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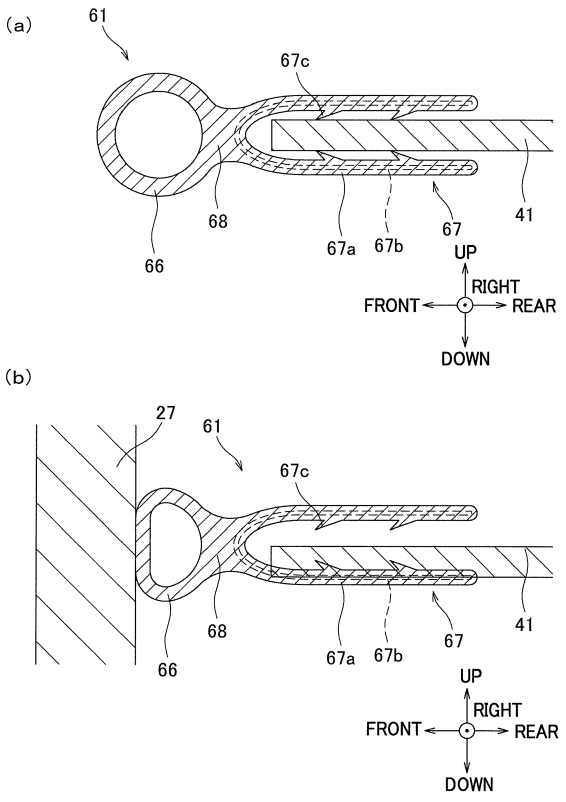
(54) SPUN YARN DRAWING APPARATUS

(57) An airflow in a thermal insulation box is restrained from becoming uneven in the axial direction of a heating roller, when a plate member is provided in a thermal insulation box of a spun yarn drawing apparatus. A plate member 41 is provided to protrude forward from the back surface of the thermal insulation box in which the front surface is arranged as a door member 27 and to be separated from the door member 27 in a closed state. A gap between the front end of this plate member 41 and the door member 27 in the closed state is closed by a sealing member 61. This restrains an airflow in the axial direction of the heating roller (i.e., in the front-rear direction) from becoming uneven.

FIG.5



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a spun yarn drawing apparatus configured to draw yarns.

[0002] For example, Patent Literature 1 (Japanese Unexamined Patent Publication No. 2015-55020) recites a spun yarn drawing apparatus in which heating rollers (godet rollers) for heating yarns are housed in a thermal insulation box having a front surface which functions as a door member. The heating rollers are disposed so that the axes thereof are parallel to the front-rear direction, and yarns are wound onto the outer circumferential surface of each roller to be lined up in the axial direction. In this spun yarn drawing apparatus, furthermore, plate members are provided to protrude forward from the back surface of the thermal insulation box toward the door member. These plate members function as flow adjustment plates or as partition plates partitioning the space inside the thermal insulation box into a high-temperature space and a low-temperature space.

SUMMARY OF THE INVENTION

[0003] When the plate members protrude excessively forward in the thermal insulation box, the door member makes contact with the plate members when the door member is closed. In this way, the door member cannot be properly closed. The plate members are therefore provided to be separated from the door member which is in a closed state. As a result, a gap is formed between the front ends of the plate members and the door member in the closed state. Contact between the door member and the plate members is prevented in this manner.

[0004] However, when there is a gap between the plate members and the door member, an airflow is generated as air flows in the gap. Because this airflow is generated at a front end portion in the thermal insulation box, the airflow greatly influences on an airflow in a front portion but an influence of the generated airflow is relatively low on an airflow in a rear portion. This is a factor of unevenness of the airflow in the thermal insulation box in the front-rear direction. Because the yarns wound onto a heating roller are lined up along the axial direction of the heating roller (i.e., along the front-rear direction), unevenness of the airflow in the front-rear direction significantly differentiates an effect of the airflow between the yarns, and this may cause the quality of the yarns to be irregular.

[0005] In consideration of the problem above, a spun yarn drawing apparatus of the present invention aims at restraining an airflow in a thermal insulation box from becoming uneven in the axial direction of a heating roller, when a plate member is provided in the thermal insulation box.

[0006] In the present invention, the following members are provided: a thermal insulation box in which a wall surface on one side in a predetermined direction is arranged to be a door member; at least one heating roller which is housed in the thermal insulation box so that an axis of the at least one heating roller is parallel to the predetermined direction, yarns being wound onto an outer circumferential surface of the at least one heating roller while being lined up in a direction along the axis; at least one plate member which protrudes toward the one side from a wall surface on the other side in the predetermined direction of the thermal insulation box, the plate member being separated from the door member in a closed state; and a sealing member closing a gap between one end on the one side of the plate member and the door member in the closed state.

[0007] According to the present invention, no airflow is generated between the at least one plate member and the door member because the sealing member is provided to close the gap between the end on the one side of the at least one plate member and the door member in the closed state. This restrains the airflow in the thermal insulation box from becoming uneven in the axial direction of the at least one heating roller.

[0008] In the present invention, preferably, an inlet through which the yarns are introduced into the thermal insulation box is formed in the thermal insulation box, and a first flow adjustment plate is provided between the inlet and the at least one heating roller as the at least one plate member, and the sealing member is provided for the first flow adjustment plate.

[0009] When there is a gap between the first flow adjustment plate and the door member, cool air around the inlet may flow to the heating roller side through the gap or warm air around the at least one heating roller may escape through the gap, with the result that the power consumption of the at least one heating roller may be increased. On this account, an airflow between the first flow adjustment plate and the door member is blocked by providing the sealing member for the first flow adjustment plate. This makes it possible to restrain increase in power consumption of the at least one heating roller.

[0010] In the present invention, preferably, an outlet through which the yarns are taken out from the thermal insulation box is formed in the thermal insulation box, and a second flow adjustment plate is provided between the outlet and the at least one heating roller as the at least one plate member, and the sealing member is provided for the second flow adjustment plate.

[0011] When there is a gap between the second flow adjustment plate and the door member, cool air around the outlet may flow to the heating roller side through the gap or warm air around the at least one heating roller may escape through the gap, with the result that the power consumption of the at least one heating roller may be increased. On this account, an airflow between the second flow adjustment plate and the door member is blocked by providing the sealing member for the second flow adjustment plate. This makes it possible to restrain increase in power consumption of the at least one heating

roller.

[0012] In the present invention, preferably, at least one preheating roller heating the yarns before drawn and at least one conditioning roller which is provided downstream in a yarn running direction of the at least one preheating roller and is higher in temperature and speed than the at least one preheating roller are provided as the at least one heating roller, and a partition plate is provided between the at least one preheating roller and the at least one conditioning roller as the at least one plate member, and the sealing member is provided for the partition plate.

[0013] When there is a gap between the partition plate and the door member, unintentional heat transfer occurs from the high-temperature conditioning roller side to the low-temperature preheating roller side, with the result that the temperature of the at least one preheating roller may exceed the set temperature. Excessive increase in temperature of the at least one preheating roller can be restrained by providing the sealing member for the partition plate in order to restrain heat transfer from the conditioning roller side to the preheating roller side.

[0014] In the present invention, preferably, a plurality of the at least one preheating roller are provided to be lined up in the yarn running direction, and the sealing member is provided for the partition plate which is provided between a last preheating roller which is the most downstream one in the yarn running direction of the preheating rollers and the at least one conditioning roller.

[0015] When plural preheating rollers are provided, because the yarns Y are serially heated by the preheating rollers, an amount of heat consumed by the heating of the yarns is small at the last preheating roller. The last preheating roller is provided in the vicinity of the at least one conditioning roller. On this account, as compared to the other preheating rollers, the temperature of the last preheating roller tends to be increased by an influence of heat from the at least one conditioning roller. Furthermore, because the yarns are drawn between the last preheating roller and the at least one conditioning roller, the temperature of the last preheating roller must be controlled particularly accurately. When the sealing member is provided for the partition plate between the last preheating roller and the at least one conditioning roller, excessive increase in temperature of the last preheating roller is restrained and the temperature of the last preheating roller can be accurately controlled.

[0016] In the present invention, preferably, a communication passage which causes a low-temperature space on the preheating roller side of the partition plate to communicate with a high-temperature space on the conditioning roller side of the partition plate is formed across a region in which the yarns are lined up in the direction of the axis.

[0017] As described above, excessive increase in temperature of the at least one preheating roller is restrained by providing the sealing member for the partition plate. However, this arrangement has a side effect that heat from the at least one conditioning roller cannot be effectively used for heating the at least one preheating roller. In this regard, when the communication passage is properly provided between the low-temperature space on the preheating roller side and the high-temperature space on the conditioning roller side, excessive increase in temperature of the at least one preheating roller is restrained and heat from the at least one conditioning roller can be effectively used for heating the at least one preheating roller. The communication passage is formed across the region in which the yarns are lined up in the axial direction. An influence of the airflow generated in the communication passage is therefore more or less even between the yarns, and the irregularity of the quality of the yarns is restrained.

[0018] In the present invention, preferably, the communication passage is a passage formed at a location different from a yarn path between the at least one preheating roller and the at least one conditioning roller.

[0019] Because the communication passage is provided to be independent from the yarn path, backward flow of heat from the low-temperature space to the high-temperature space due to an accompanied flow generated by the running yarns is prevented, with the result that heat is efficiently transferred from the high-temperature space to the low-temperature space.

[0020] In the present invention, preferably, the communication passage is formed between the partition plate and a wall surface which is a part of the thermal insulation box and is parallel to the predetermined direction.

[0021] This facilitates air to flow in the communication passage along the wall surface of the thermal insulation box, with the result that heat is efficiently transferred from the high-temperature space to the low-temperature space.

[0022] In the present invention, preferably, a shielding member is provided to extend toward the outer circumferential surface of the at least one conditioning roller from a location in the wall surface of the thermal insulation box parallel to the predetermined direction, the location being on the conditioning roller side of the communication passage, and the at least one conditioning roller rotating so that a part of the outer circumferential surface of the at least one conditioning roller, which opposes a leading end portion of the shielding member, moves away from the communication passage.

[0023] With this arrangement, an accompanied flow generated by the running yarns is blocked by the shielding member, and hence escape of heat in the accompanied flow away from the communication passage is restrained. As a result, heat is efficiently transferred from the high-temperature space to the low-temperature space.

[0024] In the present invention, preferably, a shutter is provided to change the flow passage area of the communication passage.

[0025] With this arrangement, the flow amount of air flowing in the communication passage is controlled and

therefore an amount of heat transferred from the high-temperature space to the low-temperature space is controlled, by adjusting the opening degree of the shutter. The optimal amount of heat transfer is changed based on conditions such as the outside temperature and the set temperature of each of the rollers determined in accordance with the type of the yarns. Even in such a case, by the adjustment of the opening degree of the shutter in accordance with the conditions, the power consumption is restrained while the temperature of the at least one preheating roller is suitably controlled, irrespective of the conditions.

[0026] In the present invention, preferably, the sealing member is attached to the at least one plate member.

[0027] The sealing member may be attached to the door member. However, in such a case, the sealing member must be accurately positioned in accordance with the position of the at least one plate member. Meanwhile, when the sealing member is attached to the plate member, accurate positioning of the sealing member is unnecessary, and hence the attachment can be easy done.

[0028] In the present invention, preferably, the sealing member extends in a longitudinal direction and along an end on the one side of the at least one plate member, and the sealing member includes a fixing portion which is U-shaped in cross section cut along a direction orthogonal to the longitudinal direction.

[0029] With this arrangement, as the end portion one the one side of the at least one plate member is pinched by the U-shaped fixing portion, the sealing member is easily attached to the at least one plate member.

[0030] In the present invention, preferably, the fixing portion includes: a U-shaped portion which is U-shaped in cross section cut along the direction orthogonal to the longitudinal direction; and a metal component which is provided along U shape of the U-shaped portion and is plastically deformable, and when the U-shaped portion is deformed so that the at least one plate member is pinched by the U-shaped portion, the metal component is plastically deformed.

[0031] This arrangement makes it possible to suitably maintain the state in which the end portion on the one side of the at least one plate member is pinched by the U-shaped portion, so as to avoid the detachment of the sealing member from the at least one plate member.

[0032] In the present invention, preferably, the fixing portion further includes a claw portion protruding inward from the U-shaped portion.

[0033] With this arrangement, because the claw portion is deformed to be closely in contact with the at least one plate member when the end portion on the one side the at least one plate member is pinched by the U-shaped portion, the airtightness between the U-shaped portion and the at least one plate member is improved.

[0034] In the present invention, preferably, the sealing member includes a hollow sealing portion which is provided between the end on the one side of the at least one plate member and the door member.

[0035] With this arrangement, the sealing portion is likely to be deformed in a squashed manner when the door member is closed. This improves the airtightness by the sealing member, and prevention of generation of an airflow in the gap between the at least one plate member and the door member is ensured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

FIG. 1 is a schematic diagram of a spun yarn take-up machine including a spun yarn drawing apparatus of an embodiment.

FIG. 2 shows the spun yarn drawing apparatus in a detailed manner.

FIG. 3 is a perspective view of a thermal insulation box.

FIG. 4 is a cross section of a sealing member.

Each of FIG. 5(a) and FIG. 5(b) is a cross section which illustrates in what manner the sealing member is attached.

Each of FIG. 6(a) and FIG. 6(b) shows a result of fluid analysis.

FIG. 7 is an enlarged view of a communication passage and its surroundings.

Each of FIG. 8(a) and FIG. 8(b) is a top view of an upper shutter.

FIG. 9 is a table showing a result of a verification experiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[Spun Yarn Take-Up Machine]

[0037] The following will describe an embodiment of a spun yarn drawing apparatus related to the present invention. FIG. 1 is a schematic diagram of a spun yarn take-up machine including the spun yarn drawing apparatus of the present embodiment. As shown in FIG. 1, the spun yarn take-up machine 1 is configured to draw, by a spun yarn drawing apparatus 3, yarns Y serially spun out from a spinning apparatus 2 and made of a solidified molten fibrous material such as polyester, and then to wind the yarns Y by a yarn winding apparatus 4. It is defined that the directions shown in FIG. 1 indicate the directions of the spun yarn take-up machine 1.

[0038] The spinning apparatus 2 is configured to generate the yarns Y by continuously spinning out a molten fibrous material such as polyester. To the yarns Y spun out from the spinning apparatus 2, oil is applied at an oil guide 10. The yarns Y are then sent to the spun yarn drawing apparatus 3 via a guide roller 11. The spun yarn drawing apparatus 3 is an apparatus for drawing the yarns Y and is provided below the spinning apparatus 2. The spun yarn drawing apparatus 3 includes plural godet rollers 31 to 35 housed in a thermal insulation box 20. The details of the spun yarn drawing apparatus 3 will be

given later.

[0039] The yarns Y drawn by the spun yarn drawing apparatus 3 are sent to the yarn winding apparatus 4 via a guide roller 12. The yarn winding apparatus 4 is an apparatus for winding the yarns Y and is provided below the spun yarn drawing apparatus 3. The yarn winding apparatus 4 includes members such as a bobbin holder 13 and a contact roller 14. The bobbin holder 13 is cylindrical in shape and extends away from the viewer of FIG. 1. The bobbin holder 13 is rotationally driven by an unillustrated motor. To the bobbin holder 13, bobbins B are attached along the axial direction to be side by side. By rotating the bobbin holder 13, the yarn winding apparatus 4 simultaneously winds the yarns Y onto the bobbins B, so as to produce packages P. The contact roller 14 makes contact with the surfaces of the packages P to adjust the shape of each package P by applying a predetermined contact pressure to each package P.

[Spun Yarn Drawing Apparatus]

[0040] FIG. 2 shows the spun yarn drawing apparatus 3 in a detailed manner, and FIG. 3 is a perspective view of the thermal insulation box 20. The spun yarn drawing apparatus 3 includes the thermal insulation box 20 and plural (five in the present embodiment) godet rollers 31 to 35 housed in the thermal insulation box 20. As shown in FIG. 3, the thermal insulation box 20 is a box formed by a top surface portion 21, a right side portion 22, a lower right inclined portion 23, a left side portion 24, a lower left inclined portion 25, a back surface portion 26, and a door member 27. The door member 27 is attached to the left side portion 24 by an unillustrated hinge, and is openable and closable as the door member 27 swings in the front-rear direction about the hinge. At a lower part of the right side portion 22, an inlet 20a is formed to introduce yarns Y into the thermal insulation box 20. At an upper part of the right side portion 22, an outlet 20b is formed to take the yarns Y out from the thermal insulation box 20.

[0041] The godet rollers 31 to 35 are heating rollers which are rotationally driven by an unillustrated motor and each includes an unillustrated heater. The heating rollers 31 to 35 are disposed to protrude from the back surface portion 26 of the thermal insulation box 20 toward the door member 27 so that the axes of these rollers are parallel to the front-rear direction (predetermined direction of the present invention). The heating rollers 31 to 35 rotate in the directions indicated by arrows in FIG. 2. The yarns Y introduced into the thermal insulation box 20 through the inlet 20a are wound onto the outer circumferential surfaces of the heating rollers 31 to 35 to be lined up in the axial direction, and are ultimately taken out from the thermal insulation box 20 through the outlet 20b.

[0042] The lower three heating rollers 31 to 33 are preheating rollers for preliminarily heating the yarns Y before drawing them. The roller surface temperature of each of these rollers is arranged to be equal to or higher than the glass transition temperature of the yarns Y (e.g., set at about 80 degrees centigrade). Meanwhile, the upper two heating rollers 34 and 35 are conditioning rollers for thermally setting the drawn yarns Y. The surface temperature of each of these rollers is arranged to be higher than the surface temperatures of the preheating rollers 31 to 33 (e.g., set at about 130 to 140 degrees centigrade). The rotational speeds, i.e., yarn feeding speeds of the conditioning rollers 34 and 35 are higher than those of the preheating rollers 31 to 33.

[0043] The yarns Y introduced into the thermal insulation box 20 through the inlet 20a are, to begin with, preliminarily heated to a drawable temperature while being transferred by the preheating rollers 31 to 33. The preliminarily-heated yarns Y are drawn on account of a difference in yarn feeding speed between the preheating roller 33 and the conditioning roller 34. The yarns Y are further heated while being transferred by the conditioning rollers 34 and 35, with the result that the drawn state is thermally set. The yarns Y having been drawn in this way go out from the thermal insulation box 20 through the outlet 20b.

[0044] In the thermal insulation box 20, plate members 41 to 44 are disposed. The plate members 41 to 44 function as flow adjustment plates which adjust a flow of air in the thermal insulation box 20. To be more specific, the plate members 41 to 44 are disposed so that the flow of air from the inlet 20a to the outlet 20b inside the thermal insulation box 20 is more or less along the yarn running direction. The plate members 42 and 43 are provided between a low-temperature space which is a lower space in which the low-temperature preheating rollers 31 to 33 are provided and a high-temperature space which is an upper space in which the high-temperature conditioning rollers 34 and 35 are provided. These plate members 42 and 43 function as partition plates separating the high-temperature space from the low-temperature space.

[0045] In the thermal insulation box 20, furthermore, shielding members 51 to 54 are disposed. The shielding members 51 to 54 extend toward the outer circumferential surface of the conditioning roller 34 or 35, and a leading end portion of each shielding member is close to the outer circumferential surface of the conditioning roller 34 or 35. In the thermal insulation box 20, an accompanied flow is generated in accordance with the running of the yarns Y. As the accompanied flow advances toward the downstream side in the yarn running direction while being amplified, a large amount of heat escapes through the outlet 20b, with the result that the heat keeping effect of the thermal insulation box 20 is deteriorated. On this account, the deterioration of the heat keeping effect is restrained by blocking the accompanied flow by the shielding members 51 to 54 in order to restrain the amplification of the accompanied flow. The shielding members 51, 52, and 54 are arranged to be swingable about their base parts in order not to obstruct yarn placement onto the conditioning rollers 34 and 35. For details, see Japanese

Unexamined Patent Publication No. 2016-216882.

[Improvement in Airflow in Thermal Insulation Box]

[0046] The plate members 41 to 44 are disposed to protrude forward from the back surface portion 26 of the thermal insulation box 20. The plate members 41 to 44 are provided to be separated from the door member 27 which is in a closed state, in order to prevent the door member 27 from making contact with the front ends of the plate members 41 to 44 when the door member 27 is closed. This arrangement, however, is disadvantageous in that an airflow is generated between the front ends of the plate members 41 to 44 and the door member 27 in the closed state, with the result that an airflow inside the thermal insulation box 20 becomes uneven in the front-rear direction. The yarns Y wound onto the heating rollers 31 to 35 are lined up along the axial direction of the heating rollers 31 to 35 (i.e., in the front-rear direction). For this reason, when the airflow inside the thermal insulation box 20 is uneven in the front-rear direction, an effect of the airflow is significantly different between the yarns Y, and the quality of the yarns Y may be irregular.

[0047] In this regard, in the present embodiment, sealing members 61 to 64 (see one-dot chain lines in FIG. 2) are attached to front end portions of the plate members 41 to 44 to close the gaps between the front ends of the plate members 41 to 44 and the door member 27 in the closed state. The sealing members 61 to 64 are wire-shaped elastic members which are long along the front ends of the plate members 41 to 44. While the following will describe the structure of the sealing member 61, each of the sealing members 62 to 64 is structurally identical with the sealing member 61.

[0048] FIG. 4 is a cross section of the sealing member 61, whereas each of FIG. 5(a) and FIG. 5(b) is a cross section which illustrates in what manner the sealing member 61 is attached. These cross sections are taken along a direction orthogonal to the longitudinal direction of the sealing member 61. The sealing member 61 includes a hollow sealing portion 66, a fixing portion 67 which is U-shaped in cross section, and a connecting portion 68 connecting the sealing portion 66 with the fixing portion 67. The sealing member 61 is integrally formed by silicon rubber, except later-described metal components 67b.

[0049] In the sealing portion 66, a through hole 66a is formed to penetrate the sealing portion in the longitudinal direction. The sealing portion 66 is therefore hollow. The fixing portion 67 includes a U-shaped portion 67a which is U-shaped, the metal components 67b embedded in the U-shaped portion 67a, and claw portions 67c. Each metal component 67b is a wire-shaped component provided along the U shape of the U-shaped portion 67a, and is made of a metal material which is plastically deformable. The metal components 67b are embedded in the sealing member 61 to be lined up in the longitudinal direction by, for example, insert molding. Each of the claw portions 67c is a protrusion which is formed to protrude inward from the U-shaped portion 67a. While in the present embodiment two pairs of opposing claw portions 67c are formed, the number of pairs of the claw portions 67c may be suitably changed, and the claw portions 67c may not oppose each other.

[0050] As shown in FIG. 5(a), when the sealing member 61 is attached to the plate member 41, the U-shaped fixing portion 67 pinches the front end portion of the plate member 41 and the fixing portion 67 is deformed to press the plate member 41. As a result, the claw portions 67c are elastically deformed and closely in contact with the plate member 41. Furthermore, when the fixing portion 67 is deformed to press the plate member 41, the metal components 67b are plastically deformed. On this account, the state in which the plate member 41 is pinched by the fixing portion 67 is suitably maintained.

[0051] After the sealing member 61 is attached to the plate member 41 in this way, the sealing portion 66 is positioned in front of the plate member 41. For this reason, as shown in FIG. 5(b), when the door member 27 is closed, the door member 27 makes contact with the sealing portion 66 and squashes the hollow sealing portion 66. As a result, the sealing portion 66 is closely in contact with the door member 27, and hence the airtightness between the door member 27 and the sealing portion 66 is improved.

[0052] The sealing members 61 to 64 structured as described above are attached to the front end portions of the plate members 41 to 44. With this, the gaps between the plate members 41 to 44 and the door member 27 are closed, and hence no airflow is generated between the front ends of the plate members 41 to 44 and the door member 27 in the closed state. This prevents the airflow in the thermal insulation box 20 from becoming uneven in the front-rear direction.

[Verification by Analysis]

[0053] How an airflow is varied between existence and non-existence of the sealing members 61 to 64 was verified by fluid analysis. To be more specific, an airflow on a VI-VI plane shown in FIG. 2 when the sealing member 64 was not attached to the plate member 44 and the airflow when the sealing member 44 was attached were analyzed. In consideration of the driving conditions of the actual machine, the rotational speeds of the preheating rollers 31 to 33 were set at 2260 to 2490 m/min, and the rotational speed of the conditioning rollers 34 and 35 was set at 4875 m/min.

[0054] Each of FIG. 6(a) and FIG. 6(b) shows a result of the fluid analysis, and shows the airflow on the VI-VI plane from above. As shown in FIG. 6(a), when the sealing member 64 was not provided, a gap was formed in front of the plate member 44 and an airflow running in this gap was generated (see the region encircled by an ellipse). Because of an influence of this, the airflow was uneven in the front-rear direction, and a part of the airflow,

which should have flown along the yarn running direction, was significantly disturbed. When the airflow is uneven in the front-rear direction in this way, the quality of yarns Y running while being lined up in the front-rear direction tends to be irregular. Furthermore, because the airflow along the yarn running direction is disturbed, yarn shaking tends to occur. It is noted that, in FIG. 6(a) and FIG. 6(b), the flow rate of the airflow rightward was high at a region directly above the conditioning roller 35.

[0055] Meanwhile, when the sealing member 64 was provided as shown in FIG. 6(b), the gap in front of the plate member 44 was closed and no air flows in the gap, with the result that unevenness of the airflow in the front-rear direction was restrained. The irregularity of the quality of the yarns Y was therefore restrained. Furthermore, the airflow along the yarn running direction was more or less suitably maintained, and yarn shaking was restrained. A similar effect was obtained at parts where the sealing members 61 to 63 were provided.

[Coexistence of Airflow Improvement and Energy Saving]

[0056] The above-described effect of airflow improvement is achieved when the sealing member 63 is provided for the plate member 43 provided between the low-temperature preheating roller 33 and the high-temperature conditioning roller 35, but the following side effect occurs. When there is a gap between the plate member 43 and the door member 27, heat transfer from the high-temperature conditioning roller 35 side to the low-temperature preheating roller 33 side is facilitated as air flows in the gap. As a result, the preheating roller 33 is efficiently heated and the power consumption of the spun yarn drawing apparatus 3 is decreased. However, when the gap is closed by the sealing member 63, heat transfer from the conditioning roller 35 side to the preheating roller 33 side is impeded as a side effect, and hence the power consumption of the spun yarn drawing apparatus 3 may be increased.

[0057] Under this circumstance, in the present embodiment, as shown in FIG. 7, a communication passage 47 is provided to cause the low-temperature space 45 which is below the plate member 43 and where the preheating roller 33 is provided to communicate with the high-temperature space 46 which is above the plate member 43 and where the conditioning roller 35 is provided. The communication passage 47 is formed between the inner surface of the left side portion 24 of the thermal insulation box 20 and the plate member 43. As heat is transferred from the high-temperature space 46 to the low-temperature space 45 through the communication passage 47, increase in power consumption of the spun yarn drawing apparatus 3 is restrained.

[0058] However, when the communication passage 47 is simply provided, heat transfer from the high-temperature space 46 to the low-temperature space 45 may be excessive, and the temperature of the preheating roller 33 may exceed the set temperature. For this reason, shutters 48 and 49 are provided in the present embodiment to change the flow passage area of the communication passage 47. FIG. 7 is an enlarged view of the communication passage 47 and its surroundings, whereas each of FIG. 8(a) and FIG. 8(b) is a top view of the upper shutter 48. FIG. 8(a) shows a state in which the upper shutter 48 is fully closed, whereas FIG. 8 (b) shows a state in which the upper shutter 48 is fully open. In FIG. 8(a) and FIG. 8(b), the upper shutter 48 is depicted by thick lines.

[0059] As shown in FIG. 7, in the plate member 43, the following portions are integrally formed: an upper partition portion 43a which extends in the left-right direction; a lower partition portion 43b which is provided below and spaced apart from the upper partition portion 43a and extends in the left-right direction; and a connecting portion 43c which connects a left end part of the upper partition portion 43a with a left end part of the lower partition portion 43b and extends in the up-down direction. Alternatively, the portions 43a to 43c may be independent members.

[0060] As shown in FIG. 8(b), a rear left corner portion of the upper partition portion 43a is arranged as a rectangular cutout portion 43d, and this cutout portion 43d is the upper end of the communication passage 47. Although not illustrated, a rear left corner portion of the lower partition portion 43b is also arranged as a rectangular cutout portion, and this cutout portion is the lower end of the communication passage 47. To put it differently, the communication passage 47 is a passage between the cutout portion 43d formed in the upper partition portion 43a and the cutout portion formed in the lower partition portion 43b.

[0061] In FIG. 8(a) and FIG. 8(b), the conditioning roller 35 is indicated by one-dot chain lines. As clearly shown in the figures, in the front-rear direction, the conditioning roller 35 (and the other heating rollers 31 to 34) is in the region in which the communication passage 47 (cutout portion 43d) is formed. To put it differently, the communication passage 47 is formed in the region in which the yarns Y are wound onto the heating rollers 31 to 35 in the axial direction, i.e., in the region in which the yarns Y are lined up in the front-rear direction.

[0062] In the upper partition portion 43a, two slots 43e which are long in the left-right direction are formed to be lined up in the front-rear direction. The upper shutter 48 is a rectangular plate member and is attached to the upper surface of the upper partition portion 43a. The upper shutter 48 is sized to be able to close the cutout portion 43d. In the upper shutter 48, two unillustrated round holes are formed to be lined up in the front-rear direction. These round holes correspond to the two slots 43e formed in the upper partition portion 43a, respectively. As shown in FIG. 7, bolts 71 are inserted into the round holes of the upper shutter 48 and the slots 43e of the upper partition portion 43a, and nuts 72 are screwed onto the bolts 71. In this way, the upper shutter 48 is fixed to the upper

partition portion 43a. The lower partition portion 43b and the lower shutter 49 are similarly arranged. The lower shutter 49 is fixed to the lower partition portion 43b by bolts 73 and nuts 74.

[0063] With the arrangement above, by moving the upper shutter 48 in the left-right direction along the slots 43e after the nuts 72 are loosened, it is possible to change the opening degree of the upper shutter 48 (i.e., the opening degree of the cutout portion 43d of the upper partition portion 43a) so as to adjust the flow passage area of the communication passage 47. Similarly, by moving the lower shutter 49 in the left-right direction along the slots after the nuts 74 are loosened, it is possible to change the opening degree of the lower shutter 49 (i.e., the opening degree of the cutout portion of the lower partition portion 43b) so as to adjust the flow passage area of the communication passage 47.

[0064] For example, as shown in FIG. 8(a), the communication passage 47 is closed when the shutters 48 and 49 are moved leftward until making contact with the inner surface of the left side portion 24 of the thermal insulation box 20. Meanwhile, when the shutters 48 and 49 are moved rightward away from the left side portion 24, the communication passage 47 is gradually opened, and the communication passage 47 can be fully opened as shown in FIG. 8(b). Furthermore, the flow amount and the way of flowing of air in the communication passage 47 are finely controllable by adjusting the opening degree of each of the shutters 48 and 49.

[0065] As described above, escape of heat from the thermal insulation box 20 together with an accompanied flow is restrained by the shielding members 51 to 54. In particular, the shielding member 54 contributes to efficient transfer of heat from the high-temperature space 46 to the low-temperature space 45. As shown in FIG. 3, the shielding member 54 extends toward the outer circumferential surface of the conditioning roller 35 from a location in the left side portion 24 of the thermal insulation box 20, which location is on the conditioning roller 35 side of (i.e., above) the communication passage 47. The conditioning roller 35 rotates clockwise so that a part A of the outer circumferential surface of the conditioning roller 35, which faces a leading end portion of the shielding member 54, moves away from the communication passage 47. With this arrangement, an accompanied flow flowing around the conditioning roller 35 is blocked by the shielding member 54, and hence escape of heat in the accompanied flow from the shielding member 54 to the downstream side in the yarn running direction is restrained. As a result, a larger amount of heat is transferred from the high-temperature space 46 to the low-temperature space 45 through the communication passage 47.

[0066] In the spun yarn drawing apparatus 3 structured as described above, the flow amount of air flowing in the communication passage 47, i.e., an amount of heat transfer is controllable by suitably adjusting the opening degrees of the upper shutter 48 and the lower shutter 49 in accordance with conditions such as the type of the yarns Y and the outside temperature. Two conflicting requirements, i.e., controllability of the preheating roller 33 and power saving of the spun yarn drawing apparatus 3, are both satisfied with good balance, by adjusting the flow passage area of the communication passage 47 to transfer heat from the high-temperature space 46 to the low-temperature space 45 as much as possible, on condition that the temperature of the preheating roller 33 does not exceed the set temperature.

[Verification Experiment]

[0067] An experiment was done to verify how the switch-ON percentage of the heater of each of the heating rollers 31 to 35 and the power consumption of the spun yarn drawing apparatus 3 are changed in response to the existence and non-existence of the sealing member 63 and the existence and non-existence of the communication passage 47. FIG. 9 is a table showing a result of the verification experiment. In the experiment, the set temperature of the preheating rollers 31 to 33 was 80°C and the set temperature of the conditioning rollers 34 and 35 was 134°C. In Example 2, the shutters 48 and 49 were fully open. The switch-ON percentage of a heater indicates the ratio of the time during which the heater is driven to maintain the surface temperature of each of the heating rollers 31 to 35 at the set temperature. Therefore the lower the switch-ON percentage of a heater is, the more the power saving is achieved. However, when the switch-ON percentage of a heater is 0, the temperature of the roller is likely to exceed the set temperature even if the heater is not driven. The switch-ON percentage of a heater is therefore preferably equal to or higher than a predetermined percent (e.g., 1%) in consideration of the controllability. The power consumption in FIG. 9 indicates total electric power required to heat the heating rollers 31 to 35.

[0068] As described above, the airflow was improved by the sealing member 63 in Example 1. However, as compared to a comparative example in which the sealing member 63 was not provided, the switch-ON percentage of the heater of the preheating roller 33 and the power consumption of the spun yarn drawing apparatus 3 were increased because of the decrease in heat transfer from the high-temperature space 46 to the low-temperature space 45. Meanwhile, in Example 2 in which the sealing member 63 and the communication passage 47 were provided, the switch-ON percentage of the heater of the preheating roller 33 and the power consumption of the spun yarn drawing apparatus 3 were lower than those of Comparative Example. Furthermore, because the communication passage 47 was formed across the region in which the yarns Y were lined up in the front-rear direction, the airflow in the thermal insulation box 20 was not significantly uneven in the front-rear direction.

[0069] When the switch-ON percentage of the heater of the preheating roller 33 is excessively small (i.e., tem-

perature control is difficult) in the case that the shutters 48 and 49 are fully open, power saving of the spun yarn drawing apparatus 3 can be achieved while maintaining the controllability of the preheating roller 33, by adjusting the opening degrees of the shutters 48 and 49.

[Advantageous Effects]

[0070] As described above, in the spun yarn drawing apparatus 3 of the present embodiment, no airflow is generated between the plate members 41 to 44 and the door member 27 because the sealing members 61 to 64 are provided to close the gaps between the front ends of the plate members 41 to 44 and the door member 27 in the closed state. This restrains the airflow in the thermal insulation box 20 from becoming uneven in the axial direction of the heating rollers 31 to 35.

[0071] In the present embodiment, in the thermal insulation box 20, the inlet 20a is formed to introduce the yarns Y into the thermal insulation box 20, the flow adjustment plate 41 (first flow adjustment plate of the present invention) is provided between the inlet 20a and the godet roller 32 as a plate member, and the sealing member 61 is provided for the flow adjustment plate 41. When there is a gap between the flow adjustment plate 41 and the door member 27, cool air around the inlet 20a may flow to the godet roller 32 side through the gap or warm air around the godet roller 32 may escape through the gap, with the result that the power consumption of the godet roller 32 may be increased. On this account, an airflow between the flow adjustment plate 41 and the door member 27 is blocked by providing the sealing member 61 for the flow adjustment plate 41. This makes it possible to restrain increase in power consumption of the godet roller 32.

[0072] In the present embodiment, in the thermal insulation box 20, the outlet 20b is formed to take the yarns Y out from the thermal insulation box 20, the flow adjustment plate 44 (second flow adjustment plate of the present invention) is provided between the outlet 20b and the godet roller 34 as a plate member, and the sealing member 64 is provided for the flow adjustment plate 44. When there is a gap between the flow adjustment plate 44 and the door member 27, cool air around the outlet 20b may flow to the godet roller 34 side through the gap or warm air around the godet roller 34 may escape through the gap, with the result that the power consumption of the godet roller 34 may be increased. On this account, an airflow between the flow adjustment plate 44 and the door member 27 is blocked by providing the sealing member 64 for the flow adjustment plate 44. This makes it possible to restrain increase in power consumption of the godet roller 34.

[0073] In the present embodiment, the preheating rollers 31 to 33 heating the yarns Y before drawn and the conditioning rollers 34 and 35 which are provided downstream in the yarn running direction of the preheating rollers 31 to 33 and are higher in temperature and speed than the preheating rollers 31 to 33 are provided as heating rollers, the partition plates 42 and 43 are provided between the preheating rollers 32 and 33 and the conditioning rollers 34 and 35 as plate members, and the sealing members 62 and 63 are provided for the partition plates 42 and 43. When there is a gap between the partition plates 42 and 43 and the door member 27, unintentional heat transfer occurs from the high-temperature conditioning rollers 34 and 35 side to the low-temperature preheating rollers 32 and 33 side, with the result that the temperature of the preheating rollers 32 and 33 may exceed the set temperature. Excessive increase in temperature of the preheating rollers 32 and 33 can be restrained by providing the sealing members 62 and 63 for the partition plates 42 and 43 in order to restrain heat transfer from the conditioning rollers 34 and 35 side to the preheating rollers 32 and 33 side.

[0074] In the present embodiment, plural preheating rollers 31 to 33 are provided to be lined up in the yarn running direction, and the sealing member 63 is provided for the partition plate 43 provided between the preheating roller 33 (last preheating roller of the present invention) which is the most downstream one in the yarn running direction of the preheating rollers 31 to 33 and the conditioning roller 35. When plural preheating rollers 31 to 33 are provided, because the yarns Y are serially heated by the preheating rollers 31 to 33, an amount of heat consumed by the heating of the yarns Y is small at the preheating roller 33. The preheating roller 33 is provided in the vicinity of the conditioning roller 35. On this account, as compared to the other preheating rollers 31 and 32, the temperature of the preheating roller 33 tends to be increased by an influence of heat from the conditioning roller 35. Furthermore, because the yarns Y are drawn between the preheating roller 33 and the conditioning roller 34, the temperature of the preheating roller 33 must be controlled particularly accurately. When the sealing member 63 is provided for the partition plate 43 between the preheating roller 33 and the conditioning roller 35, excessive increase in temperature of the preheating roller 33 is restrained and the temperature of the preheating roller 33 can be accurately controlled.

[0075] In the present embodiment, the communication passage 47 which causes the low-temperature space 45 which is on the preheating roller 33 side of the partition plate 43 to communicate with the high-temperature space 46 which is on the conditioning roller 35 side of the partition plate 43 is formed across the region where the yarns Y are lined up in the axial direction. As described above, excessive increase in temperature of the preheating roller 33 is restrained by providing the sealing member 63 for the partition plate 43. However, this arrangement has a side effect that heat from the conditioning roller 35 cannot be effectively used for heating the preheating roller 33. In this regard, when the communication passage 47 is properly provided between the low-temperature space 45 on the preheating roller 33 side and the high-temperature space 46 on the conditioning

roller 35 side, excessive increase in temperature of the preheating roller 33 is restrained and heat from the conditioning roller 35 can be effectively used for heating the preheating roller 33. This communication passage 47 is formed across the region in which the yarns Y are lined up in the axial direction. An influence of the airflow generated in the communication passage 47 is therefore more or less even between the yarns Y, and the irregularity of the quality of the yarns Y is restrained.

[0076] In the present embodiment, the communication passage 47 is a passage which is formed at a location different from the yarn path between the preheating roller 33 and the conditioning roller 35. Because the communication passage 47 is provided to be independent from the yarn path, backward flow of heat from the low-temperature space 45 to the high-temperature space 46 due to an accompanied flow generated by the running yarns Y is prevented, with the result that heat is efficiently transferred from the high-temperature space 46 to the low-temperature space 45.

[0077] In the present embodiment, the communication passage 47 is formed between the side face portion 24, which is a part of the thermal insulation box 20 and is parallel to the front-rear direction, and the partition plate 43. This facilitates air to flow in the communication passage 47 along the side face portion 24 of the thermal insulation box 20, with the result that heat is efficiently transferred from the high-temperature space 46 to the low-temperature space 45.

[0078] In the present embodiment, the shielding member 54 is provided to extend toward the outer circumferential surface of the conditioning roller 35 from a location in the side face portion 24 of the thermal insulation box 20, which location is on the conditioning roller 35 side of the communication passage 47, and the conditioning roller 35 rotates so that the part A of the outer circumferential surface of the conditioning roller 35, which faces the leading end portion of the shielding member 54, moves away from the communication passage 47. With this arrangement, an accompanied flow generated by the running yarns Y is blocked by the shielding member 54, and hence escape of heat in the accompanied flow away from the communication passage 47 is restrained. As a result, heat is efficiently transferred from the high-temperature space 46 to the low-temperature space 45.

[0079] In the present embodiment, the shutters 48 and 49 are provided to change the flow passage area of the communication passage 47. With this arrangement, the flow amount of air flowing in the communication passage 47 is controlled and therefore an amount of heat transferred from the high-temperature space 46 to the low-temperature space 45 is controlled, by adjusting the opening degrees of the shutters 48 and 49. The optimal amount of heat transfer is changed based on conditions such as the outside temperature and the set temperature of each of the rollers 33 and 35 determined in accordance with the type of the yarns Y. Even in such a case, by the adjustment of the opening degrees of the shutters 48 and 49 in accordance with the conditions, the power consumption is restrained while the temperature of the preheating roller 33 is suitably controlled, irrespective of the conditions.

[0080] In the present embodiment, the sealing members 61 to 64 are attached to the plate members 41 to 44. The sealing members 61 to 64 may be attached to the door member 27. However, in such a case, the sealing members 61 to 64 must be accurately positioned in accordance with the positions of the plate members 41 to 44. Meanwhile, when the sealing members 61 to 64 are attached to the plate members 41 to 44, accurate positioning of the sealing members 61 to 64 is unnecessary, and hence the attachment of the sealing members 61 to 64 can be easily done.

[0081] In the present embodiment, the sealing members 61 to 64 extend in the longitudinal direction along the front ends of the plate members 41 to 44, and each of the sealing members 61 to 64 has the fixing portion 67 which is U-shaped in cross section cut along the direction orthogonal to the longitudinal direction. With this arrangement, as the front end portion of each of the plate members 41 to 44 is pinched by the U-shaped fixing portion 67, the sealing members 61 to 64 are easily attached to the plate members 41 to 44.

[0082] In the present embodiment, the fixing portion 67 includes the U-shaped portion 67a which is U-shaped in cross section cut along the direction orthogonal to the longitudinal direction and the metal components 67b which are provided along the U shape of the U-shaped portion 67a and are plastically deformable. When the U-shaped portion 67a is deformed so that each of the plate members 41 to 44 is pinched by the U-shaped portion 67a, the metal components 67b are plastically deformed. This arrangement makes it possible to suitably maintain the state in which each of the front end portions of the plate members 41 to 44 is pinched by the U-shaped portion 67a, so as to avoid the detachment of the sealing members 61 to 64 from the plate members 41 to 44.

[0083] In the present embodiment, the fixing portion 67 further includes the claw portions 67c protruding inward from the U-shaped portion 67a. With this arrangement, because the claw portions 67c are deformed to be closely in contact with each of the plate members 41 to 44 when the front end portion of each of the plate members 41 to 44 is pinched by the U-shaped portion 67a, the airtightness between the U-shaped portion 67a and each of the plate members 41 to 44 is improved.

[0084] In the present embodiment, each of the sealing members 61 to 64 has the hollow sealing portion 66 which is provided between the front end of each of the plate members 41 to 44 and the door member 27. With this arrangement, the sealing portion 66 is likely to be deformed in a squashed manner when the door member 27 is closed. This improves the airtightness by the sealing members 61 to 64, and prevention of generation of an airflow in the gaps between the plate members 41 to 44 and the door member 27 is ensured.

[0085] In the present embodiment, the sealing members 61 to 64 are made of silicon rubber. Because silicon rubber excels in heat resistance, the sealing members 61 to 64 can be suitably used in the spun yarn drawing apparatus 3 in which the inside of the thermal insulation box 20 is hot.

[Other Embodiments]

[0086] The following will describe modifications of the above-described embodiment.

[0087] In the embodiment above, the sealing members 61 to 64 are attached to the plate members 41 to 44 in order to eliminate the gaps between the door member 27 of the thermal insulation box 20 and the plate members 41 to 44. Alternatively, the sealing members 61 to 64 may be attached to the door member 27. The sealing members 61 to 64 may be different from those in the embodiment above, in terms of shape and material.

[0088] In the embodiment above, the communication passage 47 is formed between the left side portion 24 of the thermal insulation box 20 and the partition plate 43. The location where the communication passage 47 is formed is not limited to this. For example, a communication passage may be provided by forming an opening in the partition plate 43. Furthermore, the number of communication passages may be two or more.

[0089] In the embodiment above, the temperature of the preheating roller 33 is efficiently increased because of the communication passage 47. Likewise, in order to efficiently increase the temperature of the preheating roller 32, a communication passage which causes the low-temperature space on the preheating roller 32 side of the partition plate 42 to communicate with the high-temperature space on the conditioning roller 34 side of the partition plate 42 may be provided. A shutter may be provided in this communication passage.

[0090] In the above-described embodiment, the communication passage 47 is formed at a location different from the yarn path. Alternatively, the yarn path may be formed in the communication passage. The shutters cannot be fully closed in this case, but the opening degrees of the shutters are adjustable as long as the yarn path is not blocked.

[0091] In the embodiment above, plural shutters 48 and 49 are provided in the communication passage 47 to be lined up in the direction D in which air flows in the communication passage 47. In this regard, the number of shutters is required to be one or more.

[0092] In the above-described embodiment, the shutters 48 and 49 are structured to be movable in the left-right direction. The specific structure of each shutter is not limited to this, and the shutter may be opened and closed in a swing manner, for example.

[0093] In the embodiment above, plural preheating rollers 31 to 33 and plural conditioning rollers 34 and 35 are provided. In this connection, plural preheating rollers and plural conditioning rollers are not prerequisite. Only at least one preheating roller and at least one conditioning roller are required.

Claims

1. A spun yarn drawing apparatus comprising:

a thermal insulation box in which a wall surface on one side in a predetermined direction is arranged to be a door member;
at least one heating roller which is housed in the thermal insulation box so that an axis of the at least one heating roller is parallel to the predetermined direction, yarns being wound onto an outer circumferential surface of the at least one heating roller while being lined up in a direction along the axis;
at least one plate member which protrudes toward the one side from a wall surface on the other side in the predetermined direction of the thermal insulation box, the plate member being separated from the door member in a closed state; and
a sealing member closing a gap between one end on the one side of the plate member and the door member in the closed state.

2. The spun yarn drawing apparatus according to claim 1, wherein,
an inlet through which the yarns are introduced into the thermal insulation box is formed in the thermal insulation box, and
a first flow adjustment plate is provided between the inlet and the at least one heating roller as the at least one plate member, and the sealing member is provided for the first flow adjustment plate.

3. The spun yarn drawing apparatus according to claim 1 or 2, wherein,
an outlet through which the yarns are taken out from the thermal insulation box is formed in the thermal insulation box, and
a second flow adjustment plate is provided between the outlet and the at least one heating roller as the at least one plate member, and the sealing member is provided for the second flow adjustment plate.

4. The spun yarn drawing apparatus according to any one of claims 1 to 3, wherein,
at least one preheating roller heating the yarns before drawn and at least one conditioning roller which is provided downstream in a yarn running direction of the at least one preheating roller and is higher in temperature and speed than the at least one preheating roller are provided as the at least one heating roller, and
a partition plate is provided between the at least one

preheating roller and the at least one conditioning roller as the at least one plate member, and the sealing member is provided for the partition plate.

5. The spun yarn drawing apparatus according to claim 4, wherein,
a plurality of the at least one preheating roller are provided to be lined up in the yarn running direction, and
the sealing member is provided for the partition plate which is provided between a last preheating roller which is the most downstream one in the yarn running direction of the preheating rollers and the at least one conditioning roller.

6. The spun yarn drawing apparatus according to claim 4 or 5, wherein, a communication passage which causes a low-temperature space on the preheating roller side of the partition plate to communicate with a high-temperature space on the conditioning roller side of the partition plate is formed across a region in which the yarns are lined up in the direction of the axis.

7. The spun yarn drawing apparatus according to claim 6, wherein, the communication passage is a passage formed at a location different from a yarn path between the at least one preheating roller and the at least one conditioning roller.

8. The spun yarn drawing apparatus according to claim 6 or 7, wherein, the communication passage is formed between the partition plate and a wall surface which is a part of the thermal insulation box and is parallel to the predetermined direction.

9. The spun yarn drawing apparatus according to claim 8, wherein,
a shielding member is provided to extend toward the outer circumferential surface of the at least one conditioning roller from a location in the wall surface of the thermal insulation box parallel to the predetermined direction, the location being on the conditioning roller side of the communication passage, and
the at least one conditioning roller rotates so that a part of the outer circumferential surface of the at least one conditioning roller, which opposes a leading end portion of the shielding member, moves away from the communication passage.

10. The spun yarn drawing apparatus according to any one of claims 6 to 9, wherein, a shutter is provided to change the flow passage area of the communication passage.

11. The spun yarn drawing apparatus according to any one of claims 1 to 10, wherein, the sealing member is attached to the at least one plate member.

12. The spun yarn drawing apparatus according to claim 11, wherein,
the sealing member extends in a longitudinal direction and along an end on the one side of the at least one plate member, and
the sealing member includes a fixing portion which is U-shaped in cross section cut along a direction orthogonal to the longitudinal direction.

13. The spun yarn drawing apparatus according to claim 12, wherein,
the fixing portion includes:

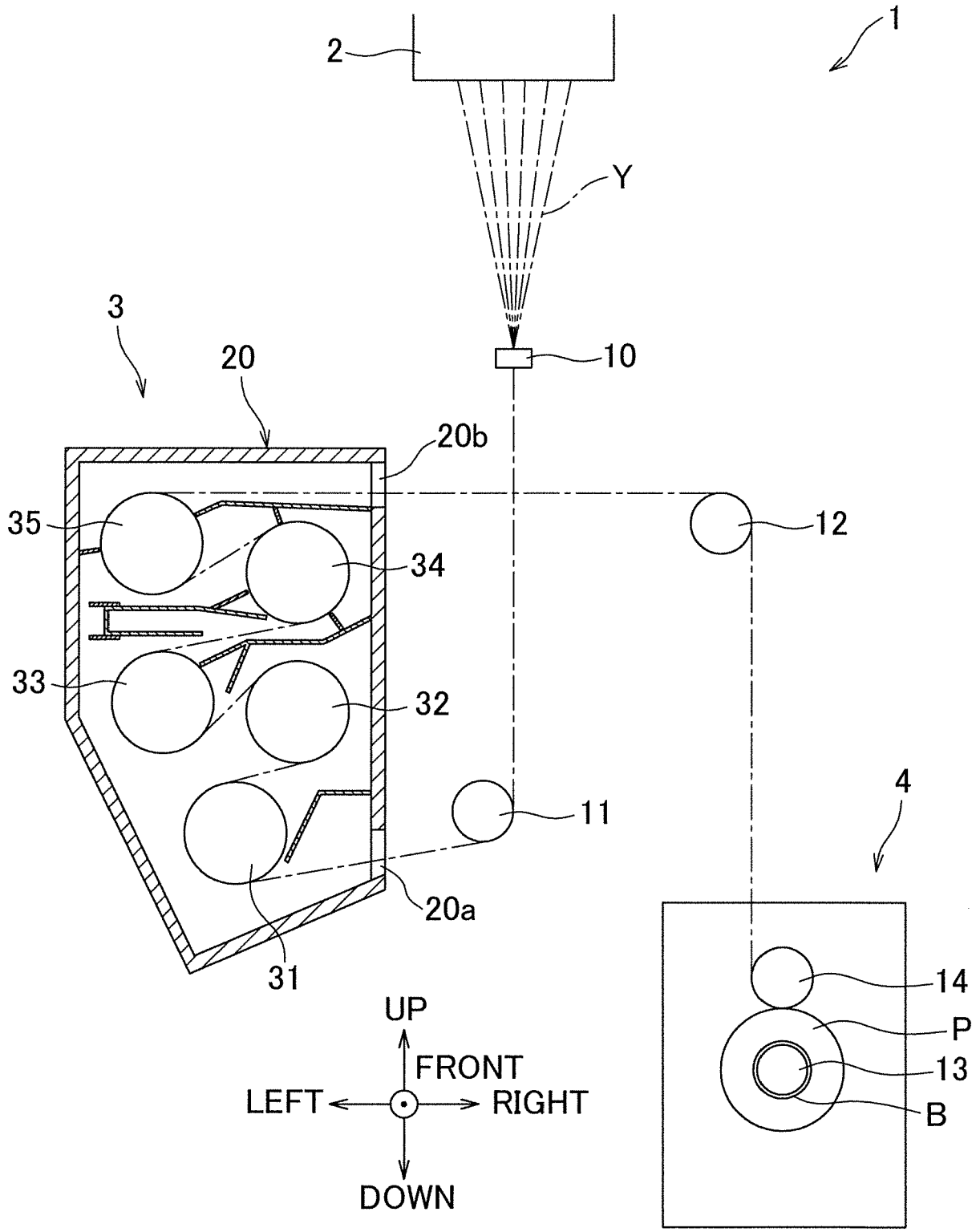
a U-shaped portion which is U-shaped in cross section cut along the direction orthogonal to the longitudinal direction; and
a metal component which is provided along U shape of the U-shaped portion and is plastically deformable, and

when the U-shaped portion is deformed so that the at least one plate member is pinched by the U-shaped portion, the metal component is plastically deformed.

14. The spun yarn drawing apparatus according to claim 13, wherein, the fixing portion further includes a claw portion protruding inward from the U-shaped portion.

15. The spun yarn drawing apparatus according to any one of claims 1 to 14, wherein, the sealing member includes a hollow sealing portion which is provided between the end on the one side of the at least one plate member and the door member.

FIG.1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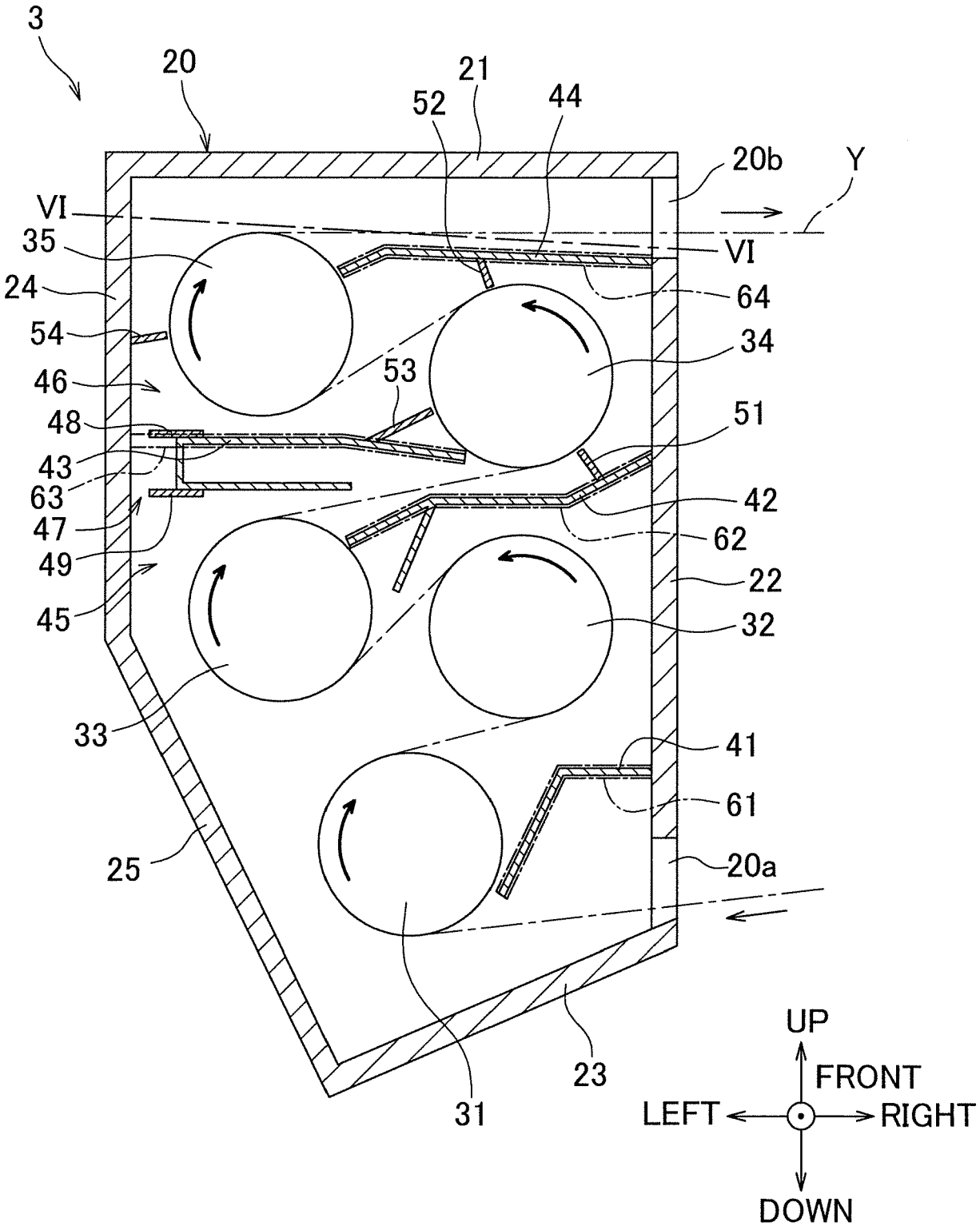
2
Y
3
20
10
20b
35
12
34
33
32
11
4
20a
31
14
P
13
B
UP
FRONT
LEFT
RIGHT
DOWN

FIG.2


3
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21
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44
20b
Y
VI
35
VI
24
64
54
34
46
53
48
51
43
63
42
47
62
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45
32
33
41
61
25
20a
23
31
UP
FRONT
LEFT
RIGHT
DOWN

FIG.3

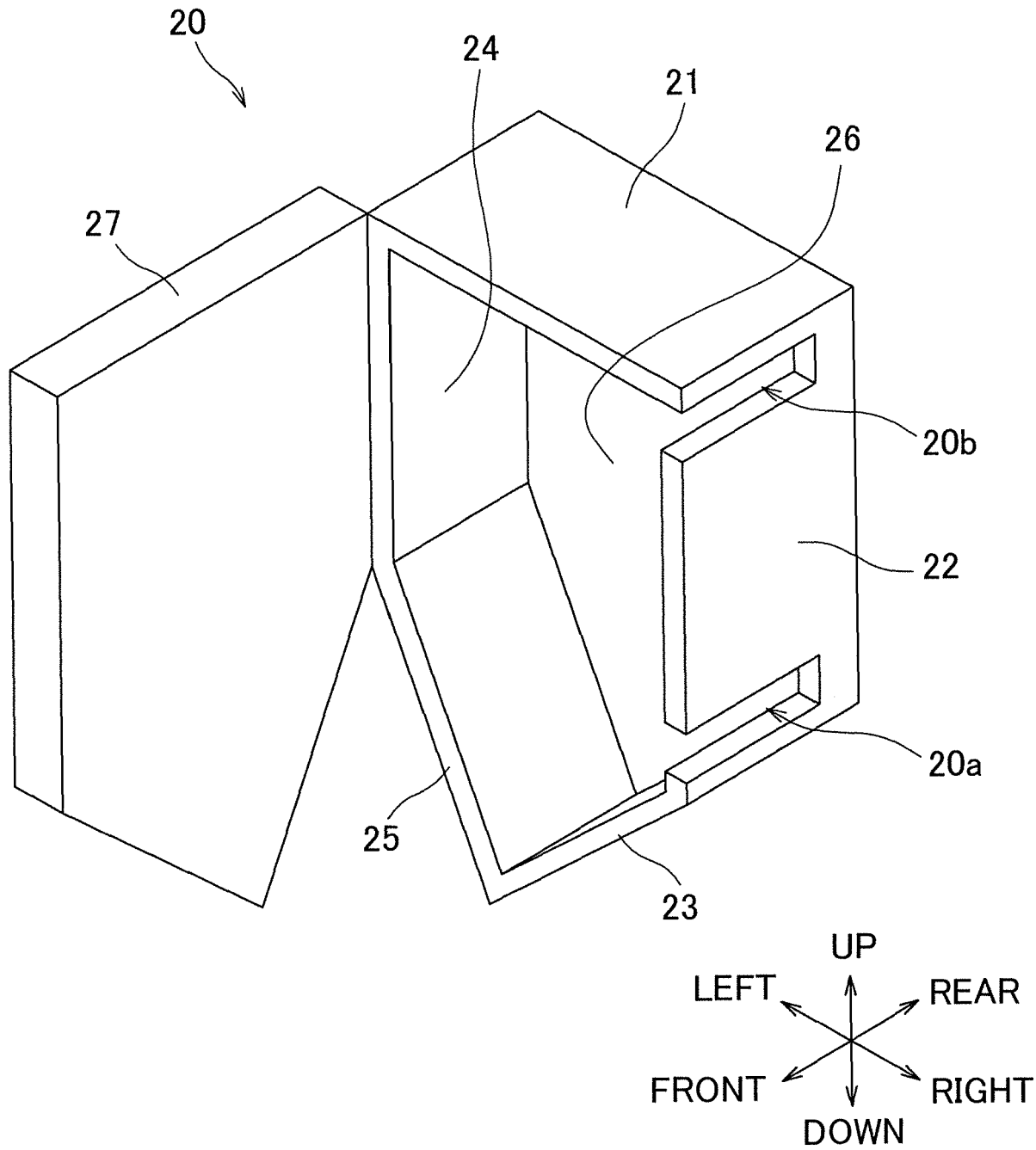


FIG.4

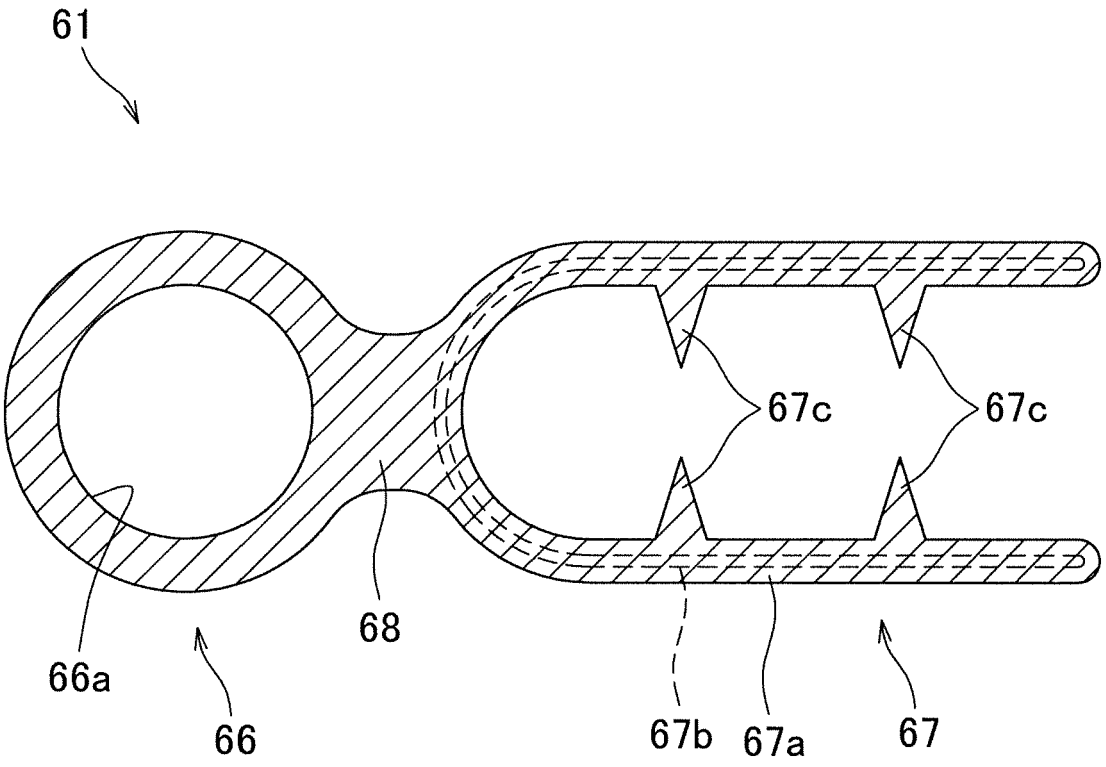


FIG.5

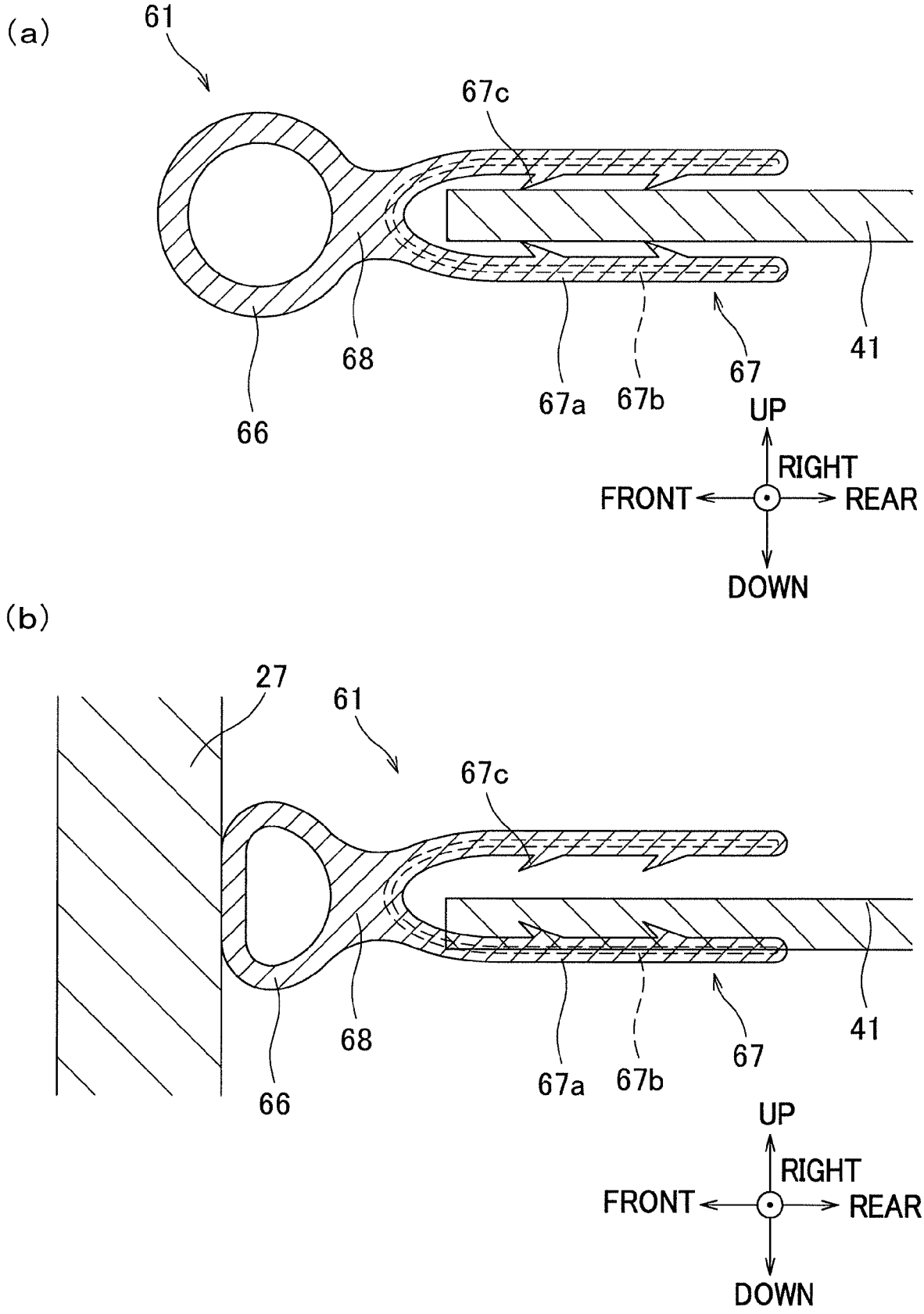
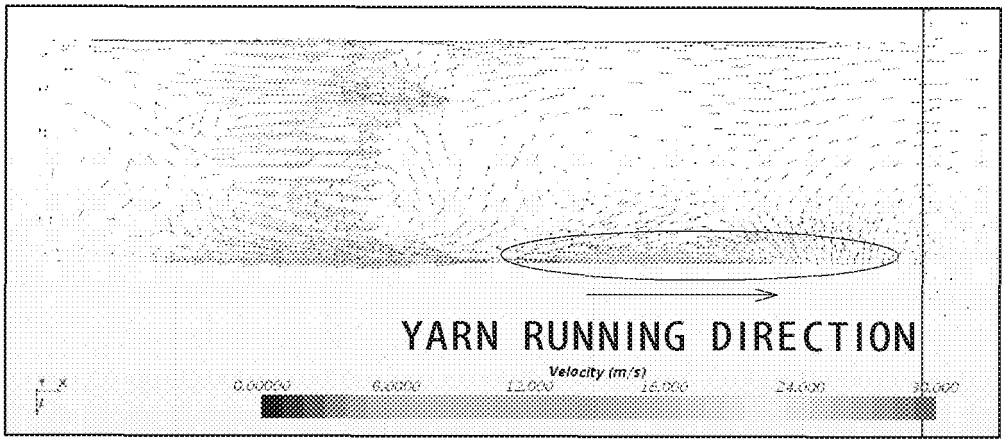
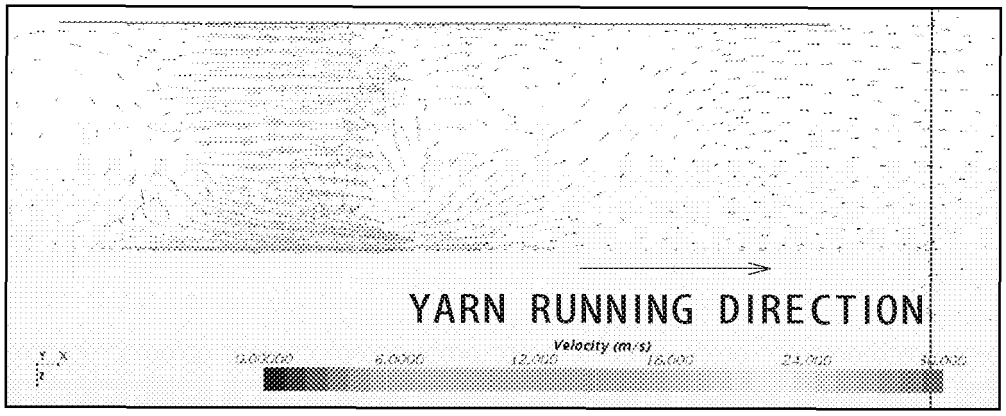

(a)
61
67c
68
66
67a
67b
67
41
UP
RIGHT
FRONT
REAR
DOWN
(b)
27
61
67c
68
66
67a
67b
67
41
UP
RIGHT
FRONT
REAR
DOWN

FIG.6

(a) WITHOUT SEALING MEMBER



(b) WITH SEALING MEMBER



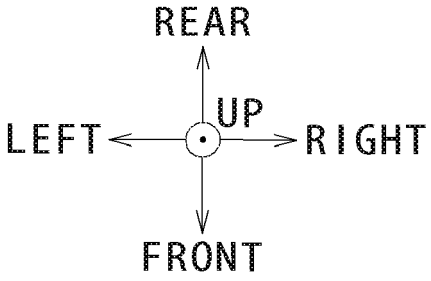
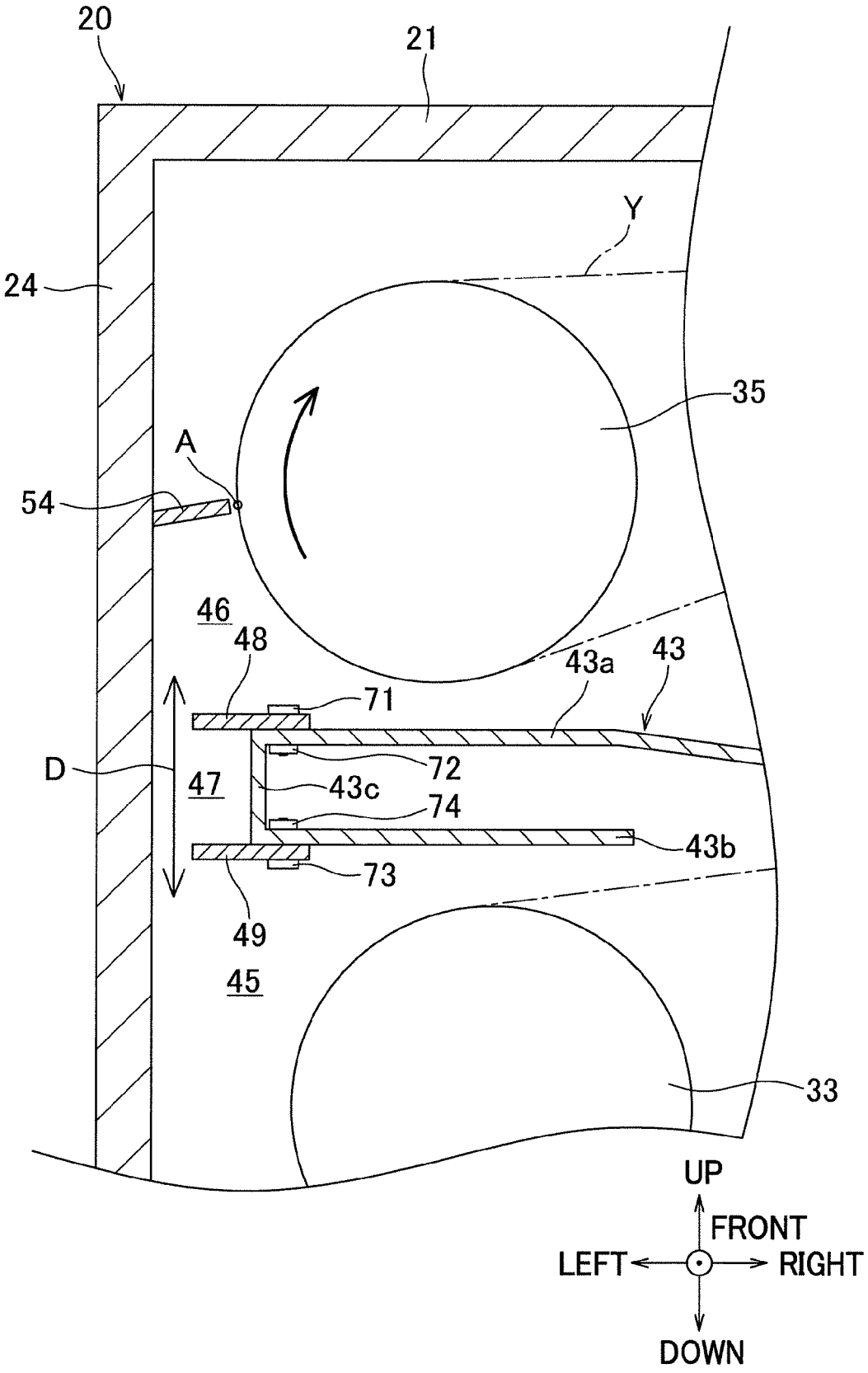


FIG.7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43a
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43b
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FRONT
LEFT
RIGHT
DOWN

FIG.8

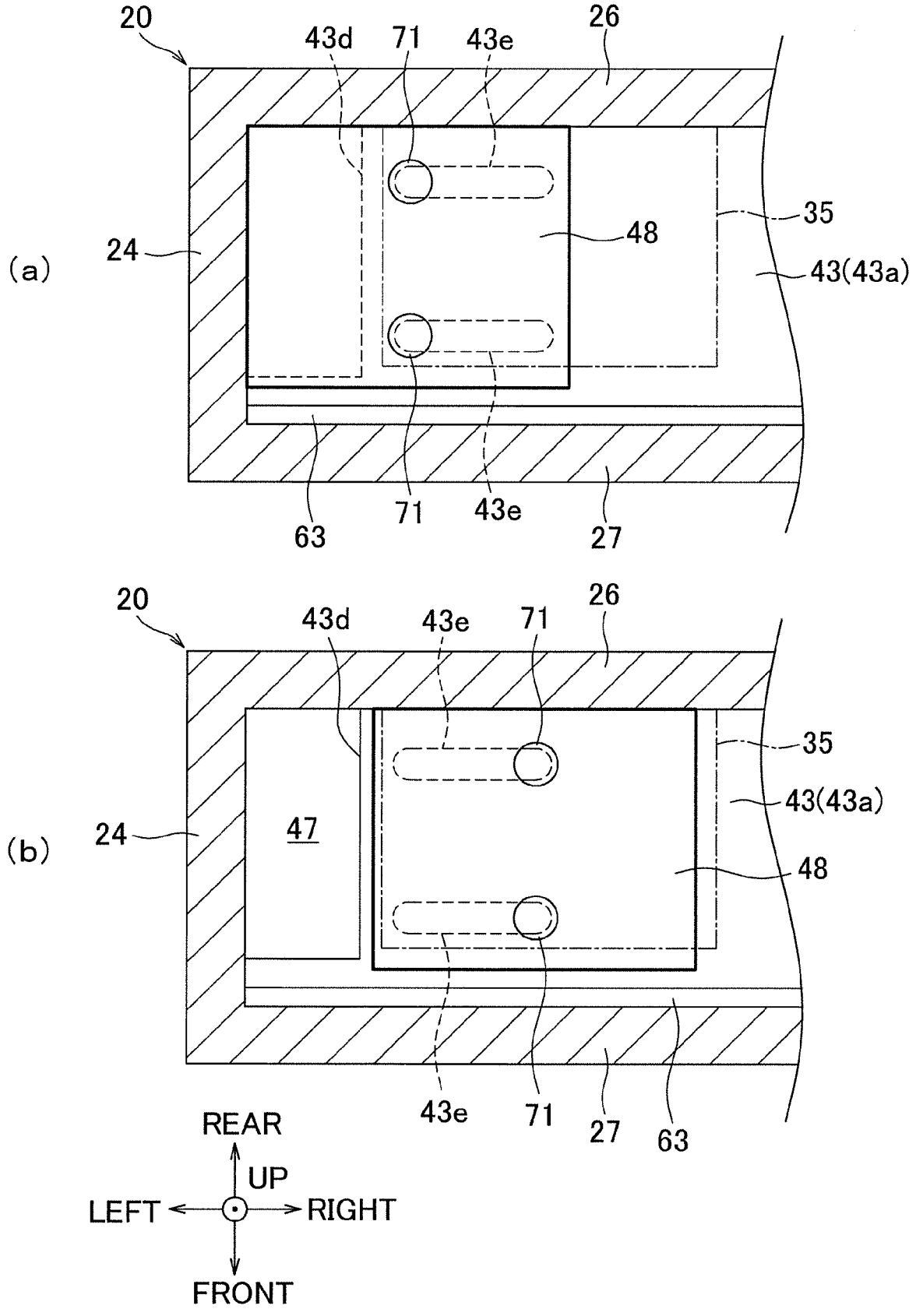
(a)
20
43d
71
43e
26
24
48
35
43(43a)
63
71
43e
27
(b)
20
43d
43e
71
26
35
43(43a)
24
47
48
43e
71
27
63
REAR
UP
LEFT
RIGHT
FRONT

FIG.9

		COMPARATIVE EXAMPLE (NEITHER SEALING MEMBER 63 NOR COMMUNICATION PASSAGE 47 IS PROVIDED)	EXAMPLE 1 (SEALING MEMBER 63 IS PROVIDED BUT COMMUNICATION PASSAGE 47 IS NOT PROVIDED)	EXAMPLE 2 (BOTH SEALING MEMBER 63 AND COMMUNICATION PASSAGE 47 ARE PROVIDED)
SWITCH-ON PERCENTAGE OF HEATER [%]	PREHEATING ROLLER 31	27.6	31.4	28.2
	PREHEATING ROLLER 32	20.6	27.2	22.2
	PREHEATING ROLLER 33	24.8	30.1	23.1
	CONDITIONING ROLLER 34	39.7	41.0	38.2
	CONDITIONING ROLLER 35	35.5	35.0	33.4
POWER CONSUMPTION [kW]		2602.0	3221.7	2395.7

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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 0332

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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D02J
D01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	9 April 2019	Van Beurden-Hopkins

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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