisted. The Z twisting injection hole 542 is an injection hole for generating the twisting airflow for twisting the yarn ends YA, YB of the yarn Y when the yarn Y is Z twisted. The whirling direction of the twisting airflow for twisting the yarn ends YA, YB of the yarn Y is opposite for when the yarn Y is S twisted and for when the yarn Y is Z twisted. Thus, the S twisting injection hole 541 and the Z twisting injection hole 542 are arranged at positions facing each other with the slit 52 in between, and are formed to generate the twisting airflow in directions opposite to each other. The directions of the S twisting injection hole 541 and the Z twisting injection hole 542 are tangential direction of the circumferential wall of the first air chamber 531 and the second air chamber 532, respectively, and the twisting airflow is formed to be in a clockwise direction and a counterclockwise direction. The S twisting injection hole 541 and the Z twisting injection hole 542 are formed at one area each in the first air chamber 531 and the second air chamber 532, respectively. The S twisting injection hole 541 and the Z twisting injection hole 542 of the first air chamber 531 and the second air chamber 532 are formed side by side on the same circumference.

[0068] The twisting nozzle 73 is attached to a block 55 arranged in the yarn splicing device 21. The block 55 is formed with an S airflow path 551 and a Z airflow path 552. The S airflow path 551 is a flow path adapted to supply the compressed air to the S twisting injection hole 541. The Z airflow path 552 is a flow path adapted to supply the compressed air to the Z twisting injection hole 542. A space communicating from the S airflow path 551 to the S twisting injection hole 541 is formed between the twisting nozzle 73 and the block 55 (not illustrated). This space becomes an airflow path from the S airflow path 551 to the S twisting injection hole 541 and supplies the compressed air to the S twisting injection hole 541. A space communicating from the Z airflow path 552 to the Z twisting injection hole 542 is formed between the twisting nozzle 73 and the block 55 (not illustrated). This space becomes an airflow path from the Z airflow path 552 to the Z twisting injection hole 542 and supplies the compressed air to the Z twisting injection hole 542. The S twisting flow path 421, to be described later, is connected to the S airflow path 551, and the Z twisting flow path 422, to be described later, is connected to the Z airflow path 552.

[0069] The yarn splicing system 100 including the yarn splicing device 21 will now be described. The yarn splicing system 100 of the present example is a system that can select and change the generating position of the untwisting air flow and the whirling direction of the twisting airflow without performing a complicated operation or replacing the component of the yarn splicing device. The yarn splicing system 100 is configured by the yarn splic-

ing device 21, the setting section 38 of the main control section 37, and the unit control section 36 of the yarn winding unit 11.

[0070] As illustrated in FIG. 4, FIG. 5, and FIG. 6, the yarn splicing device 21 includes an untwisting airflow supplying mechanism 41 and a twisting airflow supplying mechanism 42 as a mechanism for supplying the compressed air to the first untwisting nozzle 71, the second untwisting nozzle 72, and the twisting nozzle 73.

[0071] The untwisting airflow supplying mechanism 41 supplies the compressed air to the first untwisting nozzle 71 and the second untwisting nozzle 72 in a manner the generating position of the untwisting airflow can be switched. The untwisting airflow supplying mechanism 41 includes a branched point 430, an S untwisting flow path 411, a Z untwisting flow path 412, an S untwisting valve 413, and a Z untwisting valve 414.

[0072] The S untwisting flow path 411 is a flow path adapted to supply the compressed air from the untwisting air piping 62 to the S first untwisting injection hole 711 and the S second untwisting injection hole 721. An S untwisting valve 413 is connected in the middle of the S untwisting flow path 411. The S untwisting valve 413 is an electromagnetic valve adapted to perform opening/closing of the S untwisting flow path 411 for each of the generating positions of the untwisting airflow based on a control signal.

[0073] The Z untwisting flow path 412 is a flow path adapted to supply the compressed air from the untwisting air piping 62 to the Z first untwisting injection hole 712 and the Z second untwisting injection hole 722. A Z untwisting valve 414 is connected in the middle of the Z untwisting flow path 412. The Z untwisting valve 414 is an electromagnetic valve adapted to perform opening/closing of the Z untwisting flow path 412 for each of the generating positions of the untwisting airflow based on a control signal.

[0074] The twisting airflow supplying mechanism 42 supplies the compressed air to the twisting nozzle 73 for each of the whirling directions of the twisting airflow. The twisting airflow supplying mechanism 42 includes a branched point 431, the S twisting flow path 421, the Z twisting flow path 422, the S twisting valve 423, and the Z twisting valve 424.

[0075] The S twisting flow path 421 is a flow path for supplying the compressed air for each of the whirling directions of the twisting airflow, and is a flow path for supplying the compressed air from the twisting air piping 63 to the S twisting injection hole 541. The S twisting valve 423 is connected in the middle of the S twisting flow path 421. The S twisting valve 423 is an electromagnetic valve for performing opening/closing of the S twisting flow path 421 for each of the whirling directions of the twisting airflow based on the control signal.

[0076] The Z twisting flow path 422 is a flow path for supplying the compressed air for each of the whirling directions of the twisting airflow, and is a flow path for supplying the compressed air from the twisting air piping 63 to the Z twisting injection hole 542. The Z twisting valve 424 is connected in the middle of the Z twisting flow path 422. The Z twisting valve 424 is an electromagnetic valve for performing opening/closing of the Z twisting flow path 422 for each of the whirling directions of the twisting airflow based on the control signal.

[0077] In the setting section 38 of the main control section 37, the operation setting of the yarn splicing device 21 of each yarn winding unit 11 can be collectively performed (see FIG. 1). The operator operates the touch panel of the setting section 38 to perform the setting. For the operation setting of the yarn splicing device 21, the generating position of the untwisting airflow for untwisting the yarn ends YA, YB and the whirling direction of the twisting airflow for twisting the yarn ends YA, YB in accordance with the untwisting condition and the twisting condition of the yarn Y to be performed with the yarn splicing operation are set as a set untwisting condition and set twisting condition. In the present example, the generating position of the untwisting airflow for untwisting the yarn ends YA, YB and the whirling direction of the twisting airflow for twisting the yarn ends YA, YB are determined and the set untwisting condition and the set twisting condition are set by selecting by the touch panel of the setting section 38 whether the yarn Y to be spliced is the yarn of S twist or the yarn of Z twist.

[0078] The main control section 37 transmits the set content set by the setting section 38 to the unit control section 36 of each yarn winding unit 11. The unit control section 36 controls the untwisting airflow supplying mechanism 41 and the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set untwisting condition and the set twisting condition.

[0079] Specifically, the unit control section 36 performs the open/close control with respect to the S untwisting valve 413 and the Z untwisting valve 414 of the untwisting airflow supplying mechanism 41 to generate the untwisting airflow for untwisting the yarn ends YA, YB at the position in accordance with the untwisting condition of the yarn to be performed with the yarn splicing operation. The unit control section 36 also performs the open/close control of the S twisting valve 423 and the Z twisting valve 424 of the twisting airflow supplying mechanism 42 to generate the twisting airflow for twisting the yarn ends YA, YB in the whirling direction in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation.

[0080] The specific operation of the yarn splicing system 100 will now be described.

[0081] First, a case in which the operator operates the touch panel of the setting section 38 to select that the yarn Y to be performed with the yarn splicing operation is S twist will be described with reference to FIG. 4 and FIG. 5. In this case, the generating position of the untwisting airflow for untwisting the yarn ends YA, YB is determined as the position of performing the untwisting with respect to the yarn Y of S twist and the whirling direction of the twisting airflow for twisting the yarn ends

YA, YB is determined as the whirling direction of the twisting airflow for performing the twisting with respect to the yarn Y of S twist, and such position and whirling direction are set as the set untwisting condition and the set twisting condition. The unit control section 36 controls the untwisting airflow supplying mechanism 41 and the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set untwisting condition and the set twisting condition.

[0082] Specifically, the unit control section 36 transmits a control signal for opening/closing the valve in the untwisting operation to the S untwisting valve 413 of the untwisting airflow supplying mechanism 41. The S untwisting valve 413 opens/closes the S untwisting flow path 411 in the untwisting operation based on the control signal. A control signal for continuously closing the valve is transmitted to the Z untwisting valve 414 of the untwisting airflow supplying mechanism 41. The Z untwisting valve 414 continuously closes the Z untwisting flow path 412 in the untwisting operation based on the control signal. According to such control, the untwisting airflow can be generated at the position of untwisting the yarn ends YA, YB of the yarn Y of S twist in the untwisting operation at the first untwisting nozzle 71 and the second untwisting nozzle 72.

[0083] The unit control section 36 transmits a control signal for opening/closing the valve in the twisting operation to the S twisting valve 423 of the twisting airflow supplying mechanism 42. The S twisting valve 423 opens/closes the S twisting flow path 421 in the twisting operation based on the control signal. A control signal for continuously closing the valve is transmitted to the Z twisting valve 424 of the twisting airflow supplying mechanism 42. The Z twisting valve 424 continuously closes the Z twisting flow path 422 in the twisting operation based on the control signal. According to such control, the twisting airflow in the whirling direction for twisting the yarn ends YA, YB of the yarn Y of S twist can be generated in the twisting operation at the twisting nozzle 73.

[0084] Next, a case in which the operator operates the touch panel of the setting section 38 to select that the yarn Y to be performed with the yarn splicing operation is Z twist will be described with reference to FIG. 4 and FIG. 6. In this case, the generating position of the untwisting airflow for untwisting the yarn ends YA, YB is determined as the position of performing the untwisting with respect to the yarn Y of Z twist and the whirling direction of the twisting airflow for twisting the yarn ends YA, YB is determined as the whirling direction of the twisting airflow for performing the twisting with respect to the yarn Y of Z twist, and such position and whirling direction are set as the set untwisting condition and the set twisting condition. The unit control section 36 controls the untwisting airflow supplying mechanism 41 and the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set untwisting condition and the set twisting condition.

[0085] Specifically, the unit control section 36 transmits a control signal for continuously closing the valve with respect to the S untwisting valve 413 of the untwisting airflow supplying mechanism 41. The S untwisting valve 413 continuously closes the S untwisting flow path 411 in the untwisting operation based on the control signal. A control signal for opening/closing the valve is transmitted with respect to the Z untwisting valve 414 of the untwisting airflow supplying mechanism 41 in the untwisting operation. The Z untwisting valve 414 opens/closes the Z untwisting flow path 412 in the untwisting operation based on the control signal. According to such control, the untwisting airflow can be generated at the position of untwisting the yarn ends YA, YB of the yarn Y of Z twist in the untwisting operation at the first untwisting nozzle 71 and the second untwisting nozzle 72.

[0086] The unit control section 36 transmits a control signal for continuously closing the valve in the twisting operation with respect to the S twisting valve 423 of the twisting airflow supplying mechanism 42. The S twisting valve 423 continuously closes the S twisting flow path 421 in the twisting operation based on the control signal. A control signal for opening/closing the valve is transmitted with respect to the Z twisting valve 424 of the twisting airflow supplying mechanism 42 in the twisting operation. The Z twisting valve 424 opens/closes the Z twisting flow path 422 in the twisting operation based on the control signal.

[0087] According to such control, the twisting airflow in the whirling direction for twisting the yarn ends YA, YB of the yarn Y of Z twist can be generated in the twisting operation at the twisting nozzle 73.

[0088] The yarn splicing device 21, the yarn winding unit 11, and the automatic winder according to the present example described above have the following effects.

[0089] According to the yarn splicing device 21, the twisting airflow for twisting the yarn ends YA, YB can be generated in the whirling direction in accordance with the twisting condition of the yarn Y to be performed with the yarn splicing operation by the control on the twisting airflow supplying mechanism 42. Thus, even if the type of yarn Y is changed, the whirling direction of the twisting airflow to be generated at the twisting nozzle 73 can be selected and changed without replacing the component of the yarn splicing device 21.

[0090] According to the yarn splicing device 21, the plurality of twisting injection holes 54 are arranged, and the open/close control is performed on the S twisting valve 423 and the Z twisting valve 424 to generate the twisting airflow for twisting the yarn ends YA, YB in the whirling direction in accordance with the twisting condition of the yarn Y to be performed with the yarn splicing operation. Thus, a simple configuration is obtained rather than a complex configuration of moving or opening/closing the injection hole itself.

[0091] According to the yarn splicing system 100, the setting section 38 for setting the set twisting condition,

and the unit control section 36 for performing the open/close control on the S twisting valve 423 and the Z twisting valve 424 based on the setting are provided. The twisting airflow for twisting the yarn ends YA, YB thus can be easily changed according to the setting. Thus, even if the type of yarn Y is changed, the whirling direction of the twisting airflow can be changed without performing a complicating operation or replacing the component of the yarn splicing device 21.

[0092] According to the yarn splicing system 100, the S twisting injection hole 541 and the Z twisting injection hole 542 for generating the twisting airflow for twisting the yarn ends YA, YB in different whirling directions when the type of yarn Y is changed are respectively provided in the first air chamber 531 and the second air chamber 532. Thus, when the twisting direction of the yarn Y is changed, the direction of the twisting airflow for twisting the yarn ends YA, YB can be easily changed, and measures can be taken for the yarn Y of S twist and the yarn Y of Z twist without replacing the component.

[0093] According to the yarn splicing system 100, the untwisting airflow for untwisting the yarn ends YA, YB can be generated at the position in accordance with the untwisting condition of the yarn Y to be performed with the yarn splicing operation by the control on the untwisting airflow supplying mechanism 41. Thus, when the twisting direction of the yarn Y is changed, the generating position of not only the twisting airflow for twisting the yarn ends YA, YB, but also the untwisting airflow for untwisting the yarn ends YA, YB can be easily changed, and measures can be taken for the yarn Y of S twist and the yarn Y of Z twist without replacing the component.

[0094] According to the automatic winder, the main control section 37 includes a touch panel serving as the operation input unit that can be operated by the operator. Thus, the whirling direction of the twisting airflow and the generating position of the untwisting airflow can be collectively changed for the plurality of yarn winding units 11, which reduces the number of operations performed by the operator.

[Second Example]

[0095] A yarn splicing system 100 applied with the yarn splicing device 21 according to a second example of the present invention, and an automatic winder serving as a textile machine equipped with the yarn splicing system 100 will be described using FIG. 7 to FIG. 10. The present example greatly differs from the first example in that in the first example, the generating position of the untwisting airflow generated at the first untwisting nozzle 71 and the second untwisting nozzle 72, and the whirling direction of the twisting airflow generated at the twisting nozzle 73 are selected and changed, whereas in the present example, the generating region of the twisting airflow generated at the twisting nozzle 73 is selected and changed. The description on the configurations common with the first example will be omitted. In the following description, the yarn splicing device 21 dedicated to the yarn Y of Z twist will be described, but may be dedicated to the yarn Y of S twist or may be the yarn splicing device 21 that can be used to the yarn Y of both S twist and Z twist.

[0096] First, the first untwisting nozzle 71, the second untwisting nozzle 72, and the twisting nozzle 73 of the yarn splicing device 21 of the present example will be described in detail.

[0097] As illustrated in FIG. 7, the first untwisting nozzle 71 is configured to generate the untwisting airflow for untwisting the yarn end YA of the yarn Y of Z twist. The first untwisting nozzle 71 is formed with the first untwisting injection hole 713 as an injection hole of the compressed air.

[0098] The second untwisting nozzle 72 is configured to generate the untwisting airflow for untwisting the yarn end YB of the yarn Y of Z twist. The second untwisting nozzle 72 is formed with the second untwisting injection hole 723 as an injection hole of the compressed air.

[0099] As illustrated in FIG. 7 to FIG. 10, the twisting nozzle 73 of the present example is configured so that the twisting airflow for twisting the yarn ends YA, YB can be generated in different generating regions. The twisting nozzle 73 includes the air chamber 53 and the plurality of twisting injection holes 54.

[0100] As illustrated in FIG. 8, the air chamber 53 is configured by the first air chamber 531 and the second air chamber 532. The air chamber 53 of the present example is arranged so that the center lines of the first air chamber 531 and the second air chamber 532 coincide with each other, as opposed to the first example.

[0101] The plurality of twisting injection holes 54 are injection holes of the compressed air formed on the respective circumferential surfaces of the first air chamber 531 and the second air chamber 532. The twisting injection hole 54 includes a main twisting injection hole 543 and a sub-twisting injection hole 544. The main twisting injection hole 543 and the sub-twisting injection hole 544 are arranged in accordance with the generating region to generate the twisting airflow for twisting the yarn ends YA, YB in different generating regions. The main twisting injection hole 543 is an injection hole for generating the twisting airflow for twisting the yarn ends YA, YB in the region (first region) closer to the middle of the air chamber 53. The sub-twisting injection hole 544 is an injection hole for generating the twisting airflow for twisting the yarn ends YA, YB in the region (second region) slightly away from the middle of the air chamber 53. The twisting airflow for twisting the yarn ends YA, YB can be generated in the entire region (third region) of the air chamber 53 by injecting the compressed air from both the main twisting injection hole 543 and the sub-twisting injection hole 544.

[0102] The directions of the main twisting injection hole 543 and the sub-twisting injection hole 544 are tangential directions of the circumferential walls of the first air chamber 531 and the second air chamber 532, and are formed in the directions of generating the whirling flow for twisting the yarn ends YA, YB of Z twist. The main twisting injec-

tion hole 543 and the sub-twisting injection hole 544 are formed in one area each in the first air chamber 531 and the second air chamber 532. The main twisting injection hole 543 and the sub-twisting injection hole 544 of the first air chamber 531 and the second air chamber 532 are formed side by side in an axial direction of the first air chamber 531 and the second air chamber 532.

[0103] The twisting nozzle 73 is attached to the block 55 arranged in the yarn splicing device 21. The block 55 is formed with a main airflow path 553 and a sub-airflow path 554. The main airflow path 553 is a flow path for supplying the compressed air to the main twisting injection hole 543. The sub-airflow path 554 is a flow path for supplying the compressed air to the sub-twisting injection hole 544. A space communicating from the main airflow path 553 to the main twisting injection hole 543 is formed between the twisting nozzle 73 and the block 55 (not illustrated). This space becomes the airflow path from the main airflow path 553 to the main twisting injection hole 543, and supplies the compressed air to the main twisting injection hole 543. A space communicating from the sub-airflow path 554 to the sub-twisting injection hole 544 is also formed between the twisting nozzle 73 and the block 55 (not illustrated). This space becomes the airflow path from the sub-airflow path 554 to the sub-twisting injection hole 544, and supplies the compressed air to the sub-twisting injection hole 544. A main twisting flow path 425, to be described later, is connected to the main airflow path 553, and a sub-twisting flow path 426, to be described later, is connected to the sub-airflow path 554.

[0104] The yarn splicing system 100 including the yarn splicing device 21 will now be described. The yarn splicing system 100 of the present example is a system that can select and change the generating region of the untwisting air flow for twisting without performing a complicated operation or replacing the component of the yarn splicing device. The yarn splicing system 100 is configured by the yarn splicing device 21, the setting section 38 of the main control section 37, and the unit control section 36 of the yarn winding unit 11.

[0105] As illustrated in FIG. 7 and FIG. 8, the yarn splicing device 21 includes the untwisting airflow supplying mechanism 41 and the twisting airflow supplying mechanism 42 as a mechanism for supplying the compressed air to the first untwisting nozzle 71, the second untwisting nozzle 72, and the twisting nozzle 73.

[0106] The untwisting airflow supplying mechanism 41 supplies the compressed air to the first untwisting nozzle 71 and the second untwisting nozzle 72. The untwisting airflow supplying mechanism 41 includes an untwisting flow path 416 and an untwisting valve 418.

[0107] The untwisting flow path 416 is a flow path for supplying the compressed air from the untwisting air piping 62 to the first untwisting injection hole 713 and the second untwisting injection hole 723. The untwisting valve 418 is connected to the middle of the untwisting flow path 416. The untwisting valve 418 is an electromagnetic valve for performing opening/closing of the untwisting flow path 416 based on the control signal.

[0108] The twisting airflow supplying mechanism 42 supplies the compressed air to the twisting nozzle 73 for each of the generating regions of the twisting airflow. The twisting airflow supplying mechanism 42 includes a main twisting flow path 425, a sub-twisting flow path 426, a main twisting valve 427, and a sub-twisting valve 428.

[0109] The main twisting flow path 425 is a flow path for supplying the compressed air for each of the generating regions of the twisting airflow, and a flow path for supplying the compressed air from the twisting air piping 63 to the main twisting injection hole 543. The main twisting valve 427 is connected to the middle of the main twisting flow path 425. The main twisting valve 427 is an electromagnetic valve for performing opening/closing of the main twisting flow path 425 based on the control signal.

[0110] The sub-twisting flow path 426 is a flow path for supplying the compressed air for each of the generating regions of the twisting airflow, and a flow path for supplying the compressed air from the twisting air piping 63 to the sub-twisting injection hole 544. The sub-twisting valve 428 is connected to the middle of the sub-twisting flow path 426. The sub-untwisting valve 428 is an electromagnetic valve for performing opening/closing of the sub-twisting flow path 426 based on the control signal.

[0111] In the setting section 38 of the main control section 37, the operation setting of the yarn splicing device 21 of each yarn winding unit 11 can be collectively performed (see FIG. 1). The operator operates the touch panel of the setting section 38 to perform the setting. For the operation setting of the yarn splicing device 21, the generating region of the twisting airflow for twisting the yarn ends YA, YB in accordance with the twisting condition of the yarn Y to be performed with the yarn splicing operation are set as a set twisting condition. In the present example, the generating region of the twisting airflow for twisting the yarn ends YA, YB is determined and the set twisting condition is set by selecting one of the first region to the third region with the touch panel of the setting section 38 as the generating region of the twisting airflow for twisting the yarn ends YA, YB of the yarn Y to be performed with the yarn splicing operation.

[0112] The main control section 37 transmits the set content set by the setting section 38 to the unit control section 36 of each yarn winding unit 11. The unit control section 36 controls the untwisting airflow supplying mechanism 41 and the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set twisting condition.

[0113] Specifically, the unit control section 36 also performs the open/close control of the main twisting valve 427 and the sub-twisting valve 428 of the twisting airflow supplying mechanism 42 to generate the twisting airflow for twisting the yarn ends YA, YB in the generating region in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation.

[0114] The specific operation of the yarn splicing sys-

tem 100 will now be described.

[0115] First, with reference to FIG. 7 and FIG. 8, a case in which the operator operates the touch panel of the setting section 38 to select the region (first region) closer to the middle of the air chamber 53 as the region for generating the twisting airflow for twisting the yarn ends YA, YB will be described. In this case, the generating region of the twisting airflow for twisting the yarn ends YA, YB is determined as the region (first region) closer to the middle of the air chamber 53, which is set as the set twisting condition. The unit control section 36 controls the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set twisting condition.

[0116] Specifically, the unit control section 36 first transmits a control signal for opening/closing the valve with respect to the untwisting valve 418 of the untwisting airflow supplying mechanism 41 to perform the untwisting operation of the yarn ends YA, YB. The untwisting valve 418 opens/closes the untwisting flow path 416 in the untwisting operation based on the control signal. According to such control, the untwisting airflow for untwisting the yarn ends YA, YB of the yarn Y can be generated in the untwisting operation at the first untwisting nozzle 71 and the second untwisting nozzle 72.

[0117] The unit control section 36 transmits a control signal for opening/closing the valve in the twisting operation to the main twisting valve 427 of the twisting airflow supplying mechanism 42. The main twisting valve 427 opens/closes the main twisting flow path 425 in the twisting operation based on the control signal. A control signal for continuously closing the valve is transmitted to the sub-twisting valve 428 of the twisting airflow supplying mechanism 42. The sub-twisting valve 428 continuously closes the sub-twisting flow path 426 in the twisting operation based on the control signal. According to such control, the twisting airflow for twisting the yarn ends YA, YB can be generated in the region (first region) closer to the middle of the air chamber 53 in the twisting operation at the twisting nozzle 73.

[0118] Next, with reference to FIG. 7 and FIG. 9, a case in which the operator operates the touch panel of the setting section 38 to select the region (second region) slightly away from the middle of the air chamber 53 as the region for generating the twisting airflow for twisting the yarn ends YA, YB will be described. In this case, the generating region of the twisting airflow for twisting the yarn ends YA, YB is determined as the region (second region) slightly away from the middle of the air chamber 53, which is set as the set twisting condition. The unit control section 36 controls the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set twisting condition.

[0119] Specifically, the unit control section 36 first transmits a control signal for opening/closing the valve with respect to the untwisting valve 418 of the untwisting airflow supplying mechanism 41 to perform the untwisting operation of the yarn ends YA, YB. The untwisting valve 418 opens/closes the untwisting flow path 416 in the untwisting operation based on the control signal. According to such control, the untwisting airflow for untwisting the yarn ends YA, YB of the yarn Y can be generated in the untwisting operation at the first untwisting nozzle 71 and the second untwisting nozzle 72.

[0120] The unit control section 36 transmits a control signal for continuously closing the valve in the twisting operation to the main twisting valve 427 of the twisting airflow supplying mechanism 42. The main twisting valve 427 continuously closes the main twisting flow path 425 in the twisting operation based on the control signal. A control signal for opening/closing the valve is transmitted to the sub-twisting valve 428 of the twisting airflow supplying mechanism 42 in the twisting operation. The sub-twisting valve 428 opens/closes the sub-twisting flow path 426 in the twisting operation based on the control signal. According to such control, the twisting airflow for twisting the yarn ends YA, YB can be generated in the region (second region) slightly away from the middle of the air chamber 53 in the twisting operation at the twisting nozzle 73.

[0121] Next, with reference to FIG. 7 and FIG. 10, a case in which the operator operates the touch panel of the setting section 38 to select the entire region (third region) of the air chamber 53 as the region for generating the twisting airflow for twisting the yarn ends YA, YB will be described. In this case, the generating region of the twisting airflow for twisting the yarn ends YA, YB is determined as the entire region (third region) of the air chamber 53, which is set as the set twisting condition. The unit control section 36 controls the twisting airflow supplying mechanism 42 to drive the yarn splicing device 21 based on the set twisting condition.

[0122] Specifically, the unit control section 36 first transmits a control signal for opening/closing the valve with respect to the untwisting valve 418 of the untwisting airflow supplying mechanism 41 to perform the untwisting operation of the yarn ends YA, YB. The untwisting valve 418 opens/closes the untwisting flow path 416 in the untwisting operation based on the control signal. According to such control, the untwisting airflow for untwisting the yarn ends YA, YB of the yarn Y can be generated in the untwisting operation at the first untwisting nozzle 71 and the second untwisting nozzle 72.

[0123] The unit control section 36 transmits a control signal for opening/closing the valve at the same timing in the twisting operation to the main twisting valve 427 and the sub-twisting valve 428 of the twisting airflow supplying mechanism 42. The main twisting valve 427 and the sub-twisting valve 428 open/close the main twisting flow path 425 and the sub-twisting flow path 426 at the same timing in the twisting operation based on the control signal. According to such control, the twisting airflow for twisting the yarn ends YA, YB can be generated in the entire region (third region) of the air chamber 53 in the twisting operation at the twisting nozzle 73.

[0124] The yarn splicing device 21, the yarn winding

unit 11, and the automatic winder according to the present example described above have the following effects.

[0125] According to the yarn splicing device 21, the twisting airflow for twisting the yarn ends YA, YB can be generated in the generating region in accordance with the twisting condition of the yarn Y to be performed with the yarn splicing operation by the control on the twisting airflow supplying mechanism 42. Thus, even if the type of yarn Y is changed, the generating region of the twisting airflow to be generated at the twisting nozzle 73 can be selected and changed without replacing the component of the yarn splicing device 21.

[0126] According to the yarn splicing device 21, the plurality of twisting injection holes 54 are arranged, and the open/close control is performed on the main twisting valve 427 and the sub-twisting valve 428 to generate the twisting airflow for twisting the yarn ends YA, YB in the generating region in accordance with the twisting condition of the yarn Y to be performed with the yarn splicing operation. Thus, a simple configuration is obtained rather than a complex configuration of moving or opening/closing the injection hole itself.

[0127] According to the yarn splicing system 100, the setting section 38 for setting the set twisting condition, and the unit control section 36 for performing the open/close control on the main twisting valve 427 and the sub-twisting valve 428 based on the setting are provided. The twisting airflow for twisting the yarn ends YA, YB thus can be easily changed according to the setting. Thus, even if the type of yarn Y is changed, the generating region of the twisting airflow can be changed without performing a complicating operation or replacing the component of the yarn splicing device 21.

[0128] According to the yarn splicing system 100, the main twisting injection hole 543 and the sub-twisting injection hole 544, which generate the twisting airflow for twisting the yarn ends YA, YB in different generating regions when the type of yarn Y is changed, are arranged in the first air chamber and the second air chamber, respectively. Thus, even if the type of yarn Y is changed, the generating region of the twisting airflow can be selected and easily changed in accordance with the property of the yarn Y to be performed with the yarn splicing operation, whereby satisfactory twisting performance can be obtained.

[0129] According to the automatic winder, the main control section 37 includes a touch panel serving as the operation input unit that can be operated by the operator. Thus, the generating region of the twisting airflow can be collectively changed for the plurality of yarn winding units 11, which reduces the number of operations performed by the operator.

[0130] The embodiments of the present invention have been described above, but the present invention is not limited to the embodiments described above, and various modifications can be made.

[0131] For example, in the first example, the position of the untwisting airflow generated at the first untwisting nozzle 71 and the second untwisting nozzle 72, and the whirling direction of the twisting airflow generated at the twisting nozzle 73 can be selected and changed, and in the second example, the generating region of the untwisting airflow generated at the twisting nozzle 73 can be selected and changed, but these are not the only cases. For example, the position of the untwisting airflow generated at the first untwisting nozzle 71 and the second untwisting nozzle 72, and the whirling direction and the generating region of the twisting airflow generated at the twisting nozzle 73 may be selected and changed.

[0132] In the first example, the center lines of the first air chamber 531 and the second air chamber 532 are offset, but the center lines of the first air chamber 531 and the second air chamber 532 may be coincided with each other as in the second example. On the contrary, the center lines of the first air chamber 531 and the second air chamber 532 of the second example may be offset.

[0133] In the first example, the S twisting injection hole 541 and the Z twisting injection hole 542 are formed in one area each in the first air chamber 531 and the second air chamber 532, respectively, but the S twisting injection hole 541 and the Z twisting injection hole 542 may be formed in one area each in the air chamber 53 with the center lines of the first air chamber 531 and the second air chamber 532 coincided with each other.

[0134] In the second example, the main twisting injection hole 543 and the sub-twisting injection hole 544 are formed in one area each in the first air chamber 531 and the second air chamber 532, respectively, but the main twisting injection hole 543 and the sub-twisting injection hole 544 may be formed in one area each in the air chamber 53.

[0135] In the first example, the S airflow path 551 and the Z airflow path 552 are formed in the block 55, as illustrated in FIG. 5 and FIG. 6, with the S twisting flow path 421 connected to the S airflow path 551 and the Z twisting flow path 422 connected to the Z airflow path 552, but the S twisting flow path 421 and the Z twisting flow path 422 may be arranged in the block 55, as illustrated in FIG. 11A. In the second example, the main airflow path 553 and the sub-airflow path 554 are formed in the block 55, as illustrated in FIG. 8, FIG. 9, and FIG. 10, with the main twisting flow path 425 connected to the main airflow path 553 and the sub-twisting flow path 426 connected to the sub-airflow path 554, but the main twisting flow path 425 and the sub-twisting flow path 426 may be arranged in the block 55, as illustrated in FIG. 11B.

[0136] In the first example, the untwisting airflow supplying mechanism 41 is configured to include the S untwisting flow path 411, the Z untwisting flow path 412, the S untwisting valve 413, and the Z untwisting valve 414 on the downstream of the branched point 430, but is not limited to such configuration. For example, a branching valve may be arranged, a pre-branching electromagnetic valve for switching the conduction of the un-

twisting air may be arranged on the upstream of the branching valve, and the S untwisting flow path 411 and the Z untwisting flow path 412 may be arranged on the downstream branched by the branching valve. According to such configuration, the S untwisting valve 413 and the Z untwisting valve 414 of the first example can be intensively arranged in the single pre-branching electromagnetic valve. The branching valve described above may have a structure capable of being switched by electric control, or may adopt a mechanical switching mechanism of being manually switched by the operator. A branching conduction switching valve in which the branching valve and the pre-branching electromagnetic valve are integrally configured may be adopted.

[0137] In the first example, the twisting airflow supplying mechanism 42 is configured to include the S twisting flow path 421, the Z twisting flow path 422, the S twisting valve 423, and the Z twisting valve 424 on the downstream of the branched point 431, but is not limited to such configuration. For example, a branching valve may be arranged, a pre-branching electromagnetic valve for switching the conduction of the twisting air may be arranged on the upstream of the branching valve, and the S twisting flow path 421 and the Z twisting flow path 422 may be arranged on the downstream branched by the branching valve. According to such configuration, the S twisting valve 423 and the Z twisting valve 424 of the first example can be intensively arranged in the single pre-branching electromagnetic valve. The branching valve described above may have a structure capable of being switched by electric control, or may adopt a mechanical switching mechanism of being manually switched by the operator. A branching conduction switching valve in which the branching valve and the pre-branching electromagnetic valve are integrally configured may be adopted. Since the branching conduction switching valve can also be switched by an electric control, the generating region of the twisting airflow can be collectively changed, which reduces the number of operations performed by the operator.

Claims

1. A yarn splicing device (21) adapted to perform a yarn splicing operation of yarn ends, **characterized in that** the yarn splicing device (21) comprises:

   a twisting nozzle (73) configured to twist the yarn ends; and
   a twisting airflow supplying mechanism (42) configured to supply compressed air to generate a twisting airflow with respect to the twisting nozzle (73) and to switch a whirling direction of the twisting airflow and/or switch a generating region of the twisting airflow; wherein
   the twisting airflow supplying mechanism (42) is configured to be controlled such that the twisting airflow for twisting the yarn ends is generated in the whirling direction and/or the generating region in accordance with a twisting condition of the yarn to be performed with the yarn splicing operation.

2. The yarn splicing device (21) according to claim 1, **characterized in that** the twisting nozzle (73) includes a plurality of twisting injection holes (54) in accordance with the whirling direction and/or the generating region to generate the twisting airflow for twisting the yarn ends in different whirling directions and/or different generating regions;
   the twisting airflow supplying mechanism (42) includes:

   a twisting flow path (421, 422, 425, 426) adapted to supply the compressed air for each of the whirling directions of the twisting airflow and/or for each of the generating regions of the twisting airflow to generate the twisting airflow with respect to the plurality of twisting injection holes (54); and
   a twisting valve (423, 424, 427, 428) adapted to open/close the twisting flow path (421, 422, 425, 426) for each of the whirling directions of the twisting airflow and/or for each of the generating regions of the twisting airflow; and
   the twisting valve (423, 424, 427, 428) is configured to be controlled such that the twisting airflow for twisting the yarn ends is generated for each of the whirling directions and/or for each of the generating regions in accordance with the twisting condition of the yarn to be performed with the yarn splicing operation.

3. A yarn splicing system (100) comprising:

   the yarn splicing device (21) according to claim 1;
   a setting section (38) adapted to set a whirling direction of a twisting airflow for twisting yarn ends and/or a generating region of the twisting airflow in accordance with a twisting condition of the yarn to be performed with a yarn splicing operation as a set twisting condition; and
   a control section (36) adapted to perform a control on the twisting airflow supplying mechanism (42) based on the set twisting condition set by the setting section (38).

4. A yarn splicing system (100) comprising:

   the yarn splicing device (21) according to claim 2;
   a setting section (38) adapted to set a whirling direction of a twisting airflow for twisting yarn ends and/or a generating region of the twisting

airflow in accordance with a twisting condition of the yarn to be performed with a yarn splicing operation as a set twisting condition; and
a control section (36) adapted to perform an open/close control on the twisting valve (423, 424, 427, 428) based on the set twisting condition set by the setting section (38).

5. The yarn splicing system (100) according to claim 4, **characterized in that**
the twisting nozzle (73) includes:

an air chamber (53) in which the plurality of twisting injection holes (54) are formed on a circumferential surface; and
the plurality of twisting injection holes (54) include a main twisting injection hole (543) and a sub-twisting injection hole (544) adapted to generate the twisting airflow for twisting the yarn ends in different generating regions.

6. The yarn splicing system (100) according to claim 5, **characterized in that**
the air chamber (53) of the twisting nozzle (73)comprises a first air chamber (531) adapted to whirl a yarn end of at least one yarn and a second air chamber (532) adapted to whirl a yarn end of at least the other yarn, the center lines of the first air chamber (531) and the second air chamber (532) being offset; and
the first air chamber (531) and the second air chamber (532) respectively have the main twisting injection hole (543) and the sub-twisting injection hole (544) formed side by side in an axial direction of the air chamber (53).

7. The yarn splicing system (100) according to claim 4, **characterized in that** the twisting nozzle (73) includes an air chamber (53) in which the plurality of twisting injection holes (54) are formed on a circumferential surface; and
the plurality of twisting injection holes (54) include an S twisting injection hole (541) adapted to generate a twisting airflow for twisting the yarn ends of a yarn of S twist and a Z twisting injection hole (542) adapted to generate a twisting airflow for twisting the yarn ends of a yarn of Z twist.

8. The yarn splicing system (100) according to claim 7, **characterized in that** the air chamber (53) of the twisting nozzle (73) comprises a first air chamber (531) adapted to whirl a yarn end of at least one yarn and a second air chamber (532) adapted to whirl a yarn end of at least the other yarn, the center lines of the first air chamber (531) and the second air chamber (532) being offset; and
the first air chamber (531) and the second air chamber (532) respectively have an S twisting injection hole (541) and a Z twisting injection hole (542) formed side by side on the same circumference.

9. The yarn splicing system (100) according to any one of claims 3 to 8, **characterized in that**
the yarn splicing device (21) includes:

an untwisting nozzle (71, 72) adapted to generate untwisting airflow for untwisting each yarn end at different positions to prepare for the twisting of the yarn ends by the twisting nozzle (73); and
an untwisting airflow supplying mechanism (41) configured to supply compressed air to the untwisting nozzle (71, 72) and to switch a generating position of the untwisting airflow; and
the untwisting airflow for untwisting the yarn ends is generated at a position in accordance with untwisting condition of the yarn to be performed with the yarn splicing operation by a control on the untwisting airflow supplying mechanism (41).

10. A textile machine comprising:

the yarn splicing system (100) according to any one of claims 3 to 9;
a plurality of yarn winding devices (11); and
a main control section (37) adapted to control the plurality of yarn winding devices (11); **characterized in that**
the yarn splicing device (21) and the control section (36) are installed in the yarn winding device (11);
the main control section (37) includes:

the setting section (38); and
the setting section (38) includes an operation input unit operable by an operator.

FIG. 1

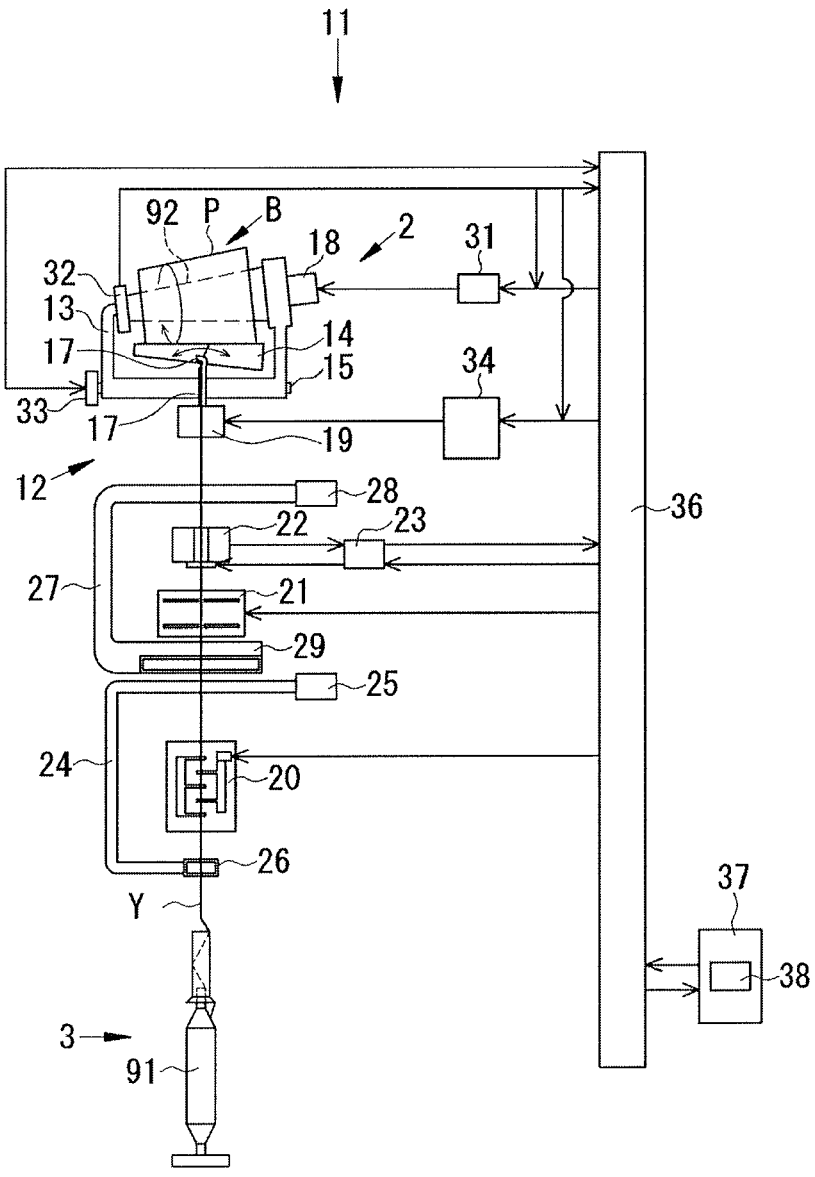

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FIG. 2

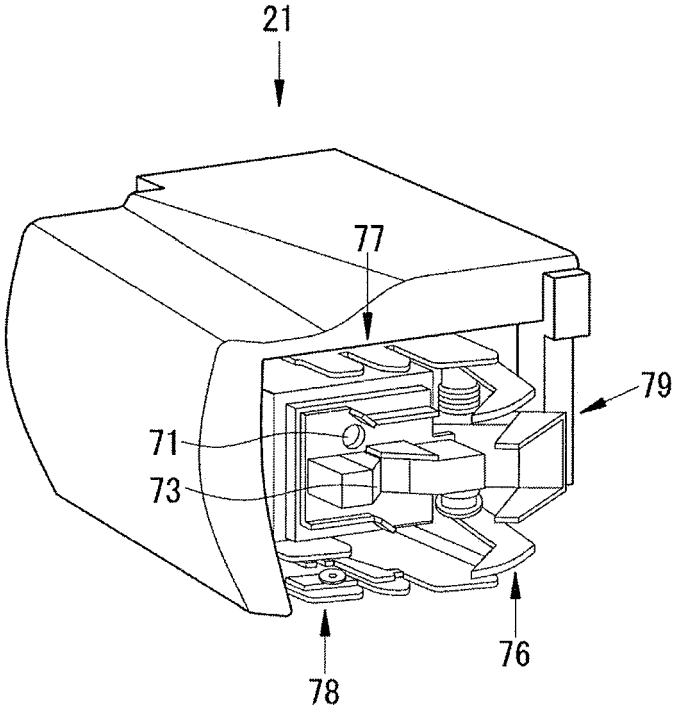

FIG. 3

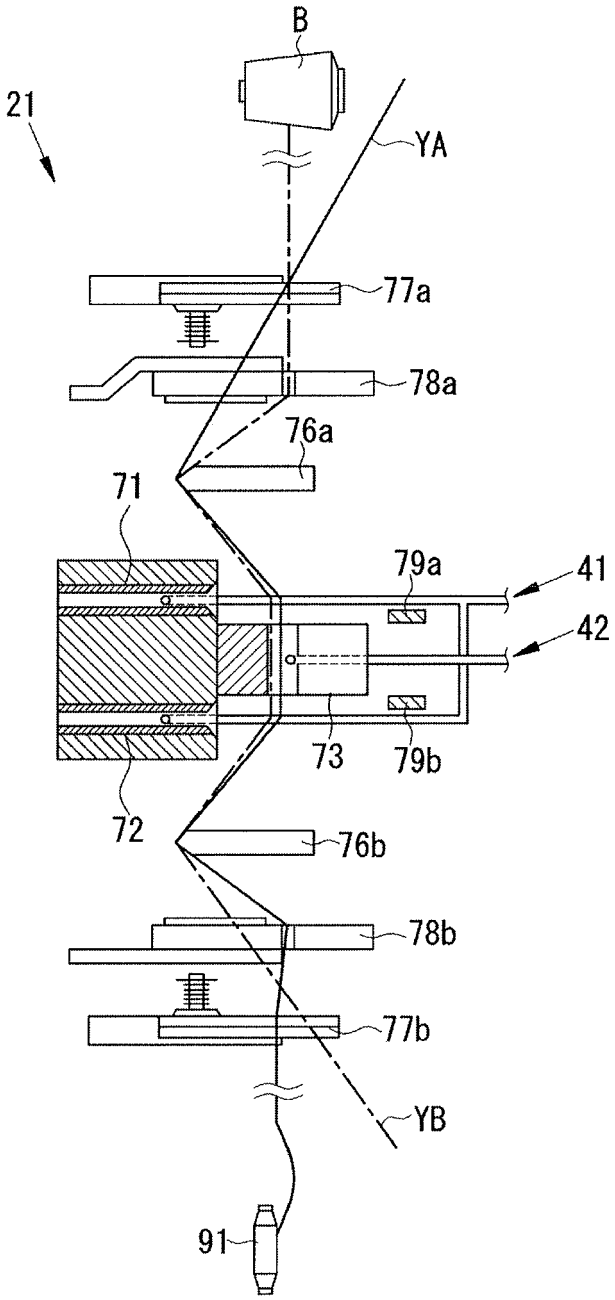

FIG. 4

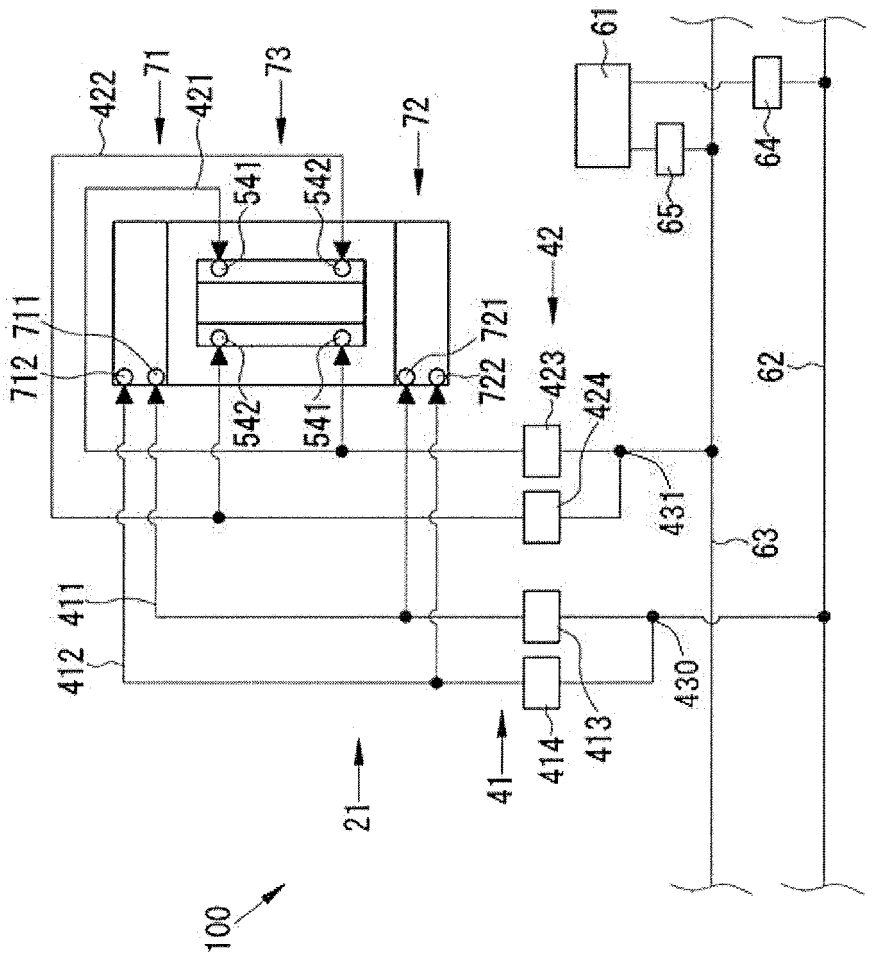
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FIG. 5A

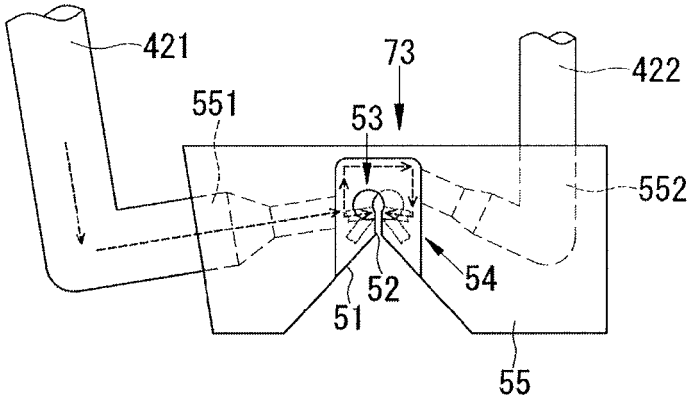


FIG. 5B

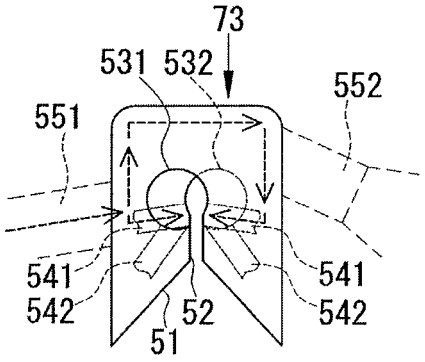


FIG. 5C

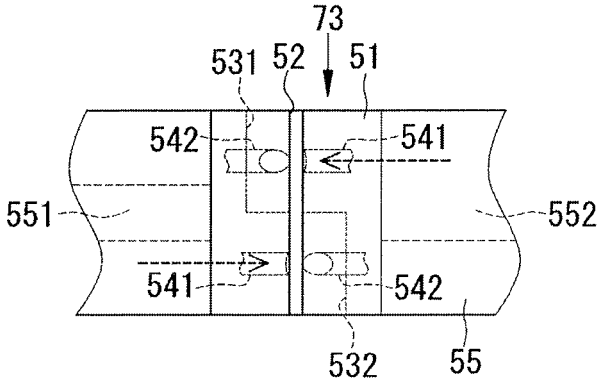


FIG. 6A

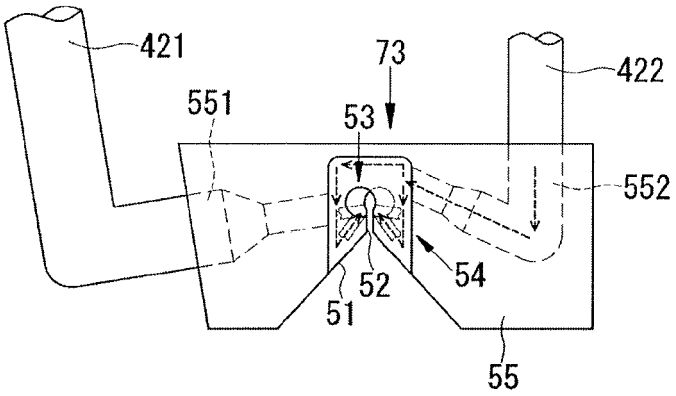


FIG. 6B

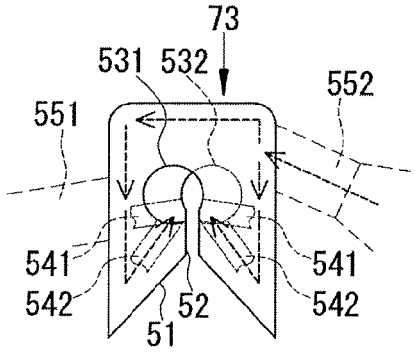


FIG. 6C

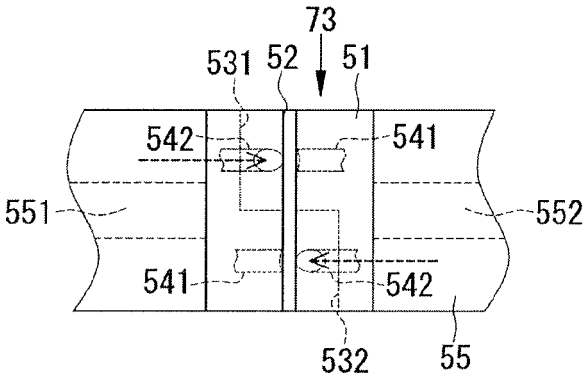
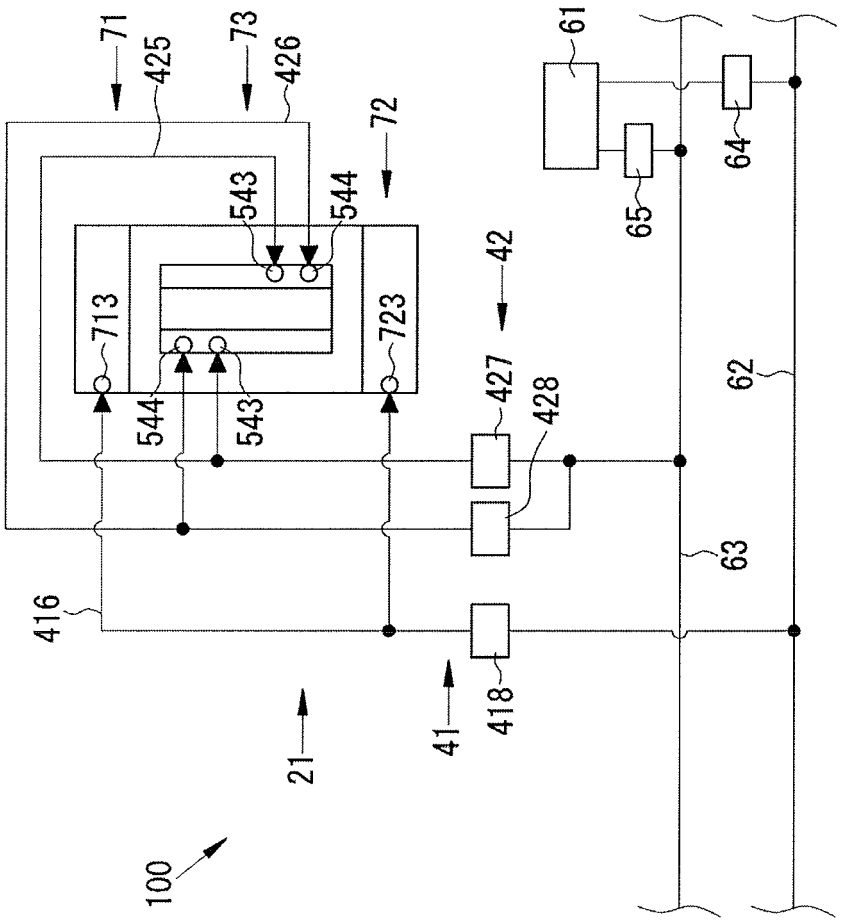


FIG. 7


71
425
73
426
72
543
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713
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543
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FIG. 8A

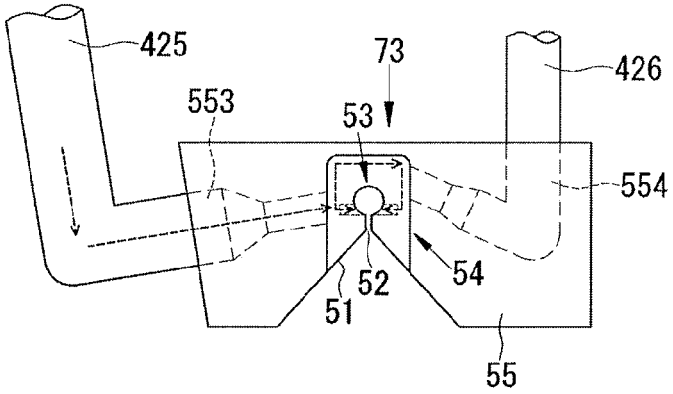


FIG. 8B

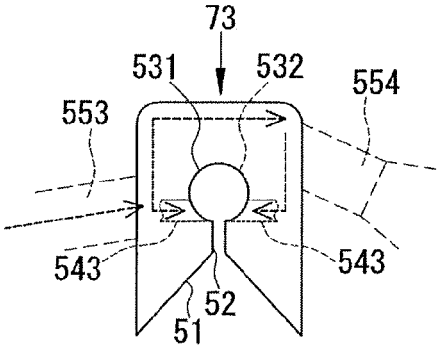


FIG. 8C

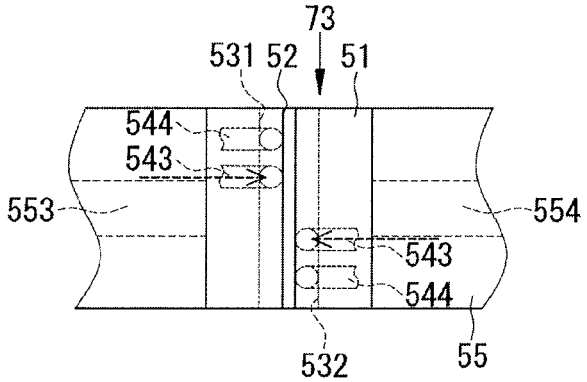


FIG. 9A

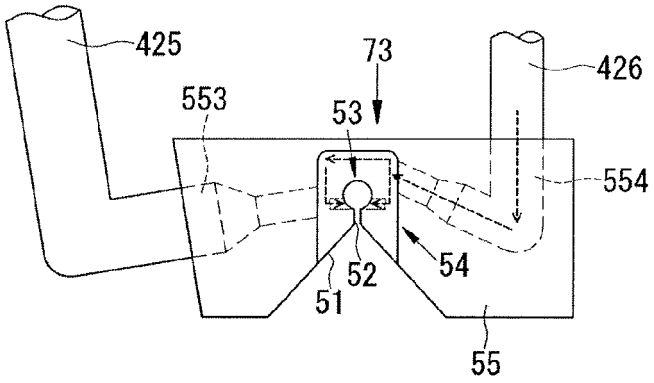


FIG. 9B

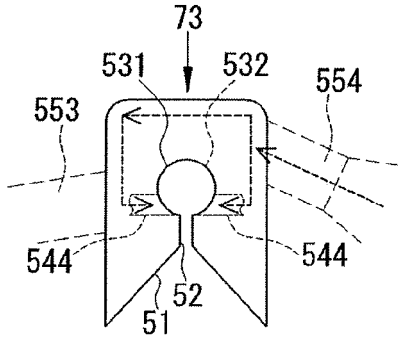


FIG. 9C

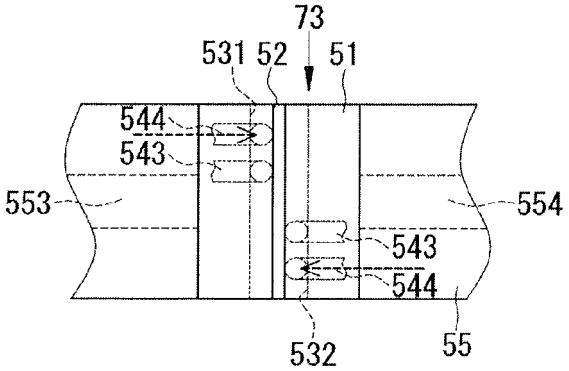


FIG. 10A

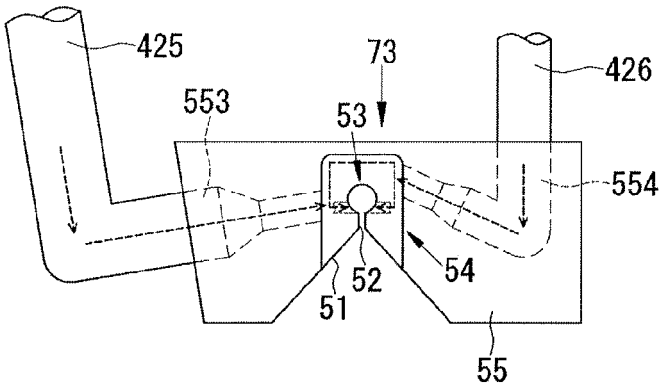


FIG. 10B

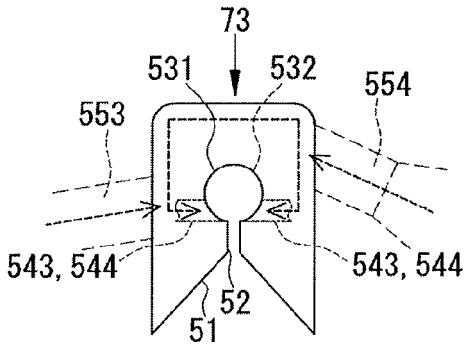


FIG. 10C

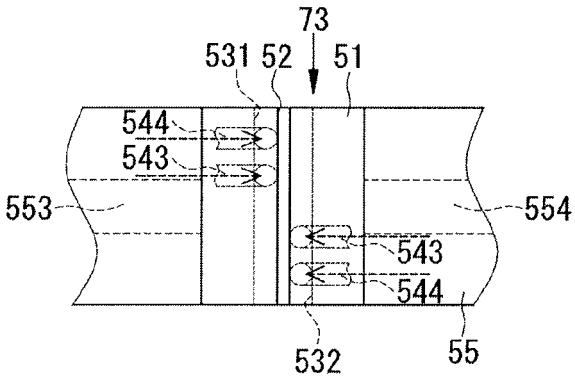


FIG. 11A

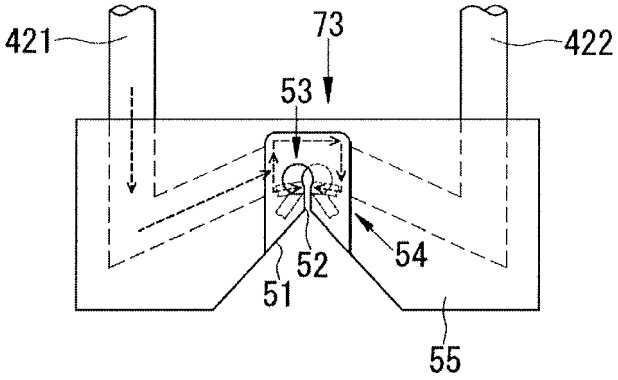
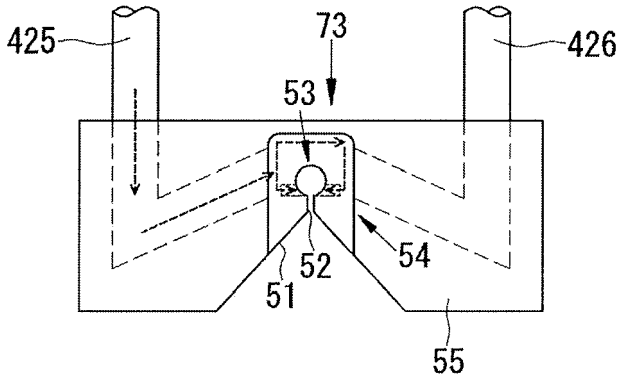


FIG. 11B



REFERENCES CITED IN THE DESCRIPTION

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- JP 3064433 A **[0004] [0009]**
- JP 62003741 A **[0063] [0064]**