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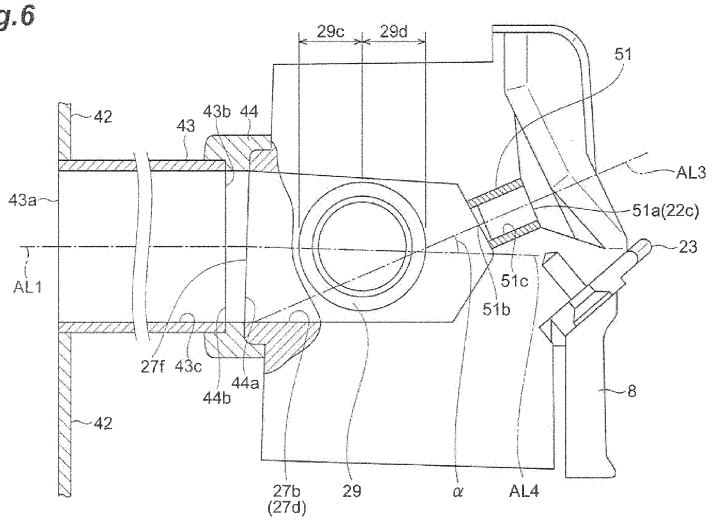
(54) MERGING STRUCTURE FOR SUCTION PIPES, AND YARN WINDING UNIT, SPINNING MACHINE AND TEXTILE MACHINERY INCLUDING THE SAME

(57) A merging structure for suction pipes configured to suck fiber waste in textile machinery includes: a first suction pipe (43) configured to channel a suction flow for sucking the fiber waste; a second suction pipe (29) configured to communicate with the first suction pipe (43) and to channel the suction flow; a third suction pipe (51) configured to communicate with the first suction pipe (43) and to channel the suction flow, the third suction pipe (51) being a member separate from the second suction pipe (29); and a connection part (27) connected with the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) to merge a downstream-side end in a direction in which the suction flow flows in the second suction pipe (29) and a downstream-side end in a direction in which the suction flow flows in the third suction pipe (51) with an upstream-side end in a direction in which the suction flow flows in the first suction pipe (43), in which part of an inner surface (27b) forming an interior space of the connection part (27) has a planar part (27a) that is a flat surface, and the second suction pipe (29) is connected to the planar part (27a).

Fig.6



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a merging structure for suction pipes, and a yarn winding unit, a spinning machine and textile machinery including the same.

BACKGROUND

[0002] Textile machinery such as a yarn winding machine is known that includes a collecting device to collect fiber waste such as waste yarn and fluff produced during operation by sucking the fiber waste. For example, Patent Literature 1 (Japanese Unexamined Patent Publication No. 2013-67873) discloses a spinning machine (textile machinery) including a spinning unit (yarn winding unit) capable of removing fiber waste produced in a yarn storing roller by sucking the fiber waste with a suction mechanism.

SUMMARY

[0003] In the textile machinery as described above, one suction pipe for sucking fiber waste may be merged with another suction pipe to collect fiber waste into a common collecting chamber. At the merging part where one suction pipe and the other suction pipe merge, a suction flow in one suction pipe may obstruct a suction flow in the other suction pipe. The merging structure for suction pipes is therefore required to have a configuration that can smoothly collect fiber waste .

[0004] It is an object of the present disclosure to provide a merging structure for suction pipes that enables smooth collecting of fiber waste, and a yarn winding unit, a spinning machine and textile machinery including the same.

[0005] This object is achieved by a merging structure according to claim 1, a yarn winding unit according to claim 13, a spinning machine according to claim 15, and textile machinery according to claim 16.

[0006] A merging structure for suction pipes according to an aspect of the present disclosure sucks fiber waste in textile machinery. The merging structure for suction pipes includes a first suction pipe configured to channel a suction flow for sucking the fiber waste, a second suction pipe configured to communicate with the first suction pipe to channel the suction flow, a third suction pipe configured to communicate with the first suction pipe to channel the suction flow, the third suction pipe being a member separate from the second suction pipe, and a connection part connected with the first suction pipe, the second suction pipe, and the third suction pipe to merge a downstream-side end in a direction in which the suction flow flows in the second suction pipe and a downstream-side end in a direction in which the suction flow flows in the third suction pipe with an upstream-side end in a direction in which the suction flow flows in the first suction pipe. Part of an inner surface forming an interior space of the connection part has a planar part that is a flat surface. The second suction pipe is connected to the planar part.

[0007] In the merging structure for suction pipes with this configuration, compared with when the second suction pipe is connected to a conventional connection part having an interior space formed in a circular shape in cross section as viewed from the connecting direction of the first suction pipe, a cross-sectional area of the interior space of the connection part can be sufficiently ensured, and the amount of protrusion of the second suction pipe in the interior space of the connection part can be reduced or the protrusion can be eliminated. This configuration can prevent or reduce clogging with fiber waste due to the reduced cross-sectional area. In addition, the suction flow coming from the second suction pipe and the suction flow coming from the third suction pipe can merge in the interior space of the connection part without obstructing the suction flow by the protrusion of the second suction pipe, thereby enabling smooth collecting of fiber waste.

[0008] In the merging structure for suction pipes according to an aspect of the present disclosure, the first suction pipe, the second suction pipe, and the third suction pipe may be connected to the connection part from directions different from each other. In the merging structure with this configuration, fiber waste can be smoothly collected even in the merging structure in which three suction pipes are connected from directions different from each other.

[0009] In the merging structure for suction pipes according to an aspect of the present disclosure, the first suction pipe, the second suction pipe, and the third suction pipe in the connection part may have different pipe characteristics from each other defined by at least one of a hollow cross-sectional area and a hollow cross-sectional shape. In the merging structure with this configuration, fiber waste can be smoothly collected even in the merging structure in which the pipe characteristics of three suction pipes are different from each other.

[0010] In the merging structure for suction pipes according to an aspect of the present disclosure, the first suction pipe, the second suction pipe, the third suction pipe, and the connection part may be formed with members different from each other. In the merging structure with this configuration, the merging structure can be readily formed by connecting the members to each other.

[0011] In the merging structure for suction pipes according to an aspect of the present disclosure, the merging structure for suction pipes may be disposed in textile machinery including a plurality of yarn winding units each configured to wind yarn to form a package and a suction duct connected to a suction source and extended along an arrangement direction of the yarn winding units. The first suction pipe of each of the yarn winding units may be connected to the suction duct. In the merging structure with this configuration, fiber waste can be smoothly collected in the merging structure provided in each yarn

winding unit and disposed on the upstream side of the suction duct in the suction direction.

[0012] In the merging structure for suction pipes according to an aspect of the present disclosure, a cross section of an interior space in the connection part as viewed from a connecting direction of the first suction pipe may be formed in a D shape. In the merging structure with this configuration, while the size of the connection part is kept, compared with when the second suction pipe is connected to a conventional connection part having an interior space formed in a circular shape in cross section as viewed from the connecting direction of the first suction pipe, a cross-sectional area of the interior space of the connection part orthogonal to the connecting direction of the first suction pipe can be sufficiently ensured, and the amount of protrusion of the second suction pipe in the interior space of the connection part can be reduced.

[0013] In the merging structure for suction pipes according to an aspect of the present disclosure, a cross section of an interior space in the connection part as viewed from a connecting direction of the first suction pipe may be formed in a D shape with a linear part and an arc-shaped part. An axial line position of the second suction pipe at a connecting position of the second suction pipe to the connection part and a central position in a longitudinal direction in the linear part may be shifted from each other in the longitudinal direction. This configuration prevents the flow from the second suction pipe from colliding with the semi-circular part at the central point and dividing into two and prevents turbulence of the flow in the interior space of the connection part due to the flow coming from the second suction pipe and dividing into two. That is, in the present structure, the axial line position at the connecting position of the second suction pipe is shifted from the center, causing a suction flow in the form of a large vortex in the interior space of the connection part. As a result, the suction flow coming from the second suction pipe and the suction flow coming from the third suction pipe smoothly merge in the interior space of the connection part, thereby enabling smooth collecting of fiber waste.

[0014] In the merging structure for suction pipes according to an aspect of the present disclosure, of hollow cross-sectional areas of the first suction pipe, the second suction pipe, and the third suction pipe at respective connecting positions to the connection part, a ratio between a largest cross-sectional area and a smallest cross-sectional area may be 1: 6 or more to 1: 68 or less. The connection of suction pipes with a small cross-sectional area difference between the suction pipes tends to suffer turbulence of the air flow in the merging space. In the merging structure with this configuration, even when the hollow cross-sectional area difference between the suction pipes is reduced such that the ratio between the largest cross-sectional area and the smallest cross-sectional area is 1:6 or more to 1:68 or less, the amount of protrusion of one pipe into the merging space can be reduced, thereby reducing merging turbulence in the merging space.

[0015] In the merging structure for suction pipes according to an aspect of the present disclosure, the first suction pipe, the second suction pipe, and the third suction pipe may be cylindrical pipes. Of inner diameters of the first suction pipe, the second suction pipe, and the third suction pipe at respective connecting positions to the connection part, a ratio between a largest inner diameter and a smallest inner diameter may be 1:2 or more to 1:8 or less. As used herein the inner diameter is a diameter in the hollow portion of each pipe. The connection of suction pipes with a small inner diameter difference between the suction pipes tends to suffer turbulence of the air flow in the merging space. In the merging structure with this configuration, even when the inner diameter difference between the suction pipes is reduced such that the ratio between the largest inner diameter and the smallest inner diameter is 1:2 or more to 1:8 or less, the amount of protrusion of one pipe into the merging space can be reduced, thereby reducing merging turbulence in the merging space.

[0016] In the merging structure for suction pipes according to an aspect of the present disclosure, an axial line direction of the first suction pipe at a connecting position to the connection part and an axial line direction of the third suction pipe at a connecting position to the connection part may have a component in an identical direction. An axial line direction of the second suction pipe at a connecting position to the connection part may form an angle of 45 degrees or more relative to the component in the identical direction. In the merging structure with this configuration, that is, the structure in which the suction flow in the second suction pipe merges in the angular direction of 45 degrees or more relative to the suction flow having a component in the identical direction that is formed by the first suction pipe and the third suction pipe, although typically the suction flow in the second suction pipe tends to cause merging turbulence, the merging turbulence can be reduced by applying the suction pipes according to an aspect of the present disclosure.

[0017] In the merging structure for suction pipes according to an aspect of the present disclosure, the axial line direction of the second suction pipe at the connecting position to the connection part may be vertical to the component in the identical direction. In the merging structure with this configuration, that is, the structure in which the suction flow in the second suction pipe merges from a vertical direction to the suction flow formed by the first suction pipe and the third suction pipe, although typically the suction flow in the second suction pipe tends to cause merging turbulence, the merging turbulence can be reduced by applying the suction pipes according to an aspect of the present disclosure.

[0018] In the merging structure for suction pipes according to an aspect of the present disclosure, when a direction orthogonal to an opening to which the first suction pipe is connected in the connection part is an axial

line direction of the connection part, an angle of intersection of an axial line direction of the third suction pipe at a connecting position to the connection part and the axial line direction of the connection part may be 25 degrees or less. In this configuration, the connecting direction of the first suction pipe (the outflow direction of the suction flow to the first suction pipe) and the connecting direction of the third suction pipe (the inflow direction of the suction flow from the third suction pipe) come close to each other to facilitate the flow of fiber waste from the third suction pipe to the first suction pipe. When the angle difference between the connecting direction of the first suction pipe and the connecting direction of the third suction pipe is small, the flow from the third suction pipe easily flows toward the first suction pipe without colliding with the inner peripheral surface of the first suction pipe or the inner surface of the connection part (the flow from the third suction pipe joins the flow to the first suction pipe before colliding with the inner peripheral surface or the inner surface) . As a result, deposition of impurity in the air at a place of collision on the inner peripheral surface or the inner surface can be prevented. As used herein the impurity refers to impurity other than fiber waste, such as dust and dirt.

[0019] In the merging structure for suction pipes according to an aspect of the present disclosure, when viewed from a connecting direction of the second suction pipe, the third suction pipe may be disposed on one side in a right-to-left direction of the second suction pipe, and the third suction pipe may be connected to the connection part such that an extended straight line in a connecting direction of the third suction pipe crosses an inner peripheral surface of the first suction pipe or an inner surface of the connection part on the other side in the right-to-left direction. In this configuration, the connecting direction of the first suction pipe and the connecting direction of the third suction pipe come close to each other to facilitate the flow of fiber waste from the third suction pipe to the first suction pipe. When the angle difference between the connecting direction of the first suction pipe and the connecting direction of the third suction pipe is small, the flow from the third suction pipe easily flows toward the first suction pipe without colliding with the inner peripheral surface of the first suction pipe or the inner surface of the connection part. As a result, deposition of impurity in the air at a place of collision can be prevented. In this structure, the angle difference between the connecting direction of the first suction pipe and the connecting direction of the third suction pipe can be reduced even when there are limitations in space or design dimensions.

[0020] The merging structure for suction pipes according to an aspect of the present disclosure may be disposed in a yarn winding unit including a yarn feeding device configured to feed yarn, a winding device configured to wind the yarn fed from the yarn feeding device to form a package, and a yarn storing device configured to store the yarn between the yarn feeding device and the winding device. The second suction pipe may communicate with a first suction inlet configured to suck fiber waste from a portion that stores the yarn in the yarn storing device. In the merging structure for suction pipes with this configuration, fiber waste can be smoothly collected even when the second suction pipe for sucking fiber waste produced in the yarn storing device and the third suction pipe are merged for sucking.

[0021] In the merging structure for suction pipes according to an aspect of the present disclosure, the third suction pipe may communicate with a second suction inlet disposed above a guide part for guide the yarn, the second suction inlet disposed between the winding device and the yarn feeding device. In the merging structure for suction pipes with this configuration, fiber waste can be smoothly collected even when the second suction pipe for sucking fiber waste produced in the yarn storing device and the third suction pipe for sucking fiber waste deposited on the guide part are merged for sucking.

[0022] A yarn winding unit according to an aspect of the present disclosure includes the merging structure for suction pipes described above, a yarn feeding device configured to feed yarn, a winding device configured to wind the yarn fed from the yarn feeding device to form a package, and a yarn storing device configured to store the yarn between the yarn feeding device and the winding device. The second suction pipe communicates with a first suction inlet configured to suck fiber waste from a portion that stores the yarn in the yarn storing device. In the yarn winding unit with this configuration, fiber waste can be smoothly collected even when the second suction pipe for sucking fiber waste produced in the yarn storing device and the third suction pipe are merged for sucking.

[0023] A yarn winding unit according to an aspect of the present disclosure, the third suction pipe may communicate with a second suction inlet disposed above a guide part for guide the yarn, the second suction inlet disposed between the winding device and the yarn feeding device. In the yarn winding unit with this configuration, fiber waste can be smoothly collected even when the second suction pipe for sucking fiber waste produced in the yarn storing device and the third suction pipe for sucking fiber waste deposited on the guide part are merged for sucking.

[0024] A spinning machine according to an aspect of the present disclosure includes the merging structure for suction pipes described above, a drafting device configured to draft a fiber bundle, an air spinning device configured to twist the fiber bundle drafted by the drafting device to form yarn, a winding device configured to wind the yarn formed by the air spinning device to form a package, and a yarn storing device configured to store the yarn between the air spinning device and the winding device. The second suction pipe communicates with a first suction inlet configured to suck fiber waste from a portion that stores the yarn in the yarn storing device. In the spinning machine with this configuration, fiber waste can be smoothly collected even when the second suction pipe for sucking fiber waste produced in the yarn storing

device and the third suction pipe are merged for sucking.

[0025] Textile machinery according to an aspect of the present disclosure include the merging structure for suction pipes described above, a plurality of yarn winding units each configured to wind yarn to form a package, and a suction duct connected to a suction source and extended along an arrangement direction of the yarn winding units. The first suction pipe of each of the yarn winding units is connected to the suction duct. In the textile machinery with this configuration, fiber waste can be smoothly collected in the merging structure provided in each yarn winding unit and disposed on the upstream side of the suction duct in the suction direction.

[0026] According to an aspect of the present disclosure, fiber waste can be smoothly collected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a front view of a spinning machine in an embodiment.

FIG. 2 is a front view of a yarn processing module in an embodiment.

FIG. 3 is a rear view of the yarn processing module in FIG. 2.

FIG. 4 is an enlarged front view of a suction pipe in FIG. 3.

FIG. 5 is an enlarged front view of a connection part in FIG. 3.

FIG. 6 is a cross-sectional view cut along line VI-VI in the connection part illustrated in FIG. 5.

FIG. 7A is an enlarged front view of the connection part in FIG. 5.

FIG. 7B is an enlarged front view of a conventional connection part.

DETAILED DESCRIPTION

[0028] Embodiments according to an aspect of the present disclosure will be described in detail below with reference to the figures . In the drawings, the same or corresponding parts are denoted by the same reference signs and an overlapping description will be omitted.

[Configuration of Spinning Machine]

[0029] As illustrated in FIG. 1, a spinning machine 1 includes a plurality of spinning units (yarn winding unit) 2, a yarn joining cart 3, a doffing cart (not illustrated in the figure), a first end frame 4, a suction duct 42, and a second end frame 5. A plurality of spinning units 2 are arranged in a row. Each spinning unit 2 forms yarn Y and winds the yarn into a package P. When yarn Y is cut or yarn Y is broken for some reason in a certain spinning unit 2, the yarn joining cart 3 performs a yarn joining operation in the spinning unit 2. When a package P becomes full in a certain spinning unit 2, the doffing cart doffs the package P and supplies a new bobbin B to the spinning unit 2.

[0030] The first end frame 4 accommodates, for example, a collecting device to collect fiber waste formed in the spinning unit 2. The suction duct 42 is connected to a suction part 41a serving as a suction source and is extended along the arrangement direction of a plurality of spinning units 2. The suction duct 42 is connected to one end (downstream-side end) 43a of a first suction pipe 43 provided for each of the spinning units 2 described later (see FIG. 6).

[0031] The second end frame 5 accommodates, for example, an air supplypart to regulate the air pressure of compressedair (air) supplied to the spinning machine 1 and supply the air to each part in the spinning machine 1 and a drive motor for supplying motive power to each part in the spinning unit 2. The second end frame 5 includes a machine control device 5a, a display screen 5b, and an input key 5c. The machine control device 5a centrally manages and controls each part in the spinning machine 1. The display screen 5b can display information on the settings and/or the state of the spinning unit 2. An operator can make a setting operation for the spinning unit 2 by performing an appropriate operation using the input key 5c.

[0032] Each spinning unit 2 includes, in order from the upstream side in the traveling direction of yarn Y, a drafting device 6, an air spinning device 7, a yarn monitoring device 8, a tension sensor 9, a yarn storing device 11, a waxing device 12, and a winding device 13. A unit controller 10 is provided every predetermined number of spinning units 2 to control the operation of the spinning units 2. In each spinning unit 2, the drafting device 6 and the air spinning device 7 function as yarn feeding devices for feeding yarn Y.

[0033] The drafting device 6 drafts sliver (fiber bundle) S. The air spinning device 7 twists the fiber bundle F drafted by the drafting device 6 using a swirl air flow to form yarn Y. The yarn storing device 11 is installed between the air spinning device 7 and the winding device 13. The yarn storing device 11 includes an electric motor 11a, a yarn storing roller 11b, and a hooking member 11c. The yarn storing roller 11b is formed in a cylindrical shape and stores yarn Y wound around the outer peripheral surface thereof. The hooking member 11c is a member for winding the hooked yarn Y around the yarn storing roller 11b and is provided at the front end (downstream-side end) of the yarn storing roller 11b.

[0034] The yarn storing device 11 has the function of stably drawing yarn Y from the air spinning device 7, the function of preventing slacking of yarn Y by storing yarn Y fed from the air spinning device 7, for example, during a yarn joining operation by the yarn joining cart 3, and the function of preventing variation in tension of yarn Y on the downstream side of the yarn storing device 11 from propagating to the air spinning device 7. The waxing device 12 applies wax to yarn Y between the yarn storing device 11 and the winding device 13. The winding device

13 winds yarn Y supplied from the drafting device 6 and the air spinning device 7 serving as yarn feeding devices around a bobbin B to form a package P.

[0035] The yarn monitoring device 8 monitors information on traveling yarn Y between the air spinning device 7 and the yarn storing device 11 and detects whether there is a yarn defect based on the monitored information. When detecting a yarn defect, the yarn monitoring device 8 transmits a yarn defect detection signal to the unit controller 10. The tension sensor 9 measures a tension of traveling yarn Y between the air spinning device 7 and the yarn storing device 11 and transmits a tension measurement signal to the unit controller 10. When the unit controller 10 detects that there is a failure based on a detection result of the yarn monitoring device 8 and/or the tension sensor 9, yarn Y is cut in the spinning unit 2.

[Configuration of Yarn Processing Module]

[0036] As illustrated in FIG. 2 and FIG. 3, a yarn processing module 20 is a module in which the yarn monitoring device 8, the tension sensor 9, and the yarn storing device 11 described above are integrated. The yarn processing module 20 is removably attached to a support frame 15 illustrated in FIG. 1. The support frame 15 is part of the frame of the spinning machine 1 and directly or indirectly supports at least one of the drafting device 6, the air spinning device 7, and the winding device 13. Although the waxing device 12 described above is not illustrated in FIG. 2 and FIG. 3, the waxing device 12 is also attachable to the yarn processing module 20.

[0037] The yarn processing module 20 includes a chassis 21, a front panel 22, and a guide member 23. The front panel 22 is attached to the front side of the chassis 21. The guide member 23 has a surface facing upward in the vertical direction and has a contact part (notch) in contact with yarn Y to restrict the travel position of the yarn. The shape of the guide member 23 is not limited thereto. The guide member 23 is attached to an upper end of the front panel 22 and guides yarn Y fed from the air spinning device 7 (see FIG. 1) to the yarn monitoring device 8.

[0038] The chassis 21 has a pair of side frames 21a, a middle frame 21b, a bottom frame 21c, and a front frame 21d. The middle frame 21b bridges between the middle portions of a pair of side frames 21a. The bottom frame 21c bridges between the lower ends of a pair of side frames 21a. The front frame 21d bridges between a pair of side frames 21a on the upper side of the middle frame 21b.

[0039] The configuration of the chassis 21 is not limited and may be modified in various ways. For example, in the chassis 21, the front frame 21d and a pair of side frames 21a may be integrally formed (formed by folding a sheet of sheet metal) . In this case, the middle frame 21b and the bottom frame 21c may be formed separately from the front frame 21d and a pair of side frames 21a (formed with separate sheet metals). The middle frame 21b may bridge between the middle portions of a pair of side frames 21a, and the bottom frame 21c may bridge between the lower portions of a pair of side frames 21a.

[0040] Each of a pair of side frames 21a has a guide groove 21e. Each guide groove 21e is engaged with a pin (not illustrated in the figure) provided on the support frame 15 (see FIG. 1) side. With the pin engaged in the guide groove 21e, the bottom frame 21c is fastened to the support frame 15 by screws. That is, the chassis 21 (thus, the yarn processing module 20) is removably attached to the support frame 15.

[0041] The yarn monitoring device 8 is attached to the front frame 21d. The yarn monitoring device 8 has a slit 85 protruding on the front side of the front panel 22 through an opening 22a provided in the front panel 22.

[0042] The tension sensor 9 is attached to the middle frame 21b. In the tension sensor 9, a slit 9a defining a region through which yarn Y travels protrudes on the front side of the front panel 22 through a notch 22b provided in the front panel 22.

[0043] The yarn storing device 11 is attached to the middle frame 21b. In the configuration of the yarn storing device 11, the electric motor 11a is disposed in an upper space S1 on the rear side of the front panel 22. The upper space S1 is a space above the middle frame 21b in the space between a pair of side frames 21a. In the configuration of the yarn storing device 11, the yarn storing roller 11b and the hooking member 11c are disposed in a lower space S2 and exposed on the front side of the front panel 22 through the notch 22b. The lower space S2 is a space below the middle frame 21b in the space between a pair of side frames 21a.

[0044] The yarn processing module 20 further includes a circuit board 25 and part of a suction mechanism 26. The circuit board 25 is disposed in the upper space S1 and attached to the front frame 21d. The circuit board 25 is electrically connected to the tension sensor 9, the electric motor 11a, and the like. The circuit board 25 has a connector 25a connected to external wiring including a power supply line and a signal line (not illustrated in the figure). The external wiring is electrically connected to the unit controller 10 and is removable from the connector 25a. The front panel 22 is provided with a display unit and an operation unit (not illustrated in the figure) electrically connected to the circuit board 25. The display unit is a display for displaying a variety of information. The operation unit is, for example, an operation button for operators.

[0045] The suction mechanism 26 includes a suction tube 28, a second suction pipe 29, a connection part 27, a first suction pipe 43 (see FIG. 6), a suction part 41a (see FIG. 1), a fiber waste collecting part 41b (see FIG. 1), and a third suction pipe 51. The yarn processing module 20 includes the suction tube 28, the second suction pipe 29, and the connection part 27 of the suction mechanism 26. The second suction pipe 29 is communicate with the first suction pipe 43 and channels a suction flow that is a flow of air. In other words, the second suction

pipe 29 guides or directs the suction flow. The second suction pipe 29 is attached to the side frame 21a with a bracket 21f interposed. This can stabilize the position of the second suction pipe 29 to the side frame 21a and thus can prevent a clearance that may be otherwise produced owing to individual differences of parts and assembly errors. The suction tube 28 is attached to one end 29a of the second suction pipe 29. The front end of the suction tube 28 is positioned in the vicinity of the base end portion (upstream-side end) of the yarn storing roller 11b to form a first suction inlet 28a. The first suction inlet 28a is disposed to face the outer peripheral surface of the yarn storing roller 11b which is a part around which yarn Y is wound. That is, the second suction pipe 29 communicates with the first suction inlet 28a that sucks fiber waste from the yarn storing roller 11b.

[0046] As illustrated in FIG. 4, the second suction pipe 29 has one end 29a facing the yarn storing device 11 with the suction tube 28 interposed, the other end (downstream-side end) 29b connected to the suction part 41a (see FIG. 1) for producing a suction flow that is a flow of air at one end 29a through the connection part 27 (see FIG. 3) and the first suction pipe 43 (see FIG. 3), and a body 30 extended from one end 29a to the other end 29b and having three (a plurality of) flection parts 31 and four (a plurality of) linear parts 33 between one end 29a and the other end 29b. On both sides of the longitudinal direction of the flection parts 31, linear parts 33, 33 having different axis AL directions are formed. An iron collar may be attached to the other end 29b of the second suction pipe 29. In this case, damage to the other end 29b by yarn Y can be prevented.

[0047] In the body 30, the inner diameter D of at least the flection part 31 is 8 mm or more. The entire inner diameter D1 of the body 30 including the linear parts 33 may be 8 mm or more. The inner diameter D of at least the flection part 31 may be 12 mm or more. The entire inner diameter D1 of the body 30 including the linear parts 33 may be 12 mm or more.

[0048] The body 30, that is, the second suction pipe 29 is a molded product formed in a predetermined shape and is formed of, for example, a resin material such as polypropylene (PP). The flexural strength of the second suction pipe 29 is, for example, 420 to 560 (kgf/cm^2). The second suction pipe 29 is a molded product basically not flexible although slight deformation under stress is permitted. The second suction pipe 29 in the present embodiment is a molded product having the body 30 approximately extended in a C shape.

[0049] As illustrated in FIG. 5 and FIG. 6, the first suction pipe 43 is a pipe having a circular hollow cross section and channels a suction flow for sucking fiber waste. In other words, the first suction pipe 43 guides or directs the suction flow. One end 43a of the first suction pipe 43 is connected to the suction duct 42 (see FIG. 1) extended in the arrangement direction of the spinning units 2. One end 42a of the suction duct 42 is connected to the fiber waste collecting part 41b (see FIG. 1) accommodated in the first end frame 4 (see FIG. 1). The fiber waste collecting part 41b has the suction part 41a (suction source: see FIG. 1) that produces a suction flow at one end 29a (and the first suction inlet 28a of the suction tube 28) of the second suction pipe 29 connected through the first suction pipe 43 described in detail later and one end 51a of the third suction pipe 51 connected through the first suction pipe 43 described in detail later. It can be said that the first suction pipe 43 is connected to the suction part 41a through the suction duct 42.

[0050] The third suction pipe 51 communicates with the first suction pipe 43 to channel a suction flow that is a flow of air. In other words, the third suction pipe 51 guides or directs the suction flow. The third suction pipe 51 includes one end 51a provided in the vicinity of the guide member 23 on the front surface of the front panel 22, the other end (downstream-side end) 51b connected to the suction part 41a (see FIG. 1) for producing a suction flow at one end 51a through the connection part 27 (see FIG. 3) and the first suction pipe 43 (see FIG. 3), and a communicative part 51c communicatively connected from one end 51a to the other end 51b. One end 51a has a second suction inlet 22c described later. The third suction pipe 51 is formed linearly (with no flection part) from one end 51a to the other end 51b. The length of the third suction pipe 51 is 10 cm or less, shorter than the length of the first suction pipe 43 and the second suction pipe 29.

[0051] The connection part 27 is connected with the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 to merge the second suction pipe 29 and the third suction pipe 51 with the first suction pipe 43. The first suction pipe 43, the second suction pipe 29, the third suction pipe 51, and the connection part 27 are formed with members different from each other (separate members). That is, the first suction pipe 43, the second suction pipe 29, the third suction pipe 51, and the connection part 27 are separate members from each other. The first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 are connected to the connection part 27 from directions different from each other. The first suction pipe 43 and the second suction pipe 29 are removably connected to the connection part 27.

[0052] The connection part 27 is disposed on the upstream side of the first suction pipe 43 and disposed on the downstream side of the second suction pipe 29 and the third suction pipe 51. That is, the connection part 27 merges one end 29a that is the downstream-side end of the second suction pipe 29 and one end 51a that is the downstream-side end of the third suction pipe 51 with the other end 43b that is the upstream-side end of the first suction pipe 43. The "upstream side" and the "downstream side" of the suction pipes refer to the upstream side and the downstream side as viewed in the direction in which fiber waste is sucked. The connection part 27 is disposed in the upper space S1 and attached to the front frame 21d. That is, when the spinning machine 1 is viewed from the front as illustrated in FIG. 1, the second suction pipe 29 is connected to the connection part 27

from the front, the third suction pipe 51 is connected to the connection part 27 from the side, and the first suction pipe 43 is connected to the connection part 27 from the rear. With such a connection configuration, fiber waste and the like present in the vicinity of the base end of the yarn storing roller 11b is sucked through the second suction pipe 29, and fiber waste and the like present in the vicinity of the guide member 23 is sucked through the third suction pipe 51.

[0053] The first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 in the connection part 27 have different pipe characteristics from each other defined by at least one of a hollow cross-sectional area and the hollow cross-sectional shape. In the present embodiment, the hollow cross-sectional shapes of the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 are circular, and the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 have hollow cross-sectional areas different from each other. Here, circular encompasses both oval and circle shapes. The inner diameter (diameter of the hollow part) of the third suction pipe 51 is preferably 4 mm or more to 11 mm or less.

[0054] Of the hollow cross-sectional areas of the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 at the respective connecting positions to the connection part 27, the ratio between the largest cross-sectional area and the smallest cross-sectional area is 1:6 or more to 1:68 or less. Preferably, the ratio between the largest cross-sectional area and the smallest cross-sectional area is 1:30 or more to 1:32 or less. The hollow cross-sectional area of the first suction pipe 43 at the connecting position to the connection part 27 is larger than the hollow cross-sectional area of the second suction pipe 29 at the connecting position to the connection part 27. The hollow cross-sectional area of the second suction pipe 29 at the connecting position to the connection part 27 is larger than the hollow cross-sectional area of the third suction pipe 51 at the connecting position to the connection part 27. The lower limit value of the hollow cross-sectional area of the third suction pipe 51 at the connecting position to the connection part 27 is set to a value that allows fiber waste (yarn waste or fluff) to be sucked. The upper limit value of the hollow cross-sectional area of the third suction pipe 51 at the connecting position to the connection part 27 is set in relation to the connection part 27, preferably 1/2 or less of the hollow cross-sectional area of the connection part 27.

[0055] The structure of the connection part 27 (the merging structure for suction pipes) will be described in more detail. As illustrated in FIG. 5 and FIG. 6, part of an inner surface 27b forming an interior space S11 of the connection part 27 has a planar part 27a that is a flat surface. The second suction pipe 29 is connected to the planar part 27a. In other words, it is indicated that the region surrounded by the outer shape of the second suction pipe 29 at the connecting position to the connection part 27 is planar. That is, it is indicated that at the connecting position to the connection part 27, a region of the second suction pipe 29 orthogonal to the axial line AL2 is planar. In other words, it is indicated that the opening of the second suction pipe 29 removed from the connection part 27 is planar.

[0056] The cross section of the interior space S11 in the connection part 27 as viewed from the connecting direction of the first suction pipe 43 (as viewed from the direction of axial line AL1 at the connecting position to the connection part 27) is formed in a D shape. In other words, when viewed from the direction of the axial line AL4 of an adapter 44, the inner surface 27b (the outer shape of the cross section of the interior space S11) in the connection part 27 is formed in a D shape with a linear part 27c that is part of the planar part 27a and a semicircular part (arc-shaped part) 27d. As used herein the D shape includes an approximately D shape. When viewed from the axial line AL4 of the adapter 44, the inner surface 27b in the connection part 27 may be formed with a linear part 27c that is part of the planar part 27a and an arc-shaped part including an arc segment or an arc-shaped part including a plurality of arc segments with different radii.

[0057] The hollow cross-sectional shape of the first suction pipe 43 is circular. On the other hand, the hollow cross section in the connection part 27 to which the first suction pipe 43 is connected is D-shaped and is not circular. Then, the adapter 44 is provided between the connection part 27 and the first suction pipe 43 for connecting them. In the adapter 44, the hollow cross section at the upstream-side end 44a is formed in a D shape, and the hollow cross section at the downstream-side end 44b is formed in a circular shape. The adapter 44 is a member for gradually transforming the hollow cross-sectional shape.

[0058] As illustrated in FIG. 7A, a position P1 on the axial line AL2 of the second suction pipe 29 at the connecting position to the connection part 27 and a central position P2 in the longitudinal direction in the linear part 27c are shifted from each other by a distance G in the longitudinal direction of the linear part 27c. As used herein the axial line AL2 of the second suction pipe 29 agrees with the axial line AL at the most downstream end of the second suction pipe 29.

[0059] As illustrated in FIG. 5 and FIG. 6, the third suction pipe 51 communicates with the second suction inlet 22c provided above (upstream side) the guide member 23 for guiding yarn Y, the second suction inlet 22c provided between the winding device 13 and the yarn feeding device (the drafting device 6 and the air spinning device 7). In a case where the direction of the axial line AL1 of the first suction pipe 43 at the connecting position to the connection part 27 and the direction of the axial line AL3 of the third suction pipe 51 at the connecting position to the connection part 27 have a component in the same direction (hereinafter referred to as "first direction") . The connection part 27 has an opening 27f. Then, when the

direction orthogonal to the opening 27f to which the first suction pipe 43 is connected through the adapter 44 in the connection part 27 is the direction of the axial line AL4 of the connection part 27, the angle α of intersection of the connecting direction of the third suction pipe 51 (the direction of the axial line AL3 at the connecting position to the connection part 27) and the direction of the axial line AL4 of the connection part 27 is 45 degrees or less. The angle α of intersection of the connecting direction of the third suction pipe 51 and the direction of the axial line AL4 of the connection part 27 may be 25 degrees or less. In the present embodiment, the direction of the axial line AL1 and the direction of the axial line AL3 have a component in the machine front-rear direction as a component in the first direction.

[0060] When viewed from the connecting direction of the second suction pipe 29, the third suction pipe 51 is disposed on one side 29d in the right-to-left direction of the second suction pipe 29, and the third suction pipe 51 is connected such that the extended straight line (the axial line AL3 at the connecting position) in the connecting direction of the third suction pipe 51 crosses an inner peripheral surface 43c of the first suction pipe 43 on the other side 29c in the right-to-left direction. The third suction pipe 51 may be connected such that the extended straight line (axial line AL3) in the connecting direction of the third suction pipe 51 crosses the semi-circular part 27d that is part of the inner surface of the connection part 27 on the other side 29c in the right-to-left direction. The direction of the axial line AL2 of the second suction pipe 29 at the connecting position to the connection part 27 forms an angle of 45 degrees or more relative to the component in the first direction. The direction of the axial line AL2 of the second suction pipe 29 at the connecting position to the connection part 27 may be vertical to the component in the first direction.

[0061] In the connection part 27, the area A1 of the opening connected with the first suction pipe 43 (the hollow cross-sectional area of the first suction pipe 43 at the connecting position), the area A2 of the opening connected with the second suction pipe 29 (the hollow cross-sectional area of the second suction pipe 29 at the connecting position), and the area A3 of the opening connected with the third suction pipe 51 (the hollow cross-sectional area of the third suction pipe 51 at the connecting position) have the relation: $A3 < A2 < A1$ and $A3 + A2 \leq A1$. The area A1 of the opening connected with the first suction pipe 43, the area A2 of the opening connected with the second suction pipe 29, and the area A3 of the opening connected with the third suction pipe 51 are defined so as to gradually expand toward the downstream side in the direction in which a suction flow flows.

[Operation and Effects]

[0062] In the foregoing embodiment, as illustrated in FIG. 5 and FIG. 6, the connection part 27 to which the second suction pipe 29 is connected has the planar part 27a at part of the inner surface 27b forming the interior space S11, and the second suction pipe 29 is connected to the planar part 27a. Thus, as illustrated in FIG. 7A and FIG. 7B, when viewed from the connecting direction of the first suction pipe 43, compared with a connection part 127 in which the second suction pipe 29 is connected to a part 127b of an inner surface 127a forming a circular interior space S12, a cross-sectional area of the interior space S11 of the connection part 27 can be sufficiently ensured, and the amount of protrusion L1 of the second suction pipe 29 in the interior space S11 of the connection part 27 can be reduced or the protrusion can be eliminated. This configuration can prevent or reduce clogging with fiber waste due to the reduced cross-sectional area. In addition, a suction flow coming from the second suction pipe 29 and a suction flow coming from the third suction pipe 51 can merge in the interior space S11 of the connection part 27 without obstructing the suction flow by the protrusion of the second suction pipe 29, thereby enabling smooth collecting of fiber waste. The configuration in the foregoing embodiment can prevent or reduce merging turbulence of suction flows from vertical two directions (including approximately vertical two directions).

[0063] In the conventional spinning machine described above, in order to collect fiber waste sucked from different locations into a collecting chamber, a merging structure (connection part) is provided for connecting one suction pipe with another suction pipe. In the connection part in which another suction pipe merges into one suction pipe in this manner, the diameter of the other suction pipe has to be significantly reduced compared with one suction pipe, for the sake of space limitations. This is because unless the diameter of the other suction pipe is reduced, an end of the other suction pipe has to be located deeper into one suction pipe and, in this case, the other suction pipe inserted deep reduces the hollow area of one suction pipe. As a result, fiber waste is unable to be smoothly collected. If the diameter of the other suction pipe is significantly reduced compared with one suction pipe, the impurity included in the sucked air is deposited on the inner peripheral surface of the suction pipe, and fiber waste such as waste yarn and fluff is caught in the deposit, which also prevents smooth collecting of fiber waste. In the foregoing embodiment, the amount of protrusion L1 of the second suction pipe 29 in the interior space S11 of the connection part 27 can be reduced without significantly reducing the diameter of the second suction pipe 29 corresponding to the other suction pipe mentioned above, compared with the first suction pipe 43 corresponding to one suction pipe mentioned above.

[0064] In the foregoing embodiment, as illustrated in FIG. 7A, when viewed from the connecting direction of the first suction pipe 43, the inner surface 27b of the connection part 27 is formed in a D shape with the linear part 27c and the semi-circular part 27d. With this configuration, the amount of protrusion L1 of the second suction pipe 29 (or an iron collar) in the interior space S11 of the connection part 27 can be even smaller than the amount

of protrusion L11 of the second suction pipe 129 (or an iron collar) (L1<L11), and the area of the interior space S11 of the connection part 27 can be larger than the area of the interior space S12 of the connection part 127, accordingly.

[0065] In the foregoing embodiment, the position P1 on the axial line AL2 of the second suction pipe 29 at the connecting position and the central position P2 in the longitudinal direction of the linear part 27c are shifted from each other in the longitudinal direction. This configuration prevents a flow from the second suction pipe 29 from colliding with the semi-circular part 27d at the central point and dividing into two and prevents turbulence of the flow in the interior space S11 of the connection part 27 due to the flow coming from the second suction pipe 29 and dividing into two. That is, in this structure, the axial line position P1 at the connecting position of the second suction pipe 29 is shifted from the central position P2 and thus from the central point of the semi-circular part 27d, causing a suction flow in the form of a large vortex in the interior space S11 of the connection part 27. As a result, the suction flow coming from the second suction pipe 29 and the suction flow coming from the third suction pipe 51 smoothly merge in the interior space S11 of the connection part 27, thereby enabling smooth collecting of fiber waste.

[0066] In the foregoing embodiment, as illustrated in FIG. 6, since the angle α of intersection of the extended straight line (axial line AL3) in the connecting direction of the third suction pipe 51 and the axial line AL4 of the connection part 27 is 45 degrees or less, the connecting direction of the first suction pipe 43 (the outflow direction of the suction flow to the first suction pipe 43) and the connecting direction of the third suction pipe 51 (the inflow direction of the suction flow from the third suction pipe 51) come closer to each other to facilitate a flow of fiber waste from the third suction pipe 51 to the first suction pipe 43. When the angle difference between the connecting direction of the first suction pipe 43 and the connecting direction of the third suction pipe 51 is small, the flow from the third suction pipe 51 flows toward the first suction pipe 43 without colliding with the inner surface 27b of the connection part 27 (or the inner peripheral surface 43c of the first suction pipe 43) . Even if the flow collides, the angle of collision with the inner surface 27b (inner peripheral surface 43c) is small, and the impurity included in the air is less likely to adhere to the inner surface 27b (inner peripheral surface 43c), compared with when the angle of collision is large (for example, the flow collides at right angle) . As a result, deposition of impurity in the air at a place of collision on the inner surface 27b of the connection part 27 (the inner peripheral surface 43c of the first suction pipe 43) can be prevented or reduced. In the foregoing embodiment, if the angle of intersection is 25 degrees or less, the flow of fiber waste from the third suction pipe 51 to the first suction pipe 43 is further facilitated.

[0067] In the foregoing embodiment, when viewed from the connecting direction of the second suction pipe 29, the third suction pipe 51 is disposed on one side 29d in the right-to-left direction of the second suction pipe 29, and the third suction pipe 51 is connected such that the extended straight line in the connecting direction (axial line AL3) of the third suction pipe 51 crosses the inner surface 27b of the connection part 27 (the inner peripheral surface 43c of the first suction pipe 43) on the other side 29c in the right-to-left direction. With this configuration, the connecting direction of the first suction pipe 43 and the connecting direction of the third suction pipe 51 come closer to each other to facilitate the flow of fiber waste from the third suction pipe 51 to the first suction pipe 43. Furthermore, when the angle difference between the connecting direction of the first suction pipe 43 and the connecting direction of the third suction pipe 51 is small, the flow from the third suction pipe 51 flows toward the first suction pipe 43 without colliding with the inner surface 27b of the connection part 27 (the inner peripheral surface 43c of the first suction pipe 43). As a result, deposition of impurity in the air at a place of collision can be prevented or reduced. In this configuration, the angle difference between the connecting direction of the first suction pipe 43 and the connecting direction of the third suction pipe 51 can be reduced even when there are limitations in space or design dimensions.

[0068] Deposition of impurity in the air at a place of collision can be prevented or reduced even more effectively, as illustrated in FIG. 6, when the connection position of the third suction pipe 51 is above the connection part 27 (above the central position in the height direction) and the angle difference between the connecting direction of the first suction pipe 43 and the connecting direction of the third suction pipe 51 is reduced (small) . That is, deposition of impurity can be prevented or reduced more effectively if the connecting direction of the third suction pipe 51 is shifted to one direction (in the present embodiment, above) and the connection angle of the third suction pipe 51 (the inflow angle of the suction flow from the third suction pipe 51) is small relative to the inner surface (in the present embodiment, the bottom wall surface forming the interior space S11) on the other direction (in the present embodiment, below) side of the connection part 27.

[0069] When the merging structure for suction pipes in the foregoing embodiment is provided in each of a plurality of spinning units 2, the pipe diameters of the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 are inevitably small, and the flexibility of manufacturing is reduced. For this manufacturing reason, it is difficult to produce the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 from sheet metal. The hollow cross section is therefore usually designed to be circular because of the limitation in pipe shape. The connection of such suction pipes with a small inner diameter difference between the suction pipes tends to suffer turbulence of the air flow in the merging space. Then, in the merging structure in the foregoing

embodiment, even when the inner diameter difference between the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 is reduced such that the ratio between the largest inner diameter and the smallest inner diameter is 1:2 or more to 1: 8 or less (preferably, 1: 4 or more to 1: 6 or less), the amount of protrusion into the interior space S11 that is the merging space of the second suction pipes 29 can be reduced, thereby reducing merging turbulence in the interior space S11.

[0070] In the merging structure for suction pipes in the foregoing embodiment, the first suction pipe 43 of each of a plurality of spinning units 2 is connected to the suction duct 42. Thus, fiber waste can be smoothly collected in the merging structure provided in each spinning unit 2 and disposed on the upstream side of the suction duct 42 in the suction direction.

[Modifications]

[0071] Although an embodiment has been described above, the embodiment according to an aspect of the present disclosure is not limited thereto. In the foregoing embodiment, a molded product formed of a resin material is employed as the second suction pipe 29. However, instead of a molded product of a resin material, a tube formed of a flexible soft resin material such as vinyl chloride may be used. In this case, for example, a guide member may be additionally used to form the shape as illustrated in FIG. 4.

[0072] In the foregoing embodiment and modification, the first suction pipe 43 and the second suction pipe 29 are connected through the connection part 27 that is a member different from the first suction pipe 43 and the second suction pipe 29. However, the embodiment is not limited thereto. For example, the first suction pipe 43 and the connection part 27 may be formed integrally. In this case, the connecting direction of the first suction pipe 43 to the connection part 27 is the direction of the axial line AL1 of the first suction pipe 43 at the boundary portion between the connection part 27 and the second suction pipe 29.

[0073] In the foregoing embodiment and modification, the hollow cross-sectional shape of the connection part 27 is transformed into the hollow cross-sectional shape of the first suction pipe 43 (that is, transformation from a D shape into a circular shape) using the adapter 44. However, the embodiment is not limited thereto. For example, the first suction pipe 43 having its cross-sectional shape changing from a D shape into a circular shape at some point in the longitudinal direction may be used, rather than using the adapter 44. In this case, the hollow cross section of the connecting position is formed in a D shape.

[0074] In the foregoing embodiment, the hollow cross section at the connecting position of the first suction pipe 43 in the connection part 27 is formed in a D shape. However, the hollow cross section at the connecting position may be formed in a circular shape. That is, the second suction pipe 29 having a circular hollow cross section may be connected to the connection part 27 having a circular hollow cross section at the connecting position to the first suction pipe 43. Also in this case, the connected portion to the second suction pipe 29 in the connection part 27 is formed in the planar part. In this case, the first suction pipe 43 and the third suction pipe 51 also may have a circular hollow cross section.

[0075] In this case, of the hollow cross-sectional areas of the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 at the respective connecting positions to the connection part 27, the ratio between the largest cross-sectional area and the smallest cross-sectional area may be 1:6 or more to 1:68 or less (preferably, 1:30 or more to 1:32 or less) . In the present embodiment, the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 may be cylindrical pipes, and, of the inner diameters of the first suction pipe 43, the second suction pipe 29, and the third suction pipe 51 at the respective connecting positions to the connection part 27, the ratio between the largest inner diameter and the smallest inner diameter may be 1:2 or more to 1:8 or less (preferably, 1:4 or more to 1:6 or less).

[0076] In the foregoing embodiment and modification, the application to the spinning machine 1 according to an aspect of the present disclosure has been described. However, the embodiment may be applicable to, for example, textile machinery other than a yarn winding machine such as an automatic winder or a spinning machine and a yarn winding unit included in such textile machinery, or textile machinery such as a drawing frame or a roving frame that is processing machinery for fiber bundle prior to yarn and a fiber processing unit included in such textile machinery.

[0077] In the spinning unit 2, the devices are disposed such that yarn Y fed from the upper side in the machine height direction is wound at the lower side. However, the devices may be disposed such that yarn Y fed from the lower side is wound at the upper side. FIG. 1 illustrates the spinning machine 1 configured to wind a cheese-shaped package P. However, a cone-shaped package P also may be wound.

[0078] In the spinning unit 2, the yarn storing device 11 has the function of drawing yarn Y from the air spinning device 7. However, yarn Y may be drawn from the air spinning device 7 with a delivery roller and a nip roller. When yarn Y is drawn from the air spinning device 7 with a delivery roller and a nip roller, for example, a slack tube or a mechanical compensator for removing slack of yarn Y with a suction air flow may be provided instead of the yarn storing device 11.

[0079] The tension sensor 9 may be disposed on the upstream side of the yarn monitoring device 8 in the traveling direction of yarn Y. The unit controller 10 may be provided for each spinning unit 2. In the spinning unit 2, the waxing device 12, the tension sensor 9, and the yarn monitoring device 8 may be eliminated.

Claims

1. A merging structure for suction pipes configured to suck fiber waste in textile machinery, comprising:

   a first suction pipe (43) configured to channel a suction flow for sucking the fiber waste;
   a second suction pipe (29) configured to communicate with the first suction pipe (43) and to channel the suction flow;
   a third suction pipe (51) configured to communicate with the first suction pipe (43) and to channel the suction flow, the third suction pipe (51) being a member separate from the second suction pipe (29); and
   a connection part (27) connected with the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) such that, with respect to a direction in which the suction flow flows, a downstream-side end (29b) of the second suction pipe (29) and a downstream-side end (51b) of the third suction pipe (51) merge with an upstream-side end (43b) of the first suction pipe (43), wherein
   part of an inner surface (27b) forming an interior space (S11) of the connection part (27) has a planar part (27a) that is a flat surface, and
   the second suction pipe (29) is connected to the planar part (27a).

2. The merging structure for suction pipes according to claim 1, wherein the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) are connected to the connection part (27) from directions different from each other.

3. The merging structure for suction pipes according to claim 1 or 2, wherein the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) in the connection part (27) have pipe characteristics different from each other, the pipe characteristics defined by at least one of a hollow cross-sectional area and a hollow cross-sectional shape.

4. The merging structure for suction pipes according to any one of claims 1 to 3, the first suction pipe (43), the second suction pipe (29), the third suction pipe (51), and the connection part (27) are formed of different members.

5. The merging structure for suction pipes according to any one of claims 1 to 4, wherein a cross section of an interior space (S11) in the connection part (27) as viewed from a connecting direction of the first suction pipe (43) is formed in a D shape.

6. The merging structure for suction pipes according to any one of claims 1 to 4, wherein
   a cross section of an interior space (S11) in the connection part (27) as viewed from a connecting direction of the first suction pipe (43) is formed in a D shape with a linear part and an arc-shaped part, and
   an axial line position of the second suction pipe (29) at a connecting position of the second suction pipe (29) to the connection part (27) and a central position in a longitudinal direction in the linear part are shifted from each other in the longitudinal direction.

7. The merging structure for suction pipes according to any one of claims 1 to 6, wherein, of the hollow cross-sectional areas of the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) at respective connecting positions to the connection part (27), a ratio between a largest cross-sectional area and a smallest cross-sectional area is 1:6 or more to 1:68. or less..

8. The merging structure for suction pipes according to any one of claims 1 to 6, wherein
   the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) are cylindrical pipes, and
   of the inner diameters of the first suction pipe (43), the second suction pipe (29), and the third suction pipe (51) at respective connecting positions to the connection part (27), a ratio between a largest inner diameter and a smallest inner diameter is 1:2 or more to 1:8 or less.

9. The merging structure for suction pipes according to any one of claims 1 to 8, wherein
   an axial line direction of the first suction pipe (43) at a connecting position to the connection part (27) and an axial line direction of the third suction pipe (51) at a connecting position to the connection part (27) have a component extending in an identical direction, and
   an axial line direction of the second suction pipe (29) at a connecting position to the connection part (27) forms an angle of 45 degrees or more relative to the component extending in the identical direction.

10. The merging structure for suction pipes according to any one of claims 1 to 9, wherein when a direction orthogonal to an opening to which the first suction pipe (43) is connected in the connection part (27) is an axial line direction of the connection part (27), an angle of intersection of an axial line direction of the third suction pipe (51) at a connecting position to the connection part (27) and the axial line direction of the connection part (27) is 25 degrees or less.

11. The merging structure for suction pipes according to any one of claims 1 to 10, wherein
    a hollow cross-sectional area of the first suction pipe (43) at a connecting position to the connection part

(27) is larger than a hollow cross-sectional area of the second suction pipe (29) at a connecting position to the connection part (27), and
the hollow cross-sectional area of the second suction pipe (29) at the connecting position to the connection part (27) is larger than the hollow cross-sectional area of the third suction pipe (51) at the connecting position to the connection part (27).

12. The merging structure for suction pipes according to any one of claims 1 to 11, wherein the first suction pipe (43) and the second suction pipe (29) are removably connected to the connection part (27) .

13. A yarn winding unit (2) comprising:

the merging structure for suction pipes according to any one of claims 1 to 12;
a yarn feeding device (7) configured to feed yarn (Y);
a winding device (13) configured to wind the yarn fed from the yarn feeding device (7) to form a package; and
a yarn storing device (11) configured to store the yarn (Y) between the yarn feeding device (7) and the winding device (13), wherein
the second suction pipe (29) communicates with a first suction inlet (28a) configured to suck fiber waste from a portion that stores the yarn in the yarn storing device (11).

14. The yarn winding unit (2) according to claim 13, wherein the third suction pipe (51) communicates with a second suction inlet (22c) disposed above a guide part for guide the yarn, the second suction inlet (22c) disposed between the winding device (13) and the yarn feeding device (7).

15. A spinning machine comprising:

the merging structure for suction pipes according to any one of claims 1 to 12;
a drafting device (6) configured to draft a fiber bundle;
an air spinning device (7) configured to twist the fiber bundle drafted by the drafting device (6) to form yarn;
a winding device (13) configured to wind the yarn formed by the air spinning device (7) to form a package; and
a yarn storing device (11) configured to store the yarn between the air spinning device (7) and the winding device (13), wherein
the second suction pipe (29) communicates with a first suction inlet (28a) configured to suck fiber waste from a portion that stores the yarn in the yarn storing device (11).

16. Textile machinery, comprising:

the merging structure for suction pipes according to any one of claims 1 to 12,
a plurality of yarn winding units (2) each configured to wind yarn to form a package, and
a suction duct (42) connected to a suction source (41a) and extended along an arrangement direction of the yarn winding units (2), wherein
the first suction pipe (43) of each of the yarn winding units (2) is connected to the suction duct (42).

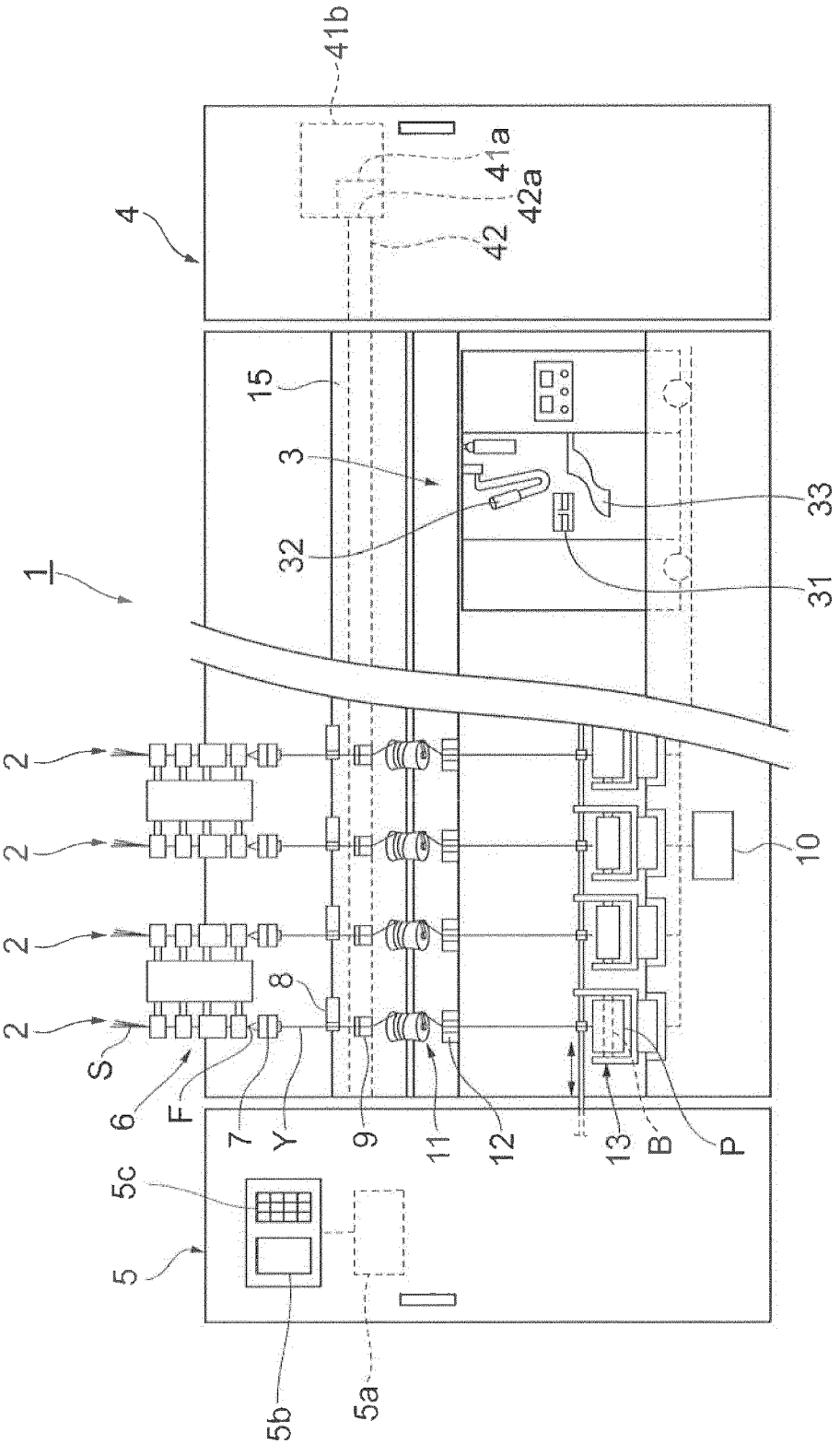
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Fig.1

Fig.2

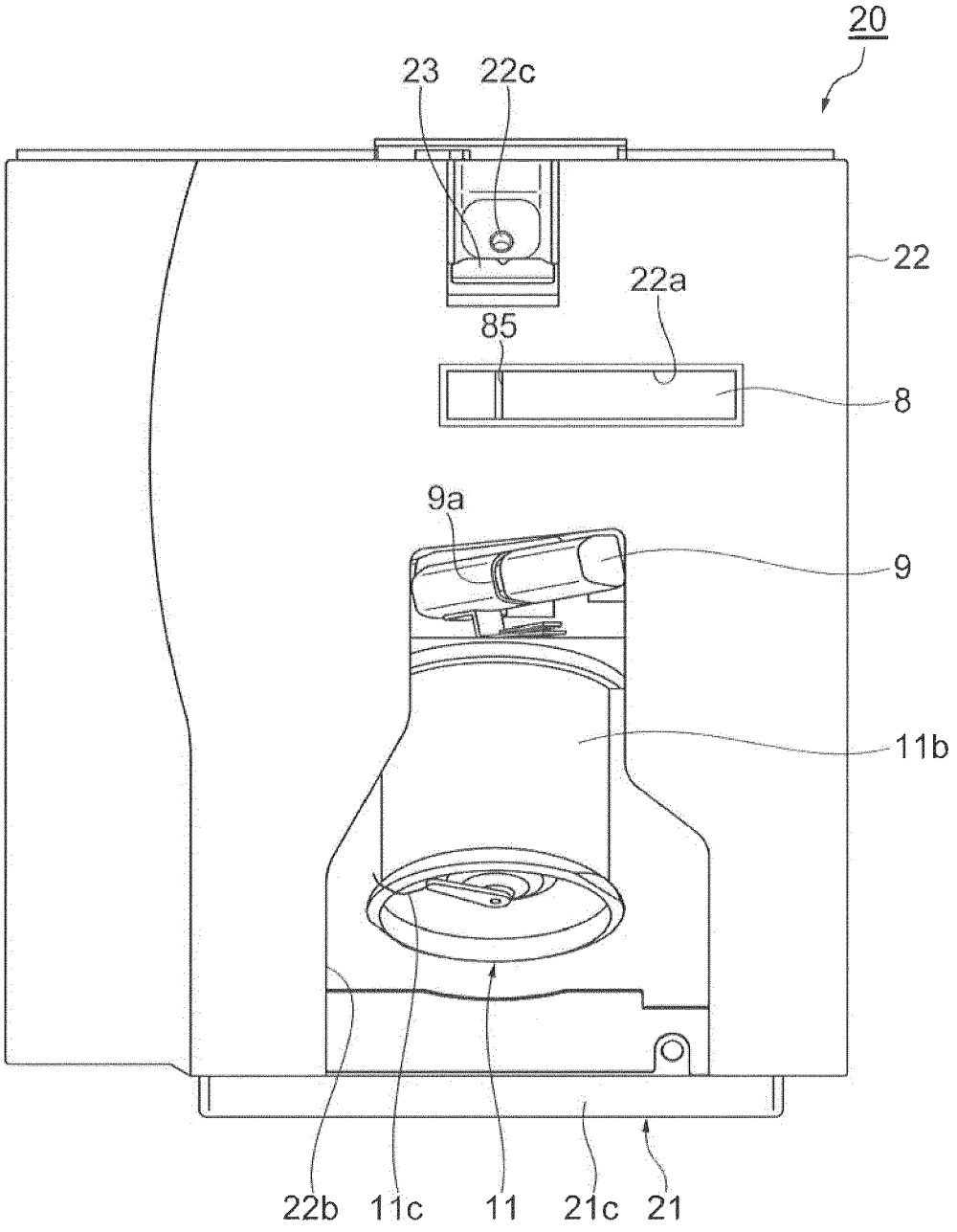
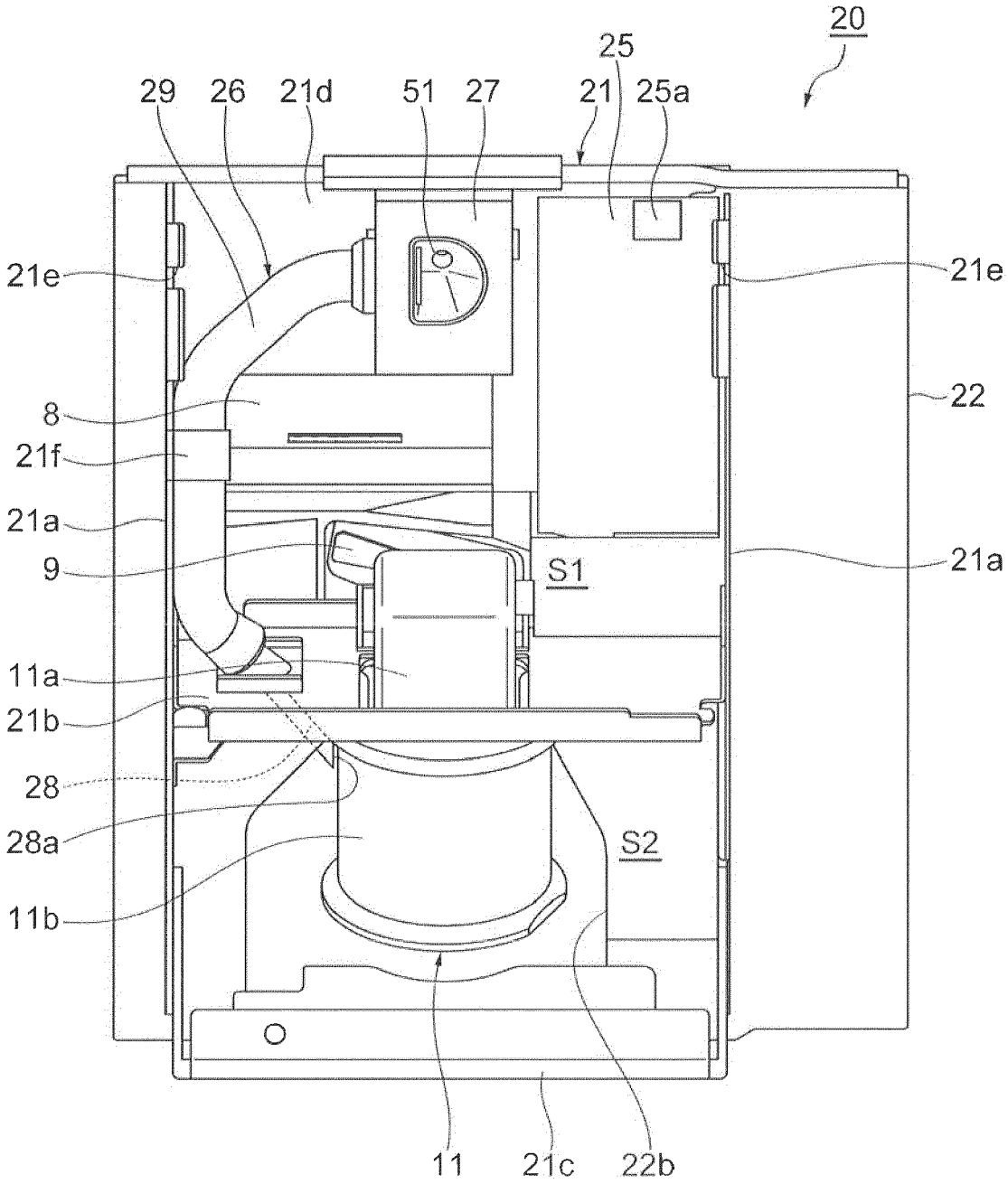


Fig.3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11a
21b
28
28a
S2
11b
11
21c
22b

Fig.4

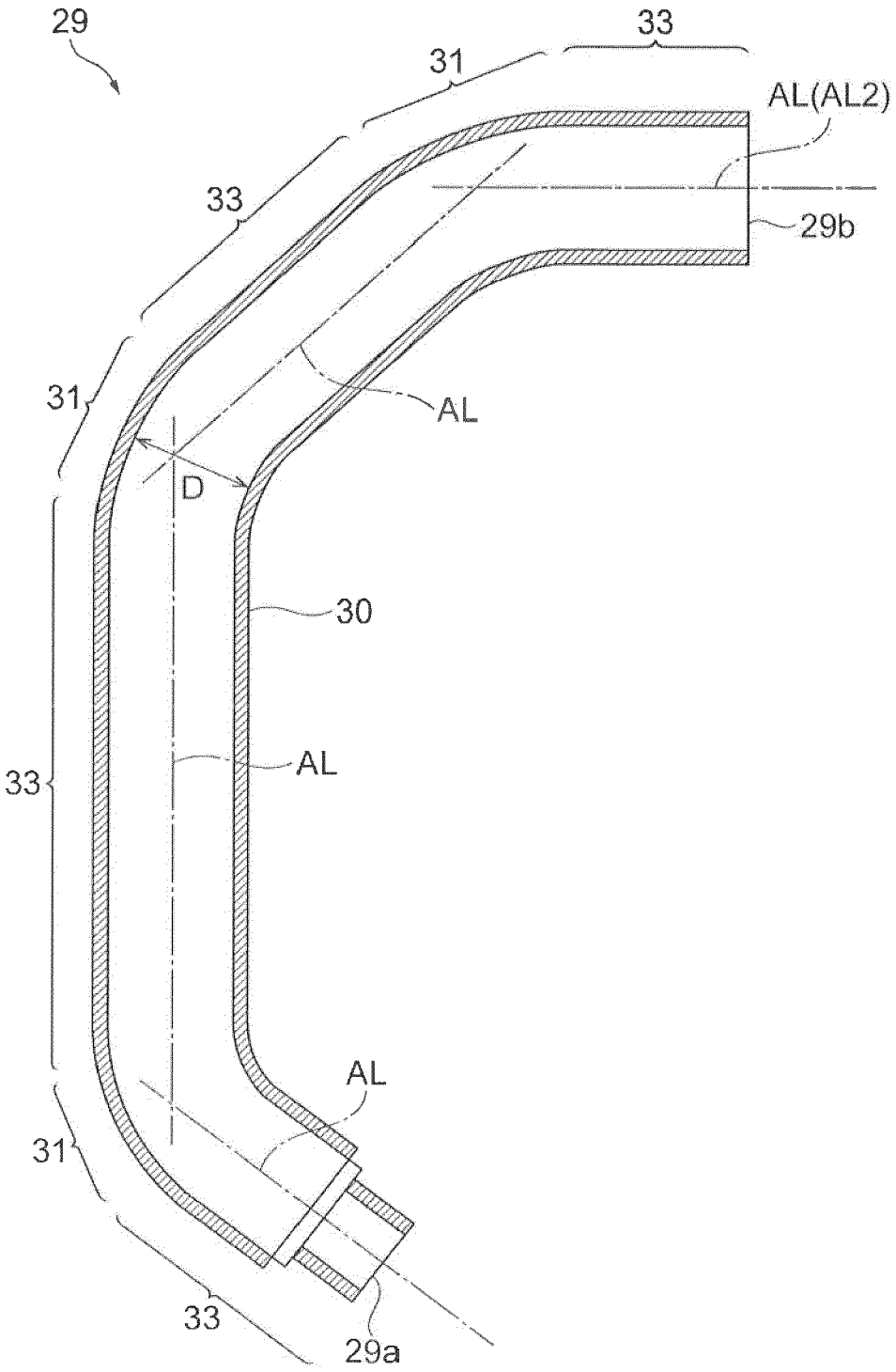
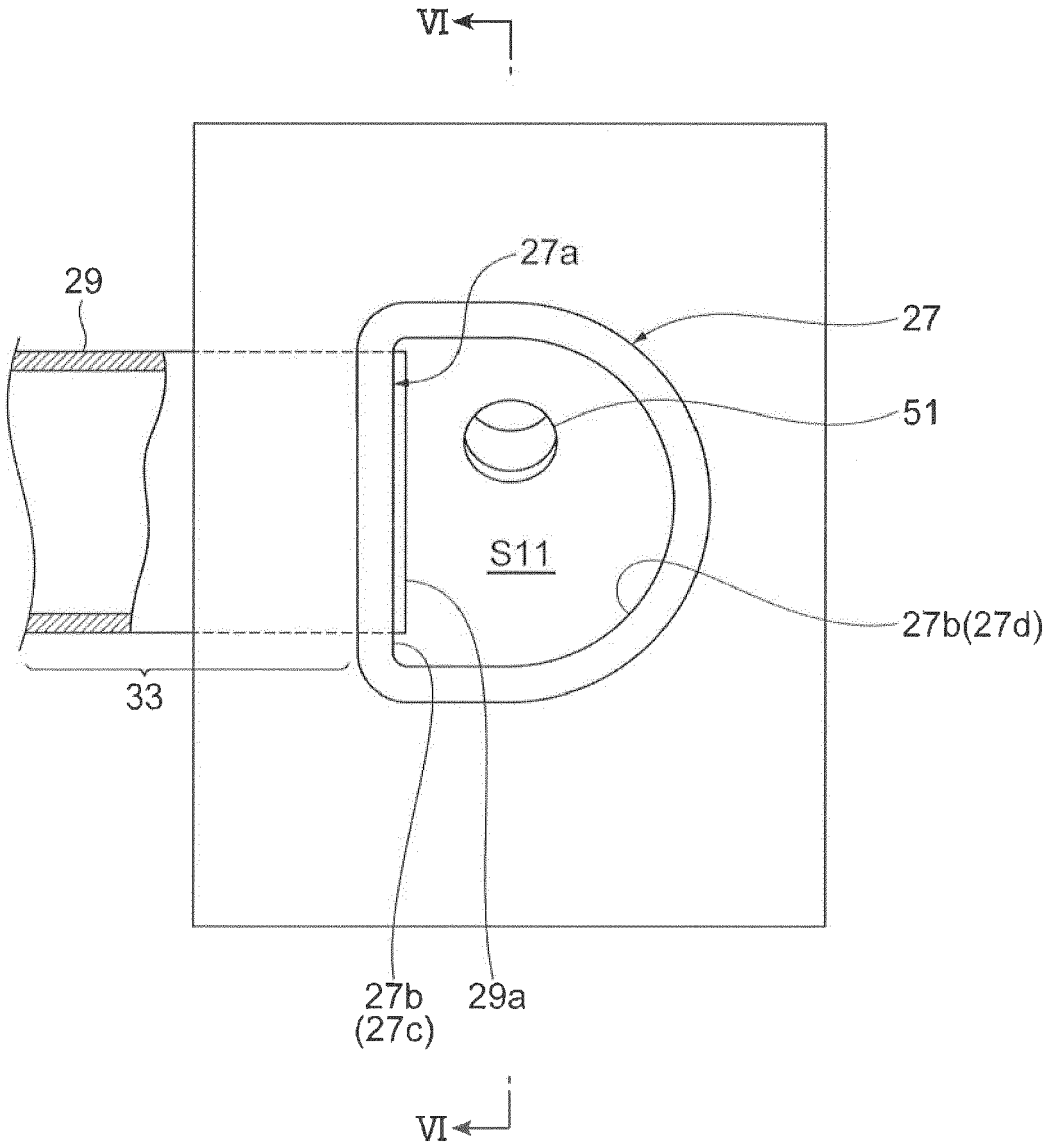


Fig.5



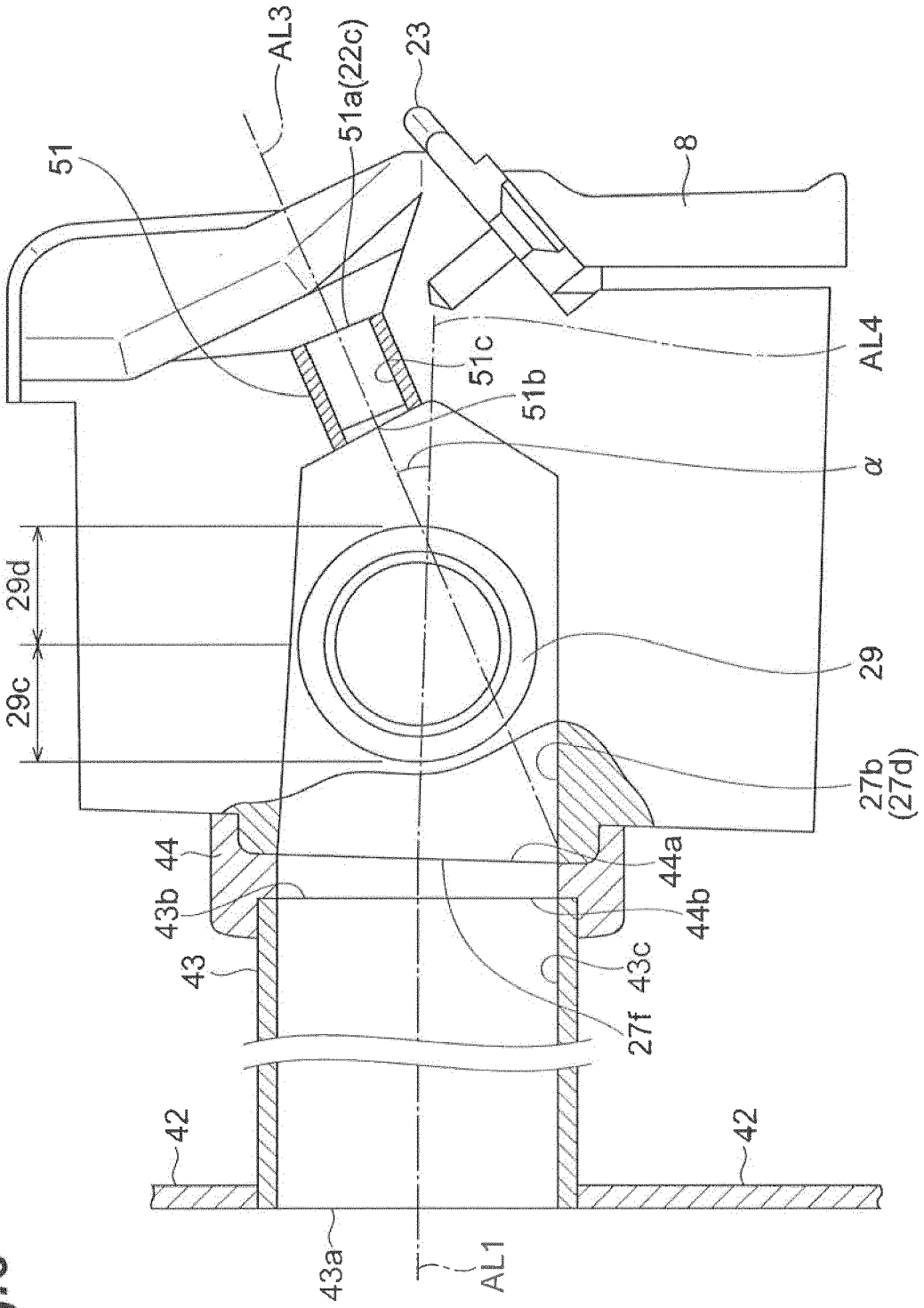

AL3
51a(22c)
23
51
8
AL4
51c
51b
α
29d
29c
29
27b
(27d)
44
43b
44a
44b
43
43c
27f
42
42
43a
AL1

Fig.6

Fig.7A

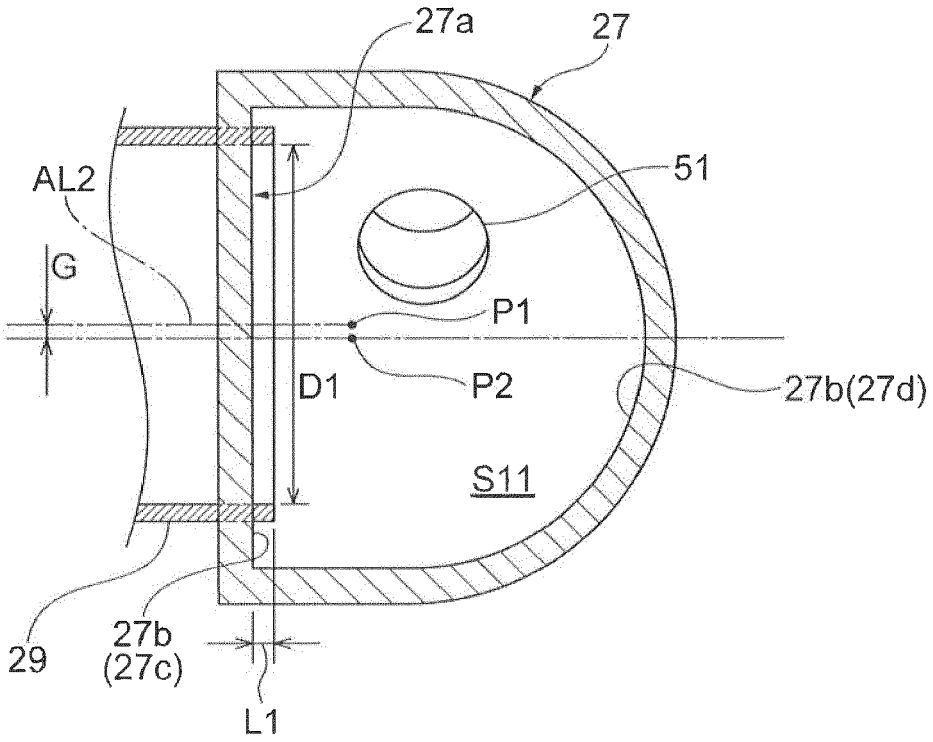
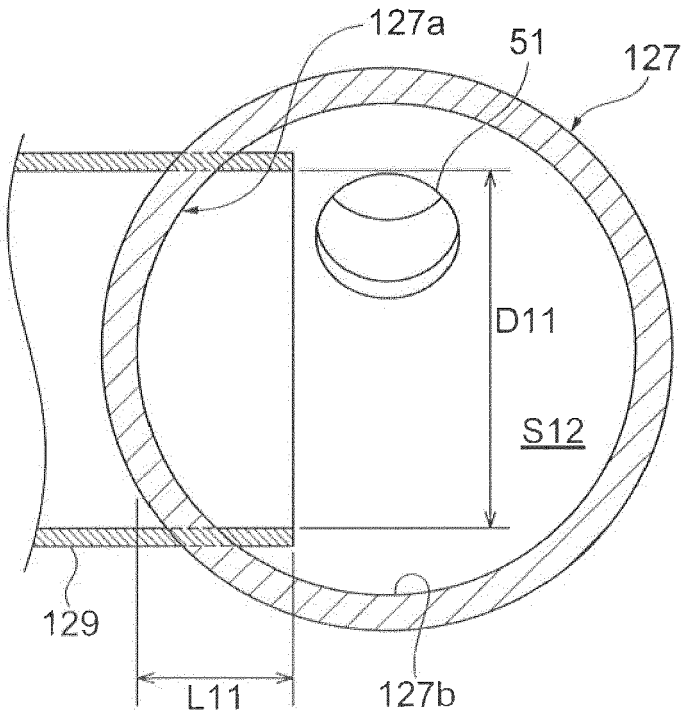

27a
27
AL2
51
G
P1
D1
P2
27b(27d)
S11
29
27b
(27c)
L1

Fig.7B


127a
51
127
D11
S12
129
L11
127b

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
Munich	31 May 2019	Todarello, Giovanni

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