



(11) **EP 3 115 485 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.01.2017 Bulletin 2017/02

(51) Int Cl.:
D01H 1/115 (2006.01)

(21) Application number: **16172580.9**

(22) Date of filing: **02.06.2016**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **06.07.2015 JP 2015134968**

(71) Applicant: **Murata Machinery, Ltd.**
Minami-ku
Kyoto-shi
Kyoto 601-8326 (JP)

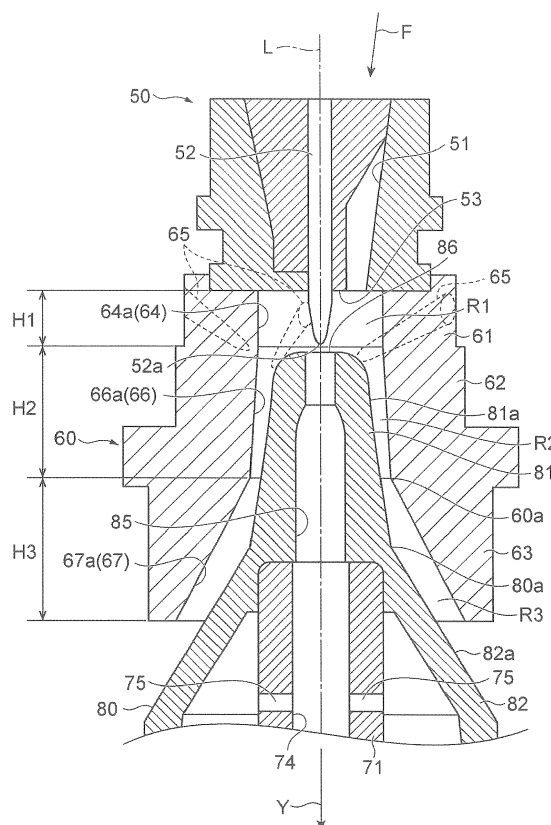
(72) Inventor: **MORITA, Akihiro**
Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Jordan, Volker Otto Wilhelm et al**
Weickmann & Weickmann
Patentanwälte PartmbB
Postfach 860 820
81635 München (DE)

(54) **NOZZLE BLOCK, PNEUMATIC SPINNING DEVICE, AND SPINNING MACHINE**

(57) In a nozzle block (60), a first space (64), a second space (66), and a third space (67) are aligned from a first side toward a second side in a predetermined direction. The second space (66) is spread at a second inner surface tapered angle from the first side toward the second side. The third space (67) is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side. A height (H1) of the first space (64) is a value greater than or equal to 3 mm and smaller than or equal to 8 mm. A height (H2) of the second space (66) is a value greater than or equal to 30% and smaller than or equal to 50% of a sum of the height (H2) and a height (H3) of the third space (67).

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a nozzle block, a pneumatic spinning device, and a spinning machine.

2. Description of the Related Art

[0002] There has been known a pneumatic spinning device including a nozzle block adapted to apply twists on an introduced fiber with whirling airflow, and a hollow guide shaft body unit including a fiber introducing port to which the fiber applied with twist is introduced, and a passage that guides the fiber introduced from the fiber introducing port to the outside (see e.g., JP 2009-001935 A and JP 2003-193339 A).

[0003] The pneumatic spinning device is desired both to ensure stable winding property (degree of twists applied on the fiber) and to enhance the spinning speed (generating speed of yarn).

[0004] However, when attempting to realize both the demands, the tension applied on the yarn sometimes becomes too high depending on the type of fiber.

BRIEF SUMMARY OF THE INVENTION

[0005] It is thus an object of the present invention to provide a nozzle block, a pneumatic spinning device, and a spinning machine capable of realizing both the ensuring of stable winding property and the enhancement of the spinning speed while suppressing the generation of high tension at the yarn.

[0006] A nozzle block of the present invention includes: a first block portion including a first space, to which a fiber is introduced, and a plurality of first nozzles, through which air injected to generate whirling airflow is passed; a second block portion including a second space, through which the air from the first space is passed; and a third block portion including a third space, through which the air from the second space is passed. The first space, the second space, and the third space are aligned from a first side toward a second side in a predetermined direction. The second space is spread at a second inner surface tapered angle from the first side toward the second side. The third space is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side. A height of the first space in the predetermined direction is a value greater than or equal to 3 mm and smaller than or equal to 8 mm. A height of the second space in the predetermined direction is a value greater than or equal to 30% and smaller than or equal to 50% of a sum of the height of the second space in the predetermined direction and a height of the third space in the predetermined direction.

[0007] As the height of the first space in the predetermined direction is greater than or equal to 3 mm and smaller than or equal to 8 mm, both the ensuring of stable winding property and the enhancement of spinning speed can be realized. As the height of the second space in the predetermined direction is a value greater than or equal to 30% and smaller than or equal to 50% of a sum of the height of the second space in the predetermined direction and the height of the third space in the predetermined direction, generation of high tension can be suppressed at the yarn.

[0008] In the nozzle block of the present invention, the first space may be spread at a first inner surface tapered angle smaller than the second inner surface tapered angle from the first side toward the second side. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be more reliably realized.

[0009] In the nozzle block of the present invention, the number of plurality of first nozzles may be five. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be more reliably realized.

[0010] A pneumatic spinning device of the present invention includes: a nozzle block, to which a fiber is introduced; and a hollow guide shaft body unit including a fiber introducing port, to which the fiber introduced to the nozzle block is introduced, and a passage adapted to guide the fiber introduced to the fiber introducing port to outside. The nozzle block includes a first block portion including a first space, to which the fiber is introduced, and a plurality of first nozzles, through which air injected to generate whirling airflow is passed, a second block portion including a second space, through which the air from the first space is passed, and a third block portion including a third space, through which the air from the second space is passed. The first space, the second space, and the third space are aligned from a first side toward a second side in a predetermined direction. The second space is spread at a second inner surface tapered angle from the first side toward the second side. The third space is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side. The hollow guide shaft body unit includes a first shaft body portion disposed across the second space and the third space, and a second shaft body portion disposed across the third space and a region on the second side with respect to the third space. The first shaft body portion and the second shaft body portion are aligned from the first side toward the second side, the first shaft body portion is spread at a first outer surface tapered angle from the first side toward the second side, the second shaft body portion is spread at a second outer surface tapered angle greater than the first outer surface tapered angle from the first side toward the second side, and a distance between an end on the first side of the first shaft body portion and a virtual plane formed by a boundary between the second space and the third space is a value greater than or equal to 3 mm

and smaller than or equal to 9 mm.

[0011] According to the pneumatic spinning device, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized while suppressing the generation of high tension at the yarn.

[0012] A pneumatic spinning device of the present invention includes: a nozzle block, to which a fiber is introduced; and a hollow guide shaft body unit including a fiber introducing port, to which the fiber introduced to the nozzle block is introduced, a passage adapted to guide the fiber introduced to the fiber introducing port to outside, and a second nozzle, through which air injected to the passage is passed. The nozzle block includes a first block portion including a first space, to which the fiber is introduced, and a plurality of first nozzles, through which air injected to generate whirling airflow is passed, a second block portion including a second space, through which the air from the first space is passed, and a third block portion including a third space, through which the air from the second space is passed. The first space, the second space, and the third space are aligned from a first side toward a second side in a predetermined direction. The second space is spread at a second inner surface tapered angle from the first side toward the second side. The third space is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side. The hollow guide shaft body unit includes a first shaft body portion disposed across the second space and the third space, and a second shaft body portion disposed across the third space and a region on the second side with respect to the third space. The first shaft body portion and the second shaft body portion are aligned from the first side toward the second side. The first shaft body portion is spread at a first outer surface tapered angle from the first side toward the second side, and the second shaft body portion is spread at a second outer surface tapered angle greater than the first outer surface tapered angle from the first side toward the second side.

[0013] According to the pneumatic spinning device, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized while suppressing the generation of high tension at the yarn. In particular, at the start of the spinning operation, when the air is injected from the plurality of first nozzles into the nozzle block and the air is injected from the second nozzle into the passage, the generation of high tension can be suppressed at the fiber bundle even while applying sufficient temporary twist on the fiber bundle so that the fiber bundle can be reliably drawn into the pneumatic spinning device.

[0014] In the pneumatic spinning device of the present invention, the distance between the end on the first side of the first shaft body portion and the virtual plane formed by the boundary between the second space and the third space may be a value greater than or equal to 3 mm and smaller than or equal to 9 mm. Thus, the generation of high tension can be suppressed at the yarn.

[0015] The pneumatic spinning device of the present invention may further include a fiber guiding section adapted to guide the fiber to the first space. Thus, the fiber can be reliably guided to the first space.

[0016] In the pneumatic spinning device of the present invention, the distance between the end face exposed to the first space in the fiber guiding section and the end on the first side of the first shaft body portion is a value greater than or equal to 2 mm and smaller than or equal to 8 mm. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized.

[0017] A spinning machine of the present invention includes: the pneumatic spinning device; a winding device adapted to wind a yarn produced by the pneumatic spinning device to form a package; and a measuring device adapted to measure a tension of the yarn between the pneumatic spinning device and the winding device.

[0018] According to the pneumatic spinning device, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized while suppressing the generation of high tension at the yarn. Since the tension of the yarn is measured, for example, whether or not the tension of the yarn Y is appropriate can be checked.

[0019] The spinning machine of the present invention may further include a display section adapted to display a value of the tension measured by the measuring device. The value of the tension of the yarn thus can be notified to the operator.

[0020] According to the present invention, a nozzle block, a pneumatic spinning device, and a spinning machine capable of realizing both the ensuring of stable winding property and the enhancement of the spinning speed while suppressing the generation of high tension at the yarn can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a front view illustrating a spinning machine according to one embodiment of the present invention;

[0022] FIG. 2 is a side view illustrating a spinning unit of the spinning machine in FIG. 1;

FIG. 3 is a cross-sectional view illustrating a pneumatic spinning device of the spinning unit in FIG. 2; and

[0023] FIG. 4 is a cross-sectional view illustrating one part of the pneumatic spinning device in FIG. 3.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0022] An embodiment of the present invention will be hereinafter described in detail with reference to the accompanying drawings. The same reference numerals

are denoted on the same or corresponding portions throughout the drawings, and redundant description will be omitted.

[0023] As illustrated in FIG. 1, a spinning machine 1 includes a plurality of spinning units 2, a yarn joining cart 3, a doffing cart (not illustrated), a first end frame 4, and a second end frame 5. The plurality of the spinning units 2 are arranged in a row. Each of the spinning units 2 is adapted to produce a yarn Y and to wind the yarn Y around a package P. The yarn joining cart 3 is adapted to perform a yarn joining operation in a spinning unit 2 after the yarn Y is cut, or the yarn Y is broken for some reason in such a spinning unit 2. The doffing cart is adapted to doff the package P and to supply a new bobbin B to the spinning unit 2 when the package P is fully-wound in a spinning unit 2.

[0024] The first end frame 4 accommodates, for example, a collecting device adapted to collect a fiber waste, a yarn waste, and the like generated in the spinning units 2. The second end frame 5 accommodates an air supplying section adapted to adjust air pressure of compressed air (air) to be supplied to the spinning machine 1 and to supply the air to each section of the spinning machine 1, a drive motor adapted to supply power to each section of the spinning unit 2, and the like. The second end frame 5 is provided with a machine control device 41, a display screen (display section) 42, and input keys 43. The machine control device 41 is adapted to intensively manage and control each section of the spinning machine 1. The display screen 42 is capable of displaying information relating to set contents and/or status, or the like of the spinning units 2. An operator can perform a setting operation of the spinning units 2 by performing an appropriate operation with the input keys 43.

[0025] As illustrated in FIGS. 1 and 2, each spinning unit 2 includes a draft device 6, a pneumatic spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn storage device 11, a waxing device 12, and a winding device 13 in this order from upstream in a travelling direction of the yarn Y. A unit controller 10 is provided for every predetermined number of the spinning units 2 and is adapted to control operations of the spinning units 2.

[0026] The draft device 6 is adapted to draft a sliver (fiber bundle) S. The draft device 6 includes a pair of back rollers 14, a pair of third rollers 15, a pair of middle rollers 16, and a pair of front rollers 17 in this order from upstream in a travelling direction of the sliver S. Each pair of rollers 14, 15, 16, and 17 includes a bottom roller and a top roller. The bottom roller is rotationally driven by the drive motor provided in the second end frame 5 or by a drive motor provided in each spinning unit 2. An apron belt 18a is provided with respect to the bottom roller of the middle rollers 16. An apron belt 18b is provided with respect to the top roller of the middle rollers 16.

[0027] The pneumatic spinning device 7 is adapted to produce the yarn Y by twisting a fiber bundle (fiber) F, which has been drafted by the draft device 6, with whirling

airflow.

[0028] The yarn monitoring device 8 is adapted to monitor information on the travelling yarn Y between the pneumatic spinning device 7 and the yarn storage device 11, and to detect presence or absence of a yarn defect based on the information acquired by the monitoring. When detecting the yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The yarn monitoring device 8 detects as the yarn defect, for example, an abnormality in thickness of the yarn Y and/or a foreign substance in the yarn Y. The yarn monitoring device 8 also detects a yarn breakage or the like. The tension sensor (measuring device) 9 is adapted to measure tension of the travelling yarn Y between the pneumatic spinning device 7 and the winding device 13, preferably between the pneumatic spinning device 7 and the yarn storage device 11, and to transmit a tension measurement signal to the unit controller 10. When the unit controller 10 determines a presence of an abnormality based on a detection result of the yarn monitoring device 8 and/or the tension sensor 9, the yarn Y is cut in the spinning unit 2. Specifically, by stopping air supply to the pneumatic spinning device 7 to interrupt the production of the yarn Y, the yarn Y is cut. Alternatively, the yarn Y may be cut with a cutter separately provided.

[0029] The waxing device 12 is adapted to apply wax to the yarn Y between the yarn storage device 11 and the winding device 13.

[0030] The yarn storage device 11 is adapted to eliminate a slack of the yarn Y between the pneumatic spinning device 7 and the winding device 13. The yarn storage device 11 has a function of stably feeding the yarn Y from the pneumatic spinning device 7, a function of preventing the yarn Y from slackening by accumulating the yarn Y fed from the pneumatic spinning device 7 at the time of the yarn joining operation or the like by the yarn joining cart 3, and a function of preventing variation in the tension of the yarn Y downstream of the yarn storage device 11 from being propagated to the pneumatic spinning device 7.

[0031] The winding device 13 is adapted to wind the yarn Y around a bobbin B to form a package P. The winding device 13 includes a cradle arm 21, a winding drum 22 and a traverse guide 23. The cradle arm 21 is adapted to rotatably support the bobbin B. The cradle arm 21 is swingably supported by a support shaft 24 and is adapted to bring a surface of the bobbin B or a surface of the package P into contact with a surface of the winding drum 22 under appropriate pressure. A drive motor (not illustrated) provided in the second end frame 5 is adapted to simultaneously drive the winding drums 22 each provided in the plurality of the spinning units 2. Accordingly, in each spinning unit 2, the bobbin B or the package P is rotated in a winding direction. The traverse guide 23 of each spinning unit 2 is provided on a shaft 25 shared by the plurality of the spinning units 2. By the drive motor in the second end frame 5 driving the shaft 25 to reciprocate

in a direction of a rotational axis of the winding drum 22, the traverse guide 23 traverses the yarn Y in a predetermined width with respect to the rotating bobbin B or package P.

[0032] After the yarn Y is cut, or is broken for some reason in a spinning unit 2, the yarn joining cart 3 travels to such a spinning unit 2 to perform the yarn joining operation. The yarn joining cart 3 includes a yarn joining device 26, a suction pipe 27 and a suction mouth 28. The suction pipe 27 is swingably supported by a support shaft 31, and is adapted to catch the yarn Y from the pneumatic spinning device 7 and to guide the caught yarn Y to the yarn joining device 26. The suction mouth 28 is swingably supported by a support shaft 32, and is adapted to catch the yarn Y from the winding device 13 and to guide the caught yarn Y to the yarn joining device 26. The yarn joining device 26 is adapted to join the guided yarns Y together. The yarn joining device 26 is a splicer using compressed air, a piecer using a seed yarn, a knotter adapted to join the yarns Y together in a mechanical manner, or the like.

[0033] When the yarn joining cart 3 performs the yarn joining operation, the package P is rotated in an unwinding direction (reversely rotated). At this time, the cradle arm 21 is moved by an air cylinder (not illustrated) such that the package P is located away from the winding drum 22, and the package P is reversely rotated by a reversely-rotating roller (not illustrated) provided in the yarn joining cart 3.

[0034] The configuration of the pneumatic spinning device 7 will be described more specifically with reference to FIGS. 3 and 4. In the following description, upstream and downstream in a travelling direction of the fiber bundle F and the yarn Y are respectively referred to as "upstream" and "downstream" simply.

[0035] As illustrated in FIG. 3, the pneumatic spinning device 7 includes a fiber guiding section 50, a nozzle block 60, and a hollow guide shaft body unit 70. The fiber guiding section 50, the nozzle block 60, and the hollow guide shaft body unit 70 are aligned on a line L from a first side (i.e., upstream) toward a second side (i.e., downstream) in a direction (predetermined direction) along the line L.

[0036] The fiber guiding section 50 includes a guiding hole 51 adapted to guide the fiber bundle F supplied from the draft device 6. The fiber guiding section 50 is provided with a needle 52 disposed along the line L such that a distal end portion 52a is located downstream.

[0037] In a space formed between the nozzle block 60 and the hollow guide shaft body unit 70, the pneumatic spinning device 7 applies twist on the fiber bundle F guided from the fiber guiding section 50 with the whirling airflow. The nozzle block 60 includes a first block portion 61, a second block portion 62, and a third block portion 63. The first block portion 61, the second block portion 62, and the third block portion 63 are aligned from upstream toward downstream and are, for example, integrally formed. The fiber guiding section 50 is disposed

at an end on a first side of the first block portion 61.

[0038] The first block portion 61 includes a first space 64, to which the fiber bundle F is introduced, and a plurality of first nozzles 65 through which air injected to generate the whirling airflow is passed. The plurality of first nozzles 65 are, for example, provided at an equiangular interval around the line L. The number of first nozzles 65 is five. The second block portion 62 includes a second space 66 through which the air from the first space 64 is passed. The third block portion 63 includes a third space 67 through which the air from the second space 66 is passed. An opening on the first space 64 side of each first nozzle 65 is located at a boundary between the first block portion 61 and the second block portion 62. That is, the first block portion 61 includes at least a part of each first nozzle 65. The opening on the first space 64 side of each first nozzle 65 may be located in the first block portion 61 or may be located in the second block portion 62.

[0039] As illustrated in FIG. 4, the first space 64, the second space 66, and the third space 67 are aligned from the upstream toward the downstream, and are formed continuously. The first space 64 is a circular truncated cone shaped space that spreads from the upstream toward the downstream at a first inner surface tapered angle and that has the line L as a center line. The second space 66 is a circular truncated cone shaped space that spreads from the upstream toward the downstream at a second inner surface tapered angle and that has the line L as a center line. The third space 67 is a circular truncated cone shaped space that spreads from the upstream toward the downstream at a third inner surface tapered angle and that has the line L as a center line.

[0040] Focusing on a virtual plane including the line L, the first inner surface tapered angle is an angle formed by two intersecting lines of an inner surface 64a defining the first space 64 and the virtual plane. Focusing on a virtual plane including the line L, the second inner surface tapered angle is an angle formed by two intersecting lines of an inner surface 66a defining the second space 66 and the virtual plane. Focusing on a virtual plane including the line L, the third inner surface tapered angle is an angle formed by two intersecting lines of an inner surface 67a defining the third space 67 and the virtual plane. The third inner surface tapered angle is greater than the second inner surface tapered angle, and the second inner surface tapered angle is greater than the first inner surface tapered angle. The angles mentioned above are angles smaller than 180 degrees. When the intersecting lines are curved lines, the lines are approximated to a straight line.

[0041] A height H1 of the first space 64 in the direction along the line L is a value greater than or equal to 3 mm and smaller than or equal to 8 mm. A height H2 of the second space 66 in the direction along the line L is a value greater than or equal to 30% and smaller than or equal to 50% of a sum of the height H2 of the second space 66 in the direction along the line L and a height

H3 of the third space 67 in a direction along the line L. For example, the sum of the height H2 and the height H3 is a value greater than or equal to 8 mm and smaller than or equal to 18 mm. The height H1 of the first space 64 is a distance (hereinafter when simply referred to as "distance", this means "distance in the direction along the line L") between a virtual plane including a contacting surface with the fiber guiding section 50 in the nozzle block 60, and a virtual plane formed by a downstream end of the first space 64 (boundary between the first space 64 and the second space 66, the boundary formed on the inner surface of the nozzle block 60). The height H2 of the second space 66 is a distance between a virtual plane formed by an upstream end of the second space 66 (boundary between the first space 64 and the second space 66, the boundary formed on the inner surface of the nozzle block 60), and a virtual plane formed by a downstream end of the second space 66 (boundary 60a between the second space 66 and the third space 67, the boundary 60a formed on the inner surface on the nozzle block 60). The height H3 of the third space 67 is a distance between a virtual plane formed by an upstream end of the third space 67 (boundary 60a between the second space 66 and the third space 67, the boundary 60a formed on the inner surface of the nozzle block 60), and a virtual plane including an end face on the downstream of the nozzle block 60.

[0042] A distance between an end face 53 exposed to the first space 64 in the fiber guiding section 50 and the upstream end of a first shaft body portion 81 is a value greater than or equal to 2 mm and smaller than or equal to 8 mm. A distance between the upstream end of the first shaft body portion 81 and a virtual plane formed by the boundary 60a between the second space 66 and the third space 67 is a value greater than or equal to 3 mm and smaller than or equal to 9 mm.

[0043] As illustrated in FIG. 3, the hollow guide shaft body unit 70 includes a hollow guide shaft body 80, a guiding pipe 71, a supporting member 72, and a fixing member 73.

[0044] The hollow guide shaft body 80 includes a first shaft body portion 81, a second shaft body portion 82, and a third shaft body portion 83. The first shaft body portion 81, the second shaft body portion 82, and the third shaft body portion 83 are aligned from upstream toward downstream and are, for example, integrally formed by ceramic. A flange 83a is provided at the downstream end of the third shaft body portion 83.

[0045] The first shaft body portion 81 is provided with a fiber introducing path 85 opened toward the inner side of the hollow second shaft body portion 82 and the third shaft body portion 83. The opening on the upstream of the fiber introducing path 85 is a fiber introducing port 86 to which the fiber bundle F introduced to the nozzle block 60 is introduced.

[0046] The guiding pipe 71 is provided with a passage 74 adapted to guide the fiber bundle F introduced to the fiber introducing port 86 to the outside. The passage 74

is opened toward the upstream and the downstream on the line L. The downstream inner diameter of the passage 74 is greater than the upstream inner diameter of the passage 74. A plurality of second nozzles 75, through which the air injected into the passage 74 is passed, is provided at the upstream end of the guiding pipe 71. The plurality of second nozzles 75 are, for example, disposed at an equiangular interval around the line L.

[0047] The supporting member 72 is provided with an accommodation hole 76 opened toward the upstream and a yarn deriving path 77 opened toward the upstream and the downstream. The upstream end of the yarn deriving path 77 is connected to the downstream end of the accommodation hole 76. The inner diameter of the yarn deriving path 77 is substantially equal to the inner diameter of the portion on the downstream of the passage 74 of the guiding pipe 71, and is smaller than the inner diameter of the accommodation hole 76. An air supplying tube 78 communicating with the accommodation hole 76 is attached to the supporting member 72. A male screw 72a is formed at the upstream end of the supporting member 72.

[0048] The fixing member 73 is a cap-shaped nut including a flange 73a. In the hollow guide shaft body unit 70, the guiding pipe 71 is disposed in the accommodation hole 76 of the supporting member 72, and the hollow guide shaft body 80 is disposed at the upstream end of the supporting member 72 so as to cover the upstream end of the guiding pipe 71. Thus, the fiber introducing path 85 of the hollow guide shaft body 80 and the passage 74 of the guiding pipe 71 are connected, and the passage 74 of the guiding pipe 71 and the yarn deriving path 77 of the supporting member 72 are connected. Under such a state, the fixing member 73 is screw fitted to the male screw 72a of the supporting member 72 while engaging the flange 83a of the hollow guide shaft body 80.

[0049] As illustrated in FIG. 4, the first shaft body portion 81 is a circular truncated cone shaped portion that spreads from the upstream toward the downstream at a first outer surface tapered angle and that has the line L as a center line. The second shaft body portion 82 is a circular truncated cone shape portion that spreads from the upstream toward the downstream at a second outer surface tapered angle and that has the line L as a center line. The first shaft body portion 81 is a portion downstream of the upstream end of the hollow guide shaft body 80. This upstream end is a portion where the upstream opening of the fiber introducing port 86 is provided, and is a rounded portion.

[0050] Focusing on a virtual plane including the line L, the first outer surface tapered angle is an angle formed by two intersecting lines of an outer surface 81a of the first shaft body portion 81 and the virtual plane. Focusing on a virtual plane including the line L, the second outer surface tapered angle is an angle formed by two intersecting lines of an outer surface 82a of the second shaft body portion 82 and the virtual plane. The second outer surface tapered angle is greater than the first outer sur-

face tapered angle. The angles mentioned above are angles smaller than 180 degrees. When the intersecting lines are curved lines, the lines are approximated to a straight line.

[0051] The first shaft body portion 81 is disposed across the second space 66 and the third space 67 with respect to the nozzle block 60. The second shaft body portion 82 is disposed across the third space 67 and a region (exterior to the third space 67) downstream of the third space 67 with respect to the nozzle block 60. That is, the boundary 60a at which the inner surface angle is switched, the boundary 60a provided between the second space 66 and the third space 67, is located upstream of the boundary 80a at which the outer surface tapered angle is switched, the boundary 80a provided between the first shaft body portion 81 and the second shaft body portion 82.

[0052] Thus, the first space 64 functions as an inverting region R1 of inverting the fiber guided by the fiber guiding section 50. A region surrounded by the inner surface 66a and the outer surface 81a of the first shaft body portion 81 in the second space 66 functions as a whirling region R2 of whirling the inverted fiber. A region surrounded by the inner surface 67a and the outer surface 81a of the first shaft body portion 81 and the outer surface 82a of the second shaft body portion 82 in the third space 67 functions as an exhausting region R3 discharging the air injected from the plurality of first nozzles 65 and passed through the inverting region R1 and the whirling region R2. In the pneumatic spinning device 7, the flange 73a of the fixing member 73 is brought into contact with a holder (not illustrated) supporting the nozzle block 60 during the spinning operation to maintain the position relationship described above.

[0053] The spinning operation of the pneumatic spinning device 7 configured as above will now be described. At the start of the spinning operation, the air is injected from the plurality of first nozzles 65 into the nozzle block 60, and the air is injected from the plurality of second nozzles 75 to the passage 74. Thus, the fiber bundle F introduced from the draft device 6 to the first space 64 through the guiding hole 51 is derived downstream through the passage 74 and the yarn deriving path 77. The air injected from each second nozzle 75 is supplied through the air supplying tube 78, a region on the outer side of the guiding pipe 71 in the accommodation hole 76 of the supporting member 72, and a region on the outer side of the guiding pipe 71 on the inner side of the second shaft body portion 82 and the third shaft body portion 83 of the hollow guide shaft body 80.

[0054] Thereafter, the injection of air from the plurality of first nozzles 65 to the first space 64 is continued, and the injection of air from the plurality of second nozzles 75 to the passage 74 is stopped. The fibers configuring the fiber bundle F are thereby inverted and whirled at the periphery of the fiber introducing port 86 so that actual twist is applied on the fiber bundle F by the whirling airflow generated from the inverting region R1 across the whirl-

ing region R2. At this time, the twists of the fiber bundle F are prevented from being propagated toward the upstream of the pneumatic spinning device 7 by the needle 52. The yarn Y produced by applying actual twists on the fiber bundle F is passed through the passage 74 and the yarn deriving path 77, and derived toward the downstream. The air injected from the plurality of first nozzles 65 is passed through the inverting region R1 and the whirling region R2 and discharged from the exhausting region R3 along with the fiber not configuring the yarn Y. During the spinning operation, the tension of the yarn Y is measured by the tension sensor 9, and the value of the measured tension is displayed on the display screen 42. Therefore, the operator can check if the yarn Y is being produced at the intended tension by checking the value displayed on the display screen 42.

[0055] As described above, in the nozzle block 60, the height H1 of the first space 64 in the direction along the line L is a value greater than or equal to 3 mm and smaller than or equal to 8 mm. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized. In the nozzle block 60, the height H2 of the second space 66 in the direction along the line L is a value greater than or equal to 30% and smaller than or equal to 50% of the sum of the height H2 of the second space 66 in the direction along the line L and the height H3 of the third space 67 in a direction along the line L. Thus, the generation of high tension can be suppressed at the yarn Y. Thus, with the nozzle block 60, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized while suppressing the generation of high tension at the yarn Y. High tension is, for example, a tension higher by a predetermined value than the tension of when the yarn Y having the intended quality is produced.

[0056] In the pneumatic spinning device 7, the first shaft body portion 81 is disposed across the second space 66 and the third space 67 with respect to the nozzle block 60, and the second shaft body portion 82 is disposed across the third space 67 and the region downstream of the third space 67 with respect to the nozzle block 60. That is, in the pneumatic spinning device 7, the boundary 60a at which the inner surface tapered angle is switched, the boundary 60a provided between the second space 66 and the third space 67, is located upstream of the boundary 80a at which the outer surface tapered angle is switched, the boundary 80a provided between the first shaft body portion 81 and the second shaft body portion 82. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized while suppressing the generation of high tension at the yarn Y. In particular, at the start of the spinning operation, when the air is injected from the plurality of first nozzles 65 into the nozzle block 60 and the air is injected from the plurality of second nozzles 75 into the passage 74, the generation of high tension is suppressed at the fiber bundle F even while applying sufficient temporary twist on the fiber bundle F, so that the fiber bundle

F can be reliably drawn into the pneumatic spinning device 7.

[0057] In the nozzle block 60, the third inner surface tapered angle of the third space 67 is greater than the second inner surface tapered angle of the second space 66, and the second inner surface tapered angle of the second space 66 is greater than the first inner surface tapered angle of the first space 64. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be more reliably realized.

[0058] In the nozzle block 60, the number of first nozzles 65 is five. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be more reliably realized.

[0059] The fiber guiding section 50 adapted to guide the fiber bundle F to the first space 64 is provided in the pneumatic spinning device 7. Thus, the fiber bundle F can be reliably guided to the first space 64.

[0060] In the pneumatic spinning device 7, the distance between the end face 53 exposed to the first space 64 in the fiber guiding section 50 and the upstream end of the first shaft body portion 81 is a value greater than or equal to 2 mm and smaller than or equal to 8 mm. Thus, both the ensuring of stable winding property and the enhancement of the spinning speed can be realized.

[0061] In the pneumatic spinning device 7, the distance between the upstream end of the first shaft body portion 81 and the virtual plane formed by the boundary 60a between the second space 66 and the third space 67 is a value greater than or equal to 3 mm and smaller than or equal to 9 mm. Thus, the generation of high tension can be suppressed at the yarn Y.

[0062] In the spinning machine 1, the tension sensor 9 adapted to measure the tension of the yarn Y between the pneumatic spinning device 7 and the winding device 13 is provided. With this configuration, it is possible to check whether or not the tension of the yarn Y is appropriate.

[0063] In the spinning machine 1, the display screen 42 adapted to display the value of the tension measured by the tension sensor 9 is provided. The value of the tension of the yarn Y is thereby notified to the operator.

[0064] An embodiment of the present invention has been described above, but the present invention is not limited to the above-described embodiment.

[0065] The height H1 of the first space 64 in the direction along the line L may be set to take a value greater than or equal to 8% and smaller than or equal to 15% of the average fiber length of the fibers configuring the fiber bundle F. The first space 64 may not be a circular truncated cone shape, and may be a circular cylinder shape. In FIG. 4, the end face 53 exposed to the first space 64 in the fiber guiding section 50 is in plane with the contacting surface with respect to the first block portion 61 in the fiber guiding section 50, but the end face 53 may be located upstream of the contacting surface or maybe located downstream of the contacting surface. The number of first nozzles 65 may be 3, 4, 6, or the like. The

value of the tension measured by the tension sensor 9 may be displayed on the display screen provided for each spinning unit 2. The display screen may also display information other than the value of the measured tension.

[0066] The hollow guide shaft body unit 70 may not include the second nozzle 75. In the hollow guide shaft body unit 70, the first shaft body portion 81, and the second shaft body portion 82 and the third shaft body portion 83 are formed as separate bodies, and the first shaft body portion 81 formed as a separate body from the second shaft body portion 82 and the third shaft body portion 83 may integrally include the upstream end of the guiding pipe 71 where the second nozzle 75 is provided (see FIG. 3). In such a case, the second shaft body portion 82 and the third shaft body portion 83 which are formed as separate bodies from the first shaft body portion 81 may be integrally formed with the fixing member 73.

[0067] In FIG. 4, the inner surface 64a, the inner surface 66a, and the inner surface 67a are illustrated as straight lines. However, at least one of the inner surface 64a, the inner surface 66a, and the inner surface 67a may be a curve. In FIG. 4, the boundary 60a is illustrated to have a pointed corner formed by two straight lines, but such a portion may be formed by a curve. Such a curve is formed in the direction of projecting into the nozzle block 60. The inner surface 66a and the inner surface 67a may not be directly connected, and a curve-shaped connecting portion, for example, may be provided between the inner surface 66a illustrated as a straight line and the inner surface 67a illustrated as a straight line. This is the same for the inner surface 64a and the inner surface 66a.

[0068] In FIG. 4, the outer surface 81a and the outer surface 82a are illustrated as straight lines. However, at least one of the outer surface 81a or the outer surface 82a may be a curve. In FIG. 4, the boundary 80a is illustrated to have a pointed corner formed by two straight lines, but such a portion may be formed by a curve. Such a curve is formed in the direction of projecting into the hollow guide shaft body 80. The outer surface 81a and the outer surface 82a may not be directly connected, and a curve-shaped connecting portion, for example, may be provided between the outer surface 81a illustrated as a straight line and the outer surface 82a illustrated as a straight line.

[0069] The pneumatic spinning device 7 may not include the needle 52, and may prevent the twists of the fiber bundle F from being propagated to upstream of the pneumatic spinning device 7 by the downstream end of the fiber guiding section 50.

[0070] In the spinning unit 2, the yarn storage device 11 has a function of feeding the yarn Y from the pneumatic spinning device 7, but the yarn Y may be fed from the pneumatic spinning device 7 with a delivery roller and a nip roller. In a case of feeding the yarn Y from the pneumatic spinning device 7 with the delivery roller and the nip roller, a slack tube adapted to absorb the slack of the yarn Y with suction airflow, a mechanic compensator, or

the like may be provided instead of the yarn storage device 11.

[0071] In the spinning machine 1, each device is disposed such that the yarn Y supplied at an upper side is wound at a lower side in a direction of a machine height. However, each device may be disposed such that the yarn Y supplied at the lower side is wound at the upper side.

[0072] In the spinning machine 1, at least one of the bottom rollers in the draft device 6, and the traverse guide 23 are driven by power from the second end frame 5 (that is, in common with the plurality of spinning units 2). However, each section (for example, the draft device 6, the pneumatic spinning device 7, the winding device 13, or the like) of the spinning unit 2 may be driven independently for each spinning unit 2.

[0073] In the travelling direction of the yarn Y, the tension sensor 9 may be disposed upstream of the yarn monitoring device 8. The unit controller 10 may be provided for every spinning unit 2. In the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 may be omitted.

[0074] FIG. 1 illustrates that the spinning machine 1 winds a cheese package P, but the spinning machine 1 can also wind a conical package P. In a case of the conical package P, a slack of the yarn Y occurs by traversing the yarn Y, but the slack can be absorbed with the yarn storage device 11. A material and a shape of each component are not limited to the above-mentioned material and shape, and various materials and shapes can be adopted.

Claims

1. A nozzle block (60) comprising:

a first block portion (61) including a first space (64), to which a fiber (F) is introduced, and a plurality of first nozzles (65), through which air injected to generate whirling airflow is passed; a second block portion (62) including a second space (66), through which the air from the first space (64) is passed; and

a third block portion (63) including a third space (67), through which the air from the second space (66) is passed,

characterized in that

the first space (64), the second space (66), and the third space (67) are aligned from a first side toward a second side in a predetermined direction,

the second space (66) is spread at a second inner surface tapered angle from the first side toward the second side,

the third space (67) is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side

toward the second side,

a height (H1) of the first space (64) in the predetermined direction is a value greater than or equal to 3 mm and smaller than or equal to 8 mm, and

a height (H2) of the second space (66) in the predetermined direction is a value greater than or equal to 30% and smaller than or equal to 50% of a sum of the height (H2) of the second space (66) in the predetermined direction and a height (H3) of the third space (67) in the predetermined direction.

2. The nozzle block (60) according to claim 1, **characterized in that** the first space (64) is spread at a first inner surface tapered angle smaller than the second inner surface tapered angle from the first side toward the second side.

3. The nozzle block (60) according to claim 1 or 2, **characterized in that** a number of the first nozzles (65) is five.

4. A pneumatic spinning device, **characterized by** a nozzle block (60) according to one of claims 1 to 3.

5. A pneumatic spinning device (7), preferably according to claim 4, comprising:

a nozzle block (60), to which a fiber (F) is introduced; and

a hollow guide shaft body unit (70) including a fiber introducing port (86), to which the fiber (F) introduced to the nozzle block (60) is introduced, and a passage (74) adapted to guide the fiber (F) introduced to the fiber introducing port (86) to outside,

characterized in that

the nozzle block (60) includes

a first block portion (61) including a first space (64), to which the fiber (F) is introduced, and a plurality of first nozzles (65), through which air injected to generate whirling airflow is passed,

a second block portion (62) including a second space (66), through which the air from the first space (64) is passed, and

a third block portion (63) including a third space (67), through which the air from the second space (66) is passed

the first space (64), the second space (66), and the third space (67) are aligned from a first side toward a second side in a predetermined direction,

the second space (66) is spread at a second inner surface tapered angle from the first side

toward the second side,
the third space (67) is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side,
the hollow guide shaft body unit (70) includes

a first shaft body portion (81) disposed across the second space (66) and the third space (67), and
a second shaft body portion (82) disposed across the third space (67) and a region on the second side with respect to the third space (67),

the first shaft body portion (81) and the second shaft body portion (82) are aligned from the first side toward the second side,
the first shaft body portion (81) is spread at a first outer surface tapered angle from the first side toward the second side,
the second shaft body portion (82) is spread at a second outer surface tapered angle greater than the first outer surface tapered angle from the first side toward the second side, and
a distance between an end on the first side of the first shaft body portion (81) and a virtual plane formed by a boundary (60a) between the second space (66) and the third space (67) is a value greater than or equal to 3 mm and smaller than or equal to 9 mm.

6. A pneumatic spinning device (7), preferably according to claim 4 comprising:

a nozzle block (60), to which a fiber (F) is introduced; and
a hollow guide shaft body unit (70) including a fiber introducing port (86), to which the fiber (F) introduced to the nozzle block (60) is introduced, a passage (74) adapted to guide the fiber (F) introduced to the fiber introducing port (86) to outside, and a second nozzle (75), through which air injected to the passage (74) is passed, **characterized in that**
the nozzle block (60) includes

a first block portion (61) including a first space (64), to which the fiber (F) is introduced, and a plurality of first nozzles (65), through which air injected to generate whirling airflow is passed,
a second block portion (62) including a second space (66), through which the air from the first space (64) is passed, and
a third block portion (63) including a third space (67), through which the air from the second space (66) is passed,

the first space (64), the second space (66), and the third space (67) are aligned from a first side toward a second side in a predetermined direction,

the second space (66) is spread at a second inner surface tapered angle from the first side toward the second side,
the third space (67) is spread at a third inner surface tapered angle greater than the second inner surface tapered angle from the first side toward the second side,
the hollow guide shaft body unit (70) includes

a first shaft body portion (81) disposed across the second space (66) and the third space (67), and
a second shaft body portion (82) disposed across the third space (67) and a region on the second side with respect to the third space (67),

the first shaft body portion (81) and the second shaft body portion (82) are aligned from the first side toward the second side,
the first shaft body portion (81) is spread at a first outer surface tapered angle from the first side toward the second side, and
the second shaft body portion (82) is spread at a second outer surface tapered angle greater than the first outer surface tapered angle from the first side toward the second side.

7. The pneumatic spinning device (7) according to claim 6, **characterized in that** a distance between an end on the first side of the first shaft body portion (81) and a virtual plane formed by a boundary (60a) between the second space (66) and the third space (67) is a value greater than or equal to 3 mm and smaller than or equal to 9 mm.

8. The pneumatic spinning device (7) according to any one of claims 5 to 7, **characterized by** further comprising a fiber guiding section (50) adapted to guide the fiber (F) to the first space (64).

9. The pneumatic spinning device (7) according to claim 8, **characterized in that** a distance between an end face (53) exposed to the first space (64) in the fiber guiding section (50) and the end on the first side of the first shaft body portion (81) is a value greater than or equal to 2 mm and smaller than or equal to 8 mm.

10. A spinning machine (1) comprising:

the pneumatic spinning device (7) according to any one of claims 4 to 9;
a winding device (13) adapted to wind a yarn (Y)

produced by the pneumatic spinning device (7)
to form a package (P); and
a measuring device (9) adapted to measure a
tension of the yarn (Y) between the pneumatic
spinning device (7) and the winding device (13). 5

11. The spinning machine (1) according to claim 10, further comprising a display section (42) adapted to display a value of the tension measured by the measuring device (9). 10

15

20

25

30

35

40

45

50

55

FIG. 1

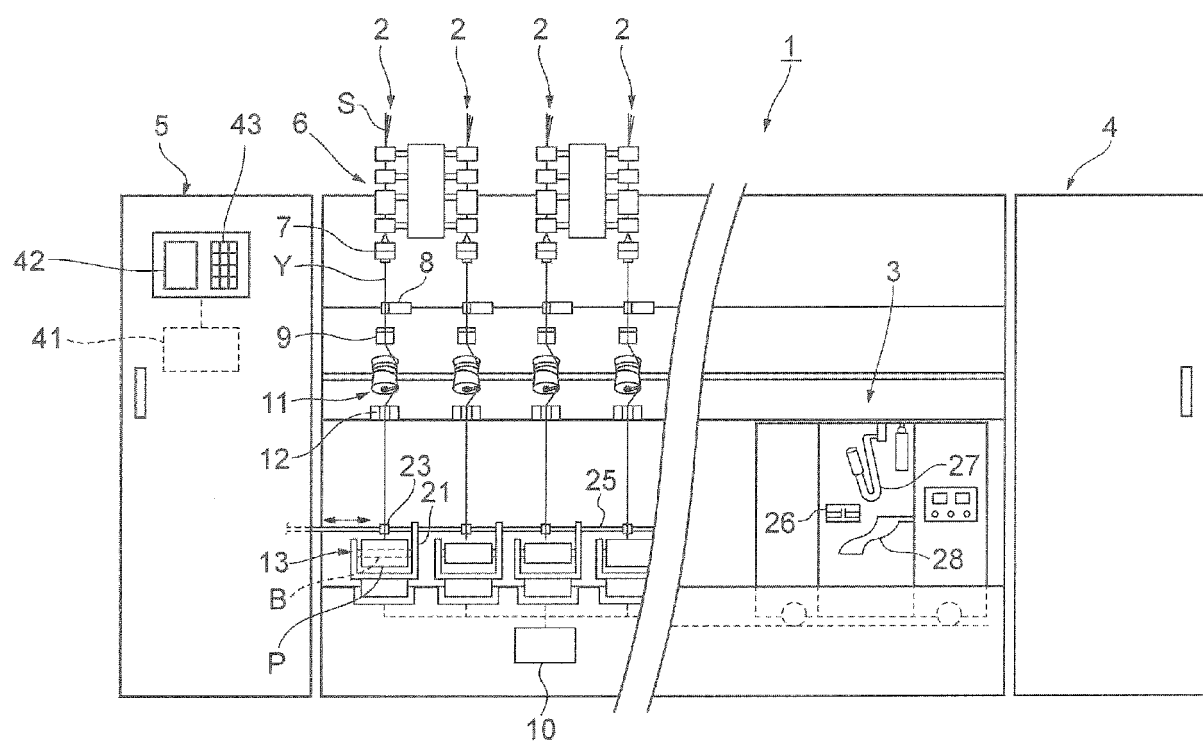


FIG. 2

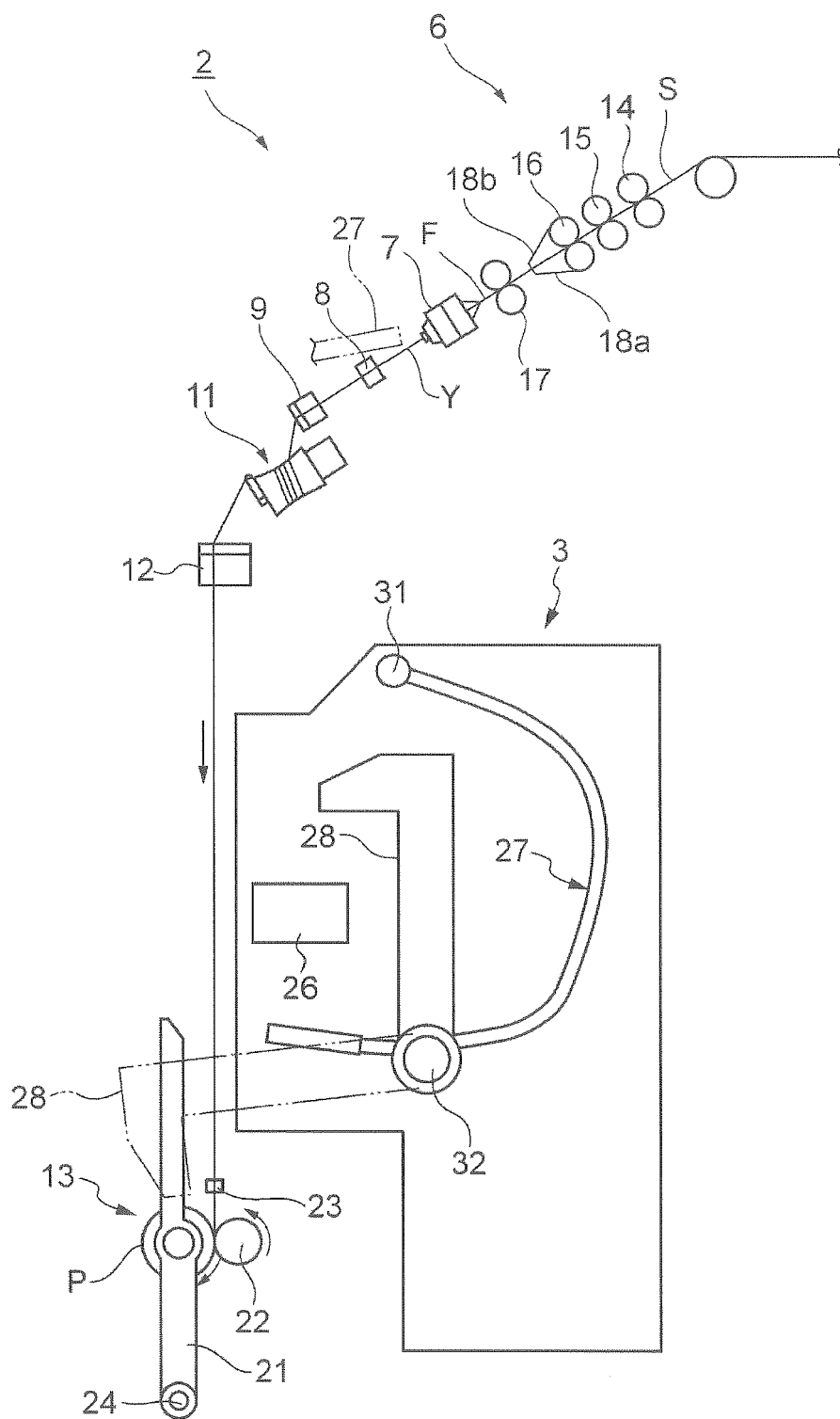


FIG. 3

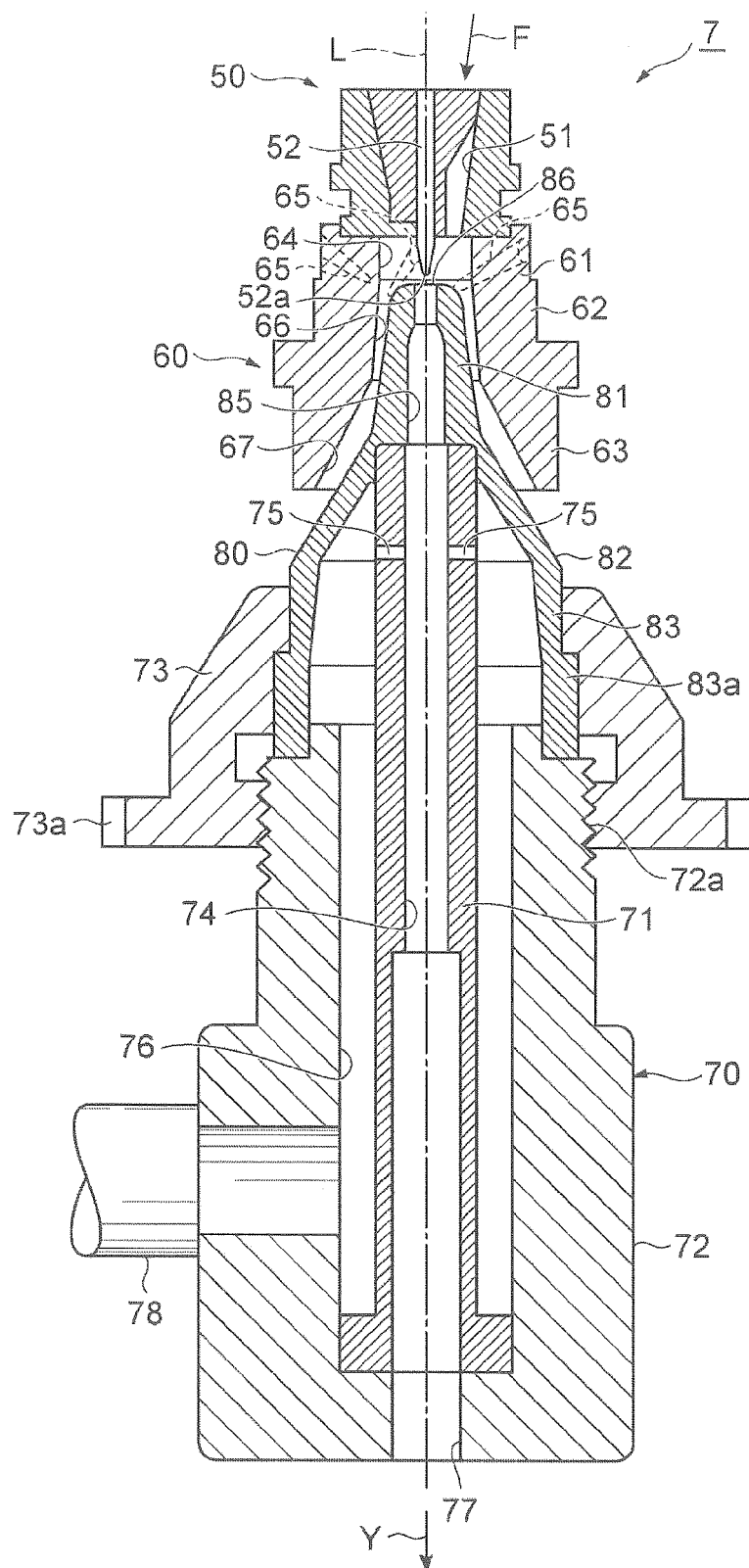
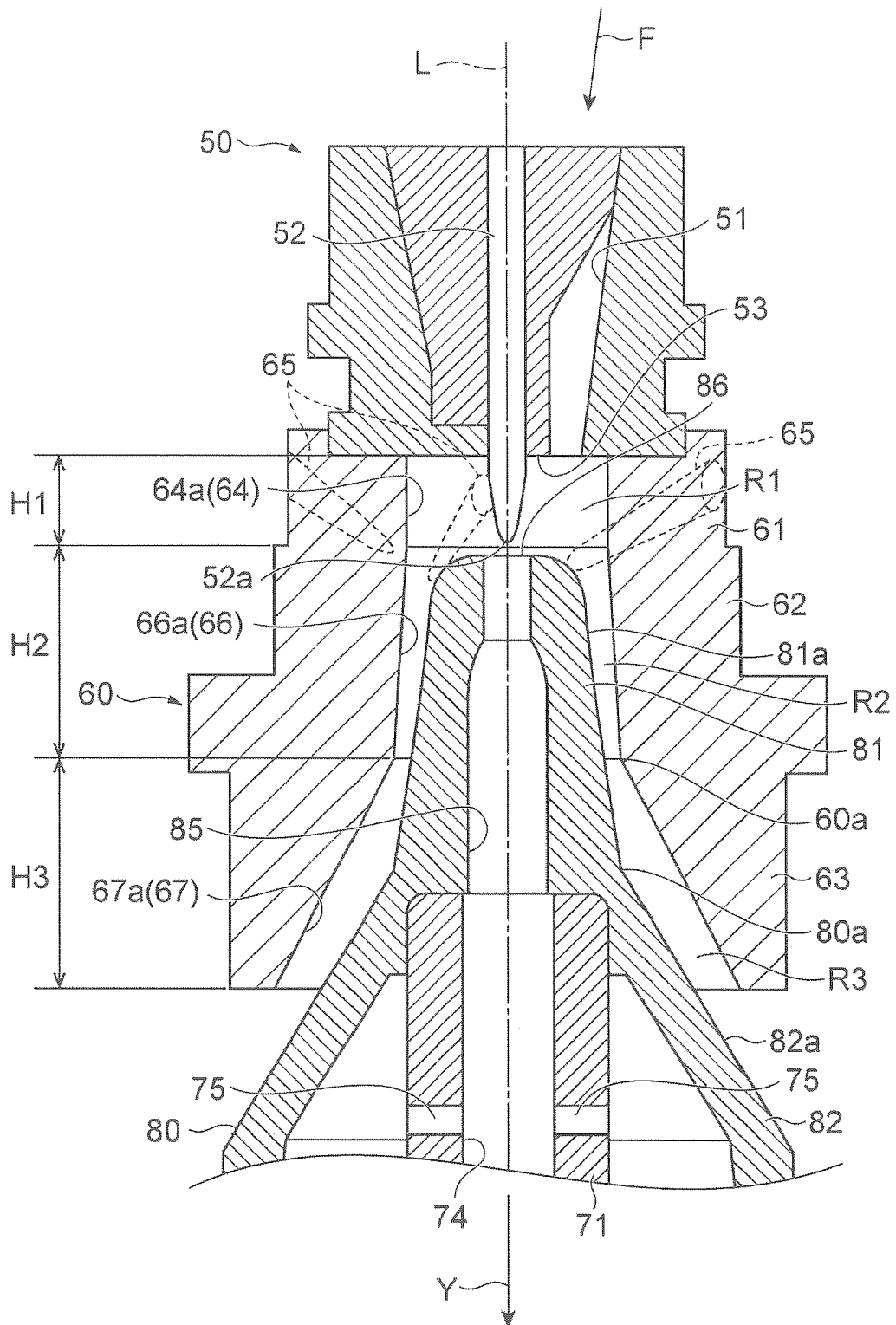


FIG. 4





EUROPEAN SEARCH REPORT

Application Number
EP 16 17 2580

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2003 193337 A (MURATA MACHINERY LTD) 9 July 2003 (2003-07-09)	1-11	INV. D01H1/115
Y	* paragraph [0052]; figure 5 *	5	
X	EP 2 453 044 A2 (MURATA MACHINERY LTD [JP]) 16 May 2012 (2012-05-16)	1-11	
Y	* paragraphs [0022] - [0028], [0059]; figure 4 *	5,6	
X	CN 101 294 319 A (UNIV DONGHUA [CN]) 29 October 2008 (2008-10-29) * figures 2,4,5 *	1-4	
Y	US 2012/192541 A1 (ARTZT PETER [DE] ET AL) 2 August 2012 (2012-08-02) * paragraph [0022]; figure 1 *	6	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 October 2016	Examiner Wendl, Helen
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 17 2580

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-10-2016

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2003193337 A	09-07-2003	NONE	
EP 2453044 A2	16-05-2012	CN 102560755 A	11-07-2012
		CN 202347164 U	25-07-2012
		EP 2453044 A2	16-05-2012
		JP 5549551 B2	16-07-2014
		JP 2012102433 A	31-05-2012
CN 101294319 A	29-10-2008	NONE	
US 2012192541 A1	02-08-2012	CN 102471951 A	23-05-2012
		DE 102009034206 A1	27-01-2011
		EP 2454402 A1	23-05-2012
		JP 2012533691 A	27-12-2012
		US 2012192541 A1	02-08-2012
		WO 2011006580 A1	20-01-2011

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2009001935 A [0002]
- JP 2003193339 A [0002]