(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 573 221 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.03.2013 Bulletin 2013/13

(51) Int Cl.:
D01H 1/14 *(2006.01)*

(21) Application number: **12174566.5**

(22) Date of filing: **02.07.2012**

(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

(30) Priority: **21.09.2011 JP 2011206528**

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

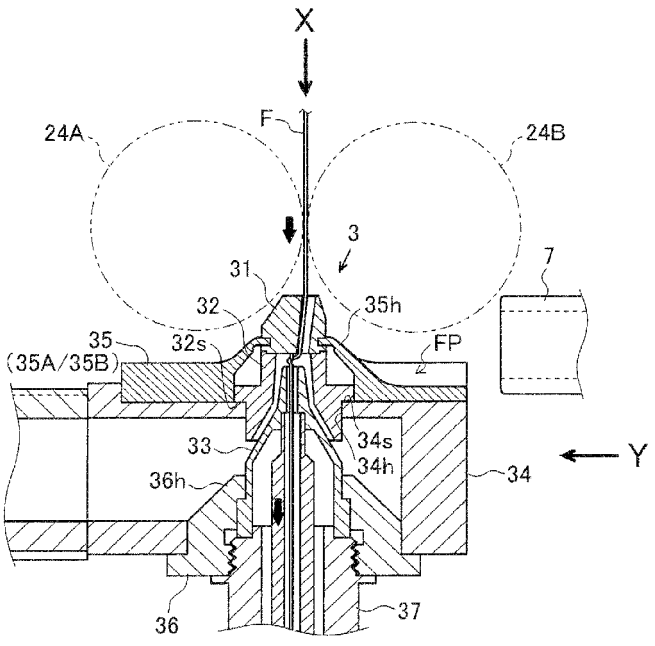
(72) Inventors:
- **Sakamoto, Naotaka**
  Kyoto, 612-8686 (JP)
- **Oka, Masaki**
  Kyoto, 612-8686 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Spinning machine

(57) A spinning machine (100) includes a drafting section (2) adapted to draft a fiber bundle (F), and a spinning section (3) adapted to twist a fiber bundle (F) drafted by the drafting section (2). The spinning section (3) includes a passage (FP) adapted to guide the fiber bundle (F) and prevent accumulation of the fiber bundle (F) at a gap formed between the drafting section (2) and the spinning section (3).

FIG. 4



EP 2 573 221 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine.

2. Description of the Related Art

[0002] Conventionally, there is known a spinning machine adapted to draft a fiber bundle and twist the drafted fiber bundle to produce a spun yarn (see e.g., Japanese Unexamined Patent Publication No. 2011-99192). Such a spinning machine includes a drafting section adapted to draft the fiber bundle and a spinning section adapted to twist the drafted fiber bundle. The spinning machine includes a suction nozzle adapted to cause a suction force in a gap formed between the drafting section and the spinning section.

[0003] A drafting section includes a plurality of draft roller pairs. Each of the draft roller pairs includes a bottom roller, which is rotated via a power mechanism, and a top roller, which makes contact with the bottom roller and rotates accompanying rotation of the bottom roller. Since the bottom rollers and the top rollers rotate while sandwiching the fiber bundle, the draft roller pairs can feed the fiber bundle. The drafting section can draft the fiber bundle by a difference in a feeding speed of the draft roller pairs adjacent to one another.

[0004] The spinning section includes a fiber guide adapted to guide the fiber bundle into a spinning chamber, a nozzle block adapted to guide air to the spinning chamber, and a spindle adapted to guide the fiber bundle twisted in the spinning chamber to outside. Since the air guided to the spinning chamber generates whirling airflow in the spinning chamber, the spinning section can twist the fiber bundle. The nozzle block is supported by a nozzle holder swingably attached to a machine frame. The fiber guide and the nozzle block are fixed to the nozzle holder by a nozzle cap.

[0005] In the above-described spinning machine, the spinning section is arranged in proximity to the draft roller pair. The fiber bundle fed by the draft roller pair is twisted by the spinning section before the fiber bundle is disturbed. A gap formed between the draft roller pair and the nozzle cap inevitably becomes narrow. When fiber dusts and the like become clogged in the spinning section for some reason, the fiber bundle may be accumulated on the nozzle cap (the gap formed between the draft roller pair and the nozzle cap). Thus, when the nozzle holder is swung in a direction away from the draft roller pair, for example, the accumulated fiber bundle may be sucked by the suction nozzle all at once thus clogging the suction nozzle.

BRIEF SUMMARY OF THE INVENTION

[0006] An object of the present invention is to provide a spinning machine in which a fiber bundle is not accumulated on a nozzle cap even if the fiber dusts and the like become clogged in the spinning section for some reason.

[0007] A first aspect of the invention relates to a spinning machine adapted to draft a fiber bundle and twist the drafted fiber bundle to produce a spun yarn. The spinning machine according to an embodiment of the present invention includes a drafting section adapted to draft a fiber bundle, and a spinning section adapted to twist the fiber bundle drafted by the drafting section. The spinning section includes a passage adapted to guide the fiber bundle and prevent accumulation of the fiber bundle at a gap between the drafting section and the spinning section.

[0008] When the fiber dusts and the like become clogged in the spinning section for some reason, the fiber bundle can be guided in a direction away from the spinning section by the passage formed in the spinning section. Accordingly, the fiber bundle can be continuously removed, and the fiber bundle can be prevented from accumulating on the nozzle cap.

[0009] A second aspect of the invention relates to the spinning machine according to the first aspect. The passage is provided independently from a normal path adapted to guide the fiber bundle from the drafting section to the spinning section.

[0010] A third aspect of the invention relates to the spinning machine according to the first aspect. The spinning section includes a fiber guide adapted to guide the fiber bundle to a spinning chamber, a nozzle block adapted to guide air to the spinning chamber, a spindle adapted to guide the fiber bundle twisted in the spinning chamber to outside, a nozzle holder adapted to support the nozzle block, and a nozzle cap adapted to fix at least the fiber guide onto the nozzle holder. The passage is formed on the nozzle cap.

[0011] The fiber bundle can be guided in the direction away from the spinning section by the passage formed on the nozzle cap. Accordingly, the fiber bundle can be continuously removed, and the fiber bundle can be prevented from accumulating on the nozzle cap.

[0012] A fourth aspect of the invention relates to the spinning machine according to the first or second aspect. The spinning section includes a fiber guide adapted to guide the fiber bundle to a spinning chamber, a nozzle block adapted to guide air to the spinning chamber, and a spindle adapted to guide the fiber bundle twisted in the spinning chamber to outside. The passage is formed on an upstream end surface of the nozzle block in a fiber bundle travelling direction.

[0013] A fifth aspect of the invention relates to the spinning machine according to any one of the first to fourth aspects. The spinning machine further includes a suction nozzle adapted to suck the fiber bundle in proximity to

the gap between the drafting section and the spinning section. The passage is adapted to guide the fiber bundle to the suction nozzle.

[0014] The fiber bundle can be guided to the suction nozzle by the passage formed on the nozzle cap. Accordingly, the fiber bundle can be continuously removed, and the fiber bundle can be prevented from accumulating on the nozzle cap.

[0015] A sixth aspect of the invention relates to the spinning machine according to the third aspect. The passage is formed by a recess or protrusions formed on the nozzle cap. Since the passage is formed by the recess or the protrusions formed on the nozzle cap, the fiber bundle can be guided in the direction away from the spinning section or the fiber bundle can be guided to the suction nozzle with a simple configurations. Accordingly, the fiber bundle can be continuously removed, and the fiber bundle can be prevented from accumulating on the nozzle cap.

[0016] A seventh aspect of the invention relates to the spinning machine according to any one of the first to sixth aspects. A width of the passage is substantially equal to a width of a suction opening of the suction nozzle. Since the suction force caused by the suction nozzle acts along the passage without becoming weak, the fiber bundle can be smoothly guided to the suction nozzle. Accordingly, the fiber bundle can be continuously removed, and the fiber bundle can be prevented from accumulating on the fiber bundle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

FIG. 1 is a view illustrating an overall configuration of a spinning machine;
FIG. 2 is a view illustrating a structure of a drafting section;
FIG. 3 is a view illustrating a structure of a spinning section;
FIG. 4 is a view illustrating an attachment structure of each member constituting the spinning section;
FIG. 5A is a view seen from a direction of an arrow X illustrated in FIG. 4 of a nozzle cap according to an embodiment of the present invention;
FIG. 5B is a view seen from a direction of an arrow Y illustrated in FIG. 4 of the nozzle cap according to the embodiment of the present invention;
FIG. 6A is a view seen from the direction of the arrow X illustrated in FIG. 4 of a nozzle cap according to another embodiment of the present invention; and
FIG. 6B is a view seen from the direction of the arrow Y illustrated in FIG. 4 of the nozzle cap according to another embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0018] First, an overall configuration of a spinning machine 100 will be briefly described. In FIG. 1, black arrows indicate a feeding direction of a fiber bundle F and a spun yarn Y.

[0019] The spinning machine 100 produces the spun yarn Y from the fiber bundle F to form a package P. The spinning machine 100 includes a sliver supplying section 1, a drafting section 2, a spinning section 3, a defect detecting section 4, a tension stabilizing section 5, and a winding section 6 along the feeding direction of the fiber bundle F and the spun yarn Y. The spinning machine 100 also includes a suction nozzle 7 adapted to cause a suction force in a gap formed between the drafting section 2 and the spinning section 3 (see FIG. 2).

[0020] The sliver supplying section 1 is adapted to supply the fiber bundle F (a sliver) to the drafting section 2. The sliver supplying section 1 includes a sliver case 11 and a sliver guide (not illustrated). The fiber bundle F accumulated in the sliver case 11 is guided by the sliver guide to the drafting section 2.

[0021] The drafting section 2 drafts the fiber bundle F to make a thickness of the fiber bundle F uniform. The drafting section 2 includes four sets of draft roller pairs 21, 22, 23, and 24, i.e., the back roller pair 21, the third roller pair 22, the middle roller pair 23, and the front roller pair 24, along the feeding direction of the fiber bundle F. A structure of the drafting section 2 will be described later.

[0022] The spinning section 3 twists the drafted fiber bundle F to produce the spun yarn Y. The spinning section 3 is arranged in proximity to the drafting section 2. The spinning section 3 can produce the spun yarn Y from the appropriately drafted fiber bundle F. A structure of the spinning section 3 and an attachment structure of each member constituting the spinning section 3 will be described later.

[0023] The defect detecting section 4 detects a defective part of the produced spun yarn Y. Specifically, the defect detecting section 4 irradiates the spun yarn Y with a light emitting diode (not illustrated) as a light source, and detects a reflected light quantity from the spun yarn Y. The defect detecting section 4 is connected to a control section (not illustrated) via an analyzer (not illustrated). The control section can determine a presence or an absence of the defective part based on a detection signal from the defect detecting section 4. In addition to abnormality in which a portion of the spun yarn Y is too thick (thick yarn) or too thin (thin yarn), the defective part of the spun yarn Y includes foreign substances contained in the spun yarn Y. Instead of an optical sensor according to the present embodiment, a capacitance sensor can be adopted as the defect detecting section 4.

[0024] The tension stabilizing section 5 is adapted to appropriately maintain and stabilize a tension applied to the spun yarn Y. The tension stabilizing section 5 includes an unwinding member 51 and a roller 52. The unwinding

member 51 rotates with the roller 52 when the tension applied to the spun yarn Y is low, and winds the spun yarn Y around the roller 52. The unwinding member 51 rotates independently from the roller 52 when the tension applied to the spun yarn Y is high, and unwinds the spun yarn Y wound around the roller 52. The tension stabilizing section 5 can appropriately maintain and stabilize the tension applied to the spun yarn Y.

[0025] The winding section 6 is adapted to form the package P by winding the spun yarn Y. The winding section 6 includes a driving roller 61 and a cradle (not illustrated). The driving roller 61 rotates a bobbin B rotatably held by the cradle. The winding section 6 traverses the spun yarn Y by a traversing device (not illustrated). Accordingly, the winding section 6 can wind the spun yarn Y around the bobbin B while traversing the spun yarn Y to form the package P.

[0026] The overall configuration of the spinning machine 100 according to one embodiment of the present invention is as described above. However, as long as the spinning machine 100 includes a passage FP, to be described later, other detailed configurations may be appropriately changed. As long as the passage FP, which is a characteristic portion of the spinning machine 100, is provided, the sliver supplying section 1, the drafting section 2, the spinning section 3, the defect detecting section 4, the tension stabilizing section 5, the winding section 6, the suction nozzle 7, and/or other configurations and/or arrangements may be appropriately changed.

[0027] In the spinning machine 100, the tension stabilizing section 5 pulls out the spun yarn Y from the spinning section 3. However, a delivery roller and a nip roller may be arranged between the spinning section 3 and the tension stabilizing section 5, and the spun yarn Y may be pulled out from the spinning section 3 with such rollers.

[0028] Next, with reference to FIG. 2, a structure of the drafting section 2 will be described in detail. In FIG. 2, black arrows indicate the feeding direction of the fiber bundle F and the spun yarn Y.

[0029] The draft roller pairs 21, 22, 23, and 24 respectively include bottom rollers 21A, 22A, 23A, and 24A, and top rollers 21B, 22B, 23B, and 24B. Apron bands 23C and 23C made of synthetic rubber are respectively wound around the bottom roller 23A and the top roller 23B constituting the middle roller pair 23.

[0030] The bottom rollers 21A, 22A, 23A, and 24A are adapted to rotate in the same direction by a power mechanism (not illustrated). The top rollers 21B, 22B, 23B, and 24B are adapted to make contact with the bottom rollers 21A, 22A, 23A, and 24A and rotate in the same direction accompanying rotation of the bottom rollers 21A, 22A, 23A, and 24A. Each of the draft roller pairs 21, 22, 23, and 24 is set such that a rotation speed sequentially becomes faster along the feeding direction of the fiber bundle F.

[0031] The feeding speed increases every time the fiber bundle F is passed through each of the draft roller pairs 21, 22, 23, and 24, and the fiber bundle F sandwiched by the draft roller pairs 21, 22, 23, and 24 is drafted between the adjacent draft roller pairs 21, 22, 23, and 24.

[0032] The spinning section 3 is arranged in proximity to the front roller pair 24. The fiber bundle F fed by the front roller pair 24 is twisted by the spinning section 3 before the fiber bundle F is disturbed. Furthermore, the spinning machine 100 includes the suction nozzle 7 adapted to cause a suction force in a gap formed between the front roller pair 24 and the spinning section 3.

[0033] The suction nozzle 7 sucks the fiber dusts blown up from the front roller pair 24 by sucking air. The fiber dusts sucked by the suction nozzle 7 is guided to an air duct 72 through a piping 71, and then discarded.

[0034] Next, with reference to FIG. 3, a structure of the spinning section 3 will be described. In FIG. 3, black arrows indicate the feeding direction of the fiber bundle F and the spun yarn Y, and white arrows indicate a flowing direction of the supplied air.

[0035] The spinning section 3 twists the fiber bundle F guided to the spinning chamber SC to produce the spun yarn Y. The spinning section 3 includes a fiber guide 31, a nozzle block 32, and a spindle 33.

[0036] The fiber guide 31 is one member constituting the spinning chamber SC. The fiber guide 31 guides the fiber bundle F drafted by the drafting section 2 into the spinning chamber SC. Specifically, the fiber guide 31 guides the fiber bundle F into the spinning chamber SC through a fiber passage 31h connected to the spinning chamber SC.

[0037] The nozzle block 32 is one member constituting the spinning chamber SC. The nozzle block 32 guides air supplied from an air supplying source to the spinning chamber SC. Specifically, the nozzle block 32 guides the air to the spinning chamber SC through air holes 32a connected to the spinning chamber SC. The air holes 32a are connected to the spinning chamber SC such that the air ejected from each of the air holes 32a into the spinning chamber SC flows in the same direction in the spinning chamber SC. Accordingly, whirling airflow is generated in the spinning chamber SC.

[0038] The spindle 33 is one member constituting the spinning chamber SC. The spindle 33 guides the fiber bundle F twisted in the spinning chamber SC, that is, the spun yarn Y to outside the spinning chamber SC. Specifically, the spindle 33 guides the spun yarn Y to outside the spinning chamber SC through a fiber passage 33h connected to the spinning chamber SC.

[0039] The spinning chamber SC will be more specifically described. The spinning chamber SC is a space surrounded by the fiber guide 31, the nozzle block 32, and the spindle 33. Specifically, the spinning chamber SC is a space surrounded by a substantially conical spindle 33 inserted from one side and the fiber guide 31 attached to the other side with respect to a substantially conical through-hole 32t provided in the nozzle block 32.

[0040] The spinning chamber SC is divided into a space SC1 formed between the fiber guide 31 and the

spindle 33, and a space SC2 formed between the nozzle block 32 and the spindle 33. In the space SC1, a trailing end of the fibers constituting the fiber bundle F is reversed by the whirling airflow (see chain double dashed lines in the drawing). In the space SC2, the trailing end of the reversed fibers is whirled by the whirling airflow (see chain double dashed lines in the drawing). The fibers whirled by the whirling airflow are sequentially wound around fibers at a center portion. In this manner, the spinning section 3 can twist the fiber bundle F.

[0041] The fiber guide 31 is provided with a needle 31n. The needle 31n guides the fiber bundle F to the spindle 33, and prevents the twist of the fiber bundle F from being transmitted upstream. However, the needle 31n may be omitted.

[0042] As long as the spinning section 3 is adapted to twist the fiber bundle F by the whirling airflow, the detailed configuration of the spinning section 3 is not limited. For example, the spinning section may generate two whirling airflows flowing in directions different from one another, and twist the fiber bundle F with such whirling airflows (e.g., Japanese Unexamined Patent Publication No. 5-86510, Japanese Unexamined Patent Publication No. 2006-161171, or the like).

[0043] Next, with reference to FIG. 4, an attachment structure of each member constituting the spinning section 3 will be described. In FIG. 4, black arrows indicate the feeding direction of the fiber bundle F and the spun yarn Y.

[0044] The nozzle block 32 is supported by a nozzle holder 34. Specifically, the nozzle block 32 is inserted to a through-hole 34h of the nozzle holder 34, and supported while a hooking surface 32s of the nozzle block 32 and an upper surface 34s of the nozzle holder 34 make contact with one another.

[0045] The fiber guide 31 is fixed to the nozzle holder 34 by a nozzle cap 35. Specifically, the fiber guide 31 is assembled to a recess of the nozzle block 32, and fixed to the nozzle holder 34 by the nozzle cap 35. A claw portion 35h of the nozzle cap 35 is hooked to the fiber guide 31. Therefore, the nozzle block 32 is fixed to the nozzle holder 34 integrally with the fiber guide 31. That is, the fiber guide 31 and the nozzle block 32 are fixed to the nozzle holder 34 by the nozzle cap 35.

[0046] The spindle 33 is fixed to a spindle holder 37 by a spindle cap 36. Specifically, the spindle 33 is assembled to a projection of the spindle holder 37, and fixed to the spindle holder 37 by the spindle cap 36. A claw portion 36h of the spindle cap 36 is hooked to the spindle 33. A female screw portion of the spindle cap 36 in the present embodiment is screwed to a male screw portion of the spindle holder 37.

[0047] Next, with reference to FIG. 5A and FIG. 5B, a nozzle cap 35A as one embodiment of the nozzle cap 35 will be described in detail. In FIG. 5A and FIG. 5B, a black arrow indicates the feeding direction of the fiber bundle F, and white arrows indicates the flowing direction of the air sucked by the suction nozzle 7.

[0048] The nozzle cap 35A includes the passage FP adapted to guide the fiber bundle F such that the fiber bundle F does not accumulate on the nozzle cap 35A. In the present embodiment, the passage FP is formed by a line of a recess 35c formed on the nozzle cap 35A. That is, the passage FP is a depressed portion of the nozzle cap 35A. The passage FP is formed towards a direction away from the claw portion 35h for hooking the fiber guide 31 (a direction to be away from a gap formed between the front roller pair 24 and the nozzle cap 35A, the direction towards the suction nozzle 7 arranged in proximity to the nozzle cap 35A).

[0049] In the spinning machine 100, even if the fiber dusts and the like become clogged in the spinning section 3 for some reason, the subsequent fiber bundle F can be guided in the direction away from the spinning section 3 by the passage FP formed on the nozzle cap 35A. In the present embodiment, since the passage FP is formed by the recess 35c formed on the nozzle cap 35A, the fiber bundle F can be guided to outside with a simple configuration. Accordingly, the fiber bundle F can be continuously removed, and the fiber bundle F can be prevented from accumulating on the nozzle cap 35A.

[0050] Next, with reference to FIG. 6A and FIG. 6B, a nozzle cap 35B as another embodiment of the nozzle cap 35 will be described in detail. In FIG. 6A and FIG. 6B, a black arrow indicates the feeding direction of the fiber bundle F, and white arrows indicate the flowing direction of the air sucked by the suction nozzle 7.

[0051] The nozzle cap 35B includes the passage FP adapted to guide the fiber bundle F such that the fiber bundle F does not accumulate on the nozzle cap 35B. In the present embodiment, the passage FP is formed by two lines of protrusions 35p formed on the nozzle cap 35B. That is, the passage FP is a portion surrounded by the two lines of protrusions 35p formed on the nozzle cap 35B. The passage FP is formed towards a direction away from the claw portion 35h for hooking the fiber guide 31 (a direction away from a gap formed between the front roller pair 24 and the nozzle cap 35B, the direction towards the suction nozzle 7 arranged in proximity to the nozzle cap 35B).

[0052] In the spinning machine 100, even if the fiber dusts and the like become clogged in the spinning section 3 for some reason, the subsequent fiber bundle F can be guided in the direction away from the spinning section 3 by the passage FP formed on the nozzle cap 35B. In the present embodiment, since the passage FP is formed by the protrusions 35p formed on the nozzle cap 35B, the fiber bundle F can be guided to outside with a simple configuration. Accordingly, the fiber bundle F can be continuously removed, and the fiber bundle F can be prevented from accumulating on the nozzle cap 35B.

[0053] As described above, the passage FP in the present embodiment is formed by the two lines of protrusions 35p formed on the nozzle cap 35B. However, instead of the protrusions 35p, guiding walls may be attached onto the nozzle cap 35 to form the passage FP.

Also in this case, effects similar to the above are obtained.

[0054] Furthermore, in the nozzle cap 35A and the nozzle cap 35B, a width W of the passage FP is substantially equal to a width (diameter) D of a suction opening of the suction nozzle 7. In the spinning machine 100, since the suction force caused by the suction nozzle 7 acts along the passage FP without becoming weak, the fiber bundle F can be smoothly guided to the suction nozzle 7. Accordingly, the fiber bundle F can be continuously removed, and the fiber bundle F can be prevented from accumulating on the nozzle cap 35A (35B).

[0055] In the embodiment described above, the passage FP is formed to have a prescribed width W towards a direction away from the claw portion 35h of the nozzle cap 35A (35B). However, the passage FP may have the width W formed wide in proximity of the claw portion 35h and substantially equal to the width (the diameter) D of the suction opening in proximity of the suction nozzle 7.

Claims

1. A spinning machine comprising:

a drafting section (2) adapted to draft a fiber bundle (F), and
a spinning section (3) adapted to twist the fiber bundle (F) drafted by the drafting section (2), and includes a passage (FP) adapted to guide the fiber bundle (F) and prevent accumulation of the fiber bundle (F) at a gap between the drafting section (2) and the spinning section (3).

2. The spinning machine according to claim 1, wherein the passage (FP) is provided independently from a normal path adapted to guide the fiber bundle (F) from the drafting section (2) to the spinning section (3).

3. The spinning machine according to claim 1 or claim 2, wherein the spinning section (3) includes:

a fiber guide (31) adapted to guide the fiber bundle (F) to a spinning chamber (SC),
a nozzle block (32) adapted to guide air to the spinning chamber (SC),
a spindle (33) adapted to guide the fiber bundle twisted in the spinning chamber (SC) to outside,
a nozzle holder (34) adapted to support the nozzle block (32),
and
a nozzle cap (35, 35A, 35B) adapted to fix at least the fiber guide (31) onto the nozzle holder (34),

wherein the passage (FP) is formed on the nozzle cap (35, 35A, 35B).

4. The spinning machine according to claim 1 or claim 2, wherein the spinning section (3) includes:

a fiber guide (31) adapted to guide the fiber bundle (F) to a spinning chamber (SC),
a nozzle block (32) adapted to guide air to the spinning chamber (SC), and
a spindle (33) adapted to guide the fiber bundle (F) twisted in the spinning chamber (SC) to outside,

wherein the passage (FP) is formed on an upstream end surface of the nozzle block (32) in a fiber bundle travelling direction.

5. The spinning machine according to any one of claim 1 through claim 4, further comprising a suction nozzle (7) adapted to suck the fiber bundle (F) from the gap between the drafting section (2) and the spinning section (3),
wherein the passage (FP) is adapted to guide the fiber bundle (F) to the suction nozzle (7).

6. The spinning machine according to claim 3, wherein the passage (FP) is formed by a recess (35C) or protrusions (35p) formed on the nozzle cap (35, 35A, 35B).

7. The spinning machine according to any one of claim 1 through claim 6, wherein a width (W) of the passage (FP) is substantially equal to a width (D) of a suction opening of the suction nozzle (7).

FIG. 1

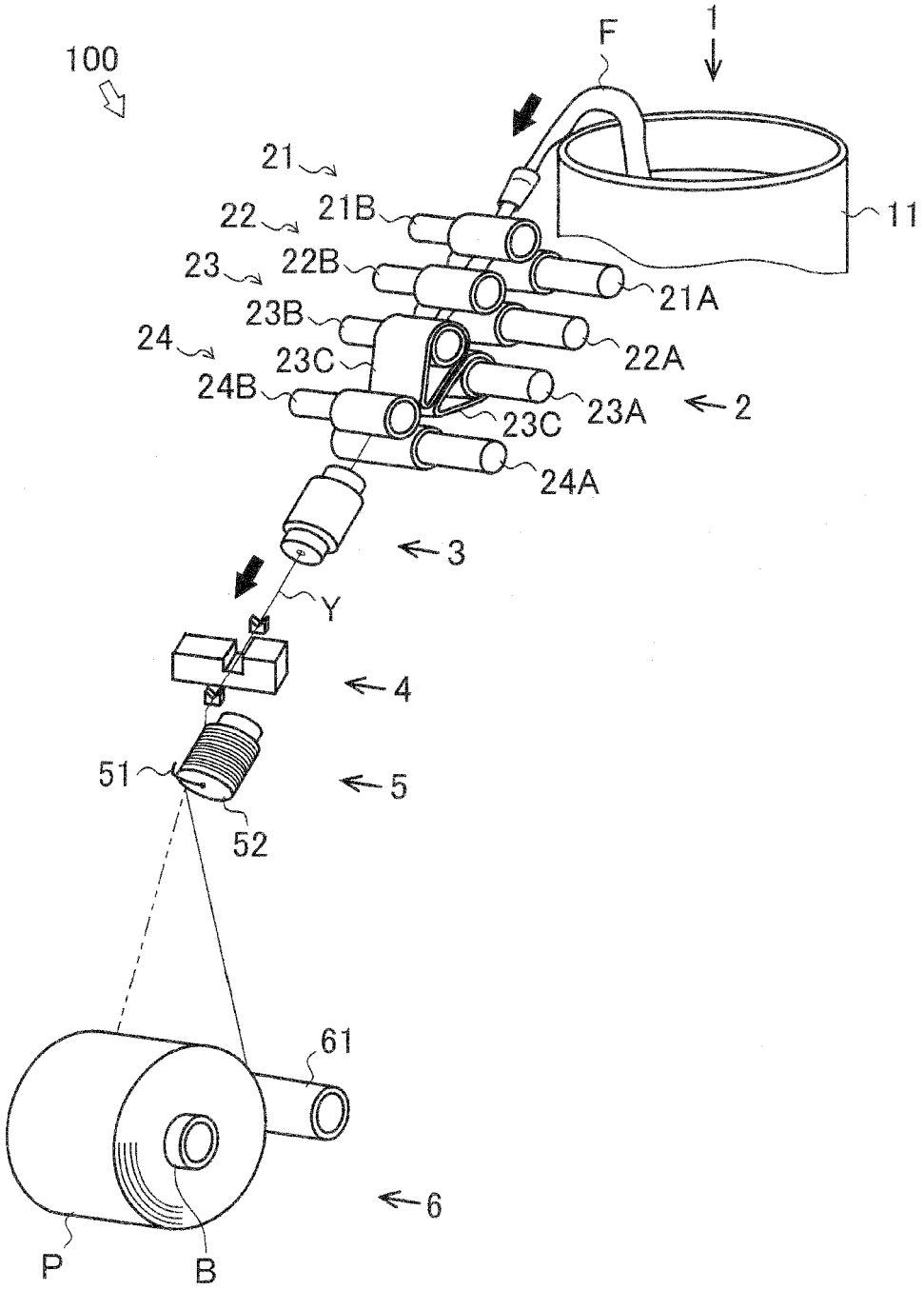

100
F
1
21
22
21B
23
22B
11
21A
23B
24
22A
23C
24B
23A
2
23C
24A
3
Y
4
51
5
52
61
6
P
B

FIG. 2

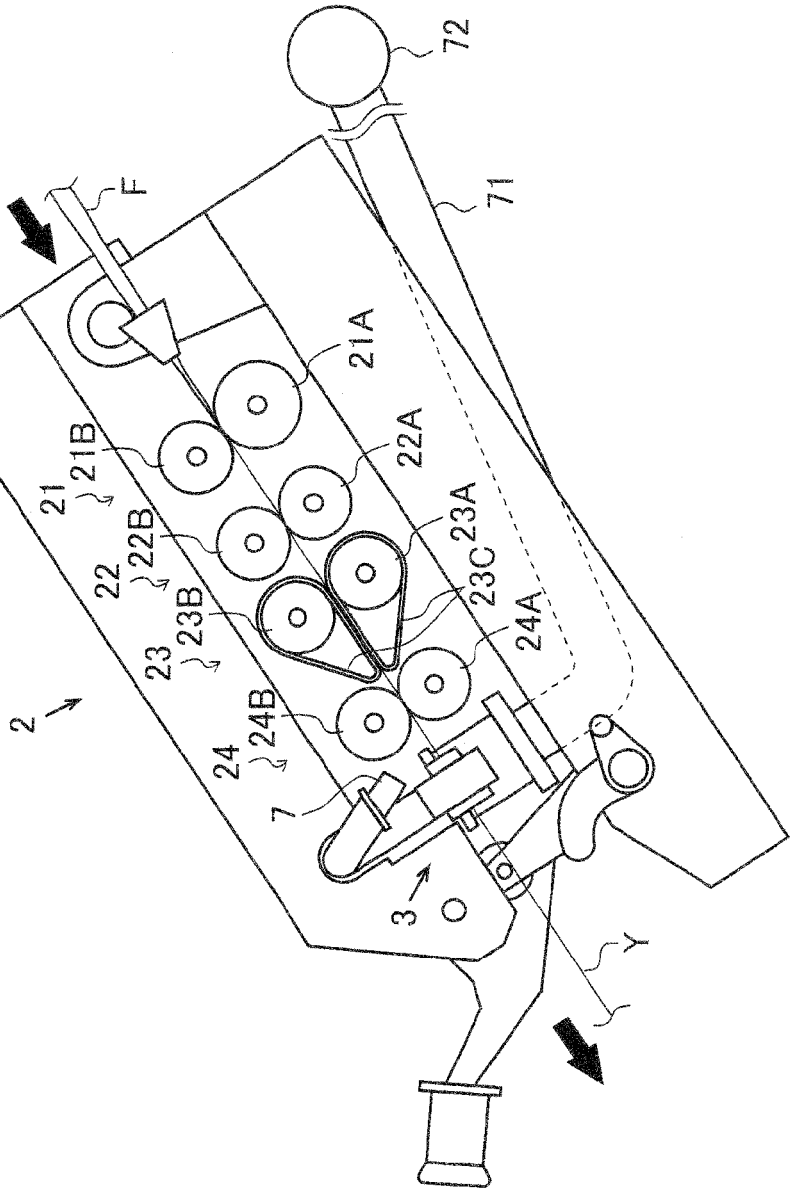


FIG. 3

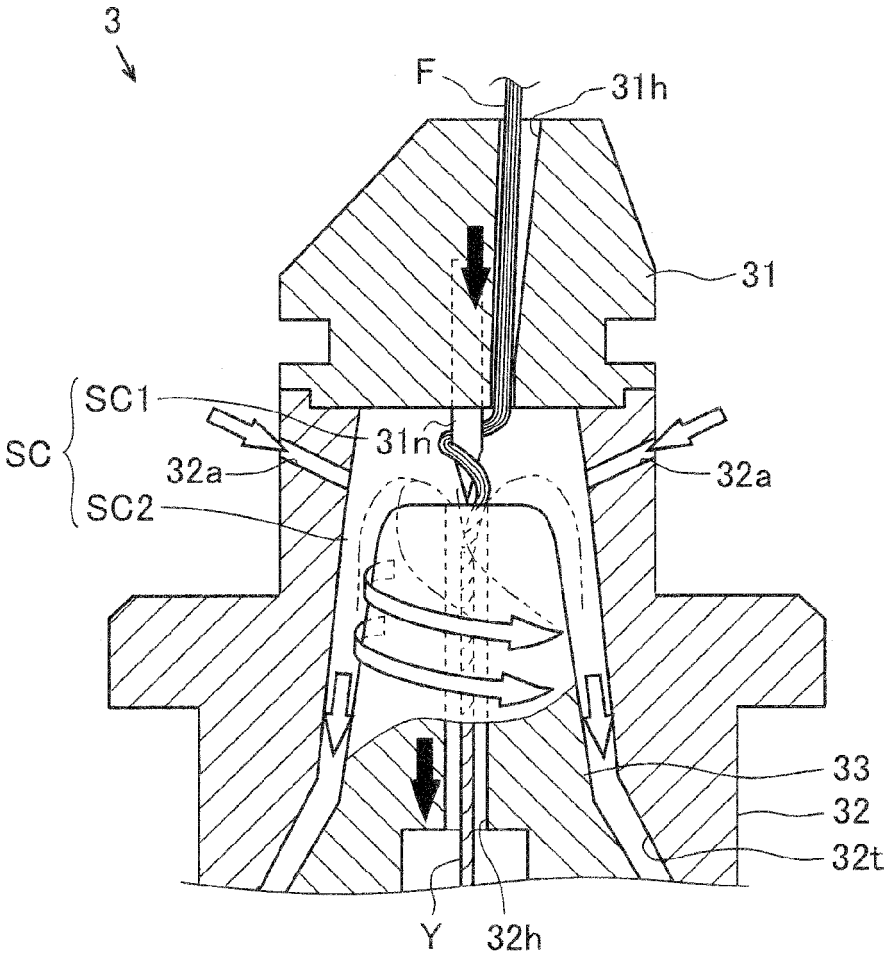


FIG. 4

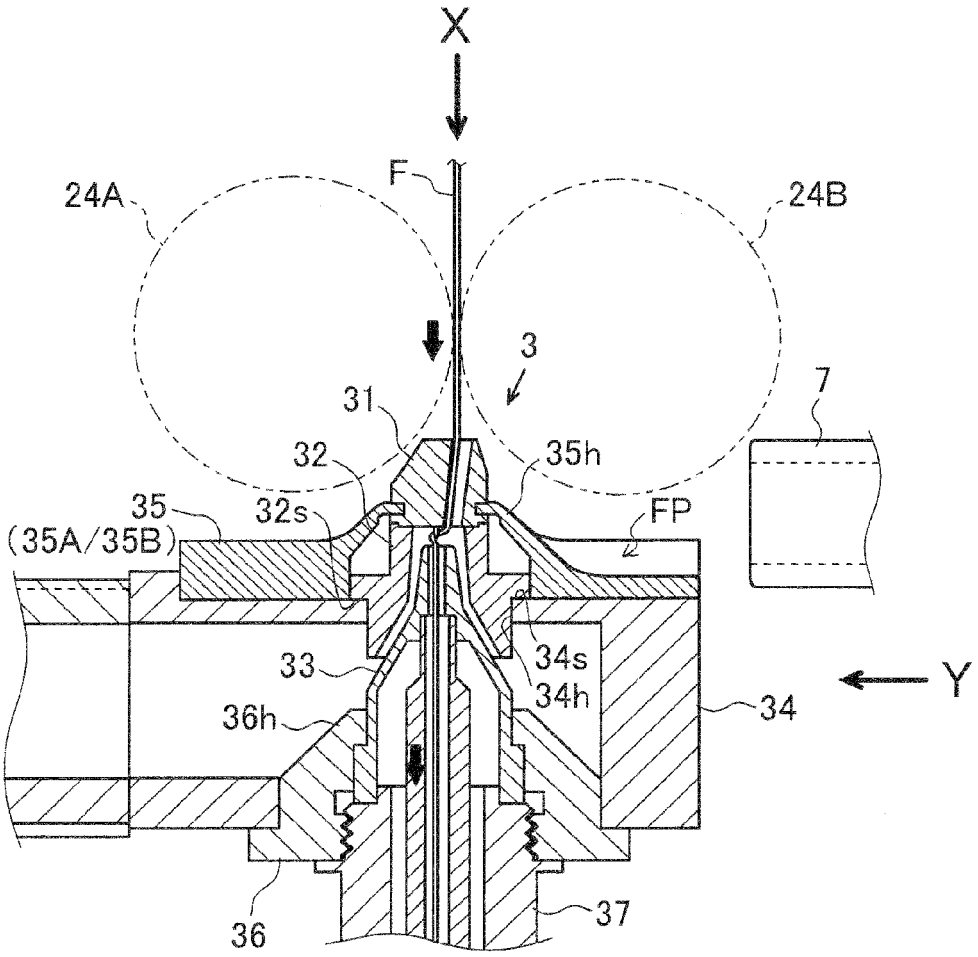


FIG. 5A

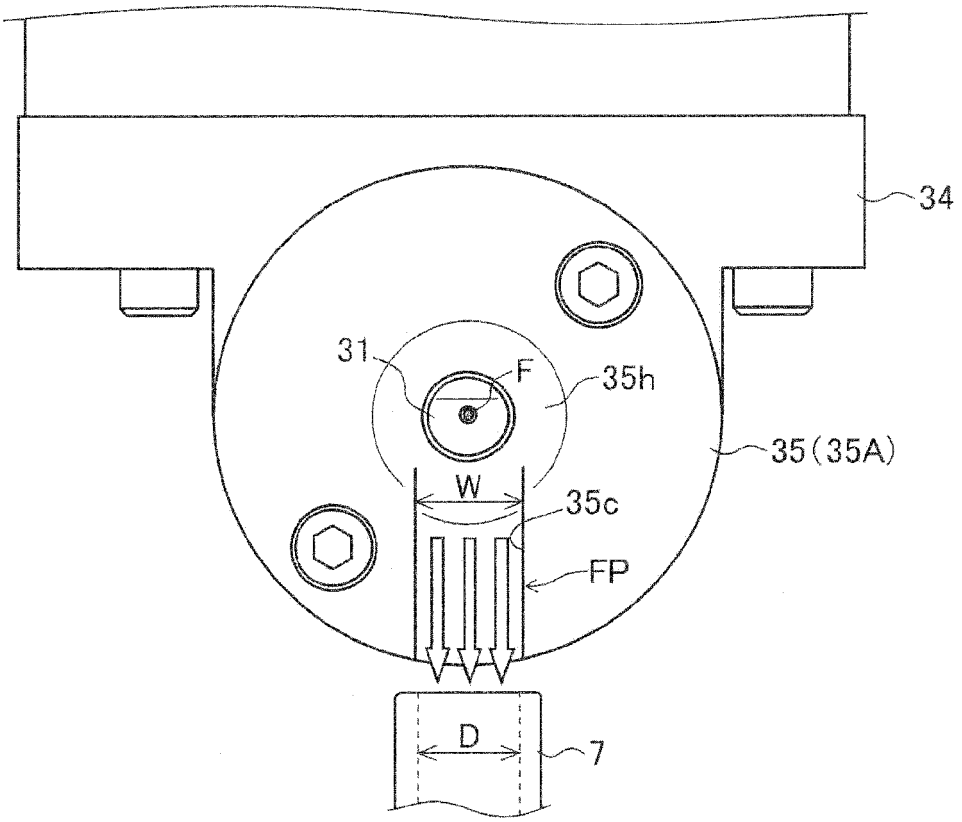


FIG. 5B

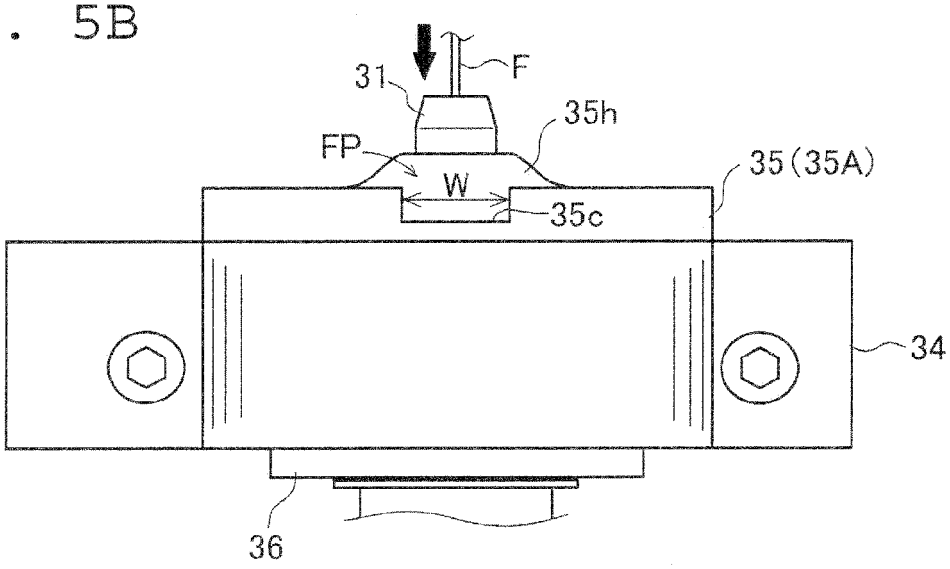


FIG. 6A

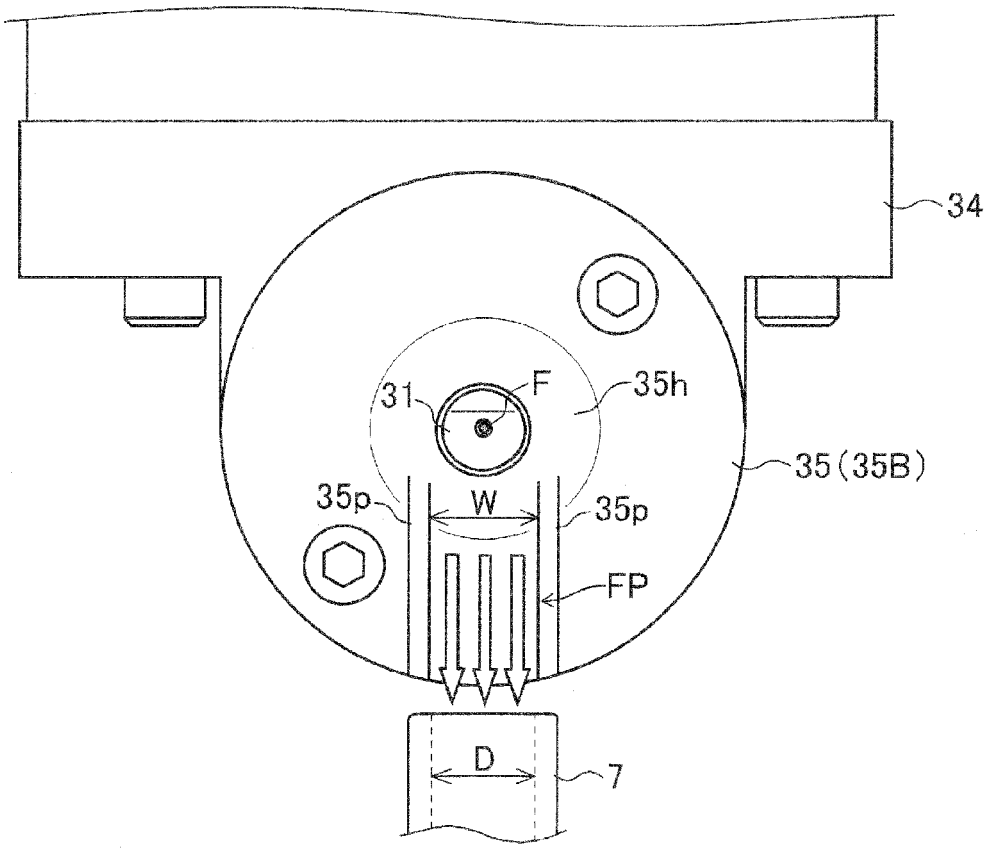
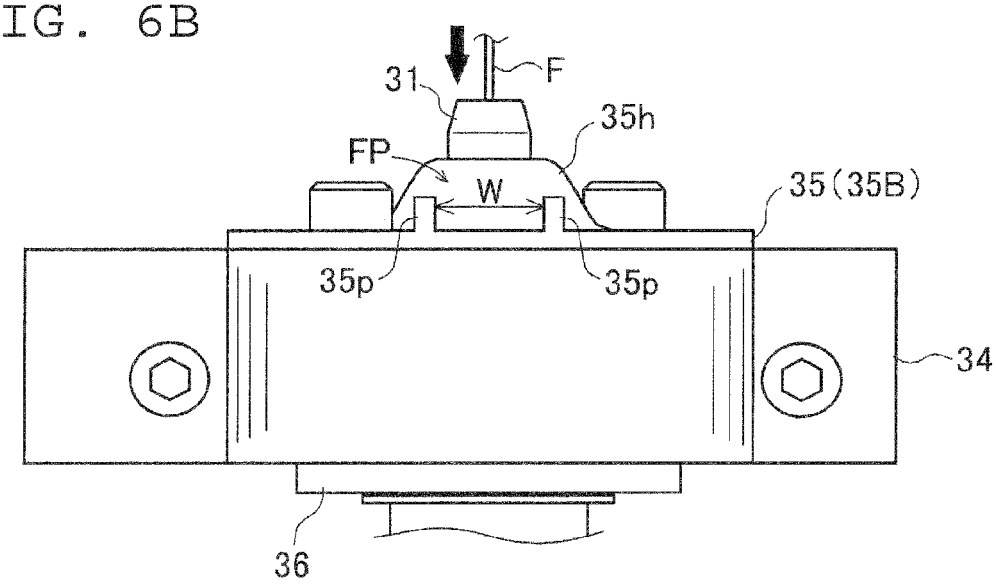


FIG. 6B



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 2011099192 A **[0002]**
- JP 5086510 A **[0042]**
- JP 2006161171 A **[0042]**