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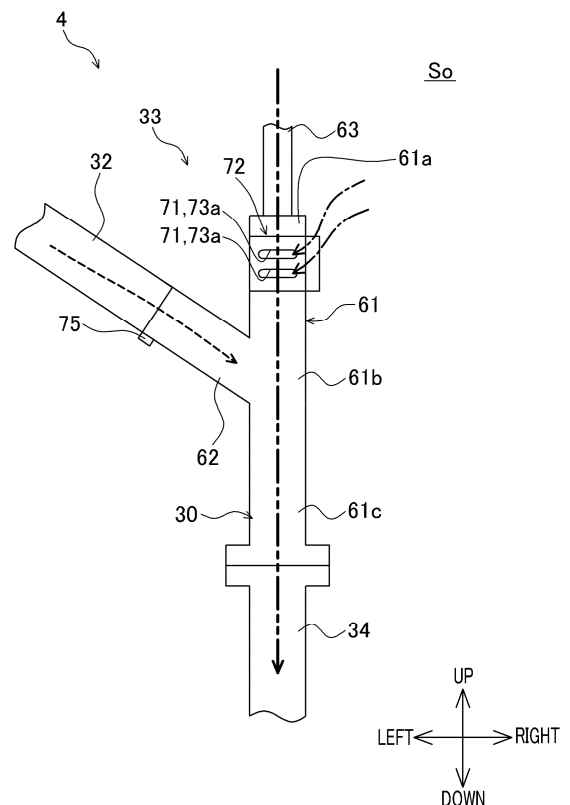
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(54) **MELT SPINNING SYSTEM**

(57) An object of the present invention is to suppress the adherence of a gas solidified body to an exhaust path in a melt spinning system.

A melt spinning system 1 includes a spinning beam 2 including a spinneret 13, a yarn cooler 3 including a cooling cylinder 21, and an exhaust unit 4. The exhaust unit 4 is provided with an exhaust path 30 configured to suck and discharge gas generated from molten polymer spun out from the spinneret 13. The exhaust unit 4 includes a suction member 31, an aspirator 33, and a gas discharge pipe. The aspirator 33 includes a primary pipe portion 61 which is configured to cause fluid (water) different from the gas to flow in a predetermined flow direction and to discharge the gas along with the fluid. The primary pipe portion 61 is provided with an outside air intake port 71 for taking in outside air from an outer space of the exhaust unit 4.

FIG.9



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a melt spinning system.

[0002] Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2020-176354) discloses a melt spinning system configured to spin out a filament. The melt spinning system includes a yarn spinning unit including a spinneret, a cooling unit including a cooling cylinder, and an exhaust unit. Molten polymer is a material of the filament, and discharged (spun out) from the spinneret. The molten polymer is cooled and solidified by cooling wind blowing from the cooling cylinder, so as to form the filament. The exhaust unit is provided between the yarn spinning unit and the cooling unit in a running direction of the filament. The exhaust unit is configured to suck monomer gas (hereinafter, this will be simply referred to as gas) generated from the molten polymer, and to discharge the gas through a predetermined exhaust path. The exhaust unit includes: a suction member (hereinafter, this will be referred to as the sucking portion) provided with a suction port formed between the spinneret and the cooling cylinder; and an aspirator (hereinafter, this will be referred to as the discharge device) configured to generate a negative pressure by means of the flow of water. The gas sucked into the sucking portion through the suction port is sucked and discharged by the discharge device. The discharge device includes: a main body (main pipe) in which water (fluid) flows; and a gas inlet (hereinafter, this will be referred to as the gas discharge pipe) provided between the suction port and the main pipe in a flow direction of the gas. The gas discharge pipe is provided with an outside air intake port for taking in outside air. The opening degree of the outside air intake port is adjusted by an adjustment portion. The outside air is taken into the gas discharge pipe so that the magnitude of a sucking pressure (negative pressure) is suitably adjusted by the discharge device.

SUMMARY OF THE INVENTION

[0003] When the outside air intake port is provided at the gas discharge pipe as described above, the monomer gas flowing nearby the outside air intake port is easily cooled and clotted by the outside air taken into the gas discharge pipe through the outside air intake port. When (i) the gas is clotted to unintentionally generate a solidified body and (ii) the solidified body adheres to an inner wall of the gas discharge pipe, the gas discharge pipe is narrowed so that the flow amount of gas flowing inside the gas discharge pipe is decreased. Furthermore, the exhaust path including the gas discharge pipe may be disadvantageously clogged.

[0004] An object of the present invention is to suppress the adherence of a gas solidified body to an ex-

haust path in a melt spinning system.

[0005] According to a first aspect of the invention, a melt spinning system comprises: at least one yarn spinning unit including a spinneret for spinning out molten polymer which is a material of a filament; at least one cooling unit which includes a cooling cylinder provided below the spinneret and which is configured to cool the molten polymer spun out from the spinneret so as to form the filament; and an exhaust unit provided with an exhaust path for sucking and discharging gas generated from the molten polymer spun out from the spinneret, the exhaust unit including: a sucking unit which is provided between the spinneret and the cooling cylinder in a direction in which the filament runs, the sucking unit being provided with a suction port for sucking the gas; a discharge device which includes a main pipe configured to cause fluid to flow in a predetermined flow direction, which is provided downstream of the sucking unit in a gas discharge direction, and which is configured to generate a negative pressure at the suction port by means of flow of the fluid so that the gas is discharged along with the fluid, the fluid being different from the gas, the exhaust path extending in the gas discharge direction; and at least one gas discharge pipe which is provided between the sucking unit and the main pipe in the gas discharge direction and which is arranged to be merged into an intermediate portion of the main pipe in the flow direction, and the main pipe being provided with an outside air intake port for taking in outside air from an outer space of the exhaust unit.

[0006] In this aspect of the present invention, the main pipe is provided with the outside air intake port. As outside air is taken into the main pipe through the outside air intake port, the pressure in the main pipe is equalized with the pressure in the outer space of the exhaust unit. Because of this, a sucking pressure in the main pipe is decreased so that a negative pressure generated at the suction port connected to the main pipe is suitably decreased. The outside air taken into the main pipe is merged into the fluid in the main pipe to be diluted. Therefore, a possibility of contact between the outside air and the gas generated from the molten polymer is decreased as compared to a case where the outside air intake port is provided at the at least one gas discharge pipe. This suppresses the gas from being cooled and clotted by the outside air. If the gas is partially clotted in the main pipe so that a solidified body is generated, this solidified body is discharged to a downstream side in the flow direction along with the fluid. Therefore, the adherence of a gas solidified body to the exhaust path is suppressed in the melt spinning system.

[0007] According to a second aspect of the invention, the melt spinning system of the first aspect is arranged such that the outside air intake port is provided upstream of a merging position between the main pipe and the at least one gas discharge pipe in the flow direction.

[0008] In this aspect of the present invention, as the outside air is taken into the main pipe at a position where there is no gas generated from the molten polymer, the outside air is merged into the fluid in the main pipe to be diluted. The taken-in outside air is considered to be already diluted to some degree with the fluid merged into the outside air at a position where the merging position between the main pipe and the at least one gas discharge pipe, e.g., at a position downstream of the outside air intake port in the flow direction. It is therefore possible to further effectively suppress the adherence of the solidified body to the exhaust path.

[0009] According to a third aspect of the invention, the melt spinning system of the first or second aspect is arranged such that the exhaust unit includes an adjustment unit which is able to adjust the opening degree of the outside air intake port.

[0010] In this aspect of the present invention, the negative pressure generated at the suction port is suitably adjusted by the adjustment unit.

[0011] According to a fourth aspect of the invention, the melt spinning system of any one of the first to third aspects is arranged such that the discharge device includes an aspirator configured to cause liquid to flow in the main pipe as the fluid.

[0012] In this aspect of the present invention, the negative pressure is generated with a simple structure.

[0013] According to a fifth aspect of the invention, the melt spinning system of the fourth aspect is arranged such that the aspirator is configured to generate the negative pressure by causing the liquid to fall by gravity.

[0014] In this aspect of the present invention, the negative pressure is easily generated by causing the liquid to fall by gravity.

[0015] According to a sixth aspect of the invention, the melt spinning system of the fourth or fifth aspect is arranged such that the aspirator is configured to generate a negative pressure of 0 Pa or less and -30 Pa or more.

[0016] In this aspect of the present invention, because a small negative pressure is generated, the disturbance of flow of the gas, etc. is suppressed.

[0017] According to a seventh aspect of the invention, the melt spinning system of the sixth aspect is arranged such that the aspirator is configured to generate a negative pressure of 0 Pa or less and -10 Pa or more.

[0018] In this aspect of the present invention, the disturbance of flow of the gas, etc. is further suppressed.

[0019] According to an eighth aspect of the invention, the melt spinning system of any one of the fourth to seventh aspects is arranged such that the liquid includes a substance dissolving a substance included in the gas.

[0020] In this aspect of the present invention, even when the gas is cooled and clotted, a solidified body is dissolved into the liquid and discharged to the downstream side in the flow direction. It is therefore possible

to effectively suppress the adherence of a solidified body to the exhaust path.

[0021] According to a ninth aspect of the invention, the melt spinning system of any one of the fourth to eighth aspects is arranged such that the main pipe extends along a vertical direction.

[0022] This aspect of the present invention causes the liquid in the main pipe to efficiently flow by gravity.

[0023] According to a tenth aspect of the invention, the melt spinning system of any one of the first to ninth aspects is arranged such that the at least one gas discharge pipe is provided with an auxiliary intake port for taking in the outside air.

[0024] The at least one gas discharge pipe may be provided with the auxiliary intake port according to need. Because the outside air is taken in through the outside air intake port also with this arrangement, an amount of the outside air taken in through the auxiliary intake port is decreased as compared to the conventional amount. It is therefore possible to suppress the adherence of a solidified body to the exhaust path.

[0025] According to an eleventh aspect of the invention, the melt spinning system of the tenth aspect is arranged such that the aperture area of the auxiliary intake port is smaller than the aperture area of the outside air intake port.

[0026] In the present invention, the aperture area indicates: effective aperture area in consideration of opening degree when the opening degree is adjustable; and nominal aperture area which is the area of the outside air intake port (or auxiliary intake port) itself when the opening degree is not adjustable. In this aspect of the present invention, an amount of the outside air taken in through the auxiliary intake port is effectively decreased. It is therefore possible to effectively suppress the adherence of a solidified body to the exhaust path.

[0027] According to a twelfth aspect of the invention, the melt spinning system of the tenth or eleventh aspect is arranged such that the exhaust unit includes an auxiliary adjustment unit which is able to adjust the opening degree of the auxiliary intake port.

[0028] In this aspect of the present invention, the negative pressure at the at least one gas discharge pipe is suitably adjusted by the auxiliary adjustment unit.

[0029] According to a thirteenth aspect of the invention, the melt spinning system of the twelfth aspect further comprises: a first yarn spinning unit functioning as one of yarn spinning units; a second yarn spinning unit which is different from the first yarn spinning unit and which functions as another of the yarn spinning units; a first cooling unit which is provided to correspond to the first yarn spinning unit and which functions as one of cooling units; and a second cooling unit which is provided to correspond to the second yarn spinning unit and which functions as another of the cooling units. Furthermore, the exhaust unit includes: a first gas discharge pipe which is provided to correspond to the first

yarn spinning unit and the first cooling unit and which functions as one of gas discharge pipes; and a second gas discharge pipe which is provided to correspond to the second yarn spinning unit and the second cooling unit and which functions as another of the gas discharge pipes, the discharge device is shared between the first gas discharge pipe and the second gas discharge pipe, and the auxiliary intake port and the auxiliary adjustment unit are provided at each of the first gas discharge pipe and the second gas discharge pipe.

[0030] In this aspect of the present invention, the negative pressure on the first gas discharge pipe side is adjusted independently from the negative pressure on the second gas discharge pipe side to some degree. It is therefore possible to effectively suppress the influence of adjustment of the negative pressure at one gas discharge pipe on the negative pressure at another gas discharge pipe.

[0031] According to a fourteenth aspect of the invention, the melt spinning system of any one of the first to thirteenth aspects is arranged such that the exhaust unit includes a supply tube for supplying the gas discharge pipes with liquid dissolving the substance included in the gas.

[0032] In this aspect of the present invention, when the gas is unintentionally clotted inside each of the gas discharge pipes so as to generate a solidified body, the solidified body is dissolved into the liquid and removed. It is therefore possible to suppress the adherence of the solidified body to the exhaust path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033]

FIG. 1 is a schematic representation of a melt spinning system of the present embodiment.

FIG. 2 is an enlarged view of a spinning beam and its surroundings.

FIG. 3 is a cross section taken along a line III-III in FIG. 2.

FIG. 4 is a plan view of a suction member and its surroundings.

FIG. 5 is a cross section taken along a line V-V in FIG. 4.

FIG. 6 shows an aspirator and its surroundings.

FIGs. 7(a) and 7(b) show a detailed structure of the aspirator.

FIGs. 8(a) and 8(b) show an adjusting member.

FIG. 9 shows an airflow in the vicinity of an outside air intake port.

FIG. 10 shows an exhaust unit of a modification.

FIG. 11 is a schematic representation of a melt spinning system of another modification.

FIG. 12 shows an exhaust unit of the modification in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] The following will describe an embodiment of the present invention. For convenience of explanation, the directions are defined below. A direction (an up-down direction on a plane of FIG. 1 and FIG. 2) in which the gravity acts will be defined as an up-down direction. A direction (left-right direction on the plane of FIG. 1) which is orthogonal to the up-down direction and in which melt spinning positions SP described later are aligned will be defined as a left-right direction. A direction (left-right direction on the plane of FIG. 2) orthogonal both to the up-down direction and the left-right direction will be defined as a front-rear direction.

(Melt Spinning System)

[0035] The following will describe a schematic structure of a melt spinning system 1 of the present embodiment with reference to FIG. 1 to FIG. 3. FIG. 1 is a schematic representation of the melt spinning system 1 of the present embodiment. FIG. 2 is an enlarged view of a spinning beam 2 described later and its surroundings. FIG. 3 is a cross section taken along a line III-III in FIG. 2.

[0036] As shown in FIG. 1, the melt spinning system 1 includes the melt spinning positions SP. Each melt spinning position SP includes constituent features for spinning out yarns Y. To be more specific, each melt spinning position SP includes the spinning beam 2 (yarn spinning unit of the present invention), a yarn cooler 3 (cooling unit of the present invention), and an exhaust unit 4.

[0037] The spinning beam 2 is configured to spin out molten polymer which is a material of the yarns Y. The yarn cooler 3 is configured to cool the molten polymer spun out from the spinning beam 2, so as to form filaments f. The exhaust unit 4 is configured to suck and discharge monomer (a material of polymer) gas generated from the molten polymer. The monomer gas sucked by the exhaust unit 4 is discharged through a fixed pipe PF which is fixedly provided.

[0038] The spinning beam 2 is configured to discharge (spin out) molten polymer from each of spinnerets 13 (described later). The molten polymer which is spun out in the present embodiment is, e.g., nylon 6 (PA6). As shown in FIG. 2, the spinning beam 2 includes pack housings 11 corresponding to the number of the yarns Y. To the pack housings 11, spinning packs 12 are respectively attached. In the present embodiment, twelve spinning packs 12 are respectively attached to twelve pack housings 11. The molten polymer is supplied to the spinning packs 12 through an unilluminated path.

[0039] For example, the pack housings 11 (and the spinning packs 12) are staggered (i.e., provided in a zig-zag manner) to form two lines along the left-right

direction. This arrangement of the pack housings 11 is a typical example, and not limited to this. For example, a spinneret 13 with nozzles 14 is provided at a lower end portion of each spinning pack 12. Molten polymer is discharged (spun out) from each nozzle 14. The molten polymer spun out from each spinneret 13 is cooled and solidified by the yarn cooler 3, so as to form the filaments f. The filaments f corresponding to one spinneret 13 form one yarn Y. In the present embodiment, the yarn Y is a multifilament yarn formed of the filaments f. However, the disclosure is not limited to this. The yarn Y may be a monofilament yarn made of one filament f. In this case, each spinneret 13 includes only one nozzle 14.

[0040] The yarn cooler 3 is configured to cool and solidify molten polymer (so as to form the filaments f) spun out from the spinning beam 2. As shown in FIG. 2, the yarn cooler 3 is provided below the spinning beam 2. The yarn cooler 3 includes a box 20, cooling cylinders 21, and partitioning cylinders 22.

[0041] As shown in FIG. 2, an internal space of the box 20 is partitioned into an upper space and a lower space by a flow adjustment plate 23. The flow adjustment plate 23 is made of a material having flow adjustment capability, such as punching metal. The flow adjustment plate 23 is provided substantially horizontally. In a space defined by the box 20, a space upper than the flow adjustment plate 23 will be referred to as the upper space, and a space lower than the flow adjustment plate 23 will be referred to as the lower space. The cooling cylinders 21 correspond to the respective spinnerets 13. Each cooling cylinder 21 is provided in the upper space, and located immediately below a corresponding spinneret 13. Each cooling cylinder 21 is substantially cylindrical in shape, and extends in the up-down direction. As shown in FIG. 3, the cooling cylinders 21 are staggered (i.e., provided in the zig-zag manner) to correspond to the spinning packs 12. Similarly to the flow adjustment plate 23, a wall of each cooling cylinder 21 is made of a material having the flow adjustment capability such as punching metal. The partitioning cylinders 22 correspond to the respective cooling cylinders 21. Each partitioning cylinder 22 is provided in the lower space, and located immediately below a corresponding cooling cylinder 21. Being different from the cooling cylinder 21, a wall of each partitioning cylinder 22 is made of an air-impermeable material. Molten polymer spun out from each spinneret 13 passes through internal spaces of a cooling cylinder 21 and a partitioning cylinder 22 which correspond to the spinneret 13 in order.

[0042] To a rear part of a lower portion of the box 20, a duct 25 is connected. Air for cooling molten polymer is sent into the duct 25 from an unillustrated compressed air source. The air is supplied into the lower space of the box 20 through the duct 25. After flowing into the lower space of the box 20, the air passes through the flow adjustment plate 23 so as to be ad-

justed to flow upward and flows into the upper space of the box 20. The air flowing into the upper space of the box 20 flows into each cooling cylinder 21 while being adjusted. Because of this, in each cooling cylinder 21, the air is blown onto the molten polymer from the outside of each cooling cylinder 21 in a radial direction so that the molten polymer is cooled and solidified. As a result, the filaments f are formed. The filaments f corresponding to each cooling cylinder 21 form one yarn Y.

[0043] The exhaust unit 4 is provided between the spinning beam 2 and the yarn cooler 3 in the running direction of the filaments f. The exhaust unit 4 is configured to suck and discharge the above-described monomer gas. The details will be given later.

[0044] Below each cooling cylinder 21 and each partitioning cylinder 22, an oil guide 5 is provided in order to apply oil to a yarn Y. The yarn Y cooled by the cooling cylinder 21 makes contact with the oil guide 5. At this stage, the oil guide 5 dispenses and applies oil to the yarn Y. The yarn Y to which oil has been applied by the oil guide 5 is taken up by a take-up roller (not illustrated) provided below the oil guide 5. Subsequently, the yarn Y is sent to a winding device (not illustrated) and wound onto a bobbin (not illustrated) in this winding device.

(Exhaust Unit)

[0045] The following will describe the exhaust unit 4 with reference to FIG. 4 to FIG. 6. FIG. 4 is a plan view of a suction member 31 described later and its surroundings. FIG. 5 is a cross section taken along a line V-V in FIG. 4. FIG. 6 shows an aspirator 33 described later and its surroundings.

[0046] The exhaust unit 4 is configured to suck and discharge a gaseous body (hereinafter, this will be simply referred to as gas) including monomer gas generated from molten polymer spun out from the spinnerets 13. Hereinafter, a direction in which the gas is discharged will be defined as a gas discharge direction. The exhaust unit 4 is provided with an exhaust path 30 (see FIG. 1 and FIG. 4) for sucking and discharging the gas. As shown in FIG. 4 to FIG. 6, the exhaust unit 4 includes the suction member 31, a duct 32, the aspirator 33 (discharge device of the present invention), and a connection pipe 34 (see FIG. 6). The exhaust unit 4 is configured to cause the gas to flow toward a downstream side in the gas discharge direction by means of a negative pressure which is generated as water flows in the aspirator 33. With this arrangement, the exhaust unit 4 is configured to discharge the gas (see arrows in FIG. 4) via the suction member 31, the duct 32, the aspirator 33, and the connection pipe 34.

[0047] As shown in FIG. 1, the suction member 31 is provided between the spinnerets 13 and the cooling cylinders 21 in the running direction of the filaments f. As shown in FIG. 4, the suction member 31 includes an enclosure member 41 and the sucking rings 42. The

enclosure member 41 surrounds the sucking rings 42 while the sucking rings 42 are attached to the enclosure member 41. The enclosure member 41 is provided for causing gas to flow toward the downstream side in the gas discharge direction through the sucking rings 42. The enclosure member 41 is connected to the aspirator 33 through the duct 32. The entire enclosure member 41 is roughly flat in shape (see FIG. 5). As shown in FIG. 5, the enclosure member 41 includes two flat plates 43 and 44 and a side wall 45. Each of the two flat plates 43 and 44 is arranged to surround the sucking rings 42. Both the two flat plates 43 and 44 are shaped substantially in the same manner, and aligned in the up-down direction. The side wall 45 connects outer circumferential portions of the flat plates 43 and 44. An internal space 46 is formed by the flat plates 43 and 44 and the side wall 45. Except its part provided with a suction port 52 (described later), the internal space 46 is substantially sealed from a space in which the melt spinning system 1 is provided.

[0048] As shown in FIG. 4 and FIG. 5, the enclosure member 41 includes, e.g., an enclosure portion 47 and two passage portions 48. FIG. 4 indicates a border between the enclosure portion 47 and two passage portions 48 by a two-dot chain line. The enclosure portion 47 surrounds the sucking rings 42. The enclosure portion 47 is substantially rectangular in shape when viewed in the up-down direction (see FIG. 4). The enclosure portion 47 is provided between the spinning beam 2 and the yarn cooler 3 in the up-down direction (see FIG. 5). The enclosure portion 47 is provided with fitting holes 49. The sucking rings 42 are fitted to the respective fitting holes 49. The fitting holes 49 are staggered (i.e., provided in the zig-zag manner) to correspond to the respective spinnerets 13. The two passage portions 48 are provided on the downstream side (on the aspirator 33 side) of the enclosure portion 47 in the gas discharge direction. The two passage portions 48 are connected to, e.g., a front end of the enclosure portion 47. Each of the two passage portions 48 is roughly triangular in shape when viewed in the up-down direction. The two passage portions 48 are aligned in the left-right direction. Each of front end portions of the two passage portions 48 is attached to the duct 32.

[0049] The sucking rings 42 are ring-shaped members for discharging gas. As shown in FIG. 5, the sucking rings 42 are provided between the spinnerets 13 and the cooling cylinders 21 in the up-down direction. Each sucking ring 42 is arranged to surround molten polymer which is immediately after being spun out from a spinneret 13. The sucking rings 42 are fitted into the respective fitting holes 49. A circumferential wall 51 of each sucking ring 42 is provided with, e.g., suction ports 52 aligned in a circumferential direction of each sucking ring 42. An internal space of each sucking ring 42 in the radial direction communicates with the internal space 46 of the enclosure member 41 through the suc-

tion ports 52.

[0050] The duct 32 connects the enclosure member 41 and the aspirator 33. The duct 32 is provided downstream of the enclosure member 41 and upstream of the aspirator 33 in the gas discharge direction. The duct 32 includes two upstream portions 35 and one downstream portion 36. To the two upstream portions 35, the front end portions (downstream end portions in the gas discharge direction) of the two passage portions 48 of the enclosure member 41 are respectively attached. The two upstream portions 35 are connected to an upstream end portion of the downstream portion 36 in the gas discharge direction to be merged. A downstream end portion of the downstream portion 36 in the gas discharge direction is connected to the aspirator 33.

[0051] The aspirator 33 is provided for sucking and discharging the gas. The aspirator 33 is provided downstream of the suction member 31 and the duct 32 in the gas discharge direction. The aspirator 33 is connected to an unillustrated water source. Water is supplied into the aspirator 33 from the water source. The water is provided for generating a negative pressure in the exhaust path 30, and included into the liquid and fluid of the present invention. The water supplied into the aspirator 33 flows in a predetermined flow direction (the up-down direction in the aspirator 33). In the present embodiment, the aspirator 33 is configured to cause the water to fall by gravity so as to generate the negative pressure. A gaseous body around the water flowing inside the aspirator 33 is taken into and flows downward (i.e., an accompanied flow is generated). A small sucking pressure (e.g., a negative pressure of -5 Pa) is generated in the exhaust path 30 by the accompanied flow. The aspirator 33 is able to change the magnitude of the negative pressure in accordance with a condition on the flow amount of the water flowing inside the aspirator 33. The aspirator 33 is preferably configured to generate a negative pressure of 0 Pa or less and -30 Pa or more (i.e., a negative pressure whose absolute value is 30 Pa or less). The aspirator 33 is further preferably configured to generate a negative pressure of 0 Pa or less and -10 Pa or more (i.e., a negative pressure whose absolute value is 10 Pa or less). The gaseous body around the water flowing inside the aspirator 33 is also included in the fluid of the present invention in addition to the water. The water is a substance which is able to dissolve monomer gas. With this arrangement, the aspirator 33 is able to discharge the monomer gas in the flow direction by dissolving the monomer gas into the water.

[0052] The connection pipe 34 is provided downstream of the aspirator 33 both in the flow direction and the gas discharge direction. An outlet 61c of the aspirator 33 is attached to an upstream end portion of the connection pipe 34 in the gas discharge direction (and the flow direction). A downstream end portion of the connection pipe 34 in the gas discharge direction

(and the flow direction) is attached to an intermediate portion of the fixed pipe PF in an extending direction of the fixed pipe PF. The connection pipe 34 may not be provided and the aspirator 33 may be directly attached to the fixed pipe PF.

[0053] As described above, the exhaust unit 4 is provided with the exhaust path 30 formed of the suction member 31, the duct 32, the aspirator 33, and the connection pipe 34 in order to cause gas to be discharged.

(Aspirator)

[0054] The following will detail the aspirator 33. As shown in FIG. 6, the aspirator 33 includes a primary pipe portion 61 and a gas inlet 62.

[0055] The primary pipe portion 61 is substantially cylindrical in shape, and extends along the up-down direction (vertical direction). The extending direction of the primary pipe portion 61 is substantially the same as the above-described flow direction. The primary pipe portion 61 includes a water inlet 61a, a merging point 61b, and an outlet 61c. The water inlet 61a is an upper part of the primary pipe portion 61. A water supply tube 63 connected to a water source is attached to the water inlet 61a. The water inlet 61a is provided with a water inflow port 64 (see FIG. 7(a)) for causing water passing through the water supply tube 63 to flow into. The merging point 61b is an intermediate part of the primary pipe portion 61 in the up-down direction. The merging point 61b is provided below the water inlet 61a. The merging point 61b is merged into the gas inlet 62. That is, the gas inlet 62 is connected to the merging point 61b. The outlet 61c is a lower part of the primary pipe portion 61. The outlet 61c is provided below the merging point 61b. The outlet 61c is provided for causing water and gas to flow out. The outlet 61c is attached to, e.g., the connection pipe 34. The outlet 61c is provided with an outflow port 65 (see FIG. 7(a)) for causing the water and the gas to flow out. The primary pipe portion 61 is included in a main pipe of the present invention.

[0056] The gas inlet 62 is substantially cylindrical in shape, and provided on a side face of the primary pipe portion 61. The gas inlet 62 is a part of the aspirator 33, and integrated with the primary pipe portion 61. The gas inlet 62 is provided with a gas inflow port 66 (see FIG. 7(a)) for causing gas to flow in. The gas inlet 62 is connected to the suction member 31 through the duct 32. A combination of the duct 32 and the gas inlet 62 is equivalent to a gas discharge pipe of the present invention.

[0057] The following will define a border between the primary pipe portion 61 and the gas inlet 62. For example, assume that the gas inlet 62 is provided on a left side face of the primary pipe portion 61, i.e., extends along a virtual plane (not illustrated) parallel to the plane of FIG. 6. In this case, when viewed in a direction orthogonal to the virtual plane (i.e., in the front-rear direction), an outer edge 61d is defined as an outer

edge which is a left part (i.e., provided on the gas inlet 62 side in the left-right direction) of an outer edge of the water inlet 61a and which extends in the up-down direction. A virtual straight line Ls (see a two-dot chain line in FIG. 6) including this outer edge 61d is also defined. Among the virtual straight line Ls, a virtual line segment Ls1 passing through the gas inlet 62 is defined as the border between the primary pipe portion 61 and the gas inlet 62 when viewed in the front-rear direction. In the present embodiment, when viewed in the front-rear direction, the virtual straight line Ls overlaps an outer edge of the outlet 61c (see FIG. 6). However, the disclosure is not limited to this. The virtual straight line Ls may not overlap the outer edge of the outlet 61c.

[0058] The following will define a border between the water inlet 61a and the merging point 61b. Similarly, when viewed in the front-rear direction, a virtual straight line including an outer edge 62a (see FIG. 6) is defined. This outer edge 62a is an upper part of an outer edge of the gas inlet 62. For avoiding complex figures, this virtual straight line is not illustrated. This virtual straight line overlaps the outer edge 62a. An intersection (point P1) between this virtual straight line and the virtual straight line Ls is also defined. A virtual line segment Ls2 passing through the point P1 and the primary pipe portion 61 horizontally is defined as the border between the water inlet 61a and the merging point 61b when viewed in the front-rear direction.

[0059] The following will define a border between the merging point 61b and the outlet 61c. Similarly, when viewed in the front-rear direction, a virtual straight line including an outer edge 62b (see FIG. 6) is defined. This outer edge 62b is a lower part of an outer edge of the gas inlet 62. This virtual straight line is not illustrated. An intersection (point P2) between this virtual straight line and the virtual straight line Ls is also defined. A virtual line segment Ls3 passing through the point P2 and the primary pipe portion 61 horizontally is defined as the border between the merging point 61b and the outlet 61c when viewed in the front-rear direction.

[0060] The following will clarify the flow direction and the gas discharge direction in the aspirator 33 with reference to FIG. 6. As described above, the flow direction is a direction in which water flows. To be more specific, the water basically flows inside the water inlet 61a, the merging point 61b, and the outlet 61c in this order. As described above, the gas discharge direction is a direction in which gas flows (is discharged). To be more specific, the gas basically flows inside the gas inlet 62, the merging point 61b, and the outlet 61c in this order. The merging point 61b and the outlet 61c are related both to the flow direction and the gas discharge direction. That is, the outlet 61c is provided downstream of the merging point 61b both in the flow direction and the gas discharge direction. Meanwhile, the water inlet 61a is related only to the flow direction. The

water inlet 61a is provided upstream of the merging point 61b in the flow direction. The gas inlet 62 is related only to the gas discharge direction. The gas inlet 62 is provided upstream of the merging point 61b in the gas discharge direction.

[0061] In the above-described aspirator 33, water flowing into the water inlet 61a flows inside the primary pipe portion 61 (see two-dot chain line arrows in FIG. 6). Accordingly, a downward accompanied flow is generated. This accompanied flow generates a negative pressure in the vicinity of the suction port 52 (see FIG. 4) connected to the exhaust path 30. Because of this, gas is sucked into the internal space 46 (see FIG. 4) of the enclosure member 41 from the internal spaces of the sucking rings 42. Subsequently, the gas flows into the gas inlet 62 of the aspirator 33 through the inside of the duct 32 (see dashed line arrows FIG. 6). The gas flowing into the gas inlet 62 exits from the outlet 61c through the merging point 61b, and flows into the fixed pipe PF through the connection pipe 34. As a result, the gas is sucked and discharged by the exhaust unit 4.

[0062] In this stage, as described above, the connection pipe 34 is connected to the intermediate portion of the fixed pipe PF. In this case, for example, when an airflow is disturbed at a junction of the fixed pipe PF and the connection pipe 34, a part of the gas may flow into the connection pipe 34 from the fixed pipe PF (see dashed line arrows in FIG. 6). Especially, when plural aspirators 33 are provided, a great deal of water may flow into the fixed pipe PF so that a strong accompanied flow is generated as the great deal of water (see FIG. 6) flows into the fixed pipe PF. When such an accompanied flow flows backward into the connection pipe 34 from the fixed pipe PF, a negative pressure may be changed greatly on the upstream side in the gas discharge direction. Because of this, the airflow may be disturbed in the vicinity of the filaments *f* immediately after being spun out (see FIG. 2) so that the filaments *f* is shaken to deteriorate the quality of yarns. It is therefore necessary to suppress the inflow of gas into the connection pipe 34 from the fixed pipe PF. In order to suppress the inflow of gas, for example, the flow amount of water flowing in the aspirator 33 may be increased so that an accompanied flow flowing from the connection pipe 34 toward the fixed pipe PF (i.e., toward the downstream side in the gas discharge direction) is strengthened. Meanwhile, when this accompanied flow is too strong, a too-strong negative pressure may be also generated in the vicinity of the filaments *f* so that the filaments *f* is swung too much because of the increase in discharge amount of gas.

[0063] In order to suppress this problem, for example, the gas inlet 62 is provided with an outside air intake port (not illustrated) for taking in air (outside air) from an outside space (outside space *So*) of the exhaust path 30 so as to suitably decrease a negative pressure. However, with this arrangement, monomer gas flowing near the outside air intake port is easily

cooled and clotted by the outside air taken into the gas inlet 62 through the outside air intake port. When (i) the gas is clotted to unintentionally generate a solidified body and (ii) the solidified body adheres to an inner wall of the gas inlet 62, the gas inlet 62 is narrowed so that the flow amount of gas flowing inside the gas inlet 62 is decreased. Furthermore, the exhaust path 30 including the gas inlet 62 may be disadvantageously clogged. Therefore, the exhaust unit 4 is structured as described below in order to suppress the adherence of a gas solidified body to the exhaust path 30.

(Detailed Structure of Exhaust Unit)

[0064] The following will describe a detailed structure of the exhaust unit 4 with reference to FIG. 7(a) to FIG. 8(b). FIG. 7(a) and FIG. 7(b) show a detailed structure of the aspirator 33. FIG. 7(a) is a cross section of the aspirator 33 taken along a line orthogonal to the front-rear direction. FIG. 7(b) shows a later-described adjustment member 72 (adjustment unit of the present invention). FIG. 8(a) and FIG. 8(b) show the adjustment of opening degree of each outside air intake port 71 (described later) by the adjustment unit 72.

[0065] As shown in FIG. 7(a), the aspirator 33 includes each outside air intake port 71. Each outside air intake port 71 is a hole for causing the outside space (outside space *So*) of the exhaust path 30 to communicate with the exhaust path 30. Air (outside air) is taken into the exhaust path 30 from the outside space *So* through each outside air intake port 71. Each outside air intake port 71 is formed at, e.g., the water inlet 61a of the primary pipe portion 61. Each outside air intake port 71 penetrates the circumferential surface of the water inlet 61a from its outer circumferential surface to its inner circumferential surface. Each outside air intake port 71 has a predetermined area (nominal aperture area). In the present embodiment, as shown in FIG. 7(a), two outside air intake ports 71 are slits extending in the circumferential direction of the water inlet 61a and aligned in the up-down direction. The position, shape, and number of the outside air intake ports 71 are not limited to those. The outside air intake ports 71 may be formed on, e.g., an upper end face 61a1 of the water inlet 61a. The outside air intake ports 71 may be, e.g., substantially circular in shape. The number of the outside air intake ports 71 may be one, or three or more.

[0066] As shown in FIG. 7(b) to FIG. 8(b), the adjustment member 72 (adjustment unit of the present invention) is attached to the water inlet 61a. The adjustment member 72 is provided for adjusting the substantial aperture area (effective aperture area in consideration of opening degree) of each outside air intake port 71 by adjusting the opening degree of each outside air intake port 71. As shown in FIG. 7(b), the adjustment member 72 includes, e.g., a cylindrical portion 73 and a handle 74.

[0067] The cylindrical portion 73 is substantially cylindrical in shape. The cylindrical portion 73 is arranged to surround at least a part of the water inlet 61a, at which the outside air intake ports 71 are formed. For example, two slits 73a are formed at the cylindrical portion 73. The two slits 73a correspond to the two outside air intake ports 71. Each slit 73a extends along the circumferential direction of the cylindrical portion 73 so as to, e.g., run substantially a halfway around the cylindrical portion 73. The two slits 73a are provided substantially at the same positions as the two outside air intake ports 71 in the extending direction (up-down direction) of the water inlet 61a. For example, the cylindrical portion 73 is rotatable in the circumferential direction of the water inlet 61a along the outer circumferential surface of the water inlet 61a. For example, the handle 74 protrudes outward in the radial direction of the cylindrical portion 73 from a part of the cylindrical portion 73 in the circumferential direction. The handle 74 has a size large enough for an operator to pinch the handle 74 by hand.

[0068] In the present embodiment, as the operator operates the handle 74, the cylindrical portion 73 is manually rotated. As the cylindrical portion 73 rotates, the slits 73a are moved in the circumferential direction of the water inlet 61a. Because of this, the positional relationship between the slits 73a and the outside air intake ports 71 is changed so that the opening degree of each outside air intake port 71 is adjusted. Specifically, hatched parts of the outside air intake ports 71 are compared between FIG. 8(a) and FIG. 8(b). In FIG. 8(a), the slits 73a entirely overlap the outside air intake ports 71 in the circumferential direction of the water inlet 61a. In FIG. 8(b), the slits 73a half overlap the outside air intake ports 71 in the circumferential direction of the water inlet 61a. The opening degree (and effective aperture area) of each outside air intake port 71 in FIG. 8(a) is twice as large as the opening degree (and effective aperture area) of each outside air intake port 71 in FIG. 8(b).

[0069] For example, the gas inlet 62 is provided with a pressure gauge 75 (see FIG. 7(b)) which is able to detect the pressure of gas in the gas inlet 62.

[0070] As such, the water inlet 61a is a part of the primary pipe portion 61 and provided with the outside air intake ports 71. To be more specific, the outside air intake ports 71 are provided upstream of the merging point 61b in the flow direction. That is, the outside air intake ports 71 are provided upstream of a merging position between the primary pipe portion 61 and the gas inlet 62 (specifically, a position where the merging point 61b is provided) in the flow direction.

(Airflow in Vicinity of Outside Air Intake Port)

[0071] The following will describe an airflow in the vicinity of the above-described outside air intake ports 71 with reference to FIG. 9. As water flows in the as-

pirator 33 (see a two-dot chain line arrow in FIG. 9), an accompanied flow is generated in the internal space of the primary pipe portion 61. This accompanied flow generates a negative pressure in (i) the gas inlet 62 and (ii) a space provided upstream of the gas inlet 62 in the gas discharge direction. This negative pressure causes gas to flow in the gas inlet 62 (see a dotted line arrow in FIG. 9). In this stage, a downward accompanied flow is generated also at the water inlet 61a. This accompanied flow generates a negative pressure also in the vicinity of the outside air intake ports 71. Because of this, outside air is taken into the water inlet 61a from the outside space So through the outside air intake ports 71 (see one-dot chain line arrows in FIG. 9). As the outside air is taken into the water inlet 61a, the pressure in the internal space of the primary pipe portion 61 including the water inlet 61a is equalized with the pressure in the outside space So (generally the atmospheric pressure). Because of this, a sucking pressure in the primary pipe portion 61 is decreased so that a sucking pressure in the vicinity of the merging point 61b is decreased. Accordingly, the negative pressure is decreased in (i) the gas inlet 62 and (ii) the space provided upstream of the gas inlet 62 in the gas discharge direction. This suitably decreases the negative pressure generated at the suction port 52. As a result, the discharge speed of gas in the vicinity of the filaments f (see FIG. 2) is suppressed from being excessively large.

[0072] In the present embodiment, outside air taken into the primary pipe portion 61 through the outside air intake ports 71 is merged into a gaseous body flowing in the primary pipe portion 61 to be diluted. Therefore, a possibility of contact between the outside air and monomer gas generated from molten polymer is decreased as compared to a case where an outside air intake port (not illustrated) is provided at the gas inlet 62. This suppresses the gas from being cooled and clotted by the outside air. If the monomer gas is partially clotted in the primary pipe portion 61 so that a solidified body is generated, this solidified body is dissolved into water and discharged to the downstream side in the flow direction.

[0073] The opening degree of each outside air intake port 71 is adjusted by, e.g., the operator. The operator moves the adjustment member 72 based on a detection result of the pressure gauge 75, and adjusts the opening degree of each outside air intake port 71. Because of this, the flow amount of outside air taken into through each outside air intake port 71 is adjusted. Accordingly, for example, the flow rate of gas in the vicinity of the suction port 52 (see FIG. 5) is suppressed from varying between the melt spinning positions SP (see FIG. 1).

[0074] As described above, the outside air intake ports 71 are formed at the primary pipe portion 61 of the aspirator 33. As outside air is taken into the primary pipe portion 61 through the outside air intake ports 71,

the pressure in the primary pipe portion 61 is equalized with the pressure in the outside space So. Because of this, a sucking pressure in the primary pipe portion 61 is decreased so that a negative pressure generated at the suction port 52 connected to the primary pipe portion 61 is suitably decreased. The outside air taken into the primary pipe portion 61 is merged into a gaseous body in the primary pipe portion 61 to be diluted. Because of this, a possibility of contact between the outside air and monomer gas generated from molten polymer is decreased as compared to a case where the outside air intake ports 71 are provided at the gas inlet 62. This suppresses the gas from being cooled and clotted by the outside air. If the gas is partially clotted in the primary pipe portion 61 so that a solidified body is generated, this solidified body is discharged to the downstream side in the flow direction along with water and an accompanied flow. Therefore, the adherence of a gas solidified body to the exhaust path 30 is suppressed in the melt spinning system 1.

[0075] The outside air intake ports 71 are provided upstream of the merging position between the primary pipe portion 61 and the gas inlet 62 in the flow direction (specifically, provided at the water inlet 61a). That is, outside air is taken into the primary pipe portion 61 at a position where there is no monomer gas generated from molten polymer. The taken-in outside air is considered to be already diluted to some degree with a gaseous body in the water inlet 61a at a position where the merging point 61b is provided, e.g., at a position downstream of the outside air intake ports 71 in the flow direction. It is therefore possible to further effectively suppress the adherence of a solidified body to the exhaust path 30.

[0076] The exhaust unit 4 includes the adjustment member 72. It is therefore possible to suitably adjust a negative pressure generated at the suction port 52, by means of the adjustment member 72.

[0077] The exhaust unit 4 includes the aspirator 33 configured to cause water (liquid) to flow. With this arrangement, a negative pressure is generated with a simple structure.

[0078] The aspirator 33 is configured to cause liquid to fall by gravity so as to generate a negative pressure. With this arrangement, a negative pressure is generated with a simple structure.

[0079] The aspirator 33 is preferably configured to generate a negative pressure of 0 Pa or less and -30 Pa or more. With this arrangement, the disturbance of flow of gas, etc. is suppressed. The aspirator 33 is further preferably configured to generate a negative pressure of 0 Pa or less and -10 Pa or more. With this arrangement, the disturbance of flow of gas, etc. is further suppressed.

[0080] Water is a substance dissolving monomer gas. Therefore, even when the monomer gas is cooled and clotted, a solidified body is dissolved into the water and discharged to the downstream side in the flow di-

rection. It is therefore possible to effectively suppress the adherence of the solidified body to the exhaust path 30.

[0081] The primary pipe portion 61 extends along the vertical direction. With this arrangement, water efficiently flows in the primary pipe portion 61 by gravity.

[0082] The following will describe a modification of the alternative embodiment embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals and the explanations thereof are not repeated.

(1) In the embodiment above, the cylindrical portion 73 of the adjustment member 72 is rotatable in the circumferential direction of the water inlet 61a. However, the disclosure is not limited to this. For example, the cylindrical portion 73 may be movable in the extending direction (up-down direction) of the water inlet 61a. In this case, the outside air intake ports 71 and the slits 73a may extend in the circumferential direction of the water inlet 61a as described above. Alternatively, the outside air intake ports 71 and the slits 73a may extend in, e.g., the up-down direction.

(2) In the embodiment above, the gas inlet 62 is a part of the aspirator 33 (i.e., integrated with the primary pipe portion 61). However, the disclosure is not limited to this. The gas inlet 62 may be provided as a tubular member different from the primary pipe portion 61 and fixed to the primary pipe portion 61 with an unillustrated fastener (joint, bolt, etc.).

(3) In the embodiment above, the primary pipe portion 61 extends along the vertical direction. However, the disclosure is not limited to this. The primary pipe portion 61 may be inclined relative to the vertical direction as long as a negative pressure is suitably generated. Also in this case, the aspirator 33 is configured to cause liquid to fall by gravity so as to generate a negative pressure.

(4) In the embodiment above, the adjustment member 72 is manually moved by the operator. However, the disclosure is not limited to this. For example, the adjustment member 72 may be moved by an unillustrated actuator (motor, etc.).

(5) In the embodiment above, the opening degree of each outside air intake port 71 is adjusted by moving the adjustment member 72. However, the disclosure is not limited to this. For example, outside air intake ports (not illustrated) having substantially the same aperture area (nominal aperture area) may be formed on the upper end face 61a1 of the water inlet 61a. Each of these outside air intake ports may be substantially circular in shape. Each of these outside air intake ports may be closed by, e.g., an unillustrated rubber plug. For example, when these outside air intake ports are fully open, this opening degree of the outside air

intake ports is defined as 100 %. In this case, the opening degree of the outside air intake ports may be determined by the number of outside air intake ports closed by rubber plugs.

(6) In the embodiment above, the opening degree of each outside air intake port 71 or an unillustrated outside air intake port (hereinafter, this will be referred to as the outside air intake port 71, etc.) is adjustable. However, the disclosure is not limited to this. The opening degree of each outside air intake port 71, etc. may not be adjustable.

(7) In the embodiment above, each outside air intake port 71, etc. is formed at the water inlet 61a. However, the disclosure is not limited to this. Each outside air intake port 71, etc. may be formed at the merging point 61b or the outlet 61c. However, when each outside air intake port 71, etc. is provided below the water inlet 61a, water flowing downward may be scattered to leak out from each outside air intake port 71, etc. Therefore, in this case, an arrangement is required to prevent the water from being scattered from each outside air intake port 71, etc. For example, a plate-shaped member may be provided in the vicinity of each outside air intake port 71, etc. so that the water scattered in the primary pipe portion 61 is received and guided into the connection pipe 34.

Alternatively, each outside air intake port 71, etc. may be provided at a different position. The explanation below will be given with reference to FIG. 10. FIG. 10 shows an exhaust unit 4M1 of a modification. The exhaust unit 4M1 is provided instead of the exhaust unit 4. The exhaust unit 4M1 is provided with an exhaust path 30M1 instead of the exhaust path 30. The exhaust unit 4M1 includes an aspirator 33M1 (discharge device of the present invention) instead of the aspirator 33. The aspirator 33M1 includes a primary pipe portion 61M1 and the gas inlet 62. The primary pipe portion 61M1 is provided instead of the primary pipe portion 61. The primary pipe portion 61M1 includes the above-described water inlet 61a, the above-described merging point 61b, the above-described outlet 61c, and a branching point 81. For example, the branching point 81 may be tubular in shape. For example, the branching point 81 may be provided on the side face of the water inlet 61a. An opposite end portion of the branching point 81 is opposite to the water inlet 61a and may be closed. That is, the branching point 81 may be provided not for causing monomer gas generated from molten polymer to flow. The branching point 81 may be provided with an outside air intake port 82. The outside air intake port 82 is provided for taking in outside air in the same manner as each outside air intake port 71. An adjustment member 83 (adjustment unit of the present invention) may be provided at the primary pipe portion 61M1. The adjust-

ment member 83 is provided for adjusting the opening degree of the outside air intake port 82 in the same manner as the adjustment member 72. In this modification, the primary pipe portion 61M1 including the branching point 81 is equivalent to the main pipe of the present invention.

(8) In the embodiment above, the aspirator 33 or the aspirator 33M1 (hereinafter, this will be referred to as the aspirator 33, etc.) is configured to cause water to flow. However, the disclosure is not limited to this. The aspirator 33, etc. may be configured to cause liquid which is able to dissolve monomer gas and which is not the water, to flow. Alternatively, the aspirator 33, etc. may be configured to cause liquid which is unable to substantially dissolve the monomer gas, to flow.

(9) In the embodiment above, each outside air intake port 71 or the outside air intake port 82 (hereinafter, this will be referred to as the outside air intake port 71, etc.) is provided at the aspirator 33, etc. However, the disclosure is not limited to this. Each outside air intake port 71, etc. may be formed at, e.g., the connection pipe 34. In this case, the connection pipe 34 is included in the main pipe of the present invention. Each outside air intake port 71, etc. may be formed only at the connection pipe 34.

(10) In the embodiment above, the aspirator 33, etc. is equivalent to the discharge device of the present invention. However, the disclosure is not limited to this. For example, as shown in FIG. 10, a blower 84 may be provided in addition to the aspirator 33M1. The blower 84 is a known blower. For example, the blower 84 may be provided downstream of the connection pipe 34 in the gas discharge direction and the flow direction. With this arrangement, a strong negative pressure is generated by the aspirator 33M1 and the blower 84. In this case, a combination of the aspirator 33M1 and the blower 84 is equivalent to the discharge unit of the present invention. Both liquid and a gaseous body which flow in the primary pipe portion 61M1 are equivalent to the fluid of the present invention. The blower 84 makes it possible to generate a stronger negative pressure as compared to a case where a negative pressure is generated only by the aspirator 33M1. The aspirator 33 may be provided (not illustrated) instead of the aspirator 33M1.

(11) When the blower 84 is provided as described in the modification (10) above, liquid may not flow in the primary pipe portion 61M1 (or 61). That is, a negative pressure may be generated only by the blower 84. In this case, the blower 84 is equivalent to the discharge device of the present invention. A gaseous body which is caused to flow in the primary pipe portion 61M1 by the blower 84 is equivalent to the fluid of the present invention. That is, a direction in which the gaseous body flows in the

primary pipe portion 61M1 is equivalent to the flow direction of the present invention. Also in this case, a stronger negative pressure is generally generated as compared to a case where a negative pressure is generated only by the aspirator 33, etc. (12) When the aspirator 33, etc. is not provided as described in the modification (11) above, the blower 84 may be provided, e.g., upstream of the primary pipe portion 61M1 (or 61) in the flow direction. Because of this, gas reaching the merging point 61b through the gas inlet 62 is pushed toward the downstream side in the flow direction by the blower 84. In this case, an arrangement is required to reliably generate a negative pressure at the gas inlet 62 so that the gas does not flow backward to the suction port 52 side from the gas inlet 62.

(13) In the embodiment above, each melt spinning position SP of the melt spinning system 1 includes one spinning beam 2, one yarn cooler 3, and one exhaust unit 4. However, the disclosure is not limited to this. The explanation below will be given with reference to FIG. 11 and FIG. 12. FIG. 11 is a schematic representation of a melt spinning system 1M of another modification. FIG. 12 shows an exhaust unit 4M2 of a modification in FIG. 11. As shown in FIG. 11, the melt spinning system 1M includes melt spinning positions SPM instead of the melt spinning positions SP. For example, each melt spinning position SPM may include two spinning beams 2, two yarn coolers 3, and one exhaust unit 4M2. That is, one exhaust unit 4M2 may be provided to correspond to two sets of a spinning beam 2 and a yarn cooler 3. The two spinning beams 2 include a spinning beam 2A (first yarn spinning unit of the present invention) and a spinning beam 2B (second yarn spinning unit of the present invention). The two yarn coolers 3 include a yarn cooler 3A (first cooling unit of the present invention) and a yarn cooler 3B (second cooling unit of the present invention). The yarn cooler 3A corresponds to the spinning beam 2A. The yarn cooler 3B corresponds to the spinning beam 2B. The exhaust unit 4M2 is provided instead of the exhaust unit 4. The exhaust unit 4M2 is provided with an exhaust path 30M2. The exhaust unit 4M2 includes, e.g., two suction members 31, two ducts 32, and an aspirator 33M2. The two suction members 31 include a suction member 31A and a suction member 31B. The two ducts 32 include a duct 32A and a duct 32B. The suction member 31A and the duct 32A correspond to the spinning beam 2A. The suction member 31B and the duct 32B correspond to the spinning beam 2B. The aspirator 33M2 is connected both to the duct 32A and the duct 32B.

[0083] As shown in FIG. 12, the aspirator 33M2 includes a primary pipe portion 61M2 (main pipe of the

present invention) and two gas inlets 62M. The primary pipe portion 61M2 includes the above-described water inlet 61a, the above-described merging point 61b, and the above-described outlet 61c. In this modification, the two gas inlets 62M are connected to the merging point 61b. The two gas inlets 62M include a gas inlet 62MA and a gas inlet 62MB. A combination of the duct 32A and the gas inlet 62MA is equivalent to a first gas discharge pipe of the present invention. A combination of the duct 32B and the gas inlet 62MB is equivalent to a second gas discharge pipe of the present invention. The primary pipe portion 61M2 is connected both to the first gas discharge pipe and the second gas discharge pipe. The gas inlet 62MA is connected to the duct 32A. The gas inlet 62MB is connected to the duct 32B. An auxiliary intake port 91 may be formed at each of the two gas inlets 62M. The auxiliary intake port 91 has a function of taking in outside air in the same manner as each outside air intake port 71. Because the outside air is taken in through each outside air intake port 71 also with this arrangement, an amount of the outside air taken in through the auxiliary intake port 91 is decreased as compared to the conventional amount. It is therefore possible to suppress the adherence of a solidified body to the exhaust path 30M2. An auxiliary intake port 91A is formed at the gas inlet 62MA as the auxiliary intake port 91. An auxiliary intake port 91B is formed at the gas inlet 62MB as the auxiliary intake port 91. The auxiliary intake port 91 may be formed at, e.g., a downstream end portion of the duct 32 in the gas discharge direction, instead of the gas inlet 62. An auxiliary adjustment unit 92 may be provided for adjusting the opening degree of the auxiliary intake port 91. The auxiliary adjustment unit 92 may be structured in the same or a similar manner as the adjustment member 72. With this arrangement, a negative pressure at each gas inlet 62M is adjusted by the auxiliary adjustment unit 92. An auxiliary adjustment unit 92A is provided as the auxiliary adjustment unit 92 corresponding to the auxiliary intake port 91A. An auxiliary adjustment unit 92B is provided as the auxiliary adjustment unit 92 corresponding to the auxiliary intake port 91B. With these arrangements, a negative pressure at the gas inlet 62MA is adjusted independently from a negative pressure at the gas inlet 62MB to some degree. It is therefore possible to effectively suppress the influence of adjustment of a negative pressure at one gas inlet 62M on a negative pressure at the other gas inlet 62M. A pressure gauge 75 may be provided in the vicinity of each of the two gas inlets 62M. A pressure gauge 75A is provided to correspond to the gas inlet 62MA. A pressure gauge 75B is provided to correspond to the gas inlet 62MB. An auxiliary intake port (not illustrated) may be formed at the above-described gas inlet 62 (see FIG. 9), and an auxiliary adjustment unit (not illustrated) may be also formed at the gas inlet 62.

[0084] The aperture area (effective aperture area) of each auxiliary intake port 91 is preferably smaller than

that (effective aperture area) of each outside air intake port 71. This effectively decreases an amount of outside air taken in through each auxiliary intake port 91. It is therefore possible to effectively suppress the adherence of a solidified body to the exhaust path 30M2. 5
When the opening degree of at least one of the auxiliary intake port 91 and the outside air intake port 71 is not adjustable, the nominal aperture area of the at least one of the auxiliary intake port 91 and the outside air intake port 71 is equivalent to the aperture area of the present invention. 10

[0085] As shown in FIG. 12, two supply tubes 93 may be provided at the aspirator 33M2. The two supply tubes 93 correspond to the two gas inlets 62M. Each supply tube 93 is provided for supplying water to a corresponding gas inlet 62M. Each supply tube 93 causes the water supply tube 63 to communicate with a corresponding gas inlet 62M. With this arrangement, a part of the water supplied to the water inlet 61a is supplied to each gas inlet 62M. Therefore, when gas is unintentionally clotted inside each gas inlet 62M so as to generate a solidified body, the solidified body is dissolved into water and removed. This suppresses the adherence of the solidified body to the exhaust path 30M2. Such a supply tube (not illustrated) may be provided at the aspirator 33 or the aspirator 33M1. 15 20 25

[0086] The exhaust unit 4M2 may include the above-described blower 84 in addition to or instead of the aspirator 33M2. The number of the spinning beams 2 and the yarn coolers 3 which correspond to one exhaust unit 4M2 may be three or more. 30

[0087] (14) In the embodiment above, the melt spinning system 1 includes the melt spinning positions SP, or the melt spinning system 1M includes the melt spinning positions SPM. However, the disclosure is not limited to this. The number of the melt spinning positions SP or SPM may be one. 35

[0088] (15) In the embodiment above, the suction member 31 includes: the sucking rings 42 arranged to surround the filaments f; and the enclosure member 41 to which the sucking rings 42 are attached. However, the disclosure is not limited to this. That is, the suction member 31 may not be arranged to surround the filaments f. 40

[0089] (16) In the embodiment above, each spinning beam 2 is configured to spin out nylon 6 as polymer. However, the disclosure is not limited to this. The present invention is applicable to a case where polymer made of another kind of nylon or polyester, etc. is spun out, as a matter of course. 45 50

Claims

1. A melt spinning system (1) comprising: at least one yarn spinning unit (2) including a spinneret (13) for spinning out molten polymer which is a material of a filament (f) ;

at least one cooling unit (3) which includes a cooling cylinder (21) provided below the spinneret (13) and which is configured to cool the molten polymer spun out from the spinneret (13) so as to form the filament (f); and an exhaust unit (4, 4M1, 4M2) provided with an exhaust path (30, 30M1, 30M2) for sucking and discharging gas generated from the molten polymer spun out from the spinneret (13), the exhaust unit (4, 4M1, 4M2) including:

a sucking unit (31) which is provided between the spinneret (13) and the cooling cylinder (21) in a direction in which the filament (f) runs, the sucking unit (31) being provided with a suction port (52) for sucking the gas;

a discharge device (33, 33M1, 33M2, 84) which includes a main pipe (61, 61M1, 61M2) configured to cause fluid to flow in a predetermined flow direction, which is provided downstream of the sucking unit (31) in a gas discharge direction, and which is configured to generate a negative pressure at the suction port (52) by means of flow of the fluid so that the gas is discharged along with the fluid, the fluid being different from the gas, the exhaust path (30, 30M1, 30M2) extending in the gas discharge direction; and

at least one gas discharge pipe (62, 62M) which is provided between the sucking unit (31) and the main pipe (61, 61M1, 61M2) in the gas discharge direction and which is arranged to be merged into an intermediate portion of the main pipe (61, 61M1, 61M2) in the flow direction, and the main pipe (61, 61M1, 61M2) being provided with an outside air intake port (71) for taking in outside air from an outer space of the exhaust unit (4, 4M1, 4M2).

2. The melt spinning system (1) according to claim 1, wherein, the outside air intake port (71) is provided upstream of a merging position between the main pipe (61, 61M1, 61M2) and the at least one gas discharge pipe (62, 62M) in the flow direction.

3. The melt spinning system (1) according to claim 1 or 2, wherein, the exhaust unit (4, 4M1, 4M2) includes an adjustment unit (72, 82) which is able to adjust the opening degree of the outside air intake port (71).

4. The melt spinning system (1) according to any one of claims 1 to 3, wherein, the discharge device (33, 33M1, 33M2, 84) includes an aspirator (33, 33M1, 33M2) configured to cause liquid to flow in the

main pipe as the fluid.

5. The melt spinning system (1) according to claim 4, wherein, the aspirator (33, 33M1, 33M2) is configured to generate the negative pressure by causing the liquid to fall by gravity. 5
6. The melt spinning system (1) according to claim 4 or 5, wherein, the aspirator (33, 33M1, 33M2) is configured to generate a negative pressure of 0 Pa or less and -30 Pa or more. 10
7. The melt spinning system (1) according to claim 6, wherein, the aspirator (33, 33M1, 33M2) is configured to generate a negative pressure of 0 Pa or less and -10 Pa or more. 15
8. The melt spinning system (1) according to any one of claims 4 to 7, wherein, the liquid includes a substance dissolving a substance included in the gas. 20
9. The melt spinning system (1) according to any one of claims 4 to 8, wherein, the main pipe (61, 61M1, 61M2) extends along a vertical direction. 25
10. The melt spinning system (1) according to any one of claims 1 to 9, wherein, the at least one gas discharge pipe (62M) is provided with an auxiliary intake port (91) for taking in the outside air. 30
11. The melt spinning system (1) according to claim 10, wherein, the aperture area of the auxiliary intake port (91) is smaller than the aperture area of the outside air intake port (71). 35
12. The melt spinning system (1) according to claim 10 or 11, wherein, the exhaust unit (4M2) includes an auxiliary adjustment unit (92) which is able to adjust the opening degree of the auxiliary intake port (91). 40
13. The melt spinning system (1) according to claim 12, further comprising: a first yarn spinning unit (2A) functioning as one of yarn spinning units (2); 45
 - a second yarn spinning unit (2B) which is different from the first yarn spinning unit (2A) and which functions as another of the yarn spinning units (2);
 - a first cooling unit (3A) which is provided to correspond to the first yarn spinning unit (2A) and which functions as one of cooling units (3); and
 - a second cooling unit (3B) which is provided to correspond to the second yarn spinning unit (2B) and which functions as another of the cooling units (3), wherein, the exhaust unit (4) includes: 55

a first gas discharge pipe (62MA) which is provided to correspond to the first yarn spinning unit (2A) and the first cooling unit (3A) and which functions as one of gas discharge pipes (62M); and

a second gas discharge pipe (62MB) which is provided to correspond to the second yarn spinning unit (2B) and the second cooling unit (3B) and which functions as another of the gas discharge pipes (62M),

the discharge device (33M2) is shared between the first gas discharge pipe (62MA) and the second gas discharge pipe (62MB), and

the auxiliary intake port (91) and the auxiliary adjustment unit (92) are provided at each of the first gas discharge pipe (62MA) and the second gas discharge pipe (62MB).

14. The melt spinning system (1) according to any one of claims 1 to 13, wherein, the exhaust unit (4M2) includes a supply tube (93) for supplying the gas discharge pipes (62M) with liquid dissolving the substance included in the gas.

FIG.1

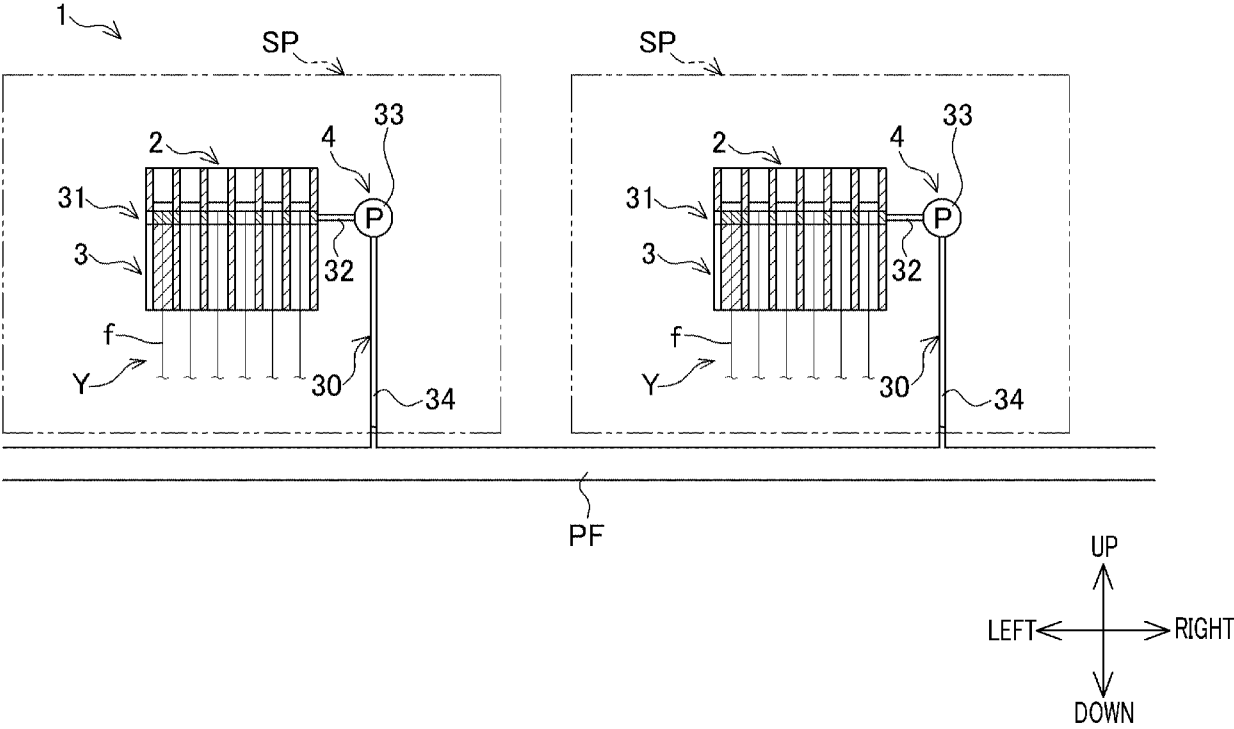


FIG.2

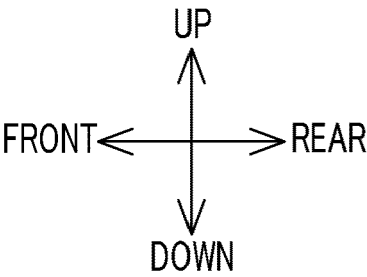
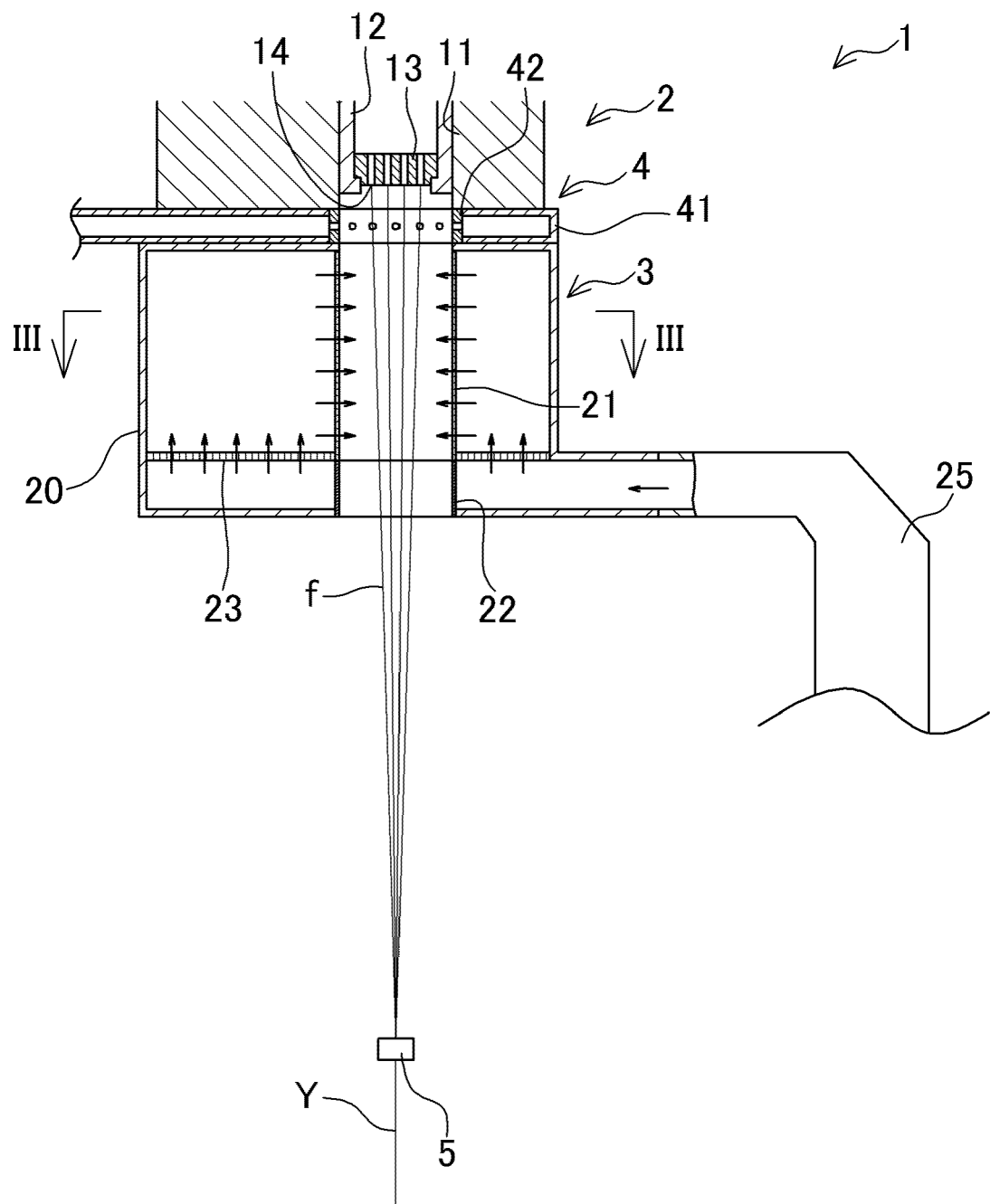


FIG.3

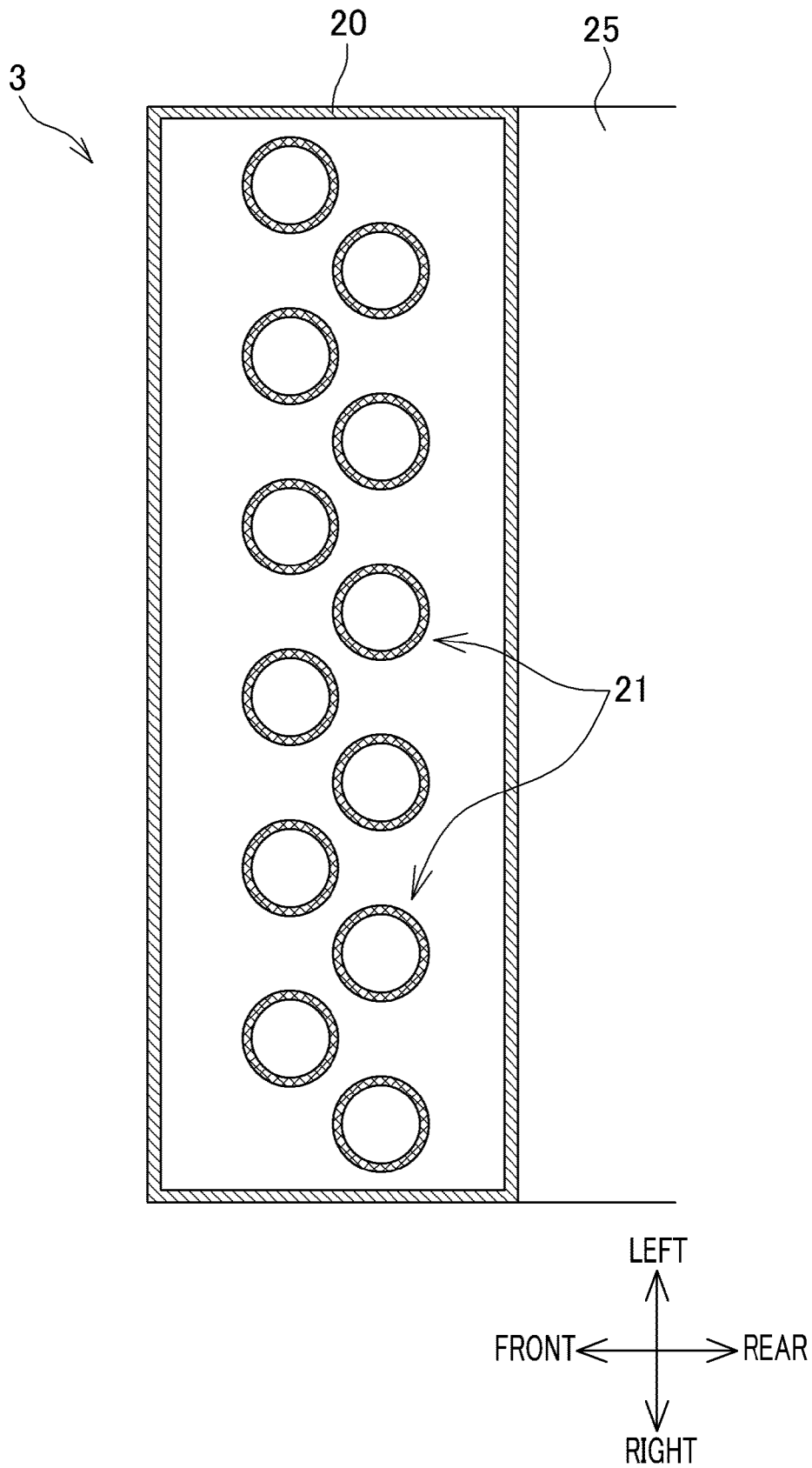


FIG.4

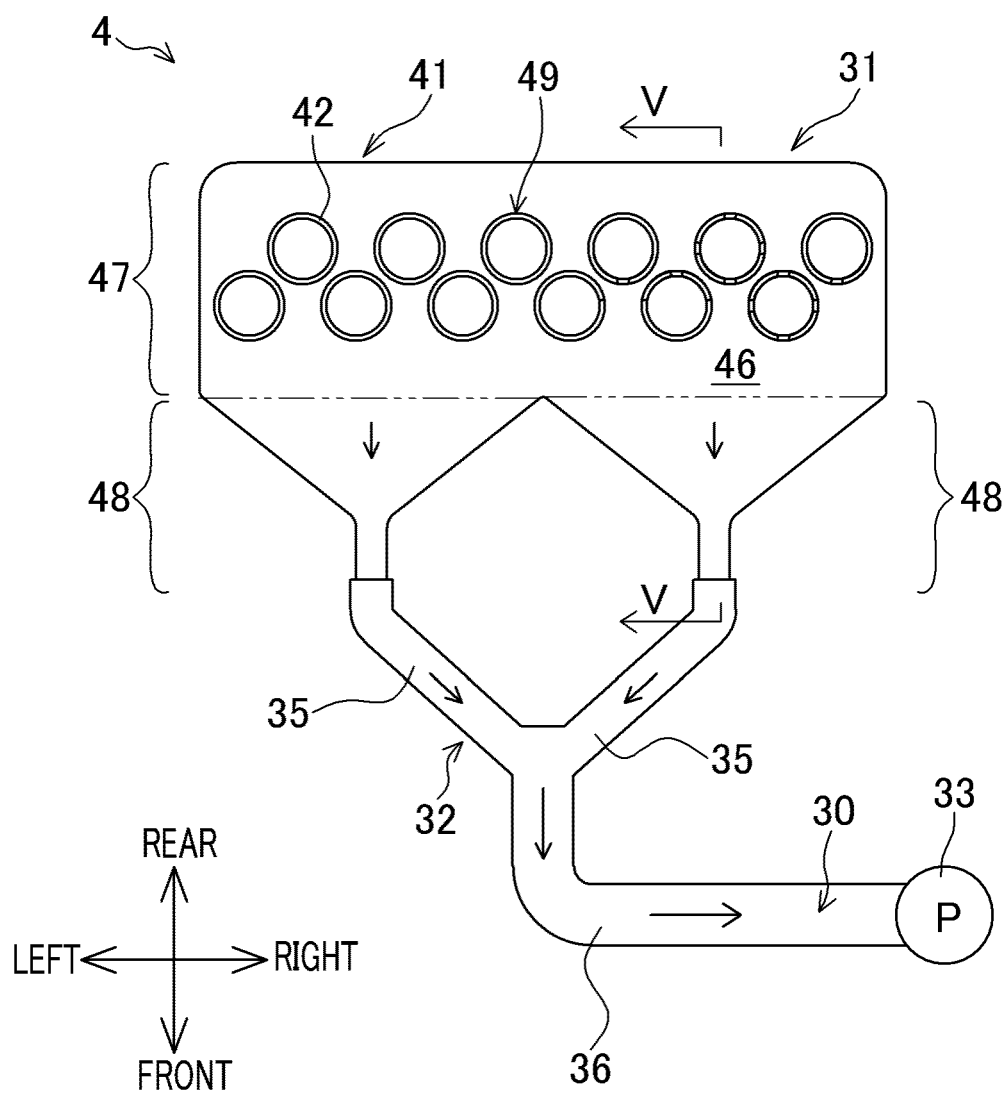


FIG.5

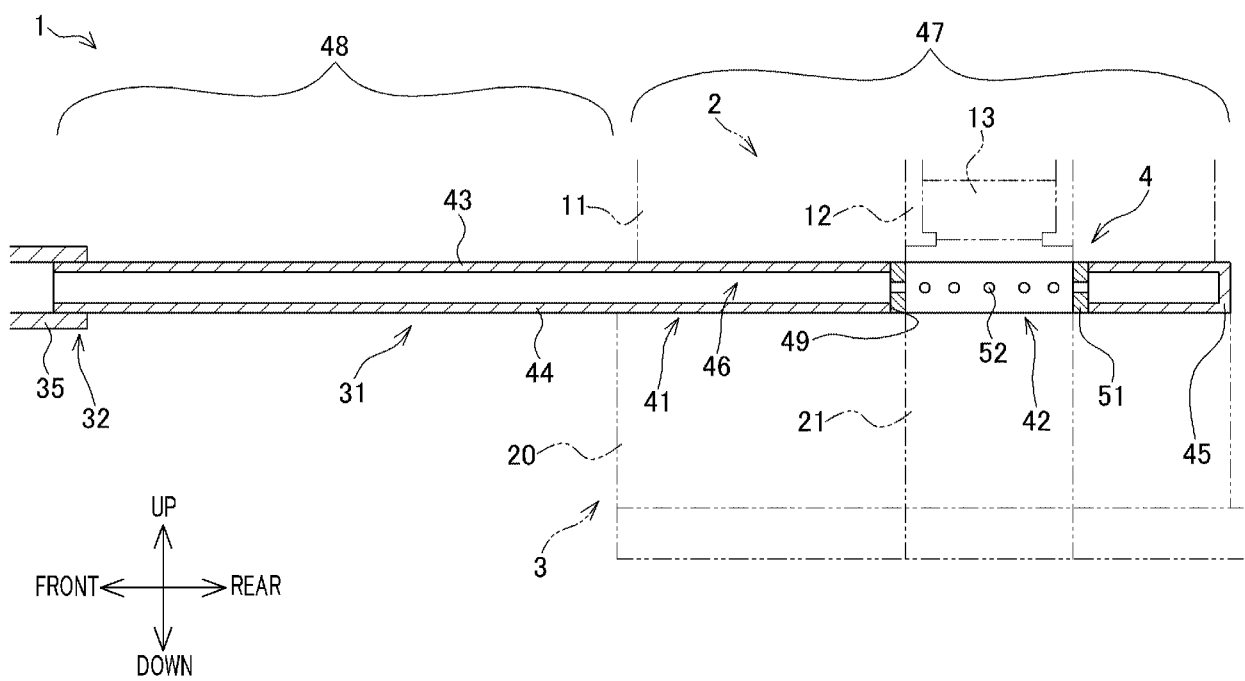


FIG.6

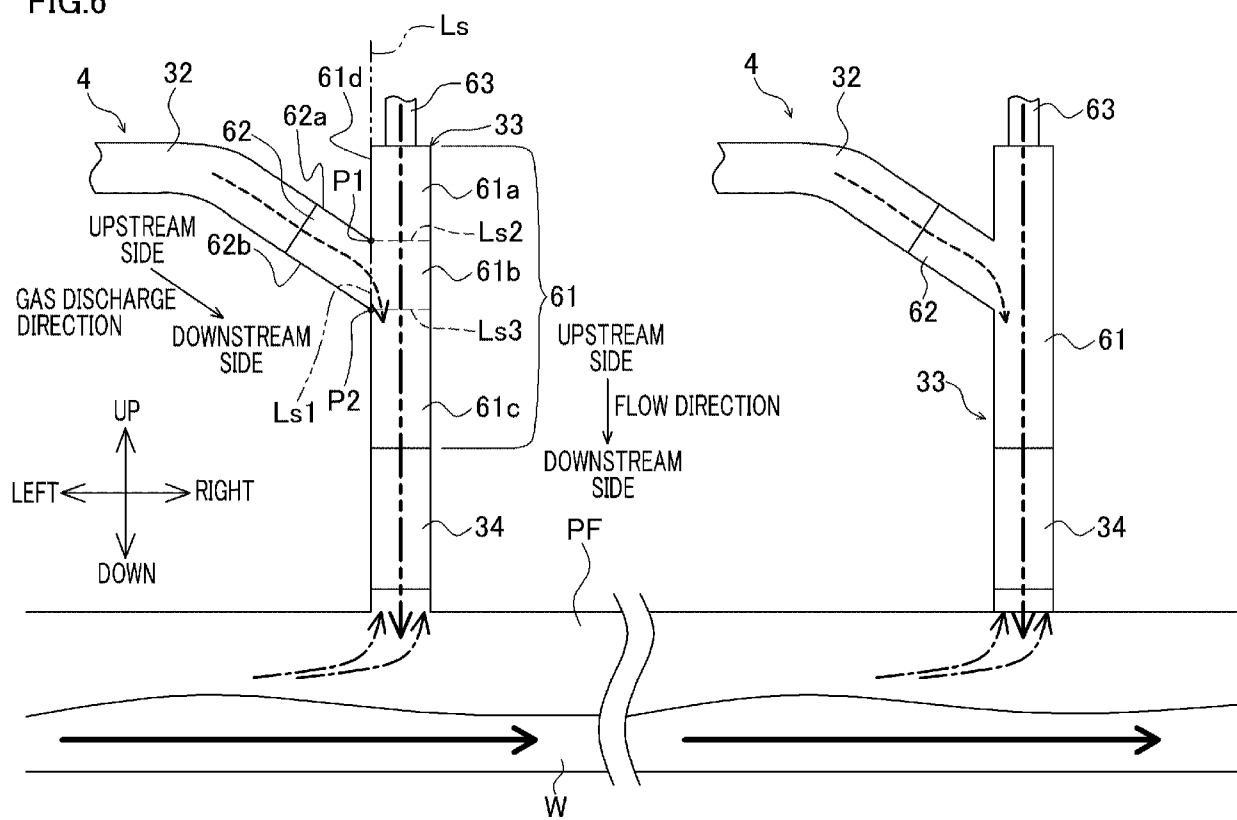


FIG. 7

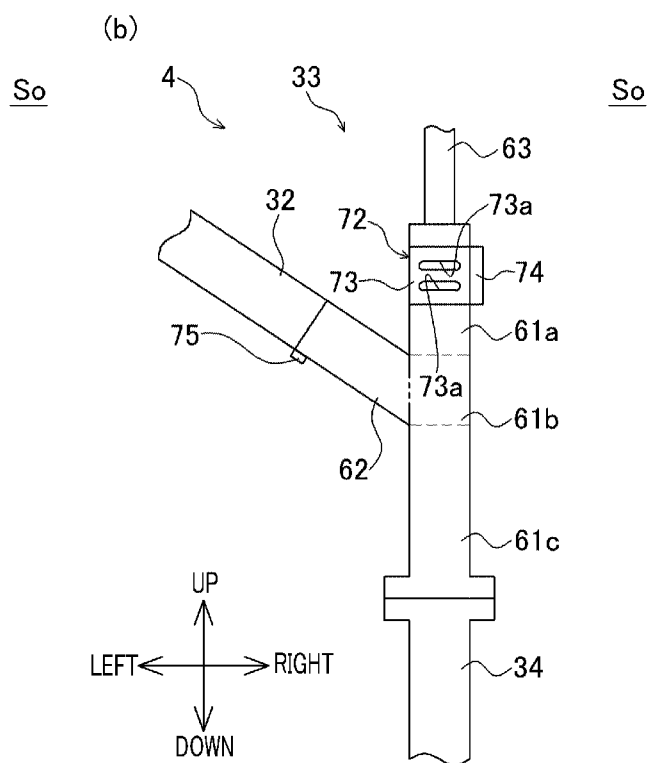
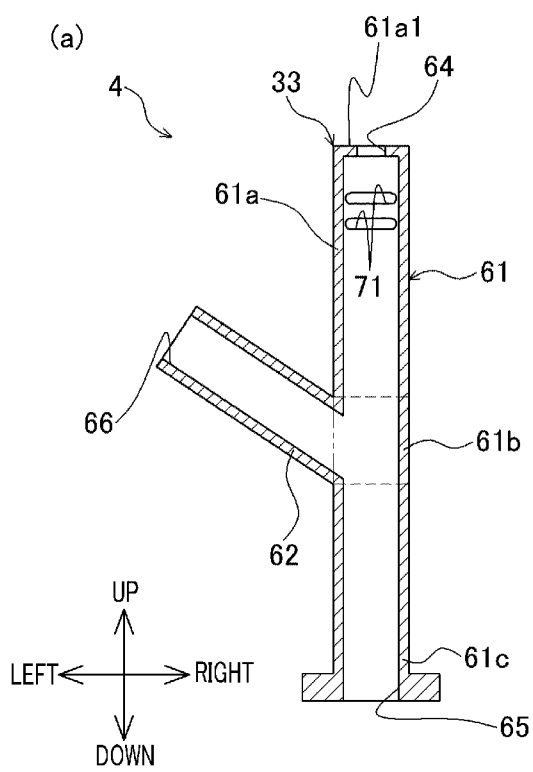
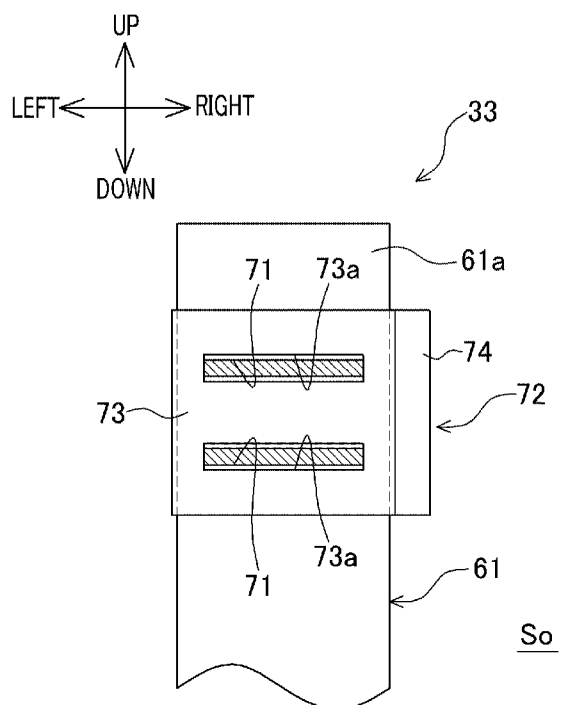


FIG.8

(a)



(b)

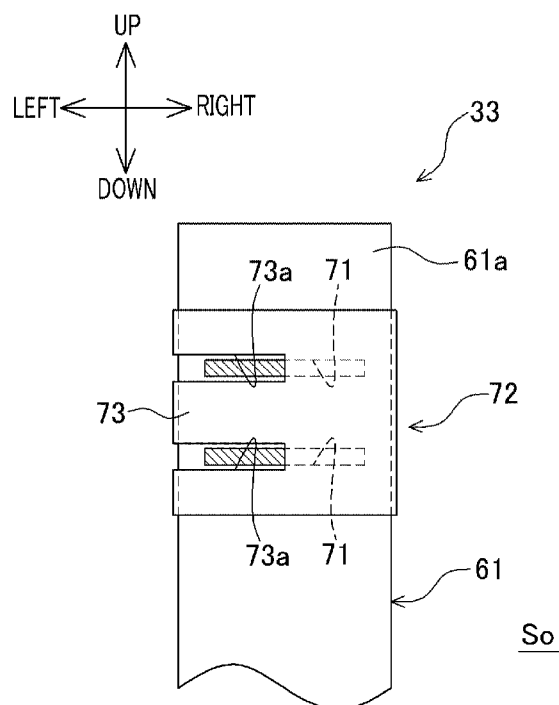


FIG.9

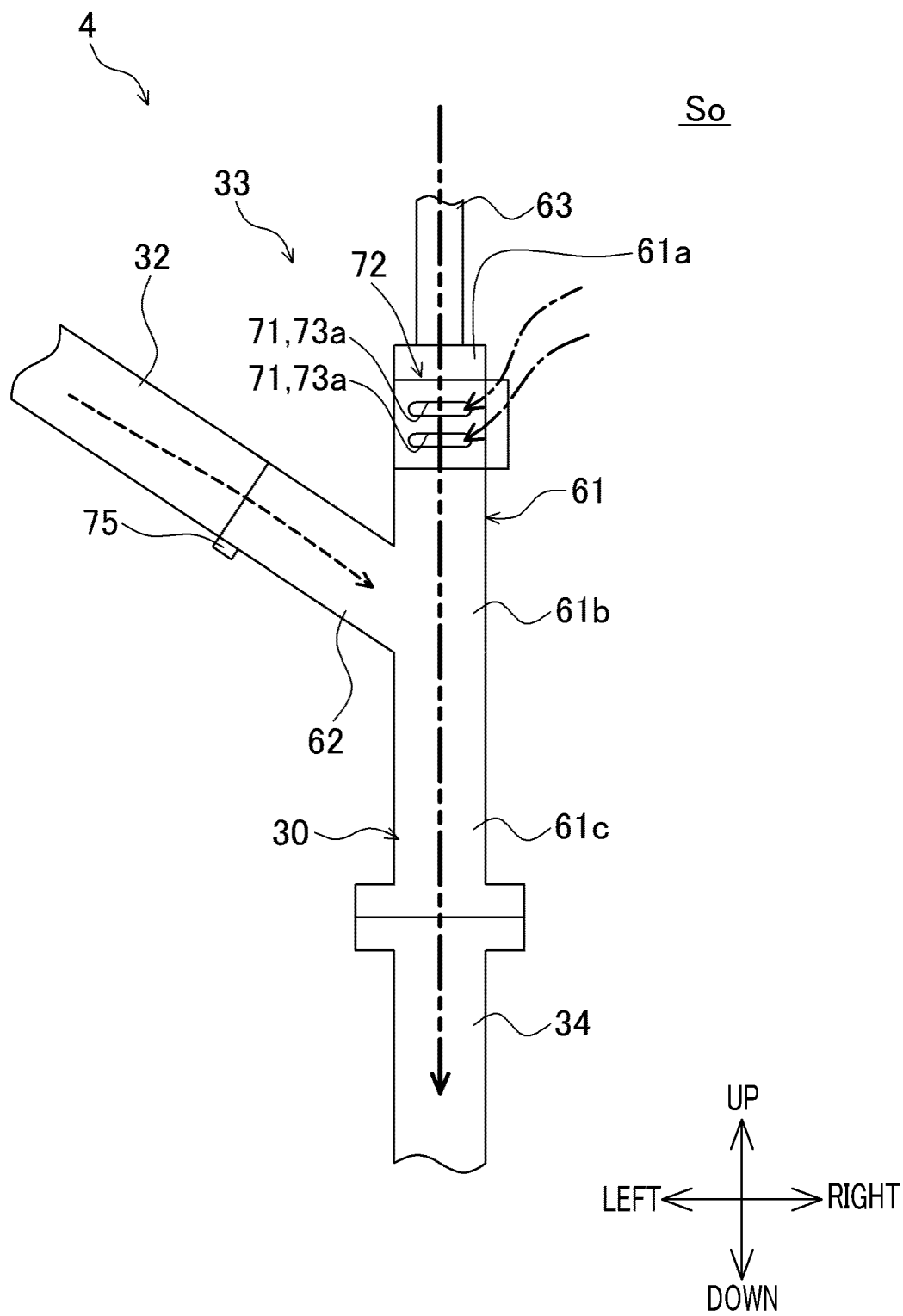


FIG.10

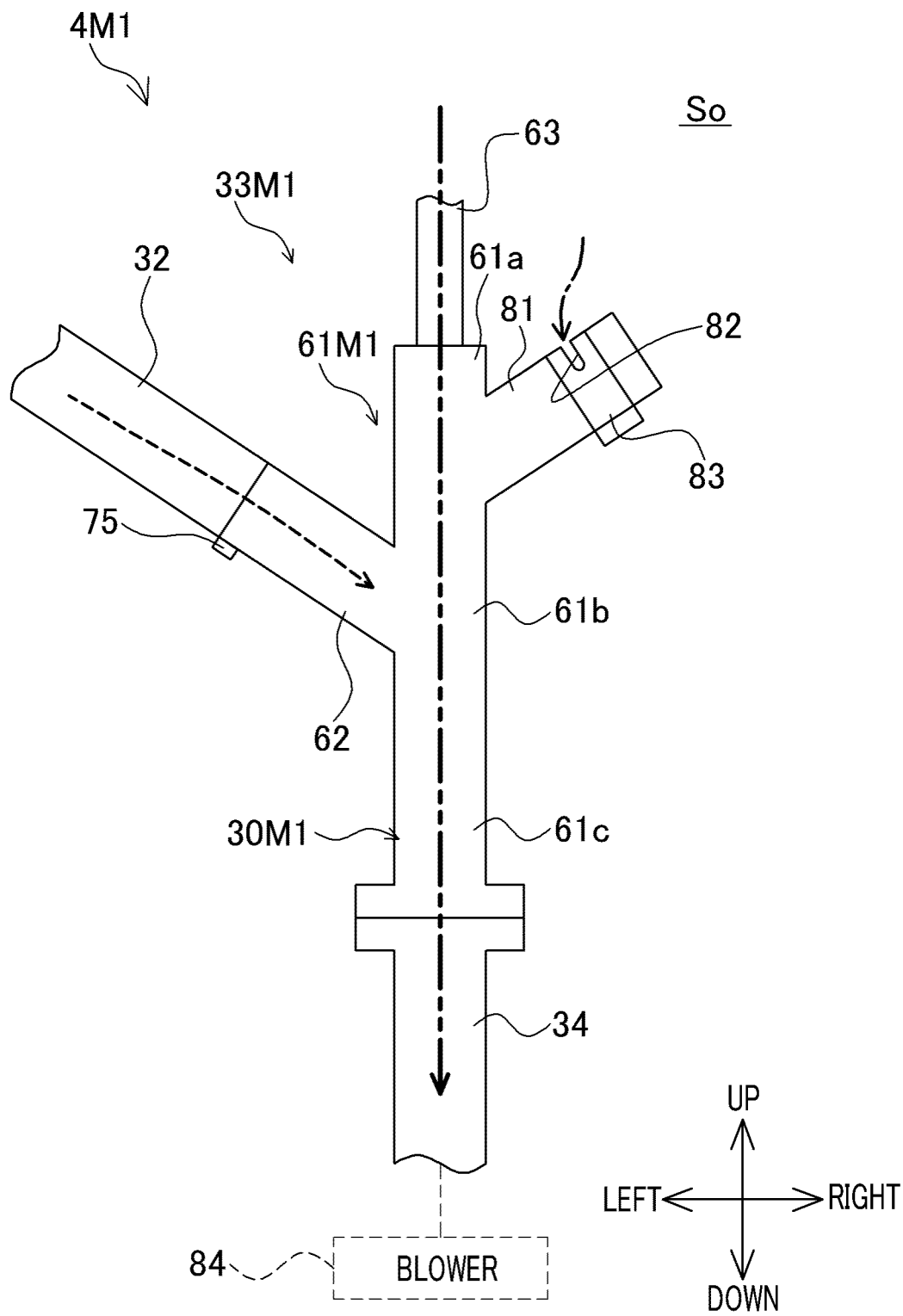


FIG.11

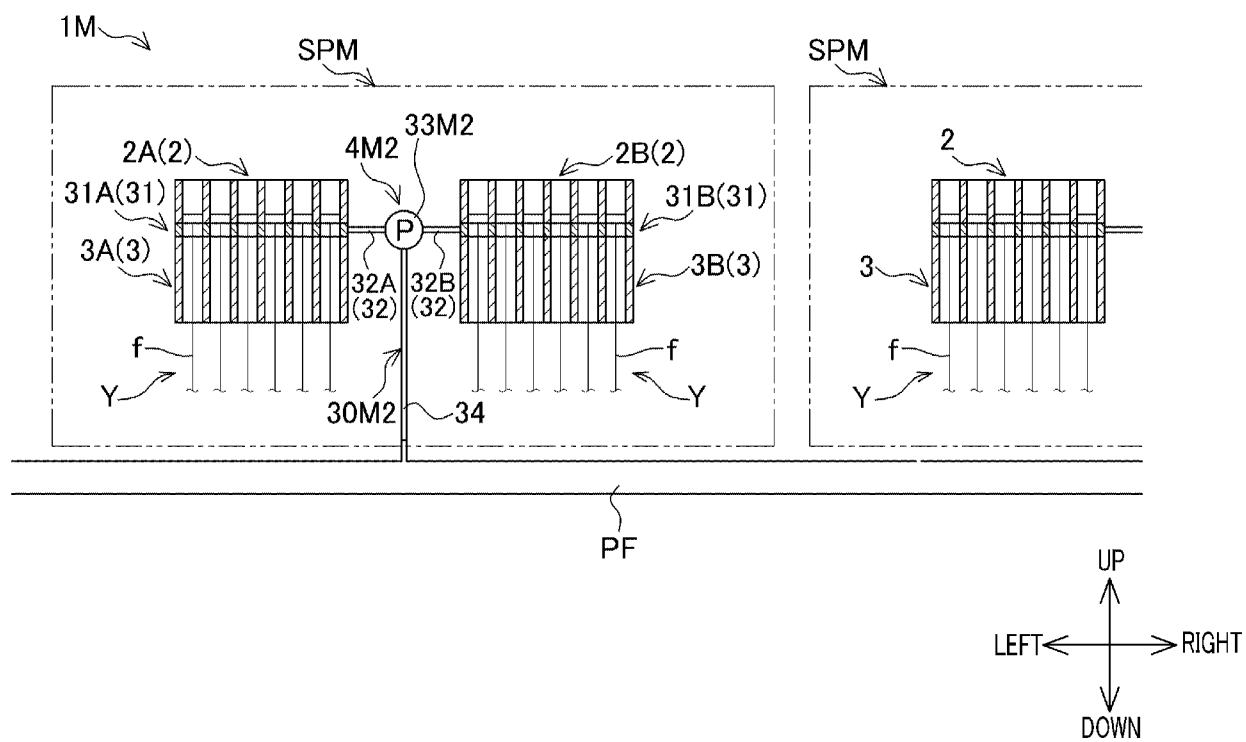
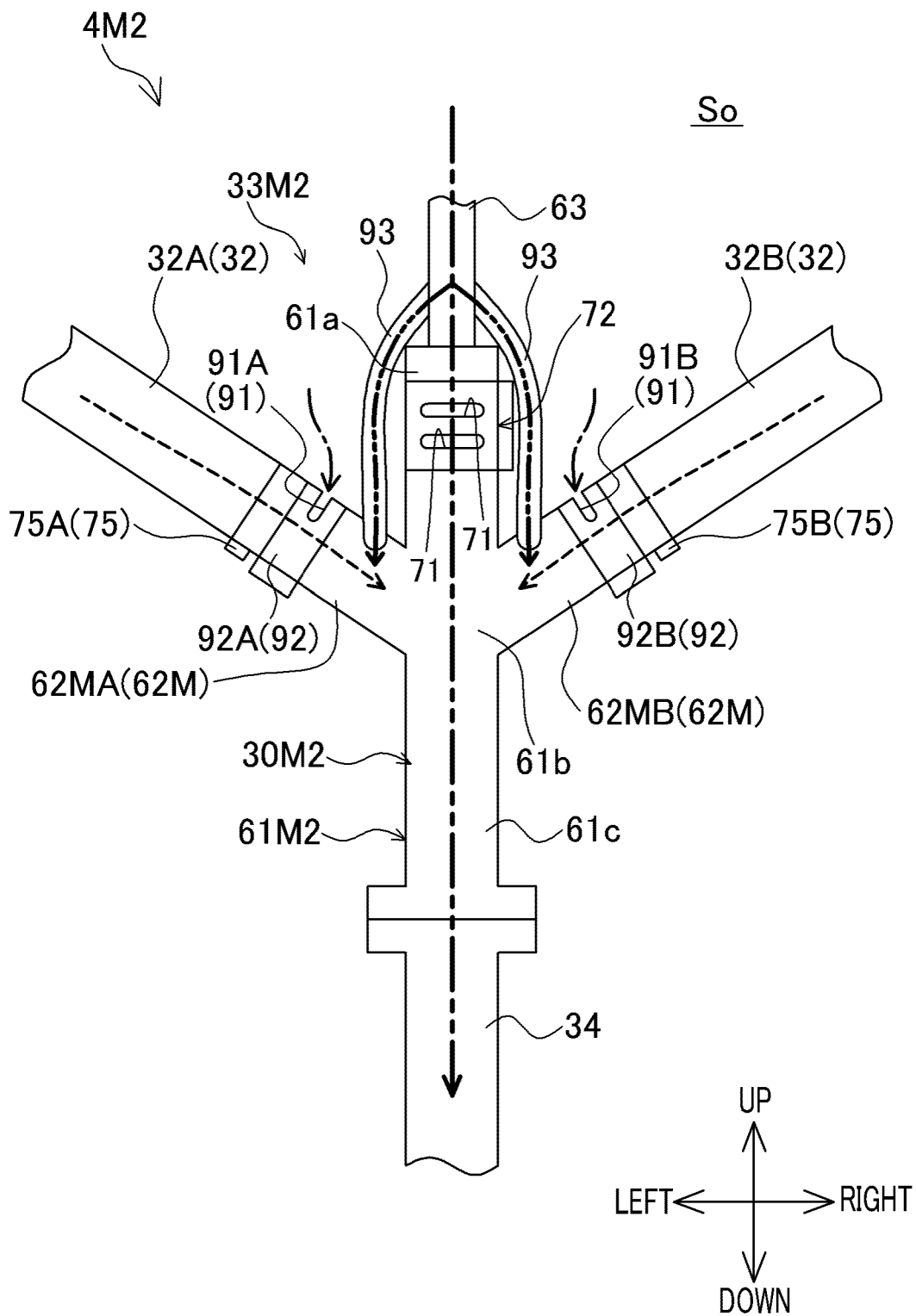


FIG.12





EUROPEAN SEARCH REPORT

Application Number

EP 26 16 6612

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 3 730 678 A1 (TMT MACHINERY INC [JP]) 28 October 2020 (2020-10-28) * paragraphs [0019], [0020], [0047] - [0054], [0059] - [0063], [0074]; figure 5 *	1-14	INV. D01D5/092 D01D4/00 D01D4/02 D01D5/00 D01D5/08 D01D5/088
A	EP 1 510 603 A1 (TORAY INDUSTRIES [JP]) 2 March 2005 (2005-03-02) * paragraphs [0033], [0039], [0042] - [0045], [0047], [0048], [0050], [0060], [0063], [0066], [0069], [0073] *	1-14	
A	EP 3 492 634 A1 (TMT MACHINERY INC [JP]) 5 June 2019 (2019-06-05) * paragraphs [0007] - [0010], [0030] - [0037], [0040], [0049], [0074] - [0085] *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		27 August 2026	Van Beurden-Hopkins
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EP 26 16 6612

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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27-08-2026

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
EP 3730678	A1	28-10-2020	CN	111826729 A	27-10-2020
			EP	3730678 A1	28-10-2020
			JP	7256066 B2	11-04-2023
			JP	2020176354 A	29-10-2020

EP 1510603	A1	02-03-2005	CN	1659319 A	24-08-2005
			EP	1510603 A1	02-03-2005
			TW	200307771 A	16-12-2003
			US	2006145385 A1	06-07-2006
			WO	03102278 A1	11-12-2003

EP 3492634	A1	05-06-2019	CN	109868511 A	11-06-2019
			CN	209082043 U	09-07-2019
			EP	3492634 A1	05-06-2019
			JP	7039269 B2	22-03-2022
			JP	2019099941 A	24-06-2019

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2020176354 A [0002]