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

(11) EP 2 573 025 A2

(12) EUROPEAN PATENT APPLICATION

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

(21) Application number: **12179435.8**

(22) Date of filing: **06.08.2012**

(51) Int Cl.:
B65H 54/70 *(2006.01)* ***D01H 11/00*** *(2006.01)*
B65H 69/06 *(2006.01)*

(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 2011206626**

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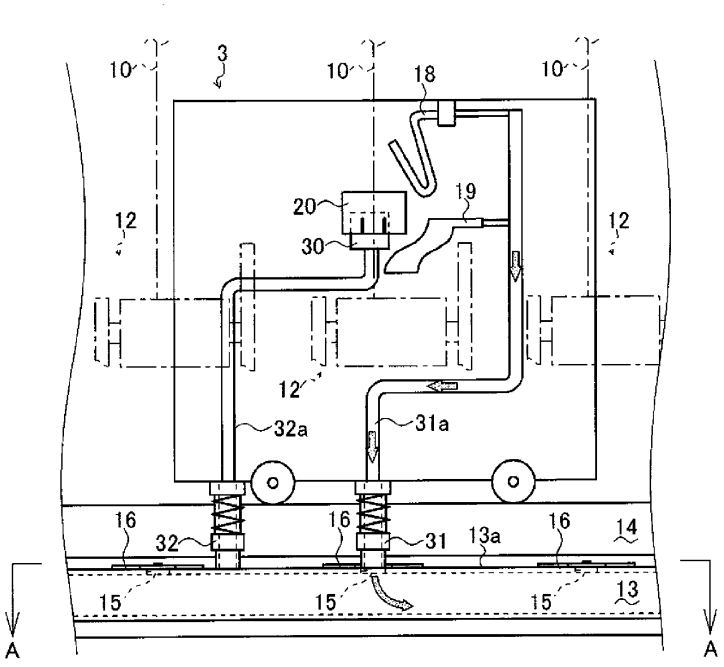
(54) Spinning machine

(57) A spinning machine (1) includes a yarn supplying device, a yarn slack eliminating device (11), a winding device (12), a yarn joining device (20), a first guiding device (18) that catches the yarn end (10a) and guides the yarn end (10a) to the yarn joining device (20), a second guiding device (19) that catches the yarn end (10b) and guides the yarn end (10b) to the yarn joining device (20), and a waste collecting section (30) that accommodates fibers generated by the yarn joining operation. The waste collecting section (30) accommodates the fibers during a suction operation of the yarn end and discharges the fibers while the suction operation is stopped.

FIG. 3A



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a spinning machine. Specifically, the present invention relates to accommodation of fiber wastes.

2. Description of the Related Art

[0002] Conventionally, there is known a winder unit including a splicer (yarn joining device) in which fibers generated at the time of unwinding are blown by an airflow from an untwisting pipe and accommodated in a waste collecting section. In such a winder unit, the waste collecting section is manually or automatically connected to a suction duct to discharge the accommodated fiber wastes. For example, a description is made in Japanese Unexamined Patent Publication No. 2009-190853.

[0003] However, in a spinning machine in which a plurality of such winder units is connected to a single suction duct, if the fiber wastes are discharged from the waste collecting section in one winder unit while a yarn joining operation is being carried out in another winder unit, a suction force required to suck a yarn end during the yarn joining operation fluctuates. The suction of the yarn end thus becomes unstable, and the yarn joining operation may be influenced.

BRIEF SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a spinning machine capable of discharging fiber wastes accommodated in a waste collecting section without influencing a yarn joining operation.

[0005] A spinning machine includes a plurality of spinning units, an operation cart, a waste collecting section, and a discharge section. Each of the plurality of spinning units includes a yarn supplying device adapted to supply a spun yarn, and a winding device adapted to wind the spun yarn supplied from the yarn supplying device into a package. The operation cart is provided to travel along an arrangement direction of the plurality of the spinning units and adapted to perform an operation with respect to at least one of the spinning units. The waste collecting section is provided in the operation cart, and adapted to accommodate fiber wastes. The discharge section is provided within an arrangement range of the plurality of the spinning units, and adapted to receive discharge of the fiber wastes from the waste collecting section. Accordingly, the fiber wastes accommodated in the waste collecting section can be efficiently discharged in the arrangement range of the spinning units.

[0006] The discharge section includes a suction duct and a first connecting section. The suction duct is arranged in a direction substantially parallel to a travelling direction of the operation cart, and is provided with a plurality of supplying sections for supplying a suction airflow to at least the operation cart. The first connecting section is adapted to connect the waste collecting section to at least one of the supplying sections at a discharge position where the fiber wastes are discharged from the waste collecting section. Accordingly, the fiber wastes accommodated in the waste collecting section can be reliably discharged to the suction duct.

[0007] The operation cart includes a yarn joining device, a first guiding device, and a second guiding device. The yarn joining device is adapted to perform a yarn joining operation of joining a yarn end from the yarn supplying device and a yarn end from the winding device when continuation of the spun yarn is disconnected. The first guiding device is adapted to catch the yarn end from the yarn supplying device by suction and to guide the yarn end to the yarn joining device. The second guiding device is adapted to catch the yarn end from the winding device by suction and to guide the yarn end to the yarn joining device. Accordingly, in each spinning unit, even if the continuation of the spun yarn is disconnected, the yarn joining operation can be carried out by the operation cart and the winding of the package can be carried out.

[0008] The spinning machine further includes a second connecting section adapted to connect the first guiding device and the second guiding device to at least one of the supplying sections. Accordingly, the first guiding device and the second guiding device can obtain the suction airflow from the discharge section, and guide the spun yarn.

[0009] The operation cart is adapted to accommodate the fiber wastes during a suction operation by at least one of the first guiding device and the second guiding device, and to discharge the fiber wastes from the waste collecting section while the suction operation is stopped. Accordingly, the fiber wastes accommodated in the waste collecting section can be discharged without influencing the yarn joining operation.

[0010] The yarn joining device includes a first untwisting nozzle and a second untwisting nozzle. The first untwisting nozzle is adapted to blow fibers of the yarn end from the yarn supplying device by air. The second untwisting nozzle is adapted to blow fibers of the yarn end from the winding device by air. An air blowing direction of the first untwisting nozzle and the second untwisting nozzle is set towards the waste collecting section. Accordingly, the fiber wastes can be accommodated in the waste collecting section without influencing the yarn joining operation during the untwisting in the yarn joining operation.

[0011] The yarn supplying device includes a pneumatic spinning device adapted to spin a fiber bundle by a whirling airflow to produce the spun yarn. Accordingly, operation efficiency of the spinning machine can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a front view illustrating a spinning machine according to one embodiment of the present invention;

FIG. 2 is a schematic cross-sectional view illustrating a side surface of the spinning machine according to one embodiment of the present invention;
FIG. 3A is a schematic view of a yarn joining cart, which is an operation cart, according to one embodiment of the present invention;
FIG. 3B is a view taken along line A-A of FIG. 3A;
FIG. 4 is a schematic view illustrating an overall structure of a yarn joining device according to one embodiment of the present invention;
FIG. 5A is a plan view of a waste collecting section according to one embodiment of the present invention;
FIG. 5B is a side view of the waste collecting section according to one embodiment of the present invention;
FIG. 6A is a schematic view illustrating a state in which supply holes formed in a suction duct are covered by shutter mechanisms according to one embodiment of the present invention;
FIG. 6B is a schematic view illustrating a state in which a first connecting section has passed over one of the supply holes formed in the suction duct according to one embodiment of the present invention;
FIG. 6C is a schematic view illustrating a state in which the first connecting section is connected to one of the supply holes formed in the suction duct according to one embodiment of the present invention;
FIG. 6D is a schematic view illustrating a state in which the first connecting section is separated from the supply holes formed in the suction duct, and a second connecting section is connected to one of the supply holes according to one embodiment of the present invention;
FIG. 7 is a schematic view illustrating a manner of untwisting performed by the yarn joining device and a manner of accommodation of the generated fiber wastes according to one embodiment of the present invention; and
FIG. 8 is a schematic view illustrating a manner in which the fiber wastes temporarily accommodated in the waste collecting section are discharged according to one embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0013] With reference to FIG. 1 and FIG. 2, an overall structure of a spinning machine 1 according to one embodiment of the present invention will be described. "Upstream" and "downstream" respectively refer to upstream and downstream in a travelling direction of a yarn during spinning. A direction in which spinning units 2 are arranged is defined as a left-right direction.

[0014] As illustrated in FIG. 1 and FIG. 2, the spinning machine 1 includes a plurality of spinning units 2 arranged in the left-right direction. The spinning machine 1 includes a plurality of spinning units 2, a yarn joining cart 3 as an operation cart, a blower box 4, a motor box 5, and a housing 6.

[0015] The spinning unit 2 produces a spun yarn 10 to form a package 41. Each spinning unit 2 includes a yarn supplying device, a yarn slack eliminating device 11 (a yarn accumulating device), and a winding device 12. In the present embodiment, the yarn supplying device refers to a draft device 7 and a spinning device 9, but the present invention is not limited thereto. For example, the yarn supplying device may include the yarn slack eliminating device 11. Each spinning unit 2 includes the draft device 7, the spinning device 9, the yarn slack eliminating device 11, and the winding device 12 in this order from upstream to downstream.

[0016] The draft device 7, which is one part of the yarn supplying device, drafts a sliver to obtain a fiber bundle 8. The draft device 7 is arranged in proximity to an upper end of the housing 6 of the spinning machine 1. The fiber bundle 8 fed from the draft device 7 is spun by the spinning device 9.

[0017] Although the detailed structure of the spinning device 9 is not illustrated, in the present embodiment, a pneumatic spinning device which uses a whirling airflow to apply twists to the fiber bundle 8 to produce the spun yarn 10 is adopted as the spinning device 9. More specifically (although not illustrated), the spinning device 9 includes a spinning chamber, a fiber guiding section, a whirling airflow generating nozzle, and a hollow guide shaft body. The fiber guiding section is adapted to guide the fiber bundle 8 supplied from the draft device 7 located upstream into the spinning chamber. The whirling airflow generating nozzle is arranged at a periphery of a path through which the fiber bundle 8 travels, and is adapted to generate the whirling airflow in the spinning chamber. This whirling airflow causes a fiber end of the fiber bundle 8 guided into the spinning chamber to be reversed and to whirl. The hollow guide shaft body guides the spun yarn 10 from the spinning chamber to outside the spinning device 9. The structure of the spinning device 9 is not limited to that of the present embodiment, and may be a pneumatic spinning device including a pair of air jet nozzles for applying twists in directions opposite to one another, and a spinning method is not particularly limited.

[0018] The yarn slack eliminating device 11 is arranged downstream of the spinning device 9. The yarn slack eliminating device 11 has a function of applying a predetermined tension to the spun yarn 10 to pull out the spun yarn 10 from the spinning device 9, a function of accumulating the spun yarn 10 fed from the spinning device 9 during a yarn joining operation by the yarn joining cart 3 (to be described later) to prevent slackening of the spun

yarn 10, and a function of adjusting the tension such that a fluctuation of the tension at the winding device 12 side is not transmitted towards the spinning device 9.

[0019] The spun yarn 10 from the spinning device 9 is fed by the yarn slack eliminating device 11 and wound by the winding device 12 into the package 41. In FIG. 1, the winding device 12 is illustrated to wind the spun yarn 10 into a cheese-shaped package 41, but the winding device 12 may also wind the spun yarn 10 into a conical package.

[0020] A yarn clearer 40 is arranged on a front side of the housing 6 of the spinning machine 1, and at a position between the spinning device 9 and the yarn slack eliminating device 11. The yarn clearer 40 monitors a thickness of the travelling spun yarn 10, and when a yarn defect of the spun yarn 10 is detected, the yarn clearer 40 transmits a yarn defect detection signal to a unit controller (not illustrated) The yarn clearer 40 may also detect a presence or an absence of foreign substances contained in the spun yarn 10 (another example of the yarn defect).

[0021] The yarn joining cart 3, which is an operation cart, performs the yarn joining operation to each spinning unit 2. The yarn joining cart 3 is arranged capable of travelling in both left and right directions (along a plurality of the spinning units 2) within a travelable range. When a yarn breakage or a yarn cut occurs in a certain spinning unit 2, the yarn joining cart 3 travels to the relevant spinning unit 2 and stops. The detailed structure of the yarn joining cart 3 will be described later.

[0022] The blower box 4 includes a blower. In FIG. 1, the blower box 4 is arranged at a right side end of the spinning machine 1. However, a position to arrange the blower box 4 is not particularly limited. A suction duct 13 (a discharge section) is connected to the blower box 4 (a discharge section). The suction duct 13 is adapted to be connectable to the yarn joining cart 3. The fiber wastes and the like generated during the yarn joining operation by the yarn joining cart 3 are sucked by the suction duct 13. The blower box 4 accommodates the fiber wastes and the like transported through the suction duct 13. The detailed structure of the suction duct 13 will be described later.

[0023] The motor box 5 includes a motor. In FIG. 1, the motor box 5 is arranged at a left side end of the spinning machine 1. However, a position to arrange the motor box 5 is not particularly limited. The motor box 5 includes a motor as a driving source of the spinning machine 1, and a decelerator (not illustrated) for transmitting power to each section of the spinning machine 1.

[0024] In the present embodiment, the spinning machine 1 includes a plurality of yarn joining carts 3 according to the number of the spinning units 2 arranged in the housing 6. If the number of the spinning units 2 is small, the number of the yarn joining carts 3 of the spinning machine 1 may be one.

[0025] A travelling space through which the yarn joining cart 3 travels is formed in a recessed manner towards a back side at a central part of a front side of the housing 6. A rail 14 for the yarn joining cart 3 is arranged in the left-right direction (the arrangement direction the spinning units 2, and the travelling direction of the yarn joining cart 3) at a lower part of the travelling space.

[0026] When the unit controller (not illustrated) receives the yarn defect detection signal, the spinning machine 1 immediately cuts the spun yarn 10 with a cutter (not illustrated), and stops the draft device 7, the spinning device 9, and the like. The unit controller transmits a control signal to the yarn joining cart 3 to cause the yarn joining cart 3 to travel to front of the relevant spinning unit 2. Thereafter, the unit controller drives the spinning device 9 or the like again, the yarn joining cart 3 performs a yarn joining operation, and winding is resumed. Instead of arranging the cutter in the spinning unit 2, the supply of air to the spinning device 9 may be stopped, and the spun yarn 10 may be cut by interrupting the production of the spun yarn 10.

[0027] Next, the structure of the yarn joining cart 3 will be specifically described with reference to FIG. 1 to FIG. 5B.

[0028] As illustrated in FIG. 1 to FIG. 3B, the yarn joining cart 3 includes a first guiding device 18, a second guiding device 19, a yarn joining device 20, a waste collecting section 30, a second connecting section 31, and a first connecting section 32. The yarn joining cart 3 is arranged to travel on the rail 14 provided in the housing 6 of the spinning machine 1. The suction duct 13 adapted to supply a suction airflow is provided in a direction parallel to the rail 14.

[0029] After the yarn breakage or the yarn cut of the spun yarn 10, the first guiding device 18 is swung upward from a standby position to catch a yarn end 10a of the spun yarn 10 (hereinafter, simply referred to as an "upper yarn") spun from the spinning device 9 by sucking air from a suction port. The first guiding device 18 is swung downward while sucking and holding the upper yarn to guide the upper yarn to the yarn joining device 20.

[0030] After the yarn breakage or the yarn cut of the spun yarn 10, the second guiding device 19 is swung downward from a standby position to catch a yarn end 10b of the spun yarn 10 (hereinafter, simply referred to as a "lower yarn") from the winding device 12 by sucking air from a suction port. The second guiding device 19 is swung upward while sucking and holding the lower yarn to guide the lower yarn to the yarn joining device 20.

[0031] The yarn joining device 20 joins the yarn end 10a of the guided upper yarn and the yarn end 10b of the guided lower yarn.

[0032] As illustrated in FIG. 4, the yarn joining device 20 includes a first untwisting nozzle 21 adapted to untwist the yarn end 10a of the upper yarn (see chain dashed line in the drawing), a second untwisting nozzle 22 adapted to untwist the yarn end 10b of the lower yarn (see solid line in the drawing), a yarn joining nozzle 23 adapted to entangle and join the untwisted yarn ends 10a and 10b, a pair of yarn guiding levers 24 adapted to arrange

the yarn ends 10a and 10b at prescribed positions, respectively, a first yarn end cutter 25 adapted to cut the yarn end 10a of the upper yarn and a second yarn end cutter 26 adapted to cut the yarn end 10b of the lower yarn, and a pair of yarn holding levers 27 adapted to hold the yarn ends 10a and 10b during the yarn joining operation. Arrows in the drawing illustrate a movable direction of each member constituting the yarn joining device 20.

[0033] The first untwisting nozzle 21 sucks and untwists the yarn end 10a of the upper yarn. The first untwisting nozzle 21 includes a first untwisting pipe 21b from which a first suction port 21a is exposed. The first untwisting pipe 21b is connected to an untwisting airflow passage 33 adapted to inject an untwisting airflow into the first untwisting pipe 21b. The untwisting airflow passage 33 is tilted in an axial direction of the first untwisting pipe 21b and connected close to the first suction port 21a of the first untwisting pipe 21b. The first untwisting nozzle 21 thus uses the untwisting airflow injected from the untwisting airflow passage 33 to suck the yarn end 10a from the first suction port 21a, and untwists the fibers using the whirling airflow generated in the first untwisting pipe 21b. The first untwisting nozzle 21 is arranged such that the air flows towards the waste collecting section 30 described later, that is, the fiber wastes generated during the untwisting are blown by the air towards the waste collecting section 30.

[0034] The second untwisting nozzle 22 sucks and untwists the yarn end 10b of the lower yarn. The second untwisting nozzle 22 includes a second untwisting pipe 22b from which a second suction port 22a is exposed. The second untwisting pipe 22b is connected to an untwisting airflow passage 34 adapted to inject the untwisting airflow into the second untwisting pipe 22b. The untwisting airflow passage 34 is tilted in an axial direction of the second untwisting pipe 22b and connected close to the second suction port 22a of the second untwisting pipe 22b. The second untwisting nozzle 22 thus uses the untwisting airflow injected from the untwisting airflow passage 34 to suck the yarn end 10b from the second suction port 22a, and untwists the fibers using the whirling airflow generated in the second untwisting pipe 22b. The second untwisting nozzle 22 is arranged so that the air flows towards the waste collecting section 30 described later, that is, the fiber wastes generated during unwinding are blown by the air towards the waste collecting section 30.

[0035] The yarn joining nozzle 23 entangles and joins the untwisted yarn end 10a of the upper yarn and the untwisted yarn end 10b of the lower yarn. The yarn joining nozzle 23 is provided with an accommodating portion 23a for accommodating the yarn end 10a of the upper yarn and the yarn end 10b of the lower yarn, and a inclined guiding portion 23b adapted to guide the yarn ends 10a and 10b to the accommodating portion 23a. The yarn joining nozzle 23 is connected to a yarn joining airflow passage 35 adapted to inject a yarn joining airflow into the yarn joining nozzle 23. The yarn joining nozzle 23 thus generates the whirling airflow in the accommodating portion 23a by the yarn joining airflow injected from the yarn joining airflow passage 35, and entangles and joins the untwisted yarn ends 10a and 10b.

[0036] The yarn guiding levers 24 guide the yarn end 10a of the upper yarn and the yarn end 10b of the lower yarn at prescribed positions, respectively. The yarn guiding levers 24 are arranged facing one another with the yarn joining nozzle 23 therebetween, and are respectively moved by a driving device (not illustrated). Before the untwisting operation, the yarn guiding levers 24 are moved to guide tip ends of the yarn ends 10a and 10b to the prescribed positions of the yarn joining nozzle 23. After the untwisting operation, when the yarn guiding levers 24 are further moved to appropriate positions, the untwisted sections of the yarn ends 10a and 10b are guided to prescribed positions in the accommodating portion 23a.

[0037] The first yarn end cutter 25 cuts the yarn end 10a to an appropriate length before the yarn end 10a of the upper yarn is untwisted. The second yarn end cutter 26 cuts the yarn end 10b to an appropriate length before the yarn end 10b of the lower yarn is untwisted. The yarn end 10a cut by the first yarn end cutter 25 is clamped by a first clamp plate 28, and the yarn end 10b cut by the second yarn end cutter 26 is clamped by a second clamp plate 29.

[0038] After the untwisted sections of the yarn ends 10a and 10b are arranged at the prescribed positions in the accommodating portion 23a by the yarn guiding levers 24, the yarn holding levers 27 fix the positions of the yarn ends 10a and 10b. The yarn holding levers 27 are moved along side surfaces of the yarn joining nozzle 23 by the driving device (not illustrated). The yarn holding levers 27 fix the positions of the yarn ends 10a and 10b such that the yarn ends 10a and 10b are sandwiched between the yarn holding levers 27 and the yarn joining nozzle 23. Thereafter, as described above, the yarn joining airflow is injected into the yarn joining nozzle 23, and the yarn ends 10a and 10b are entangled and joined. The yarn joining operation and the spinning operation are stably performed, and the spinning operation can be smoothly resumed. Operation efficiency of the spinning machine 1 thus can be improved.

[0039] The waste collecting section 30 accommodates the fiber wastes and the like generated in the yarn joining operation. The waste collecting section 30 is fixed in proximity to the yarn joining device 20, specifically, the main body of the yarn joining device 20 with an appropriate means such as a screw (see FIG. 2). As illustrated in FIG. 5A and FIG. 5B, the waste collecting section 30 includes a waste collecting chamber 30a, a fiber introducing port 30b, and a lid 30c.

[0040] The waste collecting chamber 30a is formed in a substantially circular column shape inside a tubular casing, for example. The whirling airflow can be generated inside the waste collecting chamber 30a. Specifically, the fiber introducing port 30b for introducing the airflow in a substantially tangential direction of the sub-

stantially circular column shaped waste collecting chamber 30a is arranged in the waste collecting section 30. When the airflow is blown towards the fiber introducing port 30b, the whirling airflow can be generated inside the waste collecting chamber 30a. The first untwisting nozzle 21 and the second untwisting nozzle 22 induce the airflow and the fiber wastes towards the fiber introducing port 30b. The material of the waste collecting chamber 30a is not particularly limited, but transparent or translucent resin is suitably used such that an accumulated amount of fiber wastes, to be described later, can be checked from outside.

[0041] The lid 30c covers an opening section formed at an upper part of the waste collecting chamber 30a. For example, the lid 30c is mounted to the upper part of the waste collecting chamber 30a via a screw-fit portion (not illustrated), and is detachably provided with respect to the waste collecting chamber 30a by rotating the screw-fit portion. An air vent port 30d opened in a substantially circular shape (including a circle) is formed at a center portion of the lid 30c. An air vent filter 30e is arranged at the air vent port 30d. The air vent filter 30e is, for example, a metal mesh-like filter in which air resistance is hardly generated and having a roughness to a degree in which the fiber wastes can be caught. Thus, the air and the fiber wastes introduced from the fiber introducing port 30b are separated by the air vent filter 30e, and the fiber wastes are accumulated in the waste collecting chamber 30a.

[0042] A fiber discharge opening 30f opening in a circular shape (a substantially circular shape) is formed at a center portion in the lower part of the waste collecting chamber 30a. The fiber wastes accumulated in the waste collecting chamber 30a can be discharged outside from the fiber discharge opening 30f.

[0043] As illustrated in FIG. 3A and FIG. 3B, the second connecting section 31 supplies the suction airflow to the first guiding device 18 and the second guiding device 19. The first connecting section 32 supplies the suction airflow to the waste collecting section 30. The second connecting section 31 and the first connecting section 32 are formed in a pipe shape. A suction airflow introducing port of the second connecting section 31 and a suction airflow introducing port of the first connecting section 32 are arranged in the yarn joining cart 3 to face the suction duct 13. The second connecting section 31 and the first connecting section 32 are urged towards the suction duct 13 by an urging member (not illustrated) such as a spring, and a tip end (suction airflow introducing port) of the second connecting section 31 and a tip end (suction airflow introducing port) of the first connecting section 32 make contact with the suction duct 13 at a predetermined force, as will be described later. That is, the second connecting section 31 and the first connecting section 32 are moved on the suction duct 13 (a supplying section forming surface 13a to be described later) accompanying the travelling of the yarn joining cart 3.

[0044] The second connecting section 31 is connected to the first guiding device 18 and the second guiding device 19 via a coupling pipe 31a. The first connecting section 32 is connected to the waste collecting section 30 via a coupling pipe 32a. The second connecting section 31 supplies the suction airflow to the first guiding device 18 and the second guiding device 19 from a supplying section 15, to be described later, formed on the suction duct 13. The first connecting section 32 supplies the suction airflow from the supplying section 15 to the waste collecting section 30.

[0045] Next, a structure of the suction duct 13 will be described with reference to FIG. 3A and FIG. 3B.

[0046] The suction duct 13 supplies the suction airflow to each section of the spinning machine 1. The suction duct 13 is arranged in a direction parallel to the rail 14. For supplying the suction airflow, a plurality of supplying sections 15 are formed at a predetermined interval on the suction duct 13 on a flat surface (hereinafter, simply referred to as the supplying section forming surface 13a) facing towards the yarn joining cart 3, the surface facing the second connecting section 31 and the first connecting section 32. A shutter mechanism 16 is arranged for each supplying section 15 on the supplying section forming surface 13a of the suction duct 13.

[0047] The second connecting section 31 or the first connecting section 32 is to be connected to the supplying section 15 of the supplying section forming surface 13a. The plurality of the supplying sections 15 are respectively formed on the supplying section forming surface 13a such that the second connecting section 31 of the yarn joining cart 3 is connected when the yarn joining cart 3 is located at a position to perform the yarn joining operation in a certain spinning unit 2.

[0048] The shutter mechanism 16 is arranged to be capable of covering the supplying section 15. The shutter mechanism 16 is made of a material having elasticity to a certain degree (e.g., plastic such as polyamide resin), and is formed as a substantially flat plate-like member. The shutter mechanism 16 includes four lids (a first lid 16a, a second lid 16b, a third lid 16c, and a fourth lid 16d) extending radially from a central part. A flat hole-closing surface (not illustrated) is formed on one surface of the respective lid.

[0049] The shutter mechanism 16 is mounted in proximity of each supplying section 15 of the supplying section forming surface 13a of the suction duct 13. The shutter mechanism 16 is rotatably arranged with a central part as a center of rotation, and is adapted to cover the supplying section 15 with the lid. The shutter mechanism 16 is structured such that the lid covering the supplying section 15 is switched every time the shutter mechanism 16 is rotated 90 degrees.

[0050] Next, the operation of the shutter mechanism 16 by the second connecting section 31 will be described with reference to FIG. 3A and FIG. 3B, and FIG. 6A to FIG. 6D. Since each lid of the supplying section 15 has exactly the same shape, the description on other lids will be omitted. Since the structure of the first connecting

section 32 is the same as the second connecting section 31, the first connecting section 32 will be mainly described.

[0051] As illustrated in FIG. 6A, if the second connecting section 31 is not connected to one supplying section 15, the relevant supplying section 15 is covered by the first lid 16a of the shutter mechanism 16. Thus, outside air is prevented from flowing into the suction duct 13 from the supplying section 15 and lowering the suction force.

[0052] As illustrated in FIG. 6B, when the yarn joining cart 3 is moved in the direction of the arrow on the supplying section forming surface 13a of the suction duct 13, the edge of the first lid 16a is pushed by the tip end of the second connecting section 31, and the shutter mechanism 16 is rotated in a counterclockwise direction. The yarn joining cart 3 thereby travels to the target spinning unit 2 while sequentially rotating the shutter mechanisms 16 arranged in line by the second connecting section 31.

[0053] When the second connecting section 31 is passed through the position of the supplying section 15, the first lid 16a is pushed by the second connecting section 31 and the shutter mechanism 16 rotates 90 degrees. Therefore, when the second connecting section 31 completely passes the position of the supplying section 15, the shutter mechanism 16 is rotated and the supplying section 15 is again covered by the second lid 16b. The outside air flowing into the suction duct 13 thus can be suppressed to a minimum.

[0054] As illustrated in FIG. 6C, when arriving at the target spinning unit 2, the yarn joining cart 3 is stopped with the shutter mechanism 16 completely opening the corresponding supplying section 15, and the second connecting section 31 is connected to the supplying section 15. The first guiding device 18 and the second guiding device 19 illustrated in FIG. 3A and FIG. 3B can receive the supply of the suction airflow. As described above, since the shutter mechanism 16 is formed in rotation-symmetry, the second connecting section 31 may approach from another side of the shutter mechanism 16 (in this case, the shutter mechanism 16 is rotated in a clockwise direction).

[0055] If the second connecting section 31 and the supplying section 15 are connected, the first connecting section 32 and other supplying sections 15 are not connected. Thus, the outside air is prevented from flowing into the suction duct 13 from the other supplying sections 15 and lowering the suction force of the first guiding device 18 and the second guiding device 19. Therefore, the first guiding device 18 and the second guiding device 19 can more reliably catch the upper yarn and the lower yarn by the suction airflow, and guide the upper yarn and the lower yarn to the yarn joining device 20.

[0056] As illustrated in FIG. 6D, when the first connecting section 32 and one supplying section 15 are connected, the second connecting section 31 and other supplying sections 15 are not connected. Thus, the outside air is prevented from flowing into the suction duct 13 from the other supplying sections 15, and lowering the suction force of when discharging the fibers from the waste collecting section 30. Therefore, as illustrated in FIG. 3A and FIG. 3B, even if the waste collecting section 30, and the first guiding device 18 and the second guiding device 19 are to be connected to the same suction duct 13, the fiber wastes accommodated in the waste collecting section 30 can be discharged without influencing the yarn joining operation (see FIG. 8).

[0057] Since the yarn joining cart 3 discharges the fiber wastes accommodated in the waste collecting section 30 between the yarn joining operations, that is, during the travelling of the yarn joining cart 3, a special movement for discharging the fiber wastes can be omitted, and satisfactory operation efficiency can be realized. However, in order to discharge the fiber wastes accommodated in the waste collecting section 30, the yarn joining cart 3 may travel and stop such that the first connecting section 32 is connected to the supplying section 15. In other words, the yarn joining cart 3 accommodates the fiber wastes in the waste collecting section 30 during the suction operation by at least one of the first guiding device 18 and the second guiding device 19, and discharges the fiber wastes from the waste collecting section 3 0 at an arbitrary position in the arrangement range of the plurality of spinning units 2 while the suction operation by the first guiding device 18 and the second guiding device 19 is stopped.

[0058] The structure of the supplying section 15 is not limited to the present embodiment, and the supplying section 15 to which only the second connecting section 31 is connected and the supplying section 15 to which only the first connecting section 32 is connected may be respectively formed on the suction duct 13. In this case, for example, the supplying section 15 to which only the first connecting section 32 is connected is formed between the adjacent spinning units 2. If the position is where the second connecting section 31 and the first connecting section 32 are not simultaneously connected, the supplying section 15 to which only the first connecting section 32 is connected may be arranged at an arbitrary position of the suction duct 13. A suction duct for supplying the suction airflow to the second connecting section 31 and a suction duct for supplying the suction airflow to the first connecting section 32 may be individually arranged in the spinning machine 1.

[0059] Next, accommodation of the fiber wastes and the discharge of the accommodated fiber wastes during the yarn joining operation will be described with reference to FIG. 2 to FIG. 4, and FIG. 6A to FIG. 8.

[0060] First, the accommodation of the fiber wastes during the yarn joining operation will be described. As illustrated in FIG. 2, FIG. 3A, FIG. 3B, and FIG. 6C, when the yarn joining cart 3 reaches a position to perform the yarn joining operation, the second connecting section 31 is connected to the supplying section 15 while rotating the shutter mechanism 16 of the relevant supplying section 15. The suction airflow is thereby supplied from the suction duct 13 to the first guiding device 18 and the

second guiding device 19 via the second connecting section 31. In this case, since the first connecting section 32 is not connected to the supplying section 15, the suction airflow is not supplied from the suction duct 13 to the waste collecting section 30.

[0061] As illustrated in FIG. 3A, FIG. 3B, and FIG. 4, the first guiding device 18 sucks the yarn end 10a spun from the spinning device 9 and guides the yarn end 10a to the yarn joining device 20. The second guiding device 19 sucks the yarn end 10b from the winding device 12 and guides the yarn end 10b to the yarn joining device 20.

[0062] The upper yarn and the lower yarn guided to the yarn joining device 20 are guided by the yarn guiding levers 24, and inserted into the accommodating portion 23a of the yarn joining nozzle 23. In this case, the upper yarn is clamped by the first clamp plate 28 and the lower yarn is clamped by the second clamp plate 29, and the lower yarn is introduced to the first yarn end cutter 25 and the upper yarn is introduced to the second yarn end cutter 26.

[0063] The upper yarn and the lower yarn are cut to a predetermined length by the first yarn end cutter 25 and the second yarn end cutter 26, respectively, and the yarn end 10a of the upper yarn and the yarn end 10b of the lower yarn are formed. A remaining portion of the cut spun yarn 10 is sucked by the first guiding device 18 and the second guiding device 19, and discharged to the suction duct 13 via the second connecting section 31.

[0064] As illustrated in FIG. 7, at the same time as or almost at the same time as the yarn cut, the compressed air is injected from the yarn joining airflow passage 35 into the first untwisting pipe 21b and the second untwisting pipe 22b. The yarn ends 10a and 10b formed by the yarn cut are sucked into the first untwisting pipe 21b and the second untwisting pipe 22b. The fibers of the yarn ends of the upper yarn and the lower yarn are untwisted by the whirling airflow inside the first untwisting pipe 21b and the second untwisting pipe 22b. At this time, fine fiber wastes are generated, but such fiber wastes are blown by the airflow.

[0065] The fiber wastes blown by the airflow pass through the first untwisting pipe 21b and the second untwisting pipe 22b, and are introduced into the waste collecting chamber 30a from the fiber introducing port 30b of the waste collecting section 30. In this case, since the airflow from the first untwisting pipe 21b and the second untwisting pipe 22b is introduced from a substantially tangential direction into the circular-column-shaped waste collecting chamber 30a, the whirling airflow is generated inside the waste collecting chamber 30a. As a result, according to the principle of cyclone (particle separator), the fiber wastes are blown towards an outer peripheral side of an inner wall of the waste collecting chamber 30a by a centrifugal force, and deposited at the lower part of the waste collecting chamber 30a by gravity. Therefore, the fiber wastes can be accommodated in the waste collecting section 30 during the untwisting in the yarn joining operation. A clean airflow from which the fiber wastes are separated is discharged to outside the waste collecting chamber 30a via the air vent filter 30e. Since the fiber wastes deposited by the centrifugal force form a clump, the fiber wastes can be easily discharged by the first connecting section 32.

[0066] When the yarn joining cart 3 is located at a position to perform the yarn joining operation, that is, when the first guiding device 18 and the second guiding device 19 are performing the suction operation, the spinning machine 1 temporarily accommodates the generated fiber wastes in the waste collecting section 30 without discharging. That is, the discharge of the fiber wastes from the waste collecting section 30 and the suction of the yarn ends by the first guiding device 18 and the second guiding device 19 can be separately carried out (not simultaneously carried out). The fiber wastes accommodated in the waste collecting section 30 thus can be discharged without influencing the yarn joining operation.

[0067] After the untwisting of the yarn end 10a and the yarn end 10b is terminated, the yarn end 10a and the yarn end 10b are respectively pulled out from the first untwisting pipe 21b and the second untwisting pipe 22b by the yarn guiding operation of the yarn guiding levers 24 and a yarn holding operation of the yarn holding levers 27, and the yarn end 10a and the yarn end 10b are then set while being overlapped with one another in the yarn joining airflow passage 35 of the yarn joining nozzle 23. When the compressed air is injected from an injection hole into the yarn joining airflow passage 35, the whirling airflow of the compressed air is generated, and the fibers of the upper yarn and the lower yarn are entangled, twisted, and joined. After the yarn joining operation is completed, the operations of the yarn guiding levers 24 and the yarn holding levers 27 are released, and the clamping of the spun yarn 10 by the first clamp plate 28 and the second clamp plate 29 is released.

[0068] Next, the discharge of the fiber wastes accommodated in the waste collecting section 30 will be described. When a request for the yarn joining operation is made, the yarn joining cart 3 starts to travel towards the spinning unit 2 that made the request .

[0069] As illustrated in FIG. 6C and FIG. 6D, the second connecting section 31 connected to the supplying section 15 rotates the shutter mechanism 16 of the supplying section 15 while moving away from the supplying section 15 with the movement of the yarn joining cart 3. The supplying section 15 is thereby covered by the shutter mechanism 16. In other words, the suction airflow from the suction duct 13 is not supplied to the first guiding device 18 and the second guiding device 19 via the second connecting section 31.

[0070] The yarn joining cart 3 is further moved, such that the first connecting section 32 is connected to one of the supplying sections 15 while rotating the shutter mechanism 16 of the relevant supplying section 15 of the plurality of supplying sections 15. The suction airflow is thereby supplied from the suction duct 13 to the waste collecting section 30 via the first connecting section 32.

As illustrated in FIG. 8, the fiber wastes accommodated in the waste collecting section 30 are discharged to the suction duct 13 from the fiber discharge opening 30f by the suction airflow.

[0071] When the yarn joining cart 3 is located at a position not to perform the yarn joining operation, that is, when the first connecting section 32 is connected to the supplying section 15, the spinning machine 1 discharges the fiber wastes from the waste collecting section 30 and does not perform the suction by the first guiding device 18 and the second guiding device 19. That is, the discharge of the fiber wastes from the waste collecting section 30 and the suction of the yarn ends by the first guiding device 18 and the second guiding device 19 are independently carried out (not simultaneously carried out). Thus, the fiber wastes accommodated in the waste collecting section 30 can be discharged without influencing the yarn joining operation. Since the fiber wastes are accommodated by the waste collecting section 30, the fiber wastes can be prevented from scattering in the yarn joining cart 3, influencing the operation of the yarn joining cart 3, or causing operation failure of the yarn joining cart 3. A frequency of a cleaning operation of the yarn joining cart 3 can also be reduced.

[0072] The embodiments of the present invention have been described above, but the present invention is not limited to the above embodiments and various modifications may be made. For example, the spinning unit 2 pulls out the spun yarn 10 from the spinning device 9 by the yarn slack eliminating device 11, but the present invention is not limited to such a structure. A delivery roller and a nip roller may be arranged between the spinning device 9 and the yarn slack eliminating device 11, and the spun yarn 10 may be pulled out from the spinning device 9 with such rollers.

[0073] The yarn joining device 20 merely needs to have a structure in which the yarn end is blown by the airflow during the yarn joining operation, and the detailed structure is not limited to the embodiments described above. The structure of the waste collecting section 30 also merely needs to be able to temporarily accommodate the fiber wastes, and is not limited to the structure described above.

[0074] The spinning machine 1 includes the plurality of spinning units 2, the yarn joining cart 3, the waste collecting section 30, and the suction duct 13 as a discharge section. Each spinning unit 2 includes the spinning device 9 adapted to supply the spun yarn 10 and the winding device 12 adapted to wind the spun yarn 10 supplied from the spinning device 9 into the package 41. The yarn joining cart 3 is provided to travel along an arrangement direction of the plurality of the spinning units 2 and adapted to perform an operation with respect to at least one of the spinning units 2. The waste collecting section 30 is provided in the yarn joining cart 3, and adapted to accommodate fiber wastes. The suction duct 13 is provided within an arrangement range of the plurality of the spinning units 2, and adapted to receive discharge of the fiber wastes accommodated in the waste collecting section 30.

[0075] The discharge section further includes the suction duct 13 and the first connecting section 32. The suction duct 13 is arranged in a direction substantially parallel to a travelling direction of the yarn joining cart 3 and provided with a plurality of supplying sections 15 for supplying the suction airflow at least to the yarn joining cart 3. The first connecting section 32 is adapted to connect the waste collecting section 30 to at least one of the supplying sections 15 at a discharge position, which is a position where the fiber wastes are discharged from the waste collecting section 30.

[0076] The yarn joining cart 3 includes the yarn joining device 20, the first guiding device 18, and the second guiding device 19. The yarn joining device 20 is adapted to perform a yarn joining operation of joining a yarn end from the spinning device 9 and a yarn end from the winding device 12 when continuation of the spun yarn 10 is disconnected. The first guiding device 18 is adapted to catch the yarn end from the spinning device 9 by suction and to guide the yarn end to the yarn joining device 20. The second guiding device 19 is adapted to catch the yarn end from the winding device 12 by suction and to guide the yarn end to the yarn joining device 20.

[0077] The spinning machine 1 further includes the second connecting section 31 adapted to connect the first guiding device 18 and the second guiding device 19 to the supplying sections 15.

[0078] The yarn joining cart 3 is adapted to accommodate the fiber wastes during a suction operation by at least one of the first guiding device 18 and the second guiding device 19, and to discharge the fiber wastes from the waste collecting section 30 while the suction operation by the first guiding device 18 and the second guiding device 19 is stopped.

[0079] The yarn joining device 20 includes the first untwisting nozzle 21 adapted to blow fibers of the yarn end from the spinning device 9 by air, and a second untwisting nozzle 22 adapted to blow fibers of the yarn end from the winding device 12 by air. The air blowing direction of the first untwisting nozzle 21 and the second untwisting nozzle 22 is set towards the waste collecting section 30.

[0080] The spinning device 9 is a pneumatic spinning device adapted to spin the fiber bundle 8 by a whirling airflow to produce the spun yarn 10.

Claims

1. A spinning machine comprising:

a plurality of spinning units (2), each spinning unit (2) including a yarn supplying device (9) adapted to supply a spun yarn (10), and a winding device (12) adapted to wind the spun yarn (10) supplied from the yarn supplying device (9) into a package (41),

an operation cart (3) provided to travel along an

arrangement direction of the plurality of the spinning units (2) and adapted to perform an operation with respect to at least one of the spinning units (2),
a waste collecting section (30) provided in the operation cart (3), and adapted to accommodate fiber wastes, **characterized by**
a discharge section provided within an arrangement range of the plurality of the spinning units (2), and adapted to receive discharge of the fiber wastes from the waste collecting section (30).

2. The spinning machine according to claim 1, **characterized in that** the discharge section includes:

a suction duct (13) arranged in a direction substantially parallel to a travelling direction of the operation cart (3) and on which a plurality of supplying sections (15) are formed, each of the supplying sections (15) being adapted to supply a suction airflow to at least the operation cart (3), and
a first connecting section (32) adapted to connect the waste collecting section (30) to at least one of the supplying sections (15) at a discharge position where the fiber wastes are discharged from the waste collecting section (30).

3. The spinning machine according to claim 2, **characterized in that** the operation cart (3) includes:

a yarn joining device (20) adapted to perform a yarn joining operation of joining a yarn end (10a) from the yarn supplying device (9) and a yarn end (10b) from the winding device (12) when continuation of the spun yarn (10) is disconnected,
a first guiding device (18) adapted to catch the yarn end (10a) from the yarn supplying device (9) by suction and to guide the yarn end (10a) to the yarn joining device (20), and
a second guiding device (19) adapted to catch the yarn end (10b) from the winding device (12) by suction and to guide the yarn end (10b) to the yarn joining device (20).

4. The spinning machine according to claim 3, **characterized by** a second connecting section (31) adapted to connect the first guiding device (18) and the second guiding device (19) to at least one of the supplying sections (15).

5. The spinning machine according to claim 3 or claim 4, **characterized in that** the operation cart (3) is adapted to accommodate the fiber wastes during a suction operation by at least one of the first guiding device (18) and the second guiding device (19), and to discharge the fiber wastes from the waste collecting section (30) while the suction operation by the first guiding device (18) and the second guiding device (19) is stopped.

6. The spinning machine according to any one of claim 1 through claim 5, **characterized in that** the yarn joining device (20) includes:

a first untwisting nozzle (21) adapted to blow fibers of the yarn end (10a) from the yarn supplying device (9), and
a second untwisting nozzle (22) adapted to blow fibers of the yarn end (10b) from the winding device (12),
wherein an air blowing direction of the first untwisting nozzle (21) and the second untwisting nozzle (22) is set towards the waste collecting section (30).

7. The spinning machine according to any one of claim 1 through claim 6, **characterized in that** the yarn supplying device (9) includes a pneumatic spinning device adapted to spin a fiber bundle (8) to produce the spun yarn (10).

FIG. 1

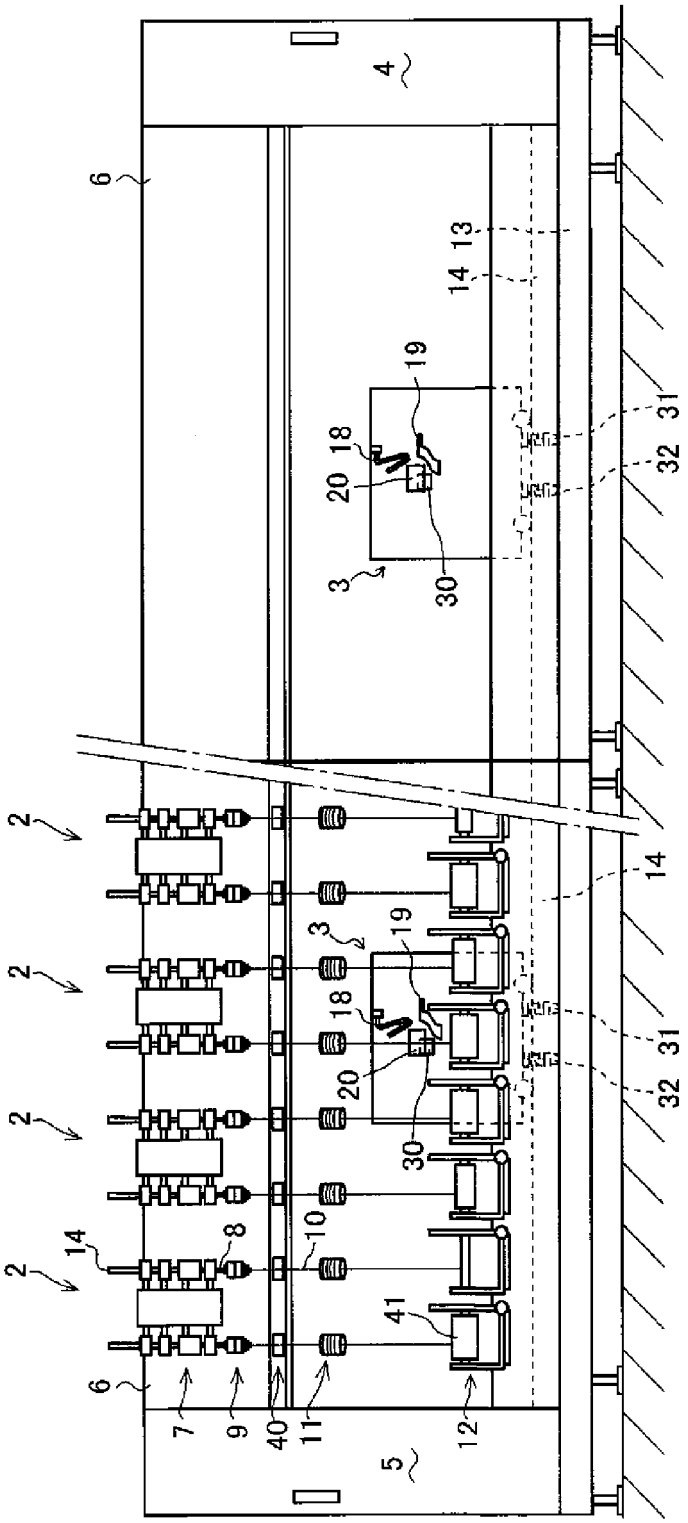


FIG. 2

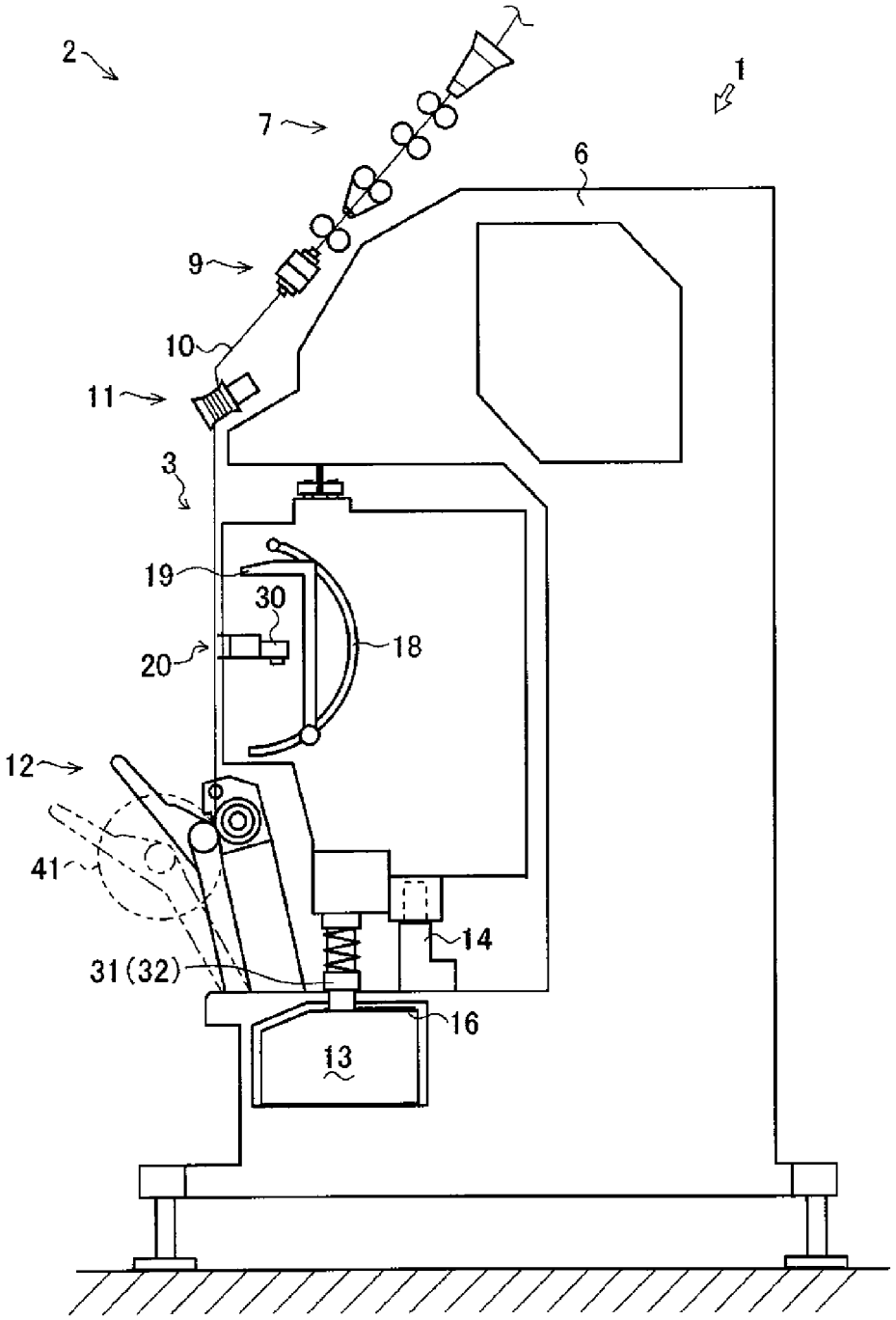
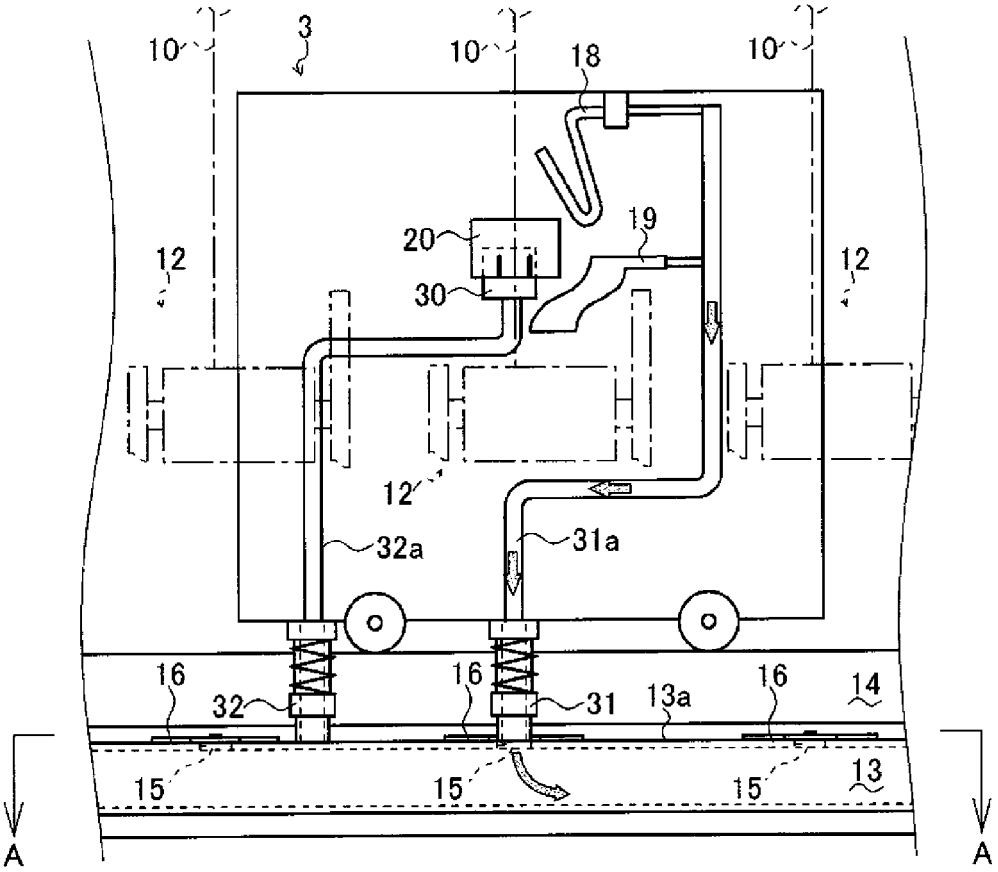


FIG. 3A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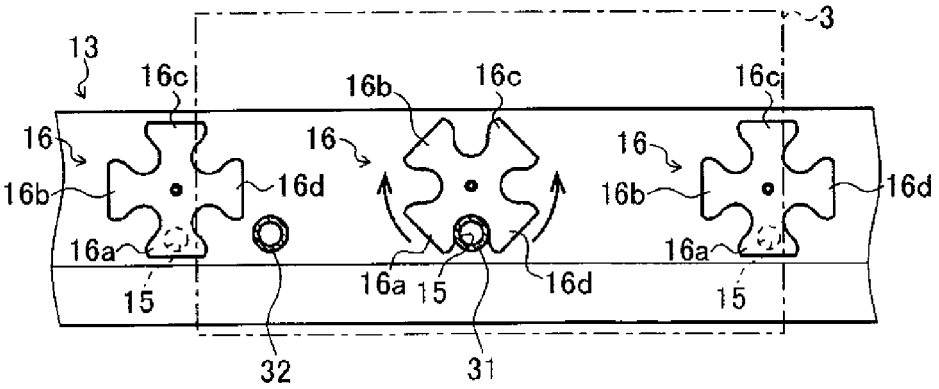
13
A
A

FIG. 3B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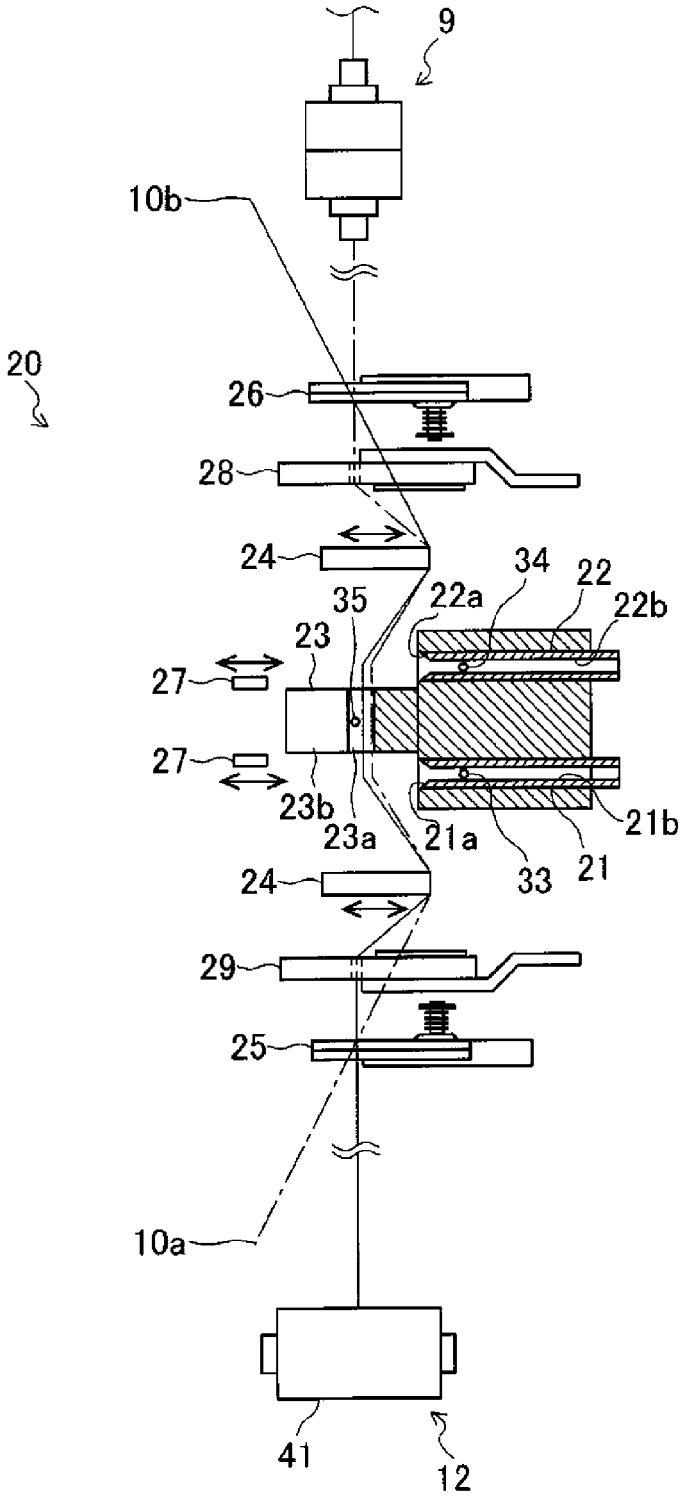
16d

FIG. 4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22a
22b
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10a
41
12

FIG. 5A

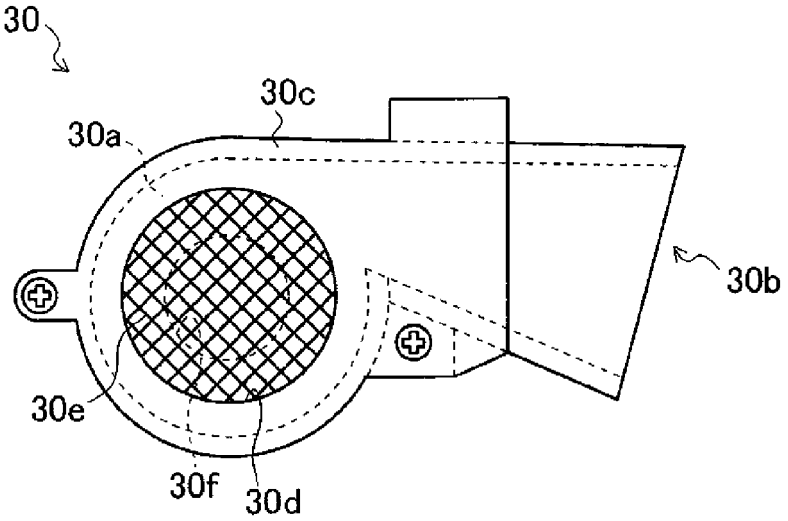


FIG. 5B

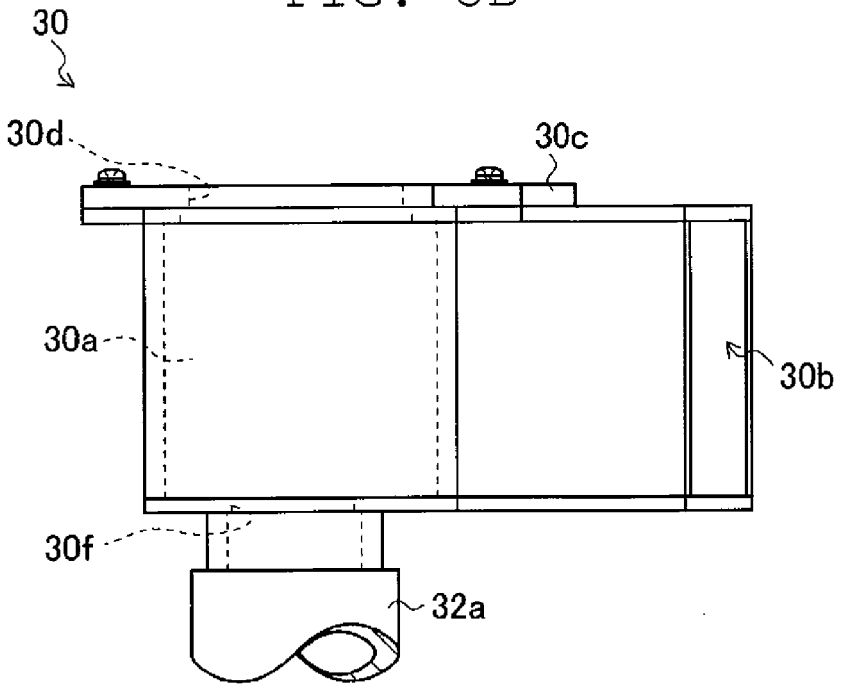


FIG. 6A

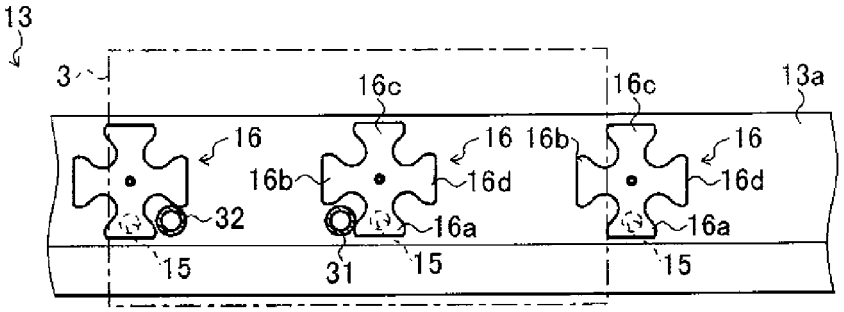


FIG. 6B

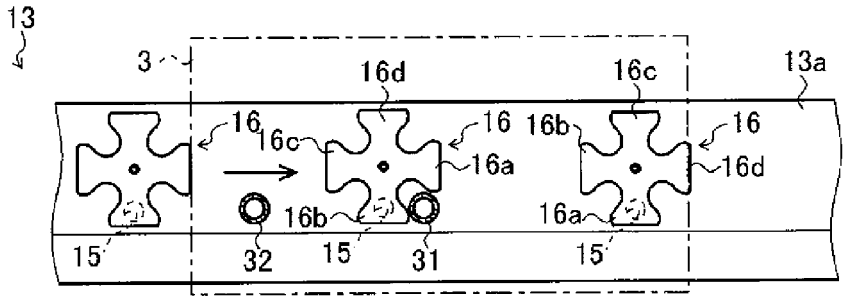


FIG. 6C

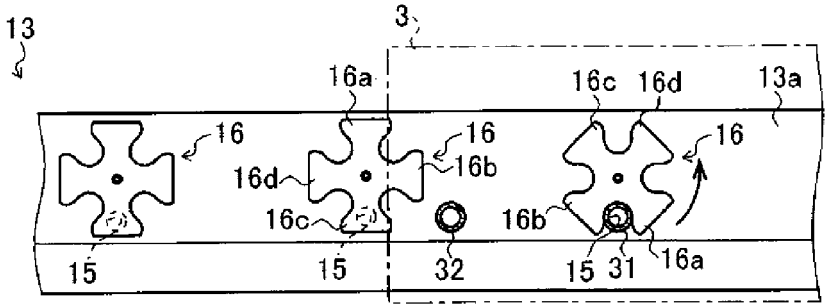


FIG. 6D

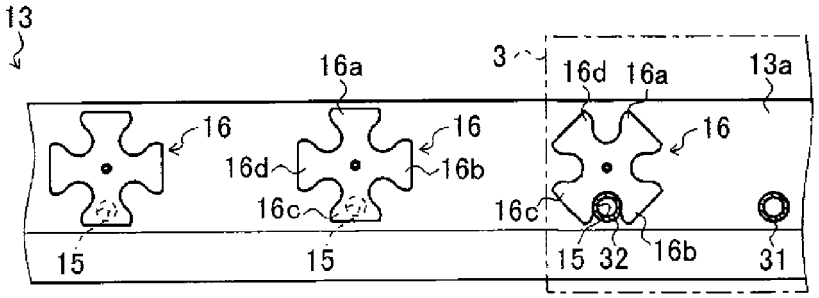
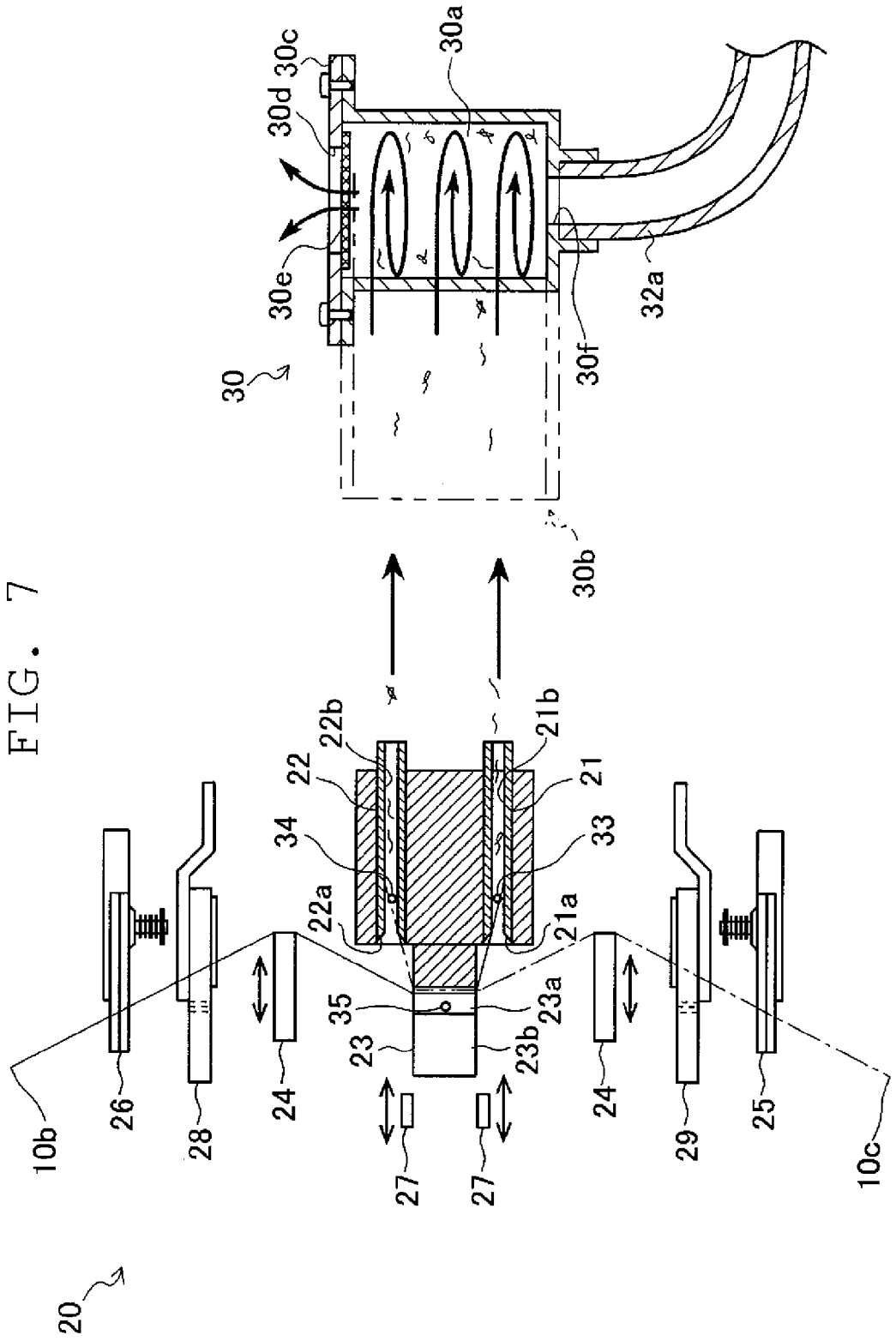


FIG. 7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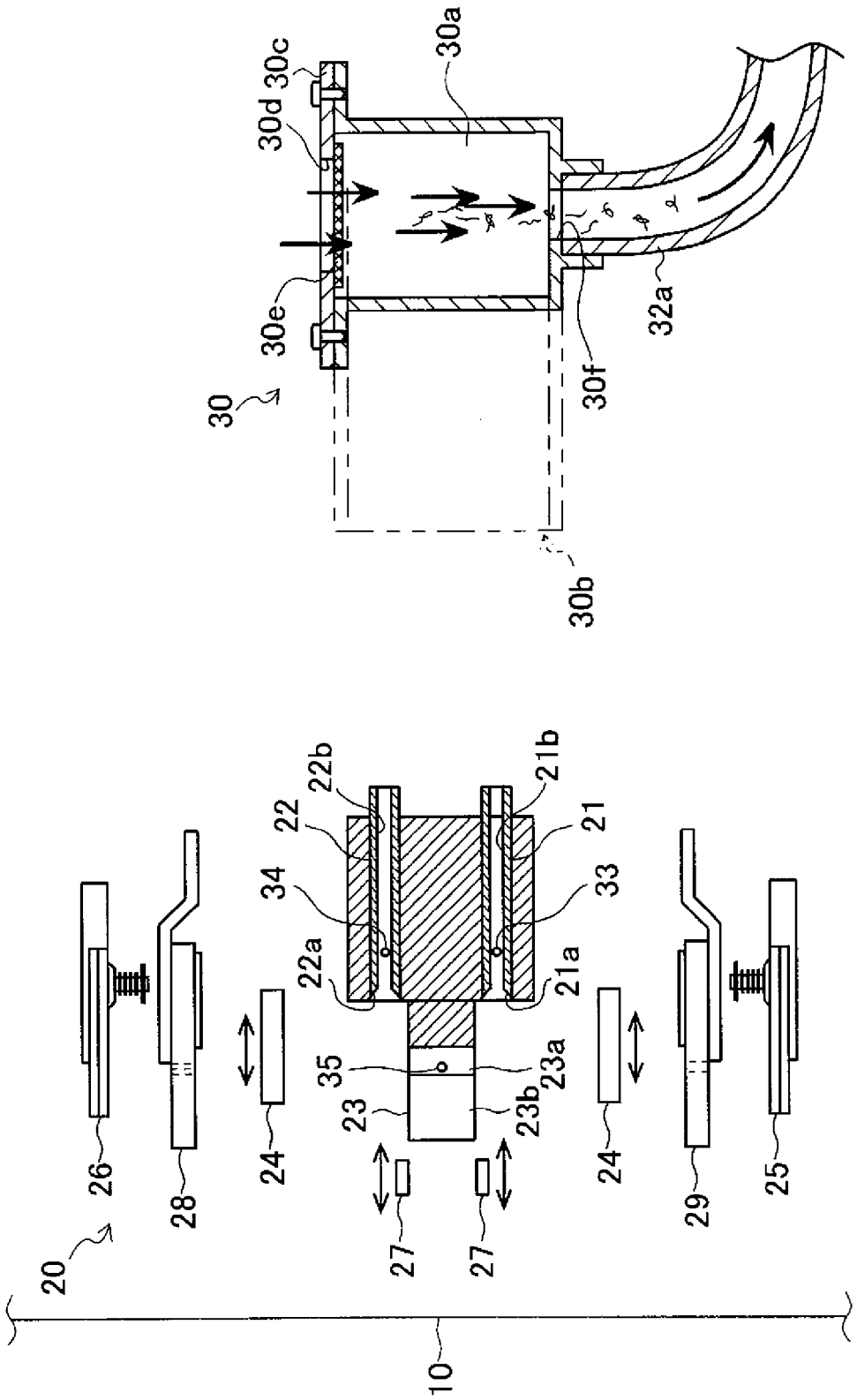
34
35
10b
10c

FIG. 8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REFERENCES CITED IN THE DESCRIPTION

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