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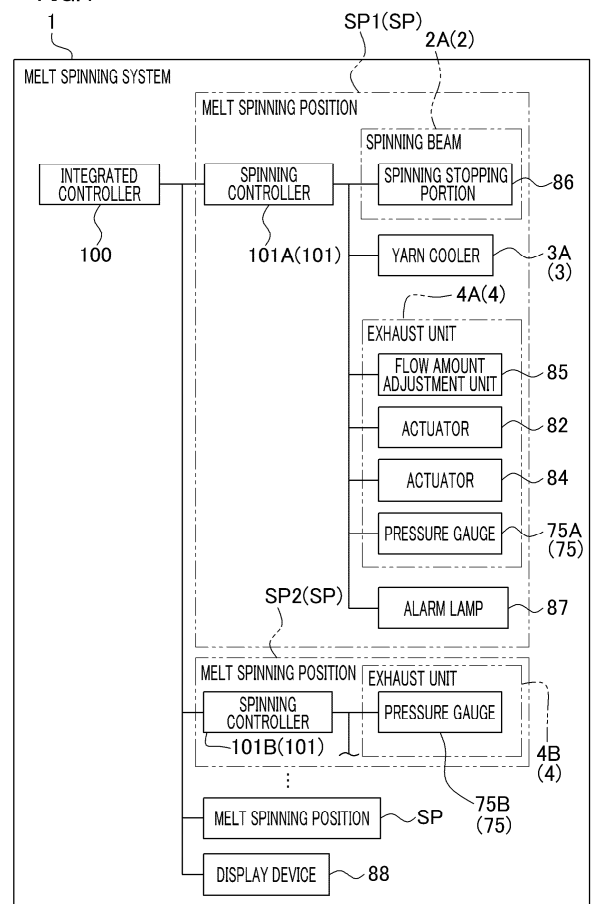
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(54) **MELT SPINNING SYSTEM**

(57) An object of the present invention is to reduce the burden on an operator in regard to the pressure of gas 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, an exhaust unit 4, a pressure gauge 75, an output unit, and a control unit. The output unit is able to make an output regarding a pressure. When molten polymer is spun out from the spinning beam 2, the control unit performs an output process of causing the output unit to make an output based on a detection result of the pressure gauge 75.

FIG.4



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 provided with a suction port formed between the spinneret and the cooling cylinder; and an aspirator. Gas sucked into the suction member through the suction port is sucked and discharged by the aspirator. The aspirator is provided with an outside air intake port for taking outside air into the exhaust path and an adjustment unit for adjusting the opening degree of the outside air intake port. In the exhaust path, a pressure gauge (pressure detection unit) configured to detect the pressure of gas is provided at a part close to the outside air intake port. Based on a detection result of the pressure detection unit, an operator adjusts the intake amount of the outside air by using the adjustment unit so that the magnitude of a sucking pressure (negative pressure) of the aspirator is suitably adjusted.

SUMMARY OF THE INVENTION

[0003] Although not illustrated in Patent Literature 1, the pressure detection unit is not always provided at the exhaust unit. For example, the operator brings the pressure detection unit each time the system is set up or regularly checked. Therefore, the operator has a large burden of the measurement, adjustment, etc. of pressure.

[0004] An object of the present invention is to reduce the burden on an operator in regard to the pressure of gas in a melt spinning system.

[0005] According to a first aspect of the invention, a melt spinning system comprises: a yarn spinning unit including a spinneret for spinning out molten polymer which is a material of a filament; a 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;

at least one exhaust unit respectively provided with at least one exhaust path for sucking and discharging gas generated from the molten polymer spun out from the spinneret; at least one pressure detection unit which is able to detect a pressure at a predetermined position in the at least one exhaust path corresponding to the at least one pressure detection unit; an output unit which is able to make an output regarding the pressure; and a control unit. When the molten polymer is spun out from the yarn spinning unit, the control unit performs an output process of causing the output unit to make the output based on a detection result of the at least one pressure detection unit.

[0006] For example, the output unit may include an apparatus, etc. for displaying information and/or adjusting the pressure. For example, the output regarding the pressure may include the display of a value of the pressure and/or the adjustment of the pressure. As the control unit always monitors the pressure inside the at least one exhaust path and causes the output unit to make the output regarding the pressure, a task of the operator is at least partially automated. It is therefore possible to reduce the burden on the operator in regard to the pressure of gas in the melt spinning system.

[0007] According to a second aspect of the invention, the melt spinning system of the first aspect further comprises: a first exhaust unit functioning as one of the at least one exhaust unit; a second exhaust unit which functions as another of the at least one exhaust unit and which is different from the first exhaust unit; a first pressure detection unit which functions as one of the at least one pressure detection unit and which corresponds to the first exhaust unit; and a second pressure detection unit which functions as another of the at least one pressure detection unit and which corresponds to the second exhaust unit.

[0008] The larger the number of exhaust units included in the melt spinning system is, the larger the number of tasks of the operator is. Because the pressure detection units are provided to correspond to the exhaust units in this aspect of the invention, this aspect of the invention is especially effective to reduce the burden on the operator.

[0009] According to a third aspect of the invention, the melt spinning system of the first aspect is arranged such that the at least one exhaust unit includes: a first exhaust path functioning as one of the at least one exhaust path; and a second exhaust path which functions as another of the at least one exhaust path and which is different from the first exhaust path, a first pressure detection unit is provided as one of the at least one pressure detection unit to be able to detect the pressure in the first exhaust path, and a second pressure detection unit is provided as another of the at least one pressure detection unit to be able to detect the pressure in the second exhaust path.

[0010] When exhaust paths are provided at exhaust units, this aspect of the invention is especially effective

to reduce the burden on the operator because pressure detection units are provided to correspond to the exhaust paths.

[0011] According to a fourth aspect of the invention, the melt spinning system of the second or third aspect is arranged such that the output unit includes a display unit which is able to display information, and the control unit is configured to perform, as the output process, a display process of causing the display unit to display information of a detection result of the first pressure detection unit and information of a detection result of the second pressure detection unit.

[0012] In this aspect of the invention, plural pieces of information of the pressure are checked by one display unit. It is therefore possible to effectively reduce the burden on the operator.

[0013] According to a fifth aspect of the invention, the melt spinning system of any one of the first or fourth aspect is arranged such that the output unit includes a notification unit which is able to report information, and the control unit is further configured to perform, as the output process, a notification process of causing the notification unit to report information regarding the pressure based on a detection result of the at least one pressure detection unit.

[0014] In this aspect of the invention, information is reported by the notification unit according to need. It is therefore possible to prompt the operator to act quickly.

[0015] According to a sixth aspect of the invention, the melt spinning system of the fifth aspect is arranged such that the control unit is further configured to perform, as the notification process, an error notification process of causing the notification unit to report information indicating an error of the pressure in regard to the at least one exhaust unit.

[0016] In this aspect of the invention, when an error occurs at the at least one exhaust unit, the operator is rapidly notified of information regarding this error. Therefore, the quick act is performed at the occurrence of the error.

[0017] According to a seventh aspect of the invention, the melt spinning system of the fifth or sixth aspect is arranged such that the control unit is further configured to perform, as the notification process, a maintenance notification process of controlling the notification unit to report information of a timing of maintenance for the at least one exhaust unit based on the detection result of the at least one pressure detection unit.

[0018] In this aspect of the invention, the operator is notified of the timing of the maintenance for the at least one exhaust unit. It is therefore possible to smoothly perform the maintenance.

[0019] According to an eighth aspect of the invention, the melt spinning system of any one of the first to seventh aspects is arranged such that the output unit includes a spinning stopping portion which is able to stop the spinneret from spinning out the molten polymer. When the occurrence of the error of the pressure in

regard to the at least one exhaust unit is determined, the control unit controls the spinning stopping portion to perform, as the output process, a stop process of stopping the yarn spinning unit from spinning out the molten polymer.

[0020] In this aspect of the invention, when an error occurs at the pressure of gas in the at least one exhaust unit, the spinning out of molten polymer is stopped. This rapidly stops the filament whose quality is abnormal from keeping produced. It is therefore possible to suppress the waste of running costs such as material costs, etc. of the filament.

[0021] According to a ninth aspect of the invention, the melt spinning system of any one of the first to eighth aspects is arranged such that the output unit includes an adjustment unit which is able to adjust the pressure at the at least one exhaust path of the at least one exhaust unit, and the control unit is configured to perform, as the output process, an adjustment process of controlling the adjustment unit based on the detection result of the at least one pressure detection unit to adjust the pressure.

[0022] This reduces the time and labor for the operator to adjust the pressure inside the at least one exhaust path.

[0023] According to a tenth aspect of the invention, the melt spinning system of the ninth aspect is arranged such that the adjustment unit includes a flow amount adjustment unit which is able to adjust the flow amount of fluid for generating a negative pressure at the at least one exhaust path.

[0024] In this aspect of the invention, the pressure inside the at least one exhaust path is adjusted by the flow amount adjustment unit.

[0025] According to an eleventh aspect of the invention, the melt spinning system of the ninth or tenth aspect is arranged such that the at least one exhaust unit includes an outside air intake port which is able to take outside air into the at least one exhaust path, and the adjustment unit includes an aperture adjustment unit which is able to adjust the opening degree of the outside air intake port.

[0026] In this aspect of the invention, as the opening degree of the outside air intake port is adjusted, the amount of the outside air taken in through the outside air intake port is adjusted. As a result, the pressure inside the at least one exhaust path is adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

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 block diagram showing an electric structure of the melt spinning system.

FIG. 5 is a plan view of a suction member and its surroundings.

FIG. 6 is a cross section taken along a line VI-VI in FIG. 5.

FIG. 7 shows an aspirator and its surroundings.

FIGs. 8(a) and 8(b) show a detailed structure of the aspirator.

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

FIGs. 10(a) and 10(b) show an adjustment member.

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

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

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] 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)

[0029] The following will describe a schematic structure of a melt spinning system 1 of the present embodiment with reference to FIG. 1 to FIG. 4. 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. FIG. 4 is a block diagram showing an electric structure of the melt spinning system 1.

[0030] As shown in FIG. 1, the melt spinning system 1 includes the melt spinning positions SP and an integrated controller 100. Each melt spinning position SP includes constituent features for spinning out yarns Y. The integrated controller 100 is a computer configured to integrally control the melt spinning positions SP.

[0031] The melt spinning positions SP include a melt spinning position SP1 and a melt spinning position SP2. 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), an exhaust unit 4, and a spinning controller 101. The melt spinning position SP1 includes a spinning

beam 2A functioning as a spinning beam 2, a yarn cooler 3A functioning as a yarn cooler 3, an exhaust unit 4A (first exhaust unit of the present invention) functioning as an exhaust unit 4, and a spinning controller 101A functioning as a spinning controller 101. The melt spinning position SP2 includes a spinning beam 2B functioning as a spinning beam 2, a yarn cooler 3B functioning as a yarn cooler 3, an exhaust unit 4B (second exhaust unit of the present invention) functioning as an exhaust unit 4, and a spinning controller 101B functioning as a spinning controller 101.

[0032] Each spinning beam 2 is configured to spin out molten polymer which is a material of the yarns Y. Each yarn cooler 3 is configured to cool the molten polymer spun out from the spinning beam 2, so as to form filaments f. Each 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] 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 adjust-

ment 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.

[0037] 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 adjusted 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.

[0038] 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.

[0039] 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.

[0040] Each melt spinning position SP includes the spinning controller 101 (see FIG. 1 and FIG. 4). The spinning controller 101 is configured to control each section of the melt spinning position SP. The spinning controller 101 includes, e.g., unillustrated CPU, ROM, and RAM. The spinning controller 101 is able to communicate with the integrated controller 100. A combination of the integrated controller 100 and spinning controllers 101 is equivalent to a control unit of the present invention.

(Exhaust Unit)

[0041] The following will describe each exhaust unit 4 with reference to FIG. 5 to FIG. 8(b). FIG. 5 is a plan view of a later-described suction member 31 and its surroundings. FIG. 6 is a cross section taken along a line VI-VI in FIG. 5. FIG. 7 shows a later-described aspirator 33 and its surroundings. FIG. 8(a) and FIG. 8(b) show a detailed structure of the aspirator 33. FIG. 8(a) is a cross section of the aspirator 33 taken along a line orthogonal to the front-rear direction. FIG. 8(b) shows a later-described aperture adjustment unit 73.

[0042] 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. 5) for sucking and discharging the gas. As shown in FIG. 5 to FIG. 7, the exhaust unit 4 includes the suction member 31, a duct 32, the aspirator 33, and a connection pipe 34 (see FIG. 7). The exhaust unit 4 is configured to allow 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. 5) via the suction member 31, the duct 32, the aspirator 33, and the connection pipe 34.

[0043] 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. 5, 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. 6). As shown in FIG. 6, 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.

[0044] As shown in FIG. 5 and FIG. 6, the enclosure member 41 includes, e.g., an enclosure portion 47 and two passage portions 48. FIG. 5 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. 5). The enclosure portion 47 is provided between the spinning beam 2 and the yarn cooler 3 in the up-down direction (see FIG. 6). 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.

[0045] The sucking rings 42 are ring-shaped members for discharging gas. As shown in FIG. 6, 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 the 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 suction ports 52.

[0046] 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.

[0047] 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 in 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). 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 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.

[0048] 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.

[0049] 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)

[0050] The following will detail the aspirator 33. As shown in FIG. 7, the aspirator 33 includes a primary pipe portion 61 and a gas inlet 62.

[0051] The primary pipe portion 61 is substantially cylindrical in shape, and extends along the up-down 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. 8(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. 8(a)) for causing the water and the gas to flow out.

[0052] 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. 8(a)) for causing gas to flow in. The gas inlet 62 is connected to the suction member 31 through the duct 32.

[0053] The following will clarify the flow direction and the gas discharge direction in the aspirator 33 with reference to FIG. 7. 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.

[0054] When an airflow is disturbed at a junction of the above-described fixed pipe PF and the connection pipe 34, a part of gas may flow into the connection pipe 34 from the fixed pipe PF (see dashed line arrows in FIG. 7). Especially, when plural aspirators 33 are provided, a great deal of water W (see FIG. 7) may flow into the fixed pipe PF so that a strong accompanied flow is generated. 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). As a result, the filaments f may be shaken, and the quality of yarns may be deteriorated. In order to suppress the inflow of gas into the connection pipe 34 from the fixed pipe PF, for example, the flow amount of the 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) side 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. As a result, the filaments f may be swung too much because of the increase in discharge amount of gas. In order to intentionally decrease this negative pressure, the aspirator 33 is therefore provided with, e.g., the outside air intake port 71 and the outside air intake port 72 as described below.

[0055] As shown in FIG. 8(a), the aspirator 33 includes the outside air intake ports 71 and 72. The outside air intake ports 71 and 72 are holes 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 the outside air intake ports 71 and 72.

[0056] 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. In the present embodiment, as shown in FIG. 8(a), two outside air intake ports 71 are provided as 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, e.g., substantially circular in shape. The number of the outside air intake ports 71 may be one, or three or more.

[0057] The outside air intake port 72 is provided at, e.g., the gas inlet 62. The outside air intake port 72 penetrates the circumferential surface of the gas inlet 62 from its outer circumferential surface to its inner circumferential surface. In the present embodiment, one outside air intake port 72 is provided as a slit extending in the circumferential direction of the gas inlet 62. The position, shape, and number of outside air intake ports 72 are not limited to those. The outside air intake port 72 may be, e.g., substantially circular in shape. The number of outside air intake ports 72 may be two or more. The aperture area of the outside air intake port 72 is preferably smaller than that of each outside air intake port 71.

[0058] As shown in FIG. 8(b), the aperture adjustment unit 73 is attached to the water inlet 61a. The aperture adjustment unit 73 is provided for adjusting the substantial aperture area (effective aperture area) of each outside air intake port 71 by adjusting the opening degree of each outside air intake port 71. An aperture adjustment unit 74 is attached to the gas inlet 62. The aperture adjustment unit 74 is provided for adjusting the opening degree (and effective aperture area) of the outside air intake port 72. The details will be given later. For example, a pressure gauge 75 (pressure detection unit of the present invention: see FIG. 8(b)) is provided in the vicinity of the outside air intake port 72 so as to detect the pressure of gas at a predetermined position in the gas inlet 62. As shown in FIG. 4, a pressure gauge 75A (first pressure detection unit of the present invention) is provided as a pressure gauge 75 corresponding to the exhaust unit 4A. A pressure gauge 75B (second pressure detection unit of the present invention) is provided as a pressure gauge 75 corresponding to the exhaust unit 4B. The aperture adjustment unit 73 and the aperture adjustment unit 74 are included in the adjustment unit and output unit of the present invention.

[0059] As shown in FIG. 8(b), a supply tube 76 may be provided at the aspirator 33. The supply tube 76 is provided for supplying water to the gas inlet 62. The supply tube 76 causes the water supply tube 63 to communicate with the gas inlet 62. With this arrangement, a part of the water supplied to the water inlet 61a is supplied to the gas inlet 62. Therefore, when gas is unintentionally solidified inside the gas inlet 62 so as to generate a solidified body, the solidified body is dissolved into the water and removed.

[0060] 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. 7). Accordingly, a downward accompanied flow is generated. This accompanied flow generates a negative pressure in the vicinity of the suction port 52 (see FIG. 5) connected to the exhaust path 30. Because of this, gas is sucked into the internal space 46 (see FIG. 5) 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. 7). 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.

(Airflow in Vicinity of Outside Air Intake Port)

[0061] The following will describe an airflow in the vicinity of the above-described outside air intake ports 71 and 72 with reference to FIG. 9. As water flows in the aspirator 33 (see two-dot chain line arrows 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 allows gas to be sucked through the gas inlet 62 (see a dotted line arrow in FIG. 9). At this stage, a negative pressure is also generated 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. Similarly, a negative pressure is also generated in the vicinity of the outside air intake port 72. As the outside air is taken into the gas inlet 62 from the outside space So through the outside air intake port 72, the negative pressure is decreased. In this way, as the outside air is taken into the exhaust path 30, a negative pressure generated at the suction port 52 is suitably decreased. As a result, the discharge speed of gas in the vicinity of the filaments f (see FIG. 2) is suppressed from being excessively large.

[0062] Various operations may be performed based on a detection result of the pressure by the pressure gauge 75. For example, the opening degree of each of the outside air intake ports 71 and 72 may be adjusted by using the aperture adjustment units 73 and 74. However, traditionally, the pressure gauge 75 is not always provided at the exhaust unit 4. For example, the operator brings the pressure gauge 75 each time the system is set up or regularly checked. Because of this, the operator has a large burden of the measurement, adjustment, etc. of the pressure. To reduce the burden on the operator in regard to the pressure of the gas in the melt spinning system 1, the melt spinning system 1 is structured as described below.

(Detailed Structure of Melt Spinning System)

[0063] The following will detail the melt spinning system 1 with reference to FIG. 4 and FIG. 8(b) to FIG. 10(b). FIG. 10(a) and 10(b) show the adjustment of opening degree of each outside air intake port 71 by using the aperture adjustment unit 73.

[0064] To begin with, the following will describe the surroundings of the aspirator 33. As described above, the aperture adjustment unit 73 is attached to the water inlet 61a (see FIG. 8(b)). The aperture adjustment unit 73 includes, e.g., a cylindrical member 81 and an ac-

tuator 82. As described above, the aperture adjustment unit 74 is attached to the gas inlet 62 (see FIG. 8(b)). The aperture adjustment unit 74 includes, e.g., a cylindrical member 83 and an actuator 84.

[0065] The cylindrical member 81 is, e.g., substantially cylindrical in shape. The cylindrical member 81 is arranged to surround at least a part which is of the water inlet 61a and at which the outside air intake ports 71 are formed. For example, two slits 81a are formed on an outer circumferential surface of the cylindrical member 81. The slits 81a respectively correspond to the two outside air intake ports 71. Each slit 81a extends along the circumferential direction of the cylindrical member 81 so as to, e.g., run substantially a half-way around the cylindrical member 81. The two slits 81a 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 member 81 is rotatable in the circumferential direction of the water inlet 61a along the outer circumferential surface of the water inlet 61a. For example, the actuator 82 is an apparatus for adjusting an angular position of the cylindrical member 81 in the circumferential direction of the cylindrical member 81. The actuator 82 may be, e.g., an unillustrated stepping motor. The actuator 82 and the cylindrical member 81 may be connected by, e.g., an unillustrated transmission mechanism configured to transmit the force of the actuator 82 to the cylindrical member 81. The transmission mechanism may be, e.g., a known gear. The actuator 82 may be electrically connected to the spinning controller 101 (see FIG. 4). In the present embodiment, the cylindrical member 81 is rotated by the actuator 82. As the cylindrical member 81 rotates, the slits 81a are moved in the circumferential direction of the water inlet 61a. Because of this, the positional relationship between the slits 81a 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 FIGs. 10(a) and 10(b). In FIG. 10(a), the slits 81a entirely overlap the outside air intake ports 71 in the circumferential direction of the water inlet 61a. In FIG. 10(b), the slits 81a 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. 10(a) is twice as large as the opening degree (and effective aperture area) of each outside air intake port 71 in FIG. 10(b).

[0066] The cylindrical member 83 is structured similarly as the cylindrical member 81. That is, the cylindrical member 83 is substantially cylindrical in shape. The cylindrical member 83 is arranged to surround at least a part which is of the gas inlet 62 and at which the outside air intake port 72 is formed. For example, a slit 83a is formed on an outer circumferential surface of the cylindrical member 83. The slit 83a is provided for ad-

justing the opening degree of the outside air intake port 72. For example, the cylindrical member 83 is rotatable in the circumferential direction of the gas inlet 62 along the outer circumferential surface of the gas inlet 62. For example, the actuator 84 is an apparatus for adjusting an angular position of the cylindrical member 83 in the circumferential direction of the cylindrical member 83. The actuator 84 may be, e.g., an unillustrated stepping motor. The actuator 84 and the cylindrical member 83 may be connected by, e.g., an unillustrated transmission mechanism. The actuator 84 is electrically connected to the spinning controller 101 (see FIG. 4). The functions of the cylindrical member 83 and the actuator 84 are the same as those of the cylindrical member 81 and the actuator 82, and thus are not further detailed.

[0067] As described above, the aspirator 33 is able to change the magnitude of a negative pressure by changing a condition on the flow amount of water flowing inside the aspirator 33. To change the condition on the flow amount of the water, the exhaust unit 4 includes a flow amount adjustment unit 85. The flow amount adjustment unit 85 is able to adjust the flow amount of the water supplied to the aspirator 33 from the water source. The flow amount adjustment unit 85 may be, e.g., a known valve. The flow amount adjustment unit 85 may be provided at, e.g., an intermediate portion of the water supply tube 63. The flow amount adjustment unit 85 is electrically connected to the spinning controller 101 (see FIG. 4). The flow adjustment unit 85 is included in the adjustment unit and output unit of the present invention.

(Other Arrangements)

[0068] The following will further describe the melt spinning system 1. As shown in FIG. 4, for example, the spinning beam 2 is preferably provided with a spinning stopping portion 86 (the output unit of the present invention). The spinning stopping portion 86 is configured to forcibly stop each spinneret 13 from spinning out molten polymer. For example, the spinning stopping portion 86 may include a known gear pump (not illustrated). The gear pump is included in a mechanism for causing each spinneret 13 to discharge a constant amount of the molten polymer per unit time. The spinning out of molten polymer may be stopped as the driving of gear pump is stopped. Alternatively, for example, the spinning stopping portion 86 may include an unillustrated cooling unit configured to forcibly cool an intermediate portion of a path of the molten polymer in the spinning beam 2 so that the molten polymer is solidified. Alternatively, for example, the spinning stopping portion 86 may be configured to forcibly close an intermediate portion of the path of the molten polymer. Alternatively, for example, the spinning stopping portion 86 may be configured to forcibly stop the spinning beam 2 from receiving a material of the molten polymer. The spinning stopping portion 86 is electrically

connected to the spinning controller 101 (see FIG. 4).

[0069] As shown in FIG. 4, each melt spinning position SP preferably includes an alarm lamp 87 (the notification unit and output unit of the present invention) which is able to raise an alarm. The alarm lamp 87 may be, e.g., a known tower lamp configured to emit a predetermined color light. The alarm lamp 87 is electrically connected to the spinning controller 101 (see FIG. 4). The alarm lamp 87 is able to be turned on or flicker in accordance with an instruction from the spinning controller 101.

[0070] As shown in FIG. 4, the melt spinning system 1 preferably includes a display device 88 (the display unit, notification unit, and output unit of the present invention). The display device 88 is, e.g., a known display. The display device 88 is electrically connected to the integrated controller 100 (see FIG. 4).

[0071] The integrated controller 100 and the spinning controller 101 (hereinafter, those will be referred to as a control unit) are able to calculate a value (hereinafter, this will be simply referred to as a pressure value) of the pressure inside the exhaust path 30 of each melt spinning position SP based on a detection result of the pressure gauge 75 in each exhaust unit 4. The control unit stores information of thresholds of the pressure in advance. Both an upper limit value and a lower limit value may be stored in the control unit as the thresholds. Alternatively, only the upper limit value or the lower limit value may be stored in the control unit as the thresholds. The control unit may store information of a target value of the pressure in advance. The control unit may be structured so that a threshold and/or the target value are/is inputtable. The operator may input the threshold and/or the target value into the control unit in advance.

(Control by Control Unit)

[0072] The following will describe the control of each section of the melt spinning positions SP by the integrated controller 100 and the spinning controllers 101 (hereinafter, those will be referred to as the control unit). In an initial state, for example, molten polymer is spun out from the spinnerets 13 in the spinning beams 2 of all melt spinning positions SP.

[0073] When the molten polymer is spun out from each spinning beam 2, the control unit performs an output process of causing each section of each melt spinning position SP to make an output regarding the pressure based on a detection result of the pressure gauge 75. The output process includes, e.g., the following processes.

[0074] The control unit is configured to control at least one of the flow amount adjustment unit 85, the aperture adjustment unit 73, and the aperture adjustment unit 74 based on a detection result of the pressure gauge 75. For example, the control unit is preferably configured to perform feedback control for at least

one of the above-described units so that a pressure value regarding each exhaust unit 4 approaches the target value by using known PID control. As such, for example, the control unit is preferably configured to always perform an adjustment process of adjusting the pressure regarding each exhaust unit 4. The adjustment process is included in the output process of the present invention.

[0075] The control unit is preferably configured to obtain pressure values regarding the melt spinning positions SP in real time, and to cause the display device 88 to display these pressure values. For example, the control unit is preferably configured to associate identification information of the melt spinning positions SP with information of the pressure values of the melt spinning positions SP and to cause the display device 88 to simultaneously display these pieces of information. However, the disclosure is not limited to this. For example, the control unit may be configured to cause the display device 88 to display combinations of (i) pieces of identification information of the melt spinning positions SP and (ii) pressure values of the corresponding melt spinning positions SP one by one in a predetermined order each time a predetermined unit time passes. Alternatively, the integrated controller 100 may be configured to cause the display device 88 to display identification information of one melt spinning position SP selected by the operator and a pressure value corresponding to this melt spinning position SP in accordance with an operation by the operator. The integrated controller 100 is configured to perform a display process of causing the display device 88 to display at least information of a detection result by the pressure gauge 75A and information of a detection result by the pressure gauge 75B. The display process is included in the output process of the present invention.

[0076] The control unit is preferably configured to compare an obtained pressure value with a threshold of the pressure, and to always determine whether the pressure value is within a predetermined range in each exhaust unit 4. When a pressure value exceeds the upper limit value or falls below the lower limit value (i.e., an abnormal state occurs) in one exhaust unit 4, the control unit may cause the display device 88 to display information indicating that the abnormal state occurs in this exhaust unit 4. Alternatively, in this case, the control unit may turn on or cause the alarm lamp 87 at this melt spinning position SP to flicker. As such, the control unit is configured to perform a notification process of causing the notification unit to report information regarding the pressure. To be more specific, the control unit is configured to perform, as the notification process, an error notification process of causing the notification unit to report information indicating an error of the pressure regarding each exhaust unit 4. The notification process is included in the output process of the present invention.

[0077] For example, the control unit may be config-

ured to estimate a timing (e.g., a date and time of the maintenance or the remaining days and time until the maintenance) of the maintenance for each exhaust unit 4 based on a temporal change in a pressure value regarding each exhaust unit 4. The control unit may be configured to cause the display device 88 to display information of an estimated timing of the maintenance. Alternatively, when it is determined that one exhaust unit 4 needs the maintenance, the control unit may turn on or cause the alarm lamp 87 corresponding to this exhaust unit 4 to flicker. As such, the control unit may be configured to control the notification unit to perform, as the notification process, a maintenance notification process of reporting information of a timing of the maintenance for each exhaust unit 4.

[0078] When an error of the pressure occurs in regard to one exhaust unit 4, the control unit preferably controls the spinning stopping portion 86 of this exhaust unit 4 to perform a stop process of stopping each spinneret 13 from spinning out molten polymer. The stop process is included in the output process of the present invention.

[0079] As described above, the control unit is configured to perform the output process. As the control unit always monitors the pressure inside the exhaust path 30 and causes the output unit to make an output regarding the pressure, a task of the operator is at least partially automated. It is therefore possible to reduce the burden on the operator in regard to the pressure of gas in the melt spinning system 1.

[0080] The melt spinning system 1 includes the exhaust unit 4A, the exhaust unit 4B, the pressure gauge 75A, and the pressure gauge 75B. In other words, the melt spinning system 1 includes the exhaust units 4 and the pressure gauges 75. The larger the number of the exhaust units 4 included in the melt spinning system 1 is, the larger the number of tasks of the operator is. Because the pressure gauges 75 are provided to correspond to the exhaust units 4 in the present invention, the present invention is especially effective to reduce the burden on the operator.

[0081] The control unit is configured to perform the display process as the output process. With this arrangement, plural pieces of information of the pressure are checked by one display device 88. It is therefore possible to effectively reduce the burden on the operator.

[0082] The control unit is configured to perform the notification process as the output process. With this arrangement, information is reported by the notification unit according to need. It is therefore possible to prompt the operator to act quickly.

[0083] The control unit is configured to perform the error notification process as the notification process. With this arrangement, when an error occurs at one exhaust unit 4, the operator is rapidly notified of information regarding this error. Therefore, the quick act is performed at the occurrence of an error.

[0084] The control unit is configured to perform the maintenance notification process as the notification process. With this arrangement, the operator is notified of a timing of the maintenance for each exhaust unit 4. It is therefore possible to smoothly perform the maintenance.

[0085] The control unit is configured to perform the stop process as the output process. With this arrangement, when an error occurs at the pressure of gas in one exhaust unit 4, the spinning out of molten polymer is stopped. This rapidly stops the filaments f whose quality is abnormal from keeping produced. It is therefore possible to suppress the waste of running costs such as material costs, etc. of the filaments f.

[0086] The control unit is configured to perform the adjustment process as the output process. This reduces the time and labor for the operator to adjust the pressure inside the exhaust path 30.

[0087] The adjustment unit includes the flow amount adjustment unit 85. The adjustment unit 85 makes it possible to adjust the pressure inside the exhaust path 30.

[0088] Each exhaust unit 4 includes the outside air intake ports 71 and 72 and the aperture adjustment units 73 and 74. As the opening degree of the outside air intake ports 71 and 72 is adjusted, the amount of outside air taken in through the outside air intake ports 71 and 72 is adjusted. As a result, the pressure inside the exhaust path 30 is adjusted.

[0089] The following will describe modifications of the above-described 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, 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 following will describe an alternative case 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 4M of the 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 4M. That is, one exhaust unit 4M 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 2MA and a spinning beam 2MB. The two yarn coolers 3 include a yarn cooler 3MA and a yarn cooler 3MB. The yarn cooler 3MA corresponds to the spinning beam 2MA. The yarn cooler 3MB corresponds to the spinning beam 2MB. The exhaust unit 4M is

provided instead of the exhaust unit 4. The exhaust unit 4M includes, e.g., two suction members 31, two ducts 32, and an aspirator 33M. 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 2MA. The suction member 31B and the duct 32B correspond to the spinning beam 2MB. The aspirator 33M is connected both to the duct 32A and the duct 32B.

As shown in FIG. 12, the aspirator 33M includes a primary pipe portion 61M and two gas inlets 62. The primary pipe portion 61M includes the above-described water inlet 61a, the above-described merging point 61b, and the above-described outlet 61c. In this modification, for example, the two gas inlets 62 are connected to the merging point 61b. The two gas inlets 62 include a gas inlet 62MA and a gas inlet 62MB. The gas inlet 62MA is connected to the duct 32A. The gas inlet 62MB is connected to the duct 32B. With these arrangements, the exhaust unit 4M is provided with two exhaust paths 30M (see FIG. 12). To be more specific, one (exhaust path 30MA; first exhaust path of the present invention) of the two exhaust paths 30M includes the duct 32A and the gas inlet 62MA. The other (exhaust path 30MB; second exhaust path of the present invention) of the two exhaust paths 30M includes the duct 32B and the gas inlet 62MB. The aspirator 33M is configured to suck and discharge gas from both the exhaust path 30MA and the exhaust path 30MB. The pressure gauge 75 is provided in the vicinity of each of the two gas inlets 62. A pressure gauge 75MA (first pressure detection unit of the present invention) is provided to correspond to the gas inlet 62MA. A pressure gauge 75MB (second pressure detection unit of the present invention) is provided to correspond to the gas inlet 62MB. As such, because the pressure gauges 75MA and 75MB are provided to correspond to the exhaust paths 30MA and 30MB in this modification, this modification is especially effective to reduce the burden on the operator.

(2) In the embodiment above, the cylindrical member 81 of the aperture adjustment unit 73 is rotatable in the circumferential direction of the water inlet 61a. However, the disclosure is not limited to this. For example, the cylindrical member 81 may be movable in the extending direction of the water inlet 61a. In this case, the outside air intake ports 71 and the slits 81a may extend in the circumferential direction of the water inlet 61a as described above. Alternatively, the outside air intake ports 71 and the slits 81a may extend in the extending direction of the water inlet 61a. The above-described shapes of the outside air intake ports 71 are examples, and may be differently arranged as long as they

are configured to take in outside air. The same applies to the outside air intake port 72 and the aperture adjustment unit 74.

(3) In the embodiment above, the cylindrical member 81 is driven by the actuator 82. However, the disclosure is not limited to this. The cylindrical member 81 may be manually moved by the operator. For example, the cylindrical member 81 may be provided with an unillustrated handle. The same applies to the cylindrical member 83. In this case, the control unit may not be configured to perform the adjustment process.

(4) In the embodiment above, the control unit is configured to perform the adjustment process, the display process, the error notification process, the maintenance notification process, and the stop process as the output process. However, the disclosure is not limited to this. The control unit may be differently arranged as long as it is configured to perform at least one of the adjustment process, the display process, the error notification process, the maintenance notification process, and the stop process as the output process. The output process may include any of the adjustment process, the display process, the error notification process, and the maintenance notification process, and the stop process.

(5) The melt spinning system 1 or 1M (hereinafter, this will be referred to as the melt spinning system 1, etc.) may include only one or some of the actuator 82, the actuator 84, the flow amount adjustment unit 85, the spinning stopping portion 86, the alarm lamp 87, and the display device 88. In this case, the control unit is configured to perform only one or some performable processes among the adjustment process, the display process, the error notification process, the maintenance notification process, and the stop process.

(6) In the embodiment above, the opening degree of the outside air intake ports 71 and 72 (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 is formed at the water inlet 61a. However, the disclosure is not limited to this. Each outside air intake port 71 may be formed at, e.g., the merging point 61b or the outlet 61c.

(8) In the embodiment above, the aspirator 33 includes the outside air intake port 71 and the outside air intake port 72. However, the disclosure is not limited to this. The aspirator 33 may include only the outside air intake port 71 or the outside air intake port 72. Alternatively, the aspirator 33 may not include the outside air intake port 71 and the outside air intake port 72.

(9) In the embodiment above, the aspirator 33 is configured to generate a negative pressure. However, the disclosure is not limited to this. For example, a known blower may be provided in addition to or instead of the aspirator 33. For example, the blower may be provided downstream of the connection pipe 34 in the gas discharge direction and the flow direction.

(10) In the embodiment above, the exhaust unit 4 or 4M includes the pressure gauge 75. However, the disclosure is not limited to this. For example, a known pressure sensor may be provided instead of the pressure gauge 75.

(11) 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.

(12) 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 necessarily arranged to surround the filaments f.

(13) 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 other kinds of nylon or polyester, etc. is spun out, as a matter of course.

Claims

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

a 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);

at least one exhaust unit (4, 4M) respectively provided with at least one exhaust path (30, 30M) for sucking and discharging gas generated from the molten polymer spun out from the spinneret (13);

at least one pressure detection unit (75) which is able to detect a pressure at a predetermined position in the at least one exhaust path (30, 30M) corresponding to the at least one pressure detection unit;

an output unit (73, 74, 85, 86, 87, 88) which is able to make an output regarding the pressure;

and

a control unit (100, 101), and when the molten polymer is spun out from the yarn spinning unit (2), the control unit (100, 101) performing an output process of causing the output unit (73, 74, 85, 86, 87, 88) to make the output based on a detection result of the at least one pressure detection unit (75).

2. The melt spinning system (1) according to claim 1, further comprising: a first exhaust unit (4A) functioning as one of the at least one exhaust unit (4, 4M);

a second exhaust unit (4B) which functions as another of the at least one exhaust unit (4, 4M) and which is different from the first exhaust unit (4A);

a first pressure detection unit (75A) which functions as one of the at least one pressure detection unit (75) and which corresponds to the first exhaust unit (4A); and

a second pressure detection unit (75B) which functions as another of the at least one pressure detection unit (75) and which corresponds to the second exhaust unit (4B).

3. The melt spinning system (1) according to claim 1, wherein, the at least one exhaust unit (4M) includes:

a first exhaust path (30MA) functioning as one of the at least one exhaust path (30M); and

a second exhaust path (30MB) which functions as another of at least one the exhaust path (30M) and which is different from the first exhaust path (30MA),

a first pressure detection unit (75MA) is provided as one of the at least one pressure detection unit (75) to be able to detect the pressure in the first exhaust path (30MA), and

a second pressure detection unit (75MB) is provided as another of the at least one pressure detection unit (75) to be able to detect the pressure in the second exhaust path (30MB).

4. The melt spinning system (1) according to claim 2 or 3, wherein, the output unit (73, 74, 85, 86, 87, 88) includes a display unit (88) which is able to display information, and the control unit (100, 101) is configured to perform, as the output process, a display process of causing the display unit (88) to display information of a detection result of the first pressure detection unit (75A, 75MA) and information of a detection result of the second pressure detection unit (75B, 75MB).

5. The melt spinning system (1) according to any one

of claims 1 to 4, wherein, the output unit (73, 74, 85, 86, 87, 88) includes a notification unit (87, 88) which is able to report information, and the control unit (100, 101) is further configured to perform, as the output process, a notification process of causing the notification unit (87, 88) to report information regarding the pressure based on a detection result of the at least one pressure detection unit (75).

6. The melt spinning system (1) according to claim 5, wherein, the control unit (100, 101) is further configured to perform, as the notification process, an error notification process of causing the notification unit (87, 88) to report information indicating an error of the pressure in regard to the at least one exhaust unit (4, 4M).
7. The melt spinning system (1) according to claim 5 or 6, wherein, the control unit (100, 101) is further configured to perform, as the notification process, a maintenance notification process of controlling the notification unit (87, 88) to report information of a timing of maintenance for the at least one exhaust unit (4, 4M) based on the detection result of the at least one pressure detection unit (75).
8. The melt spinning system (1) according to any one of claims 1 to 7, wherein, the output unit (73, 74, 85, 86, 87, 88) includes a spinning stopping portion (86) which is able to stop the spinneret (13) from spinning out the molten polymer, and when the occurrence of the error of the pressure in regard to the at least one exhaust unit (4, 4M) is determined, the control unit (100, 101) controls the spinning stopping portion (86) to perform, as the output process, a stop process of stopping the yarn spinning unit (2) from spinning out the molten polymer.
9. The melt spinning system (1) according to any one of claims 1 to 8, wherein, the output unit (73, 74, 85, 86, 87, 88) includes an adjustment unit (73, 74, 85) which is able to adjust the pressure at the at least one exhaust path (30, 30M) of the at least one exhaust unit (4, 4M), and the control unit (100, 101) is configured to perform, as the output process, an adjustment process of controlling the adjustment unit (73, 74, 85) based on the detection result of the at least one pressure detection unit (75) to adjust the pressure.
10. The melt spinning system (1) according to claim 9, wherein, the adjustment unit (73, 74, 85) includes a flow amount adjustment unit (85) which is able to adjust the flow amount of fluid for generating a negative pressure at the at least one exhaust path (30, 30M).

11. The melt spinning system (1) according to claim 9 or 10, wherein, the at least one exhaust unit (4, 4M) includes an outside air intake port (71, 72) which is able to take outside air into the at least one exhaust path (30, 30M), and the adjustment unit (73, 74, 85) includes an aperture adjustment unit (73, 74) which is able to adjust the opening degree of the outside air intake port (71, 72).

FIG.1

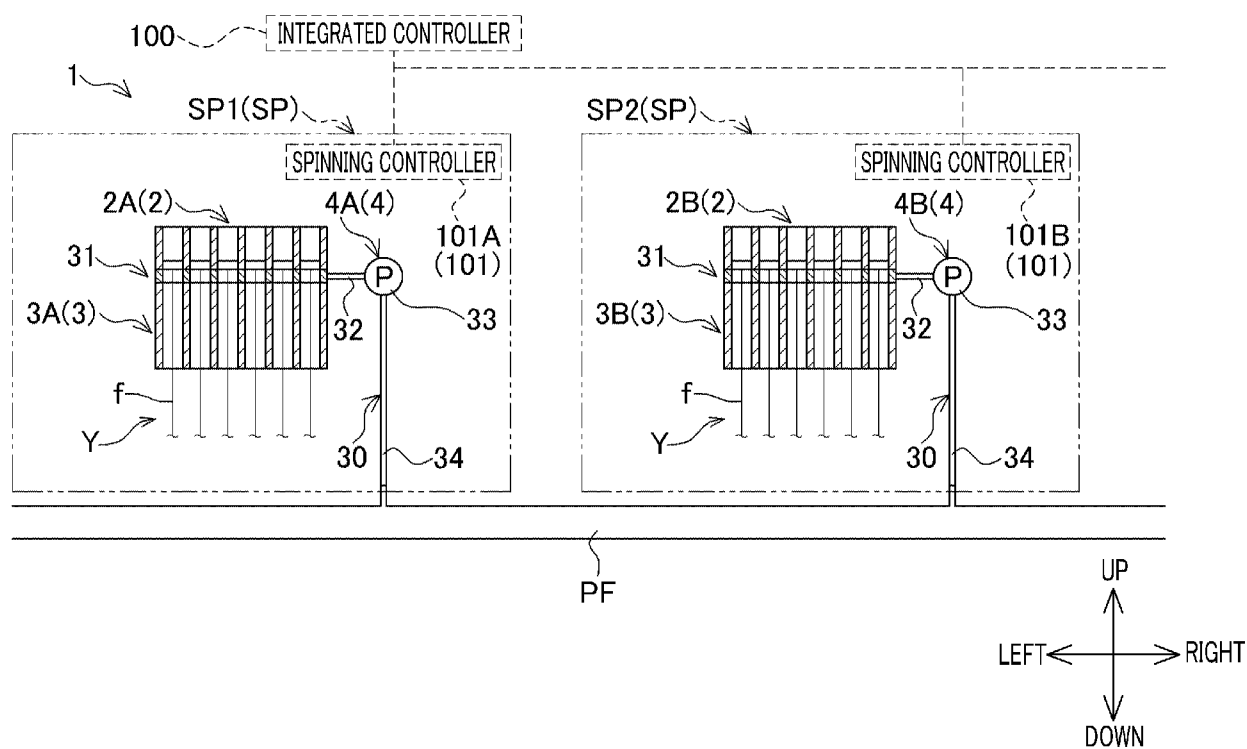


FIG.2

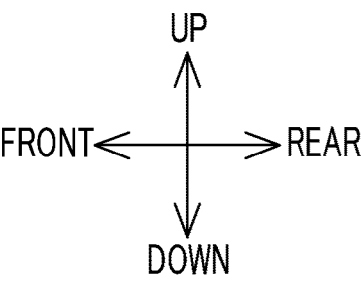
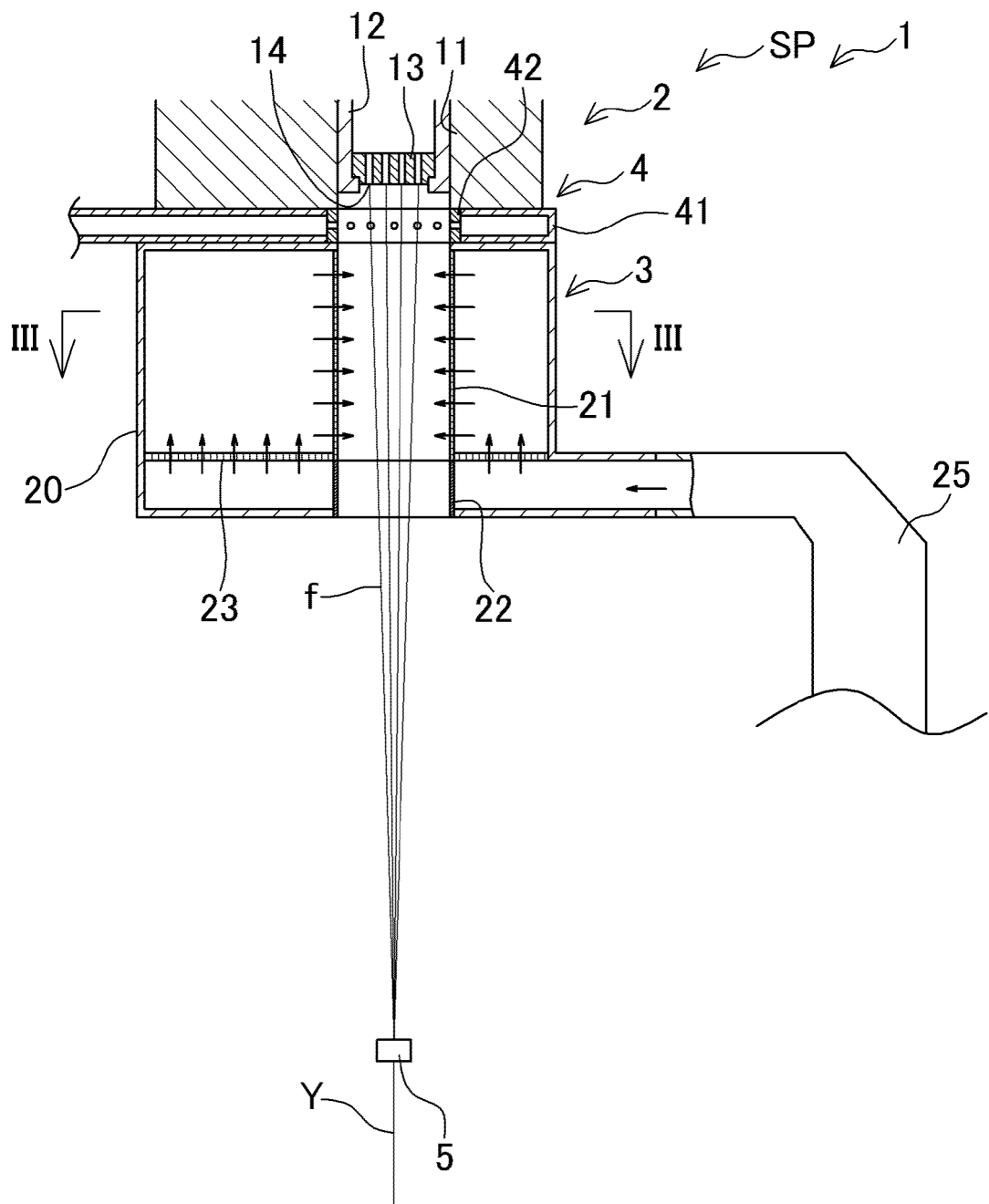


FIG.3

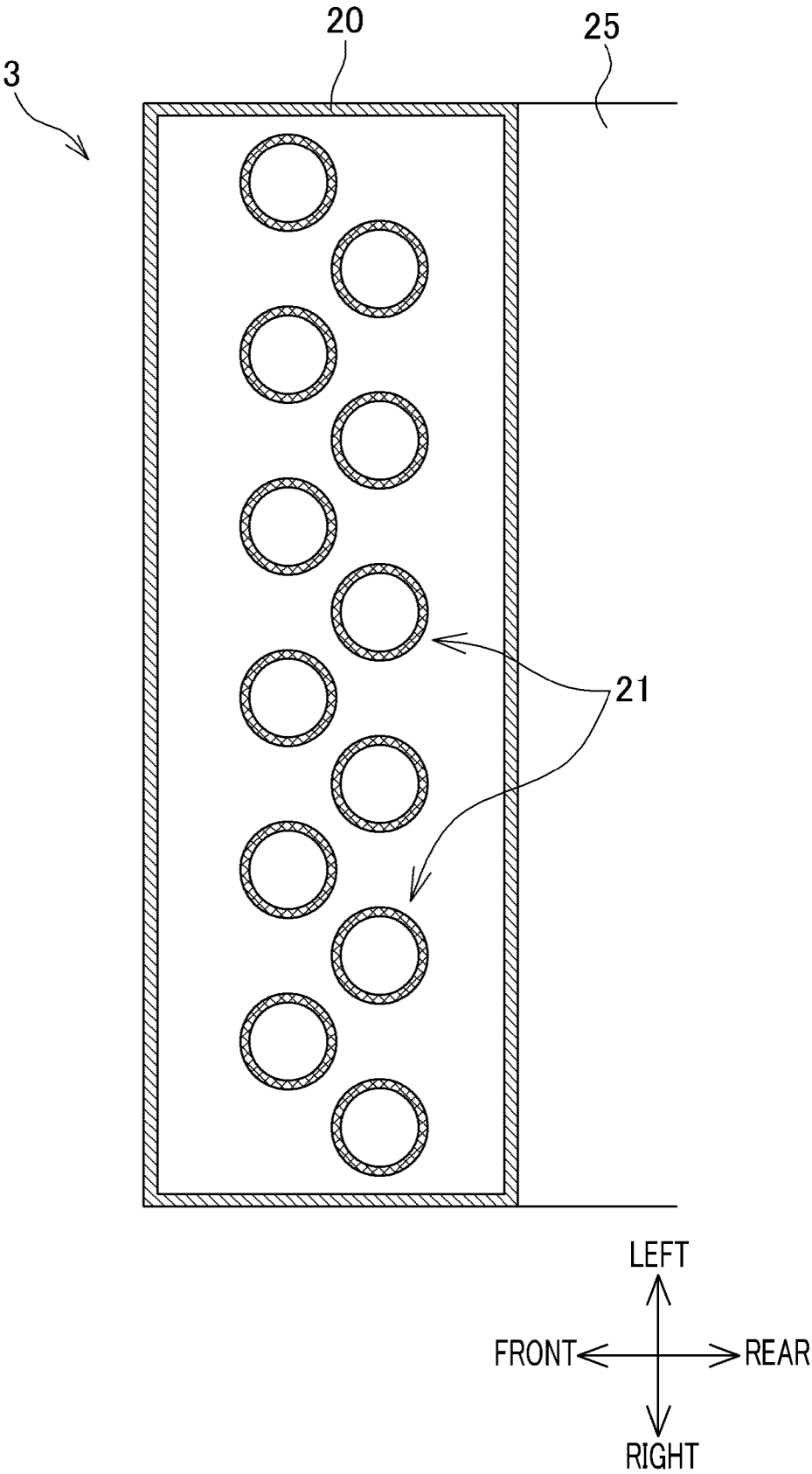


FIG. 4

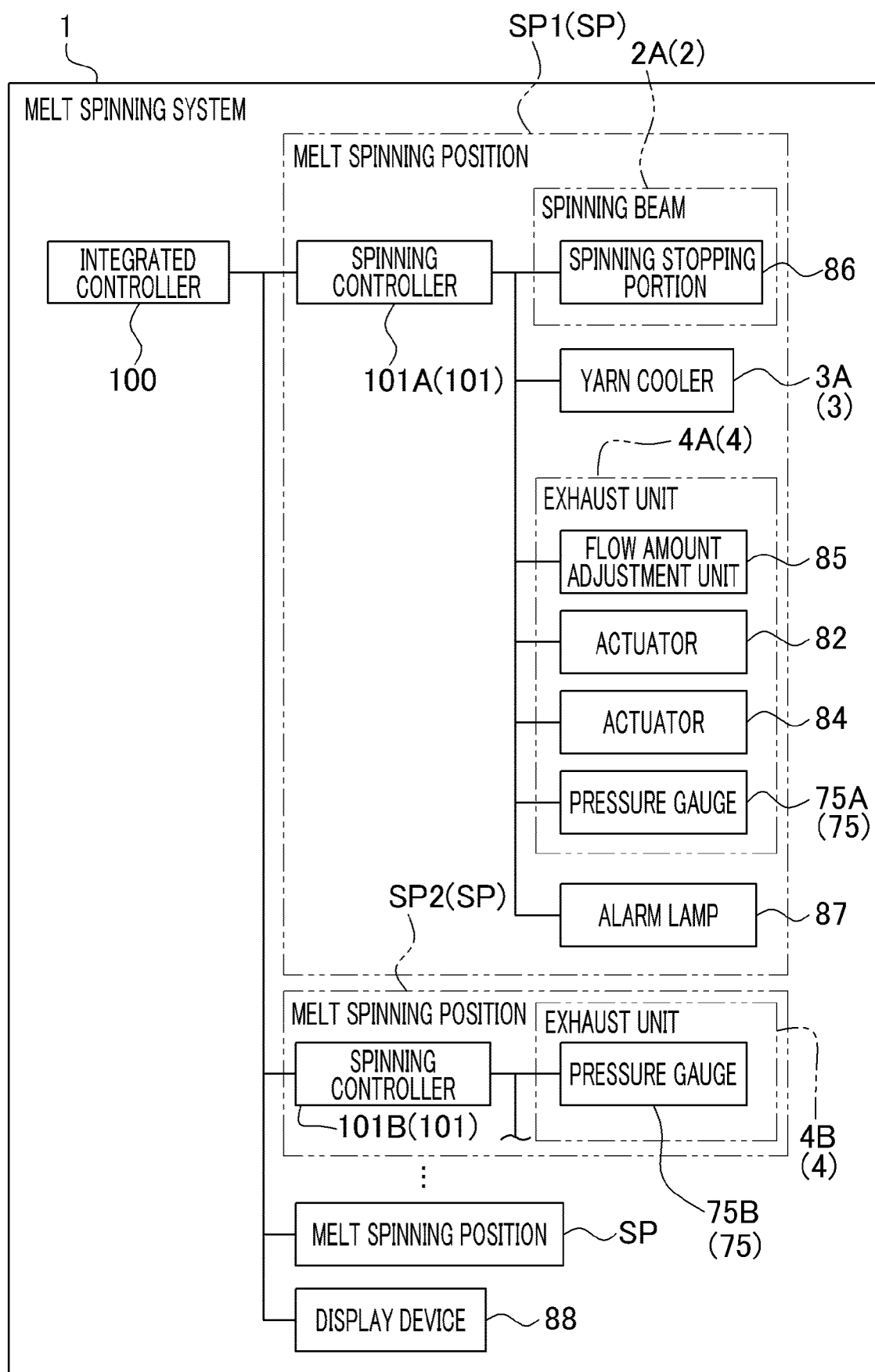


FIG.5

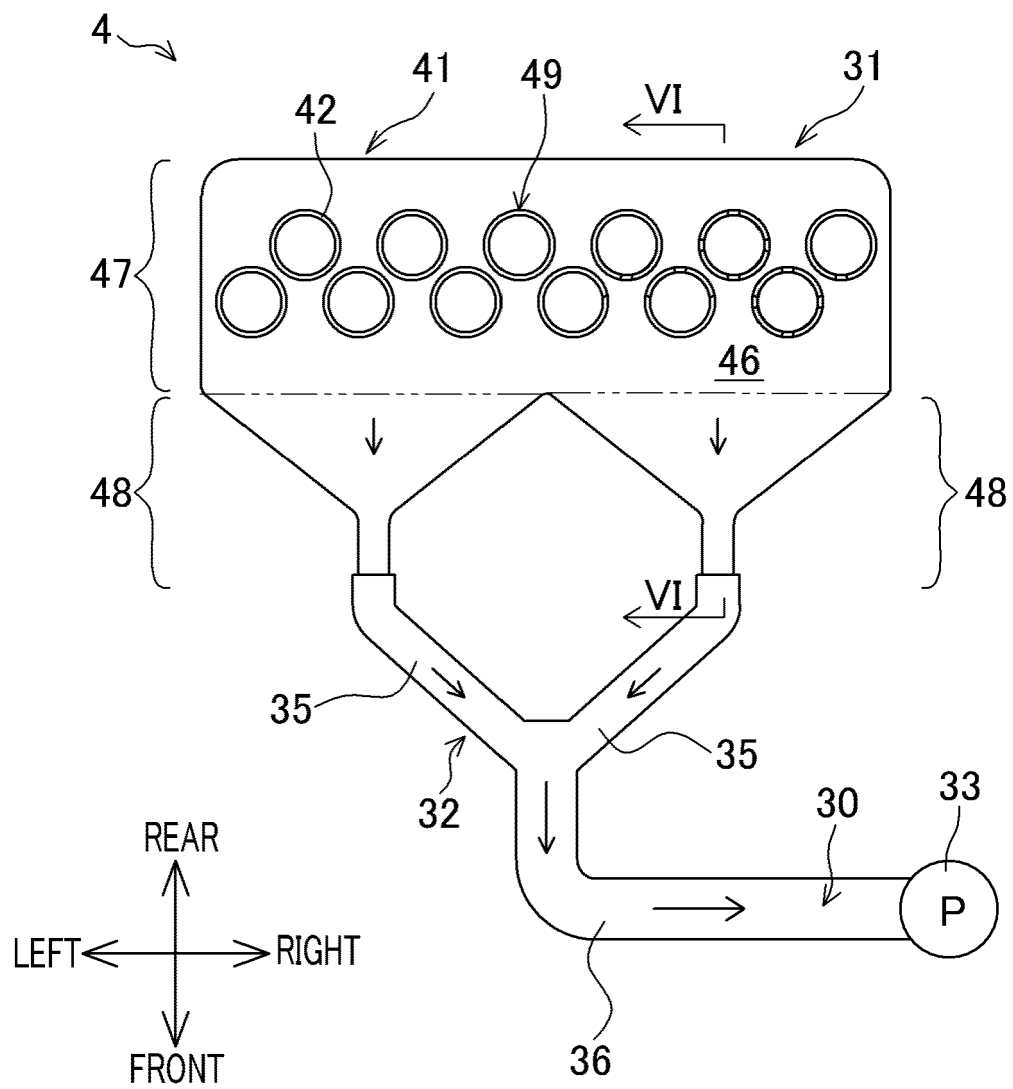
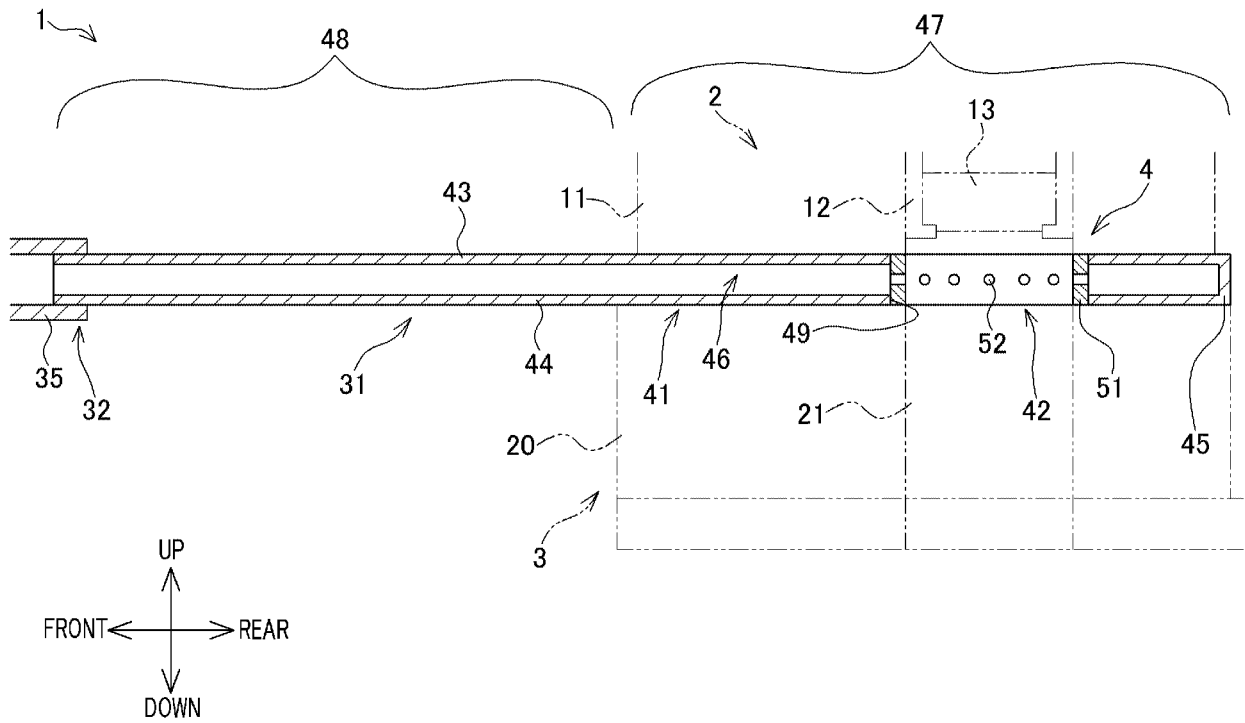


FIG.6



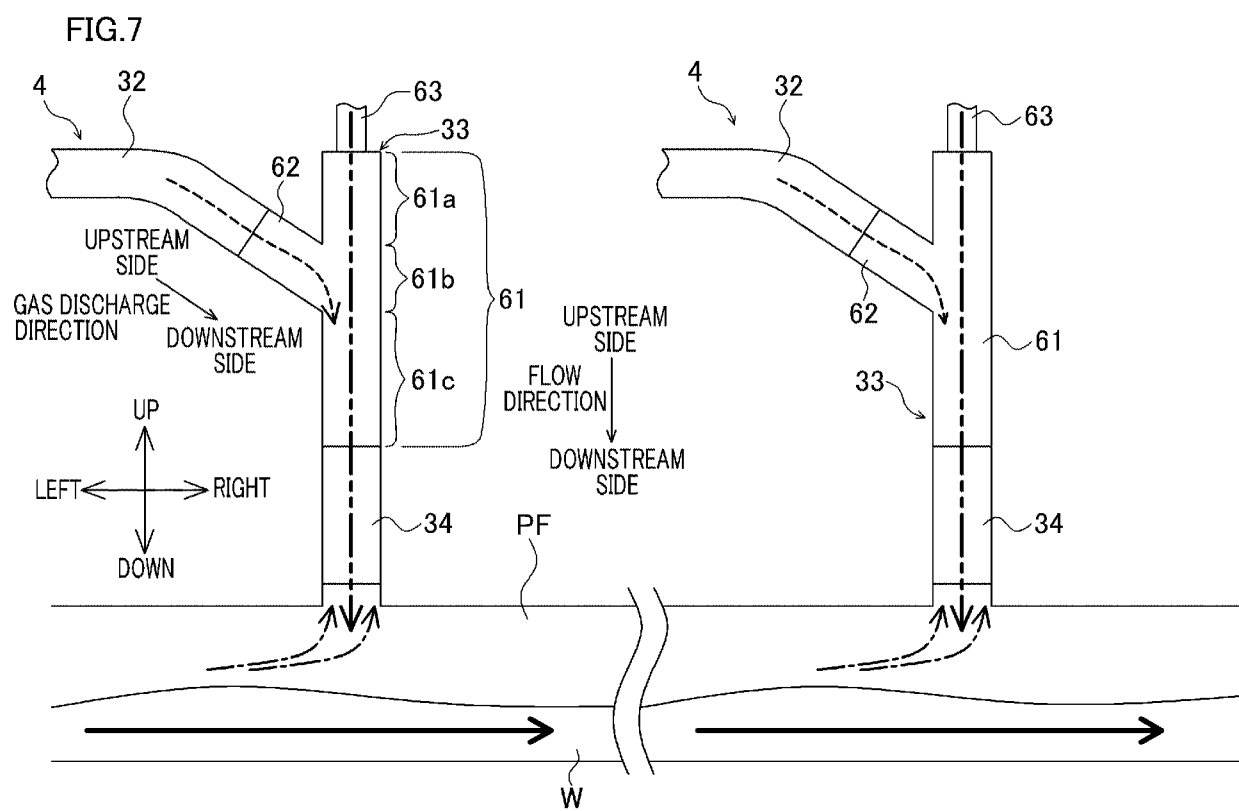


FIG.8

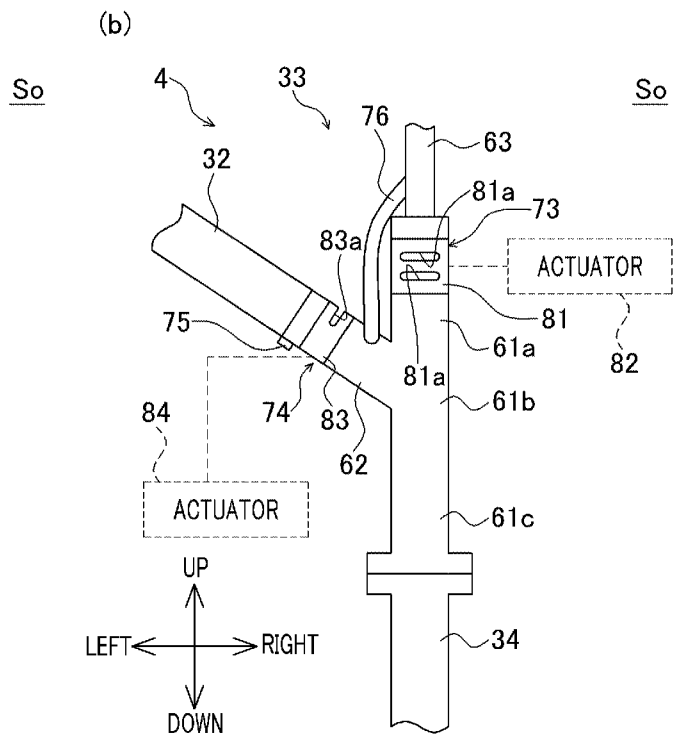
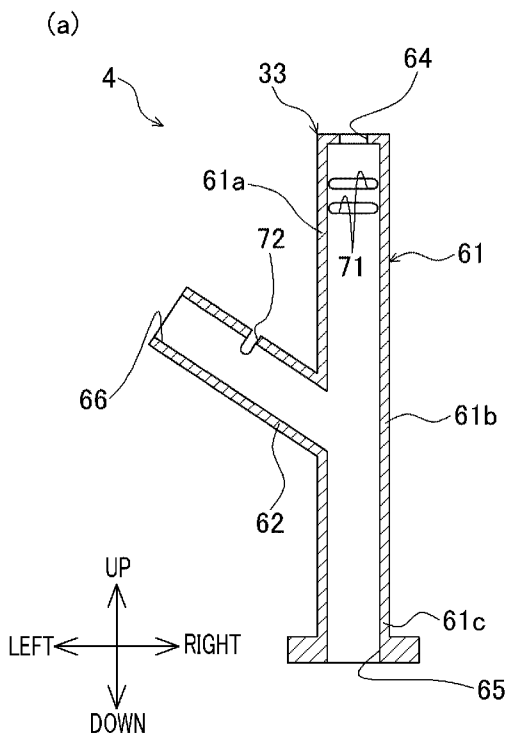


FIG.9

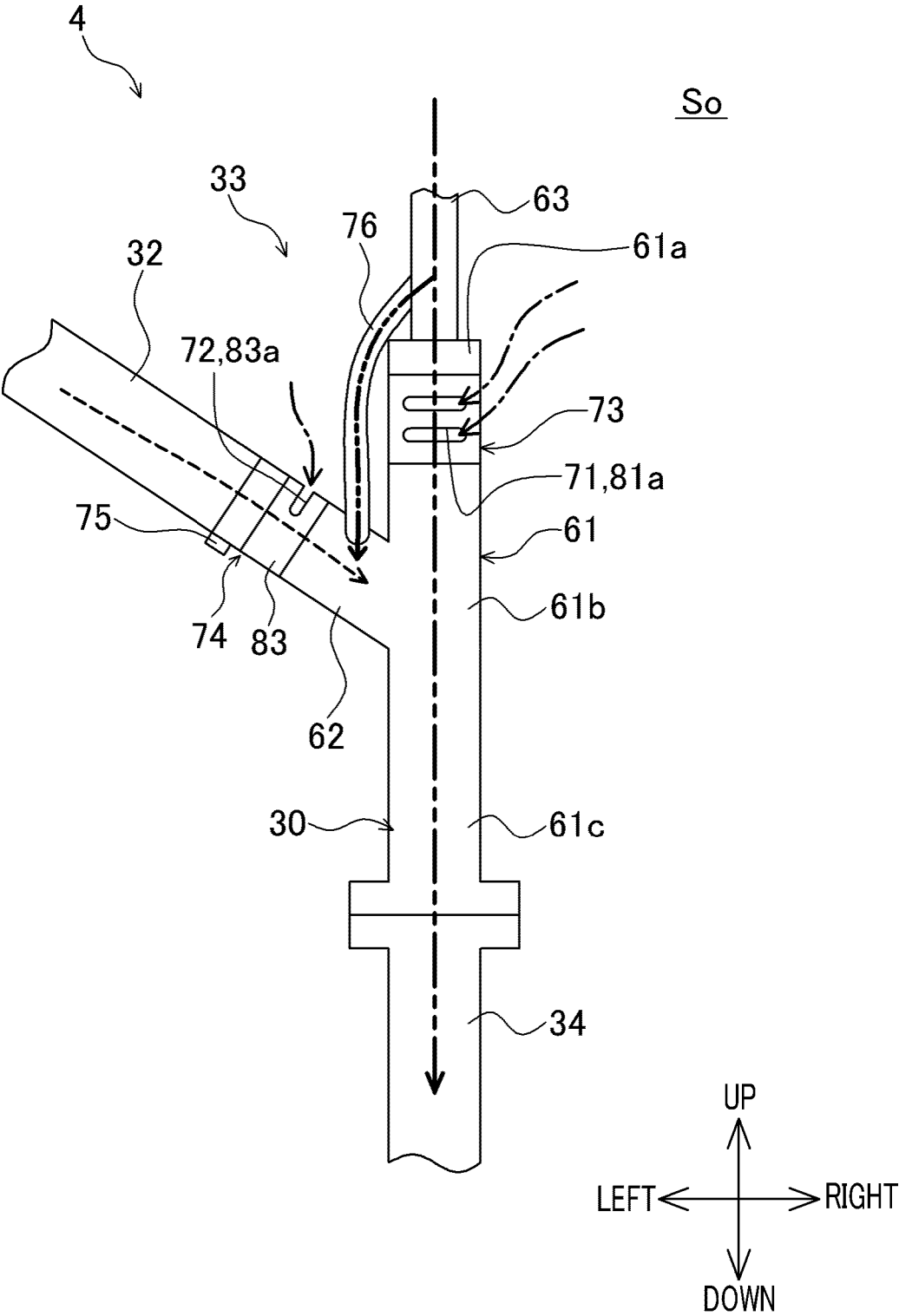


FIG.10

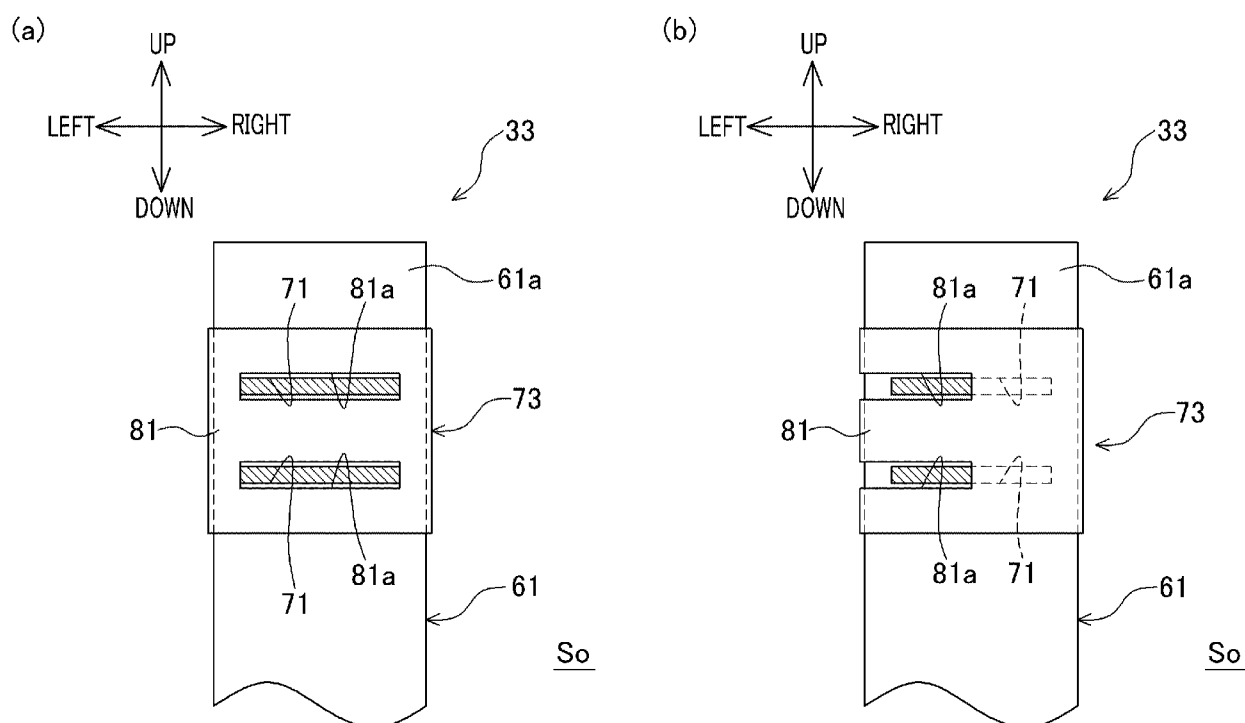


FIG.11

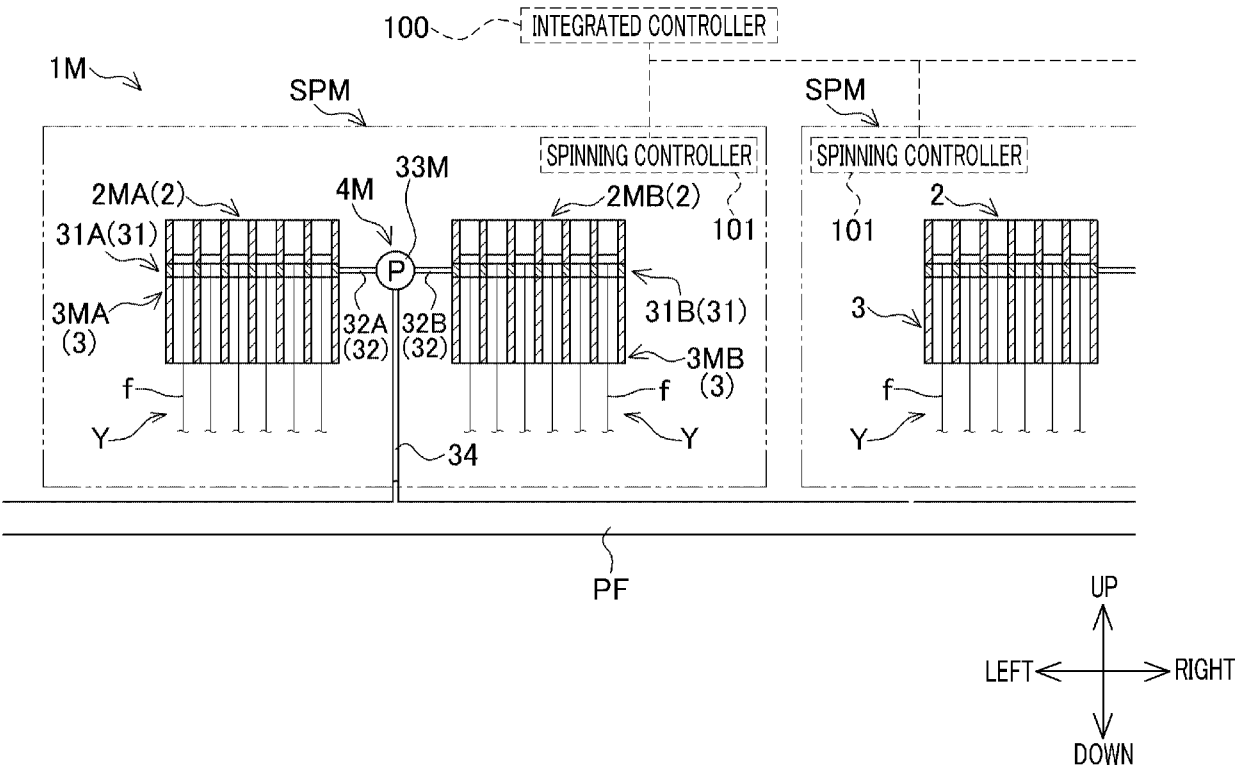
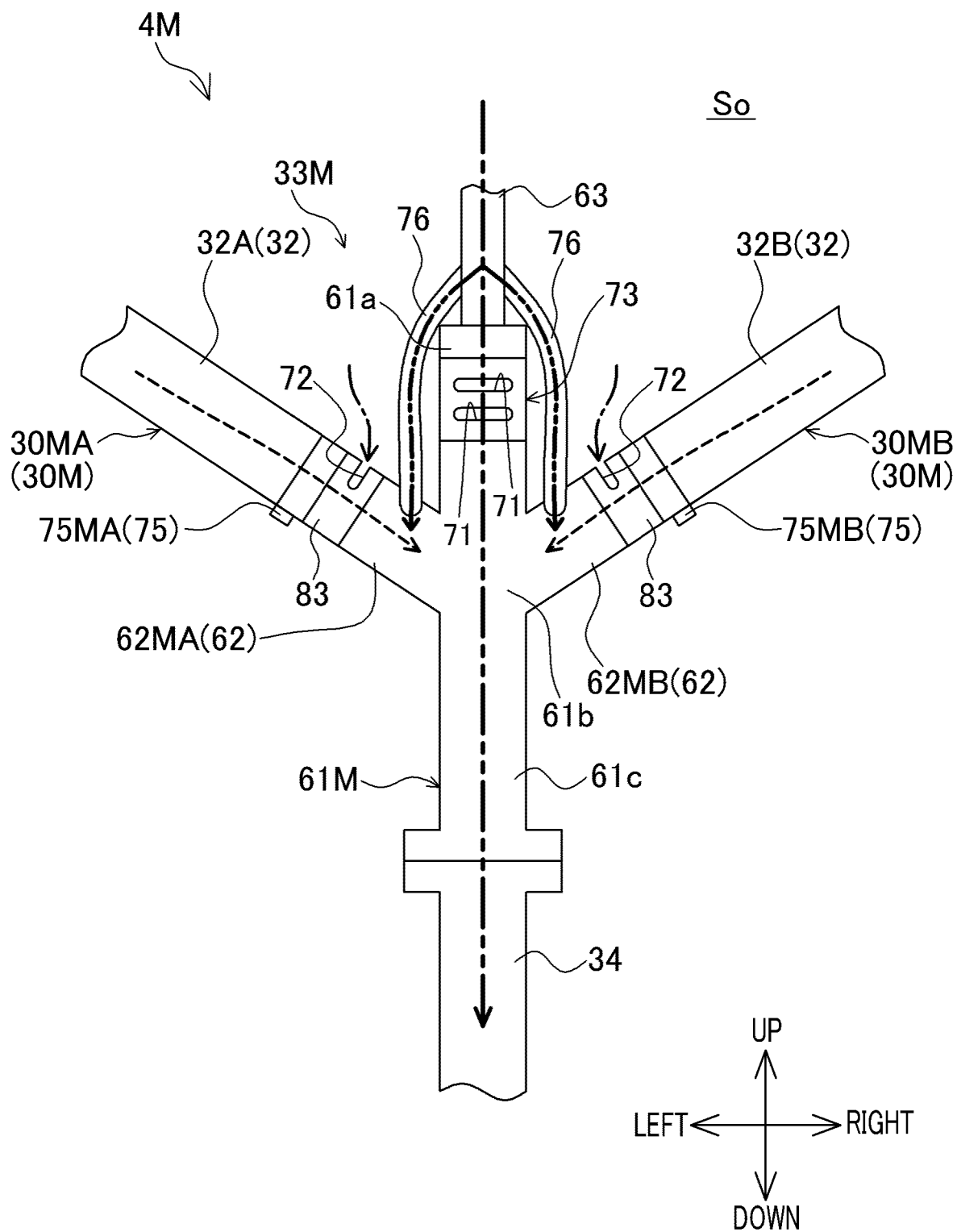


FIG.12





EUROPEAN SEARCH REPORT

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A	* paragraphs [0013] - [0016], [0022], [0033], [0043], [0075], [0077], [0083], [0084] *	7	D01D1/09 D01D4/00 D01D4/02 D01D5/092
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 August 2026	Examiner Van Beurden-Hopkins
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