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(54) **Yarn heating apparatus**

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a yarn heating apparatus for heating yarns.

[0002] Japanese Unexamined Patent Publication No. 2001-262429 teaches that yarns spun out from a spinning machine are heated and drawn by two roller units and then wound by a winder. More specifically, the yarns spun out from the spinning machine are wound between a godet roller and a separate roller in each roller unit, and are heated by the godet roller while reciprocating between the rollers plural times. The heated yarns are then drawn between the two godet rollers of the respective roller units.

[0003] The godet roller and the separate roller of each roller unit are housed in the internal space (thermal insulation space) inside a box (thermal insulation box), to restrain the heat generated by the heater of the godet roller from escaping to the outside from the space. In addition to the above, two slits are formed on the outer walls of the box. The yarns enter the internal space through one of the slits (yarn entrance) and go out from the internal space to the outside through the other slit (yarn exit).

[0004] Now, when yarns run, an air flow (accompanied flow) is typically generated around the yarns. For this reason, when the yarns enter the internal space through the slit, cool air outside the box flows into the internal space. Furthermore, when the yarns go out from the internal space through the slit, warm air inside the space leaks out from the space to the outside of the box through the slit. As cool air flows into the internal space and warm air flows out from the internal space, the temperature in the space decreases, thereby increasing the power consumption of the heater required for heating the yarns to suitable temperatures.

[0005] In particular, when the number of running yarns or when yarns run at a high speed, the problem above becomes serious because the accompanied flow is increased and hence an amount of cool air flowing into the internal space and an amount of warm air flowing out from the space are increased.

[0006] GB 1 375 151 A discloses an apparatus for producing filaments comprising a nozzle through which the filaments are extruded, a spinning shaft, a heated take-off godet, a drawing godet and a winding spool. Residual drawing of the filaments takes place in a residual drawing zone in which the filaments are exposed to a controlled atmosphere, for example, a steam atmosphere, the steam being fed in via an inlet and withdrawn through an outlet.

[0007] SU 1 432 105 A1 discloses a unit for the thermal treatment of polymer threads having a thermally insulated chamber with slots for thread passage. The chamber is divided into sections by air permeable baffles. The sections contain feeding discs, heated treatment rollers and

thread cooling transporting cylinders. The unit further has air supply and suction devices. The air supply device is connected to the section which contains the transporting cylinders and the air suction device is connected to the section which contains the treatment rollers or feeding discs. The thread initially passes through the feeding discs, moves to the heated roller and is drawn between the disc and the roller. The thread moves from the rollers to the transporting cylinders where it is cooled by cold air.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a yarn heating apparatus with a reduced power consumption for heating yarns fed by a yarn feeding roller.

[0009] A yarn heating apparatus according to the first aspect of the invention includes the features of claim 1.

[0010] According to the present invention, the cool air having flown into the thermal insulation box from the outside flows into the connecting space, and then only a part of the same flows into the thermal insulation space through the yarn entrance. The cool air is therefore unlikely to flow into the thermal insulation space. Furthermore, since a part of the warm air having flown out from the thermal insulation space through the yarn exit returns to the thermal insulation space through the connecting space and the yarn entrance, the warm air is unlikely to flow out from the thermal insulation box. As such, the temperature decrease in the thermal insulation space on account of the accompanied flow, is restrained and the power consumption of the heater is reduced.

[0011] According to the second aspect of the invention, the yarn heating apparatus of the first aspect is arranged so that the connecting space is divided into a plurality of regions by a partition which has two yarn paths corresponding to the yarn entrance and the yarn exit, respectively.

[0012] According to the present invention, the partition dividing the connecting space into plural regions prevents the cool air having flown into the connecting space from the outside of the thermal insulation box from flowing into the thermal insulation space and prevents the warm air having flown out from the thermal insulation space to the connecting space from flowing out from the thermal insulation box. As such, the temperature decrease in the thermal insulation space on account of the accompanied flow is further effectively restrained.

[0013] According to the present invention, the yarn heating apparatus of the first or second aspect is arranged so that the connecting space is provided with a guide which guides air from the yarn exit side toward the yarn entrance side.

[0014] According to the present invention, the air having flown out from the thermal insulation space through the yarn exit is likely to be guided by the guide in the connecting space, flow toward the yarn entrance, and return to the thermal insulation space. As such, the temperature decrease in the thermal insulation space on ac-

count of the accompanied flow is significantly restrained.

[0015] According to the third aspect of the invention, the yarn heating apparatus of the first or third aspect is arranged so that the connecting space increases in height toward the yarn entrance.

[0016] According to the present invention, since the height of the connecting space increases toward the yarn entrance, the warm air having flown out from the thermal insulation space through the yarn exit is likely to flow toward the yarn entrance side of the connecting space, toward which the height increases, and to return to the thermal insulation space. The temperature decrease in the thermal insulation space on account of the accompanied flow is therefore significantly restrained.

[0017] According to the fourth aspect of the invention, the yarn heating apparatus of any one of the first to third aspects is arranged so that the connecting space is provided with an air blower which feeds wind from the yarn exit side toward the yarn entrance side.

[0018] According to the present invention, the warm air having flown out from the thermal insulation space through the yarn exit is likely to return to the thermal insulation space because the air is blown toward the yarn entrance side in the connecting space by the air blower. The temperature decrease in the thermal insulation space on account of the accompanied flow is therefore significantly restrained.

[0019] According to the fifth aspect of the invention, the yarn heating apparatus of any one of the first to fourth aspects is arranged so that the yarn feeding roller is a heating roller including the heater.

[0020] According to the present invention, even when the yarn feeding roller is a heating roller having a heater, a part of the warm air having flown out from the thermal insulation space through the yarn exit returns to the thermal insulation space through the connecting space and the yarn entrance, it is possible to restrain the temperature decrease in the thermal insulation space on account of the accompanied flow.

[0021] According to the sixth aspect of the invention, the yarn heating apparatus of any one of the first to fifth aspects is arranged so that the yarn feeding roller is a roller for drawing the yarns.

[0022] According to the present invention, even when the yarn feeding roller is a roller for drawing the yarns, it is possible to restrain the temperature decrease in the thermal insulation space on account of the accompanied flow because a part of the warm air having flown out from the thermal insulation space through the yarn exit returns to the thermal insulation space through the connecting space and the yarn entrance.

[0023] According to the first to sixth aspects, the cool air having flown into the thermal insulation box from the outside flows into the connecting space and then only a part thereof flows into the thermal insulation space through the yarn entrance. The cool air is therefore unlikely to flow into the thermal insulation space. Furthermore, since a part of the warm air having flown out from

the thermal insulation space through the yarn exit returns to the thermal insulation space through the connecting space and the yarn entrance, the warm air is unlikely to flow out from the thermal insulation box. For these reasons, the temperature decrease in the thermal insulation space on account of the accompanied flow is restrained and the power consumption of the heater is reduced.

[0024] A yarn heating apparatus according to the seventh aspect of the invention include the features of claim 7.

[0025] According to the present invention, a part of heat of the warm air on the yarn exit side, which flows out from the thermal insulation box on account of the accompanied flow generated around the yarn exit, is transferred from the yarn exit side to the yarn entrance side by the heat transfer unit, and the cool air flowing into the internal space on account of the accompanied flow generated around the yarn entrance is heated by the heat of the warm air. In other words, when the warm air flows out from the thermal insulation box, a part of the heat of this warm air does not escape from the thermal insulation box and remains in the internal space. For this reason, the temperature decrease in the internal space is restrained and the power consumption of the heater required for heating the yarns to suitable temperatures is reduced.

[0026] According to the eighth aspect of the invention, the yarn heating apparatus of the seventh aspect is arranged so that the internal space is, by partitions, divided into: a thermal insulation space in which the yarn feeding roller and the heater are provided; an entrance-side space between the thermal insulation space and the yarn entrance; and an exit-side space between the thermal insulation space and the yarn exit, the partition separating the thermal insulation space from the entrance-side space corresponds to the yarn entrance and has an entrance-side connecting path which connects the thermal insulation space with the entrance-side space, the partition separating the thermal insulation space from the exit-side space corresponds to the yarn exit and has an exit-side connecting path which connects the thermal insulation space with the exit-side space, and the heat transfer unit transfers heat from the exit-side space to the entrance-side space.

[0027] According to the present invention, a part of the heat of the warm air having flown out from the thermal insulation space to the exit-side space on account of the accompanied flow is transferred to the entrance-side space by the heat transfer unit, and the cool air having flown into the entrance-side space from the outside of the thermal insulation box is heated by the heat of the warm air and flows into the thermal insulation space. In other words, a part of the heat having escaped from the thermal insulation space to the exit-side space returns to the thermal insulation space. For this reason, the temperature decrease in the thermal insulation space is restrained and the power consumption of the heater required for heating the yarns to suitable temperatures is

reduced.

[0028] In addition to the above, since the thermal insulation space is separated from the entrance-side space by the partition and these spaces are connected with each other only by the entrance-side connecting path, the cool air having flown into the entrance-side space flows into the thermal insulation space after being sufficiently heated by the heat transferred from the exit-side space. It is therefore possible to certainly restrain the temperature decrease in the thermal insulation space.

[0029] In addition to the above, since the exit-side space is separated from the thermal insulation space by the partition and these spaces are connected with each other only by the exit-side connecting path, the heat is unlikely to escape from the thermal insulation space to the exit-side space and hence the temperature decrease in the thermal insulation space is certainly restrained.

[0030] In addition to the above, since the entrance-side space is separated from the exit-side space by the partition, it is possible to prevent the heat having been transferred from the exit-side space to the entrance-side space by the heat transfer unit from returning to the exit-side space.

[0031] According to the ninth aspect of the invention, the yarn heating apparatus of the eighth aspect is arranged so that the partitions dividing the internal space are made of a heat insulating material.

[0032] According to the present invention, since the partition separating the entrance-side space from the exit-side space is made of a heat insulating material, the heat transfer between the thermal insulation space, the entrance-side space, and the exit-side space via the partition is unlikely to occur, and hence it is possible to prevent heat from escaping from the thermal insulation space to the entrance-side space and the exit-side space and to prevent the heat having been transferred from the exit-side space to the entrance-side space by the heat transfer unit from returning to the exit-side space.

[0033] According to the tenth aspect of the invention, the yarn heating apparatus of the eighth or ninth aspect is arranged so that the exit-side space is connected to an exhaust duct.

[0034] According to the present invention, it is possible to exhaust the oil smoke generated by heating the yarns to the outside of the thermal insulation box through the duct. Furthermore, since the exhaust duct is connected to the exit-side space which is separated from the thermal insulation space by the partition, the heat is less likely to escape from the exhaust duct as compared to a case where the exhaust duct is connected to the thermal insulation space. In addition to the above, since the heat in the exit-side space is transferred to the entrance-side space by the heat transfer unit, the heat is further less likely to escape from the exhaust duct.

[0035] According to the eleventh aspect of the invention, the yarn heating apparatus of the tenth aspect is arranged so that the heat transfer unit is provided in a region which is in the exit-side space and between a con-

nection port of the duct which connects the duct with the exit-side space and the exit-side connecting path.

[0036] According to the present invention, the warm air having flown into the exit-side space from the thermal insulation space through the exit-side connecting path passes through the region where the heat transfer unit is provided and then is exhausted through the exhaust duct. The heat is therefore further less likely to escape through the exhaust duct.

[0037] According to the twelfth aspect of the invention, the yarn heating apparatus of any one of the eighth to eleventh aspects is arranged so that the heat transfer unit has a heat pipe which extends across the entrance-side space and the exit-side space.

[0038] According to the present invention, it is possible to efficiently transfer the heat in the exit-side space to the entrance-side space through the heat pipe.

[0039] According to the thirteenth aspect of the invention, the yarn heating apparatus of any one of the seventh to twelfth aspects is arranged so that the yarn feeding roller is a heating roller having the heater.

[0040] According to the present invention, even when the yarn feeding roller is a heating roller having a heater, the temperature decrease in the thermal insulation space is restrained because a part of the heat having escaped from the thermal insulation space returns to the thermal insulation space. Furthermore, since the yarn feeding roller is a heating roller having a heater, it is unnecessary to provide a heater in addition to the yarn feeding roller, thereby simplifying the structure of the device.

[0041] According to the fourteenth aspect of the invention, the yarn heating apparatus of any one of the seventh to thirteenth aspects is arranged so that the yarn feeding roller is a roller for drawing the yarns.

[0042] According to the present invention, even when the yarn feeding roller is a roller for drawing yarns, the temperature decrease in the thermal insulation space is restrained because a part of the heat having escaped from the thermal insulation space returns to the thermal insulation space.

[0043] According to the seventh to fourteenth aspects of the invention, a part of heat of the warm air on the yarn exit side, which flows out from the thermal insulation box on account of the accompanied flow generated around the yarn exit, is transferred from the yarn exit side to the yarn entrance side by the heat transfer unit, and the cool air flowing into the internal space on account of the accompanied flow generated around the yarn entrance is heated by the heat of the warm air. In other words, when the warm air flows out from the thermal insulation box, a part of the heat of this warm air does not escape from the thermal insulation box and remains in the internal space. For this reason, the temperature decrease in the internal space is restrained and the power consumption of the heater required for heating the yarns to suitable temperatures is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044]

Fig. 1 schematically shows a yarn producing device according to First Embodiment of the invention.

Fig. 2 is a perspective view of the roller unit of Fig. 1.

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

Fig. 4 is a cross section taken along the IV-IV line in Fig. 3.

Fig. 5 relates to a modification 1 of First Embodiment and is equivalent to Fig. 3.

Fig. 6 relates to a modification 2 of First Embodiment and is equivalent to Fig. 4.

Fig. 7 relates to a modification 3 of First Embodiment and is equivalent to Fig. 4.

Fig. 8 relates to a modification 4 of First Embodiment and is equivalent to Fig. 3.

Fig. 9 relates to a modification 5 of First Embodiment and is equivalent to Fig. 3.

Fig. 10 relates to a modification 6 of First Embodiment and is equivalent to Fig. 3.

Fig. 11 schematically shows a yarn producing device according to Second Embodiment of the invention.

Fig. 12 is a perspective view of the roller unit of Fig. 11.

Fig. 13 is a cross section taken along the XIII-XIII line in Fig. 12.

Fig. 14 is a cross section taken along the XIV-XIV line in Fig. 13.

Fig. 15 relates to a modification 1 of Second Embodiment and is equivalent to Fig. 13.

Fig. 16 relates to a modification 2 of Second Embodiment and is equivalent to Fig. 13.

Fig. 17 relates to a modification 3 of Second Embodiment and is equivalent to Fig. 13.

Fig. 18 relates to a modification 4 of Second Embodiment and is equivalent to Fig. 13.

Fig. 19 relates to a modification 5 of Second Embodiment and is equivalent to Fig. 14.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0045] The following will describe a preferred first embodiment of the present invention.

[0046] As shown in Fig. 1, a yarn producing device 1 includes a spinning machine 2, two roller units 3 and 4 (yarn heating apparatuses), and a winder 5. The spinning machine 2 spins out plural (e.g., about 24 to 32) yarns Y downward. When spun out, the yarns Y are aligned in the direction orthogonal to the surface of Fig. 1. The roller units 3 and 4 heat and draw the yarns Y spun out from the spinning machine 2. The winder 5 winds the yarns Y, which have been drawn by the roller units 3 and 4, onto unillustrated bobbins.

[0047] Regarding the components of the yarn producing device 1, the spinning machine 2 and the winder 5

will not be detailed below because they are identical with conventional ones. The following will therefore detail the roller units 3 and 4.

[0048] The roller unit 3 is, as shown in Fig. 1, provided below the spinning machine 2, and includes, as shown in Fig. 1 to Fig. 4, a godet roller 11, a separate roller 12, and a thermal insulation box 13 in which the rollers are housed.

[0049] The thermal insulation box 13 is a substantially rectangular parallelepiped box made of a heat insulating material, and has therein a thermal insulation space 21 and a connecting space 22. The thermal insulation box 13 is further provided with a door 13a at its one end in the direction in which the yarns Y are aligned. As the door 13a is closed, the thermal insulation space 21 and the connecting space 22 are sealed. On the other hand, as the door 13a is opened, the thermal insulation space 21 and the connecting space 22 are exposed.

[0050] The thermal insulation space 21 includes therein the godet roller 11 and the separate roller 12. The godet roller 11 is cantilevered by an unillustrated frame which is provided on the opposite side of the thermal insulation box 13 from the door 13a. The yarns Y spun out from the spinning machine 2 are pulled by the godet roller 11.

[0051] The separate roller 12 is provided above the godet roller 11 and, in the same manner as the godet roller 11, cantilevered by the unillustrated frame provided on the opposite side of the thermal insulation box 13 from the door 13a. The yarns Y pulled by the godet roller 11 are wound between the godet roller 11 and the separate roller 12 plural times, and then sent to the roller unit 4. In First Embodiment, the godet roller 11 and the separate roller 12 are equivalent to a yarn feeding roller of the present invention.

[0052] In addition to the above, each of the godet roller 11 and the separate roller 12 is a heating roller including therein a heater 15. The yarns Y are heated while reciprocating between the godet roller 11 and the separate roller 12. Since the godet roller 11 and the separate roller 12 are housed in the thermal insulation space 21, the heat generated by the heater 15 does not leak out from the thermal insulation space 21 to the outside. In this regard, since in First Embodiment the godet roller 11 and the separate roller 12 are heating rollers including the heaters 15 therein, the structure of the device is simple.

[0053] The connecting space 22 is a space formed above the thermal insulation space 21 of the thermal insulation box 13. The thermal insulation space 21 is separated from the connecting space 22 by a wall 23. The wall 23 has two slits 24a and 24b sandwiching the rollers 11 and 12. These slits 24a and 24b are substantially in parallel to the direction of alignment of the yarns Y.

[0054] The slit 24a is arranged to be substantially as long as the connecting space 22 to introduce the yarn Y from the front side (see Fig. 4). The end of the slit 24a on the door 13a side is open, whereas a part 24a1 which is the opposite end of this opening functions as a yarn

entrance of the present invention through which the yarns Y are introduced into the thermal insulation space 21. The slit 24b functions as a yarn exit of the present invention through which the yarns Y go out from the thermal insulation space 21. In the same manner as the slit 24a, the end of the slit 24b on the door 13a side is open: however, the slit 24b is shorter than the slit 24a.

[0055] An upper wall 13c of the thermal insulation box 13, which forms the ceiling of the connecting space 22, has, at around the parts opposing the slits 24a and 24b, a slit 25a substantially identical in shape with the slit 24a and a slit 25b substantially identical in shape with the slit 24b. The slits 25a and 25b are, in the same manner as the slits 24a and 24b, open at the ends on the door 13a side, respectively (see Fig. 2 and Fig. 3).

[0056] The above-described openings of the slits 24a, 24b, 25a, and 25b are sealed by the door 13a when the door 13a is closed.

[0057] In First Embodiment, the door 13a is opened and the yarns are placed onto the godet roller 11 and the separate roller 12. In doing so, it is necessary to cause the yarns Y to pass through the slits 24a, 24b, 25a, and 25b. In this regard, First Embodiment is arranged as described above so that the slits 24a, 24b, 25a, and 25b are open at the ends on the door 13a side. For this reason, it is easy to cause the yarns Y to pass through the slits 24a, 24b, 25a, and 25b through the openings, when the yarns are placed.

[0058] In the connecting space 22, a guide wall 26 is formed to extend from the vicinity of the opening of the slit 24b to the vicinity of the part 24a1 (yarn entrance) of the slit 24a.

[0059] In addition to the above, a side wall 13b of the thermal insulation box 13, which forms the side wall surface opposite to the door 13a of the connecting space 22, is provided with a filter 27. The connecting space 22 is connected to, via the filter 27, a duct 9 provided outside the thermal insulation box 13. The duct 9 is connected to an unillustrated blower. The yarns Y are typically coated with oil including water. Therefore, oil smoke is generated as the yarns Y are heated. In this regard, First Embodiment is arranged so that the blower is activated to suck air in the connecting path 22 through the duct 9, so that the oil in the air is captured by the filter 27. This makes it possible to keep the work environment clean.

[0060] The roller unit 4 has a structure similar to the roller unit 3. Hereinafter, to clearly distinguish the description of the roller unit 3 from the description of the roller unit 4, each of the components of the roller unit 4 will be recited with a dash after the part number, e.g. a godet roller 11' and a separate roller 12', as compared to the equivalent components of the roller unit 3.

[0061] The roller unit 4 is arranged, as shown in Fig. 1, to be vertically inverted as compared to the roller unit 3, i.e. arranged so that the connecting space 22' is below the thermal insulation space 21' and the slit 25b' of the roller unit 4 is above the roller unit 3 and opposes the slit 25b of the roller unit 3.

[0062] In the roller unit 4 arranged as above, to the contrary to the roller unit 3, the slit 24b' is equivalent to the yarn entrance of the present invention and the part 24a1' forming the end opposite to the opening of the slit 24a' is equivalent to the yarn exit of the present invention.

[0063] In the yarn producing device 1 arranged as described above, the yarns Y spun out from the spinning machine 2 are pulled by the godet roller 11 of the roller unit 3. In so doing, the yarns Y pass through the end portion of the slit 25a opposite to the opening to enter the connecting space 22, and then pass through the part 24a1 (yarn entrance) of the slit 24a to enter the thermal insulation space 21.

[0064] The yarns Y pulled by the godet roller 11 reciprocate between the godet roller 11 and the separate roller 12 plural times, and are then supplied from the godet roller 11 to the godet roller 11' of the roller unit 4. In so doing, the yarns Y pass through the slit 24b (yarn exit) to enter the connecting space 22 (i.e., go out from the thermal insulation space 21), pass through the slit 25b to go out from the thermal insulation box 13 and then pass through the slit 25b' to enter the connecting space 22', and pass through the slit 24b' (yarn entrance) to enter the thermal insulation space 21'.

[0065] The yarns Y pulled by the godet roller 11' reciprocate between the godet roller 11' and the separate roller 12', and are then supplied from the godet roller 11' to the winder 5. In so doing, the yarns Y pass through the part 24a1' (yarn exit) of the slit 24a' to enter the connecting space 22' (i.e., go out from the thermal insulation space 21'), pass through the end portion of the slit 25a' opposite to the opening to go out from the thermal insulation box 13', and then are supplied to the winder 5.

[0066] The yarns Y run from the spinning machine 2 toward the winder 5 at a speed of, for example, about 4000 to 6000m/min. In so doing, the yarns Y are heated while reciprocating between the godet roller 11 and the separate roller 12 and between the godet roller 11' and the separate roller 12'. In addition to the above, the rotation speed of the godet roller 11' of the roller unit 4 is higher than that of the godet roller 11 of the roller unit 3. The heated yarns Y are drawn by a force corresponding to the difference in the rotation speeds, between the godet roller 11 and the godet roller 11'.

[0067] Now, when the yarns Y run, an air flow (accompanied flow) is typically generated around the yarns Y. For this reason, provided that in the roller unit 3 the thermal insulation box 13 does not have the connecting space 22 and the slits 25a and 25b, the yarns Y outside the thermal insulation box 13 directly enter the thermal insulation space 21 through the slit 24a, and hence cool air outside the thermal insulation box 13 flows into the thermal insulation space 21 through the slit 24a, on account of the accompanied flow.

[0068] Furthermore, the yarns Y in the thermal insulation space 21 directly go out from the thermal insulation space 21 to the outside of the thermal insulation box 13 through the slit 24b, and hence warm air inside the ther-

mal insulation space 21 flows out from the thermal insulation space 21 to the outside of the thermal insulation box 13 through the slit 24b, on account of the accompanied flow.

[0069] Because of the cool air flowing into the thermal insulation space 21 and the warm air flowing out from the thermal insulation space 21 as above, the temperature of the thermal insulation space 21 is likely to decrease and hence the power consumption for the heater required to heat the yarns Y to suitable temperatures is increased.

[0070] In addition to the above, since in First Embodiment the number of yarns Y is large (e.g., about 24 to 32), and the speed of the yarns Y is not low (e.g., about 4000 to 6000m/min), the accompanied flow is large and the amount of cool air flowing in from the outside of the thermal insulation box 13 and the amount of warm air flowing out from the thermal insulation space 21 are also large. For these reasons, when the connecting space 22 and the slits 25a and 25b are not provided, the temperature inside the thermal insulation space 21 is highly likely to decrease and the power consumption of the heater 15 required for heating the yarns Y to suitable temperatures is particularly large.

[0071] In this connection, in First Embodiment the thermal insulation box 13 is provided with the connecting space 22. Therefore only a part of the cool air flowing into the connecting space 22 from the outside of the thermal insulation box 13 through the slit 25a flows into the thermal insulation space 21 through the slit 24a. As such, the cool air does not easily flows into the thermal insulation space 21. Furthermore, since a part of the warm air flowing out from the thermal insulation space 21 through the slit 24b does not leak out from the thermal insulation box 13 through the slit 25b, and eventually returns to the thermal insulation space 21 through the connecting space 22 and the slit 24a. As such, the warm air does not easily leak out from the thermal insulation box 13. It is therefore possible to restrain the temperature decrease in the thermal insulation space 21 on account of the accompanied flow, and to reduce the power consumption of the heater 15.

[0072] In addition to the above, First Embodiment is arranged so that the connecting space 22 is provided with the guide wall 26. For this reason, the warm air having flown out from the thermal insulation space 21 to the connecting space 22 through the slit 24b easily flows toward the part 24a1 of the slit 24a along the guide wall 26, but does not easily flow toward the other parts of the slit 24a as disturbed by the guide wall 26. In other words, the air having flown out from the thermal insulation space 21 through the slit 24b is, in the connecting space 22, guided by the guide wall 26 from the yarn exit side to the yarn entrance side.

[0073] Furthermore, since the accompanied flow flowing from connecting space 22 to the thermal insulation space 21 is generated around the part 24a1 of the slit 24a which is the yarn entrance, the air reaching the vi-

cinity of the part 24a1 of the slit 24a in the connecting space 22 flows into the thermal insulation space 21 along with the accompanied flow.

[0074] For this reason, the air flowing out from the thermal insulation space 21 to the connecting space 22 through the slit 24b sufficiently returns to the thermal insulation space 21, thereby significantly restraining the temperature decrease inside the thermal insulation space 21 due to the accompanied flow.

[0075] Furthermore, provided that in the roller unit 4 the thermal insulation box 13' does not have the connecting space 22' and the slits 25a' and 25b' in the same manner as above, the cool air flowing into the thermal insulation space 21' and the warm air flowing out from the thermal insulation space 21' increase the power consumption of the heater 15' required for heating the yarns Y to suitable temperatures.

[0076] In this regard, since in First Embodiment the thermal insulation box 13' is provided with the connecting space 22' in the same manner as above, a part of the warm air flowing out from the thermal insulation space 21' through the slit 24a' (part 24a1') returns to the thermal insulation space 21' via the connecting space 22' and the slit 24b'. As such, the temperature decrease in the thermal insulation space 21' due to the accompanied flow is restrained, and hence the power consumption of the heater 15' is decreased.

[0077] In addition to the above, since the warm air flowing out through the slit 24a' (part 24a1') is likely to return to the thermal insulation space 21' through the slit 24b' by being guided by the guide wall 26' toward the slit 24b', the temperature decrease in the thermal insulation space 21' due to the accompanied flow is significantly decreased.

[0078] Now, various modifications of First Embodiment will be described. It is noted that the same components as in First Embodiment are denoted by the same reference numerals as in First Embodiment, respectively, and the description thereof will be omitted. It is noted that, although the following will describe modifications of the structure of the roller unit 3, the same modifications are possible for the roller unit 4.

[0079] The connecting space for connecting the slit 24a (part 24a1) with the slit 24b may be arranged to be different from First Embodiment above. For example, according to a modification (modification 1), as shown in Fig. 5, the connecting space 31 is inclined toward the slit 24a (leftward in the figure; on the yarn entrance side), and therefore the bottom 31a and the ceiling 31b of the connecting space 31 are inclined surfaces inclined toward the slit 24a so as to be tilted with respect to the horizontal direction.

[0080] In this case, the warm air flowing out from the thermal insulation space 21 to the connecting space 31 through the slit 24b easily flows toward the slit 24a (part 24a1) of the connecting space 31 at the high position and returns to the thermal insulation space 21. This makes it possible to significantly restrain the temperature de-

crease in the thermal insulation space 21 due to the accompanied flow.

[0081] Furthermore, in addition to the guide wall 26, the bottom 31a and the ceiling 31b of the connecting space 31 also function as guides for guiding the air in the connecting space 31 from the slit 24b side toward the part 24a1 side of the slit 24a.

[0082] The modification 1 is arranged so that the bottom 31a and the ceiling 31b of the connecting space 31 are inclined surfaces. Alternatively, for example, the bottom 31a and the ceiling 31b of the connecting space 31 may be stepped surfaces.

[0083] According to another modification (modification 2), as shown in Fig. 6, in addition to First Embodiment above, a guide wall 41 is provided to oppose the guide wall 26 and extends substantially in parallel to the guide wall 26, and the part 24a1 of the slit 24a and the slit 24b are positioned between the guide wall 26 and the guide wall 41. With this arrangement, in the space above the thermal insulation space 21, only the part between the guide wall 26 and the guide wall 41 functions as the connecting space 42. In the case above, furthermore, the guide wall 41 is provided with the filter 27 and a part of the duct 9 is provided in the thermal insulation box 13.

[0084] According to the arrangement above, the warm air flowing out from the thermal insulation space 21 to the connecting space 22 through the slit 24b is guided not only by the guide wall 26 but also the guide wall 41 toward the part 24a1 of the slit 24a. This further facilitates the air to return to the thermal insulation space 21. According to the arrangement above, furthermore, since the volume of the connecting space 42 is smaller than the volume of the connecting space 22 of First Embodiment above, the temperature of the air flowing out from the thermal insulation space 21 through the slit 24b is not easily decreased in the connecting space 42, and the temperature of the air flowing out from the thermal insulation space 21 is not significantly decreased during the return to the thermal insulation space 21. It is therefore possible to significantly restrain the temperature decrease in the thermal insulation space 21 due to the accompanied flow.

[0085] According to another modification (modification 3), as shown in Fig. 7, a fan 51 (air blower) is provided in the connecting space 42 to blow air from the slit 24b side toward the part 24a1 side of the slit 24a, in addition to the arrangement of the modification 2. In this case, the warm air flowing out from the thermal insulation space 21 through the slit 24b is blown in the connecting space 22 by the fan 51 toward the part 24a1 of the slit 24a, and hence the warm air is likely to return to the thermal insulation space 21. This further restrains the temperature decrease in the thermal insulation space 21 due to the accompanied flow.

[0086] While in the modification 3 the fan 51 is provided in the connecting space 42 of the modification 2, a fan may be provided in the connecting space 22 of First Embodiment above.

[0087] According to another modification (modification 4), as shown in Fig. 8, the connecting space 56 is arranged to be higher than the connecting space 22 (see Fig. 3) and is divided by a partition 57 into upper and lower regions, i.e. into an upper region 56a and a lower region 56b. The partition 57 has slits 58a and 58b (yarn paths) at around the part opposing the slits 24a and 25a and at around the part opposing the slits 24b and 25b, respectively.

[0088] In this case, only a part of the cool air flowing from the outside of the thermal insulation box 13 into the connecting space 56 (upper region 56a) through the slit 25a flows into the lower region 56b through the slit 58a, and a part of this part flows into the thermal insulation space 21 through the slit 24a. In other words, the partition 57 separating the upper region 56a from the lower region 56b in the connecting space 56 restrains the cool air, which flows from the outside of the thermal insulation box 13 into the connecting space 56, from flowing into the thermal insulation space 21. Therefore the cool air outside the thermal insulation box 13 does not easily flow into the thermal insulation space 21.

[0089] Furthermore, only a part of the warm air flowing out from the thermal insulation space 21 to the connecting space 56 (lower region 56b) through the slit 24b flows out to the upper region 56a through the slit 58b, and only a fraction of this part flows out from the thermal insulation box 13 through the slit 25b. In other words, the partition 57 separating the upper region 56a from the lower region 56b in the connecting space 56 restrains the warm air, which flows out from the thermal insulation space 21 through the slit 24b, from flowing out to the outside of the thermal insulation box 13. The air which does not flow out from the thermal insulation box 13 flows into the upper region 56a and the lower region 56b and then returns to the thermal insulation space 21 through the slit 24a. Therefore the warm air in the thermal insulation space 21 is unlikely to flow out from the thermal insulation box 13.

[0090] Because of the above, it is possible to efficiently restrain the temperature decrease in the thermal insulation space 21 due to the accompanied flow. While in the modification 4 the connecting space 56 is divided into the upper region 56a and the lower region 56b by the partition 57, the connecting space may be divided into three or more portions by partitions having slits functioning as yarn paths.

[0091] In addition to the above, while in First Embodiment above the connecting space 22 is provided with the guide wall 26, this guide wall 26 may not be provided. Also in this case, since the slit 24a is connected with the slit 24b by the connecting space 22, the warm air flowing out from the thermal insulation space 21 through the slit 24b returns to the thermal insulation space 21 via the connecting space 22 and the slit 24a.

[0092] In addition to the above, while in First Embodiment above the godet roller 11 and the separate roller 12 are both heating rollers having the heaters 15, only

one of the godet roller 11 and the separate roller 12 may be a heating roller, e.g. only the godet roller 11 is a heating roller.

[0093] Alternatively, neither the godet roller 11 nor the separate roller 12 is a heating roller, and a heater is additionally provided. For example, according to another modification (modification 5), as shown in Fig. 9, three rollers 61 to 63 (yarn feeding rollers) each of which does not have a heater are provided in the thermal insulation space 21, and heaters 64 and 65 are provided between the roller 61 and the roller 62 and between the roller 62 and the roller 63, respectively, to oppose the yarns Y fed between the rollers.

[0094] Also in this case, in the same manner as First Embodiment above, the warm air having flown out from the thermal insulation space 21 through the slit 24b passes through the connecting space 22 and the part 24a1 of the slit 24a and returns to the thermal insulation space 21. It is therefore possible to restrain the temperature decrease in the thermal insulation space 21 due to the accompanied flow and reduce the power consumption of the heaters 64 and 65.

[0095] While in the cases above the connecting space is provided only above the thermal insulation space 21, a different arrangement may be adopted. According to another modification (modification 6), as shown in Fig. 10, a connecting space 71 stretches from above the thermal insulation space 21 to the rightward of the figure. Furthermore, in place of the slit 24b (see Fig. 9), a slit 24c (yarn exit) is formed through a side wall 73 of the thermal insulation space 21 by which the space 21 is separated from the connecting space 72, and in place of the slit 25b (see Fig. 9), a slit 25c is formed at a part of the side wall 13d of the thermal insulation box 13 to oppose the slit 24c of the side wall 73.

[0096] In the thermal insulation space 21, the rollers 61 to 63 and the heaters 64 and 65 are provided in the same manner as the modification 5. However, as the positional relationship between the slit 24a and the slit 24c is different from that of the slit 24a and the slit 24b, the positions of the components 61 to 65 are different from those in the modification 5. More specifically, the positions of the rollers 61 to 63 and the heaters 64 and 65 are entirely shifted in the clockwise direction in Fig. 10, as compared to the positions in the modification 5.

[0097] Also in this case, the warm air flowing out to the connecting space 71 through the slit 24c returns to the thermal insulation space 21 via the slit 24a. It is therefore possible to restrain the temperature decrease in the thermal insulation space 21 and to reduce the power consumption of the heaters 64 and 65.

[0098] In this case, since the slit 24c is positioned to be lower than the slit 24a and hence the warm air flowing out to the connecting space 71 through the slit 24c easily flows from the part around the slit 24c toward the part around the slit 24a which is higher in position than the slit 24c. It is therefore possible to efficiently cause the air flowing out to the connecting space 71 to return to the

thermal insulation space 21.

[0099] While in First Embodiment above the present invention is applied to the roller unit which heats and draws yarns and has a godet roller and a separate roller, the present invention may be applied to another yarn heating apparatus which has a yarn feeding roller for feeding yarns, a heater heating the yarns fed by the yarn feeding roller, and a thermal insulation box housing the yarn feeding roller and the heater.

[0100] Now, a preferred second embodiment of the present invention will be described.

[0101] As shown in Fig. 11, a yarn producing device 101 includes spinning machine 102, two roller units 103 and 104 (yarn heating apparatuses), and a winder 105. The spinning machine 102 spins out plural (e.g., about 24 to 32) yarns Y downward. When spun out, the yarns Y are aligned in the direction orthogonal to the surface of Fig. 11. The roller units 103 and 104 heat and draw the yarns Y spun out from the spinning machine 102. The winder 105 winds the yarns Y, which have been drawn by the roller units 103 and 104, onto unillustrated bobbins.

[0102] It is noted that, in the above-described arrangement of the yarn producing device 101, the spinning machine 102 and the winder 105 are identical with the conventional ones and the descriptions thereof are omitted. The following will therefore detail the roller units 103 and 104.

[0103] The roller unit 103 is, as shown in Fig. 11, provided below the spinning machine 102, and as shown in Fig. 11 to Fig. 14, has a thermal insulation box 113 for housing a godet roller 111 and a separate roller 112.

[0104] The thermal insulation box 113 is a substantially rectangular parallelepiped box made of a heat insulating material. The thermal insulation box 113 is provided with a door 113a at one end in the direction of alignment of yarns Y spun out from the spinning machine 102. As the door 113a is closed, the internal space 120 of the thermal insulation box 113 is closed. On the other hand, the internal space 120 is exposed as the door 113a is opened.

[0105] Through a wall 113b on the upper side of the thermal insulation box 113 are formed slits 125a and 125b. The slits 125a and 125b are in parallel to the direction of alignment of the yarns Y, and the ends thereof on the door 113a side are open. The slit 125a and the slit 125b, however, are different from each other in length. While the slit 125a extends along substantially the entirety of the thermal insulation box 113, the slit 125b is shorter than this slit 125a. In addition to the above, as the door 113a is closed, the openings of the slits 125a and 125b are closed by the door 113a.

[0106] The yarns Y spun out from the spinning machine 102 are, as described later, supplied to the internal space 120 through the end portion 125a1 (yarn entrance) of the slit 125a on the side opposite to the door 113a, and the yarns Y in the internal space 120 go out from the internal space 120 through the slit 125b (yarn exit).

[0107] Now, the internal space 120 of the thermal insulation box 113 will be detailed. The internal space 120

of the thermal insulation box 113 is divided by partitions 128 to 130 made of a heat insulating material into a thermal insulation space 121, an entrance-side space 122, an exit-side space 123, and an isolated space 124.

[0108] In the thermal insulation space 121 are provided a godet roller 111 and a separate roller 112. The godet roller 111 is cantilevered by an unillustrated frame which is provided on the opposite side of the thermal insulation box 113 from the door 113a. The yarns Y spun out from the spinning machine 102 are pulled by the godet roller 111.

[0109] The separate roller 112 is provided above the godet roller 111 and, in the same manner as the godet roller 111, cantilevered by the unillustrated frame provided on the opposite side of the thermal insulation box 113 from the door 113a. The yarns Y pulled by the godet roller 111 are wound between the godet roller 111 and the separate roller 112 plural times, and then sent to the roller unit 104. In Second Embodiment, the godet roller 111 and the separate roller 112 are equivalent to the yarn feeding roller of the present invention.

[0110] In addition to the above, each of the godet roller 111 and the separate roller 112 is a heating roller including therein a heater 115. The yarns Y are heated while reciprocating between the godet roller 111 and the separate roller 112.

[0111] The entrance-side space 122 is provided above the thermal insulation space 121 to oppose the end portion 125a1 of the slit 125a (i.e. between the thermal insulation space 121 and the yarn entrance), and is separated from the thermal insulation space 121 by a horizontally-extending partition 128 to establish a vertical relation therebetween. The partition 128 has a slit 126a which opposes the slit 125a, and the entrance-side space 122 and the thermal insulation space 121 are connected to each other only via the end portion 126a1 (entrance-side connection path) which is opposite to the door 113a of the slit 126a. The slit 126a is open at the end on the door 113a side, in the same manner as the slit 125a.

[0112] The exit-side space 123 extends in the direction of alignment of the yarns Y along the substantially entirety of the thermal insulation box 113, to oppose the slit 125b above the thermal insulation space 121 (i.e. extends between the thermal insulation space 121 and the yarn exit). The exit-side space 123 is separated from the thermal insulation space 121 by the partition 128 to establish a vertical relation therebetween, in the same manner as the entrance-side space 122. The partition 128 is further provided with a slit 126b (exit-side connection path) which opposes the slit 125b. Therefore the exit-side space 123 and the thermal insulation space 121 are connected with each other only via the slit 126b. The slit 126b is open at the end on the door 113a side in the same manner as the slit 125b.

[0113] At the side wall 113c of the exit-side space 123 on the opposite side from the door 113a of the thermal insulation box 113, a connection port 113d having a filter 127 is formed. This connection port 113d is connected

to an exhaust duct 109. The exhaust duct 109 is connected to an unillustrated blower. The yarns Y are typically coated with oil including water. Therefore, oil smoke is generated as the yarns Y are heated. In this regard, Second Embodiment is arranged so that the blower is activated to suck air in the exit-side space 123 through the exhaust duct 109, so that the oil in the air is captured by the filter 127. This makes it possible to keep the work environment clean.

[0114] The isolated space 124 consists of the upper part of the thermal insulation space 121 along with the entrance-side space 122 and the exit-side space 123. The space 124 is separated from the thermal insulation space 121 by the partition 128 to establish a vertical relation therebetween, and separated also from the entrance-side space 122 by a substantially L-shaped partition 129. The space 124 is further separated from the exit-side space 123 by a partition 130 which is substantially in parallel to the slits 125a and 125b. That is to say, the isolated space 124 is connected to none of the thermal insulation space 121, the entrance-side space 122, and the exit-side space 123.

[0115] In the internal space 120 of the thermal insulation box 113 is provided a heat exchanger 140 (heat transfer unit). The heat exchanger 140 transfers heat in the exit-side space 123 to the entrance-side space 122, and includes a plurality of heat pipes 141, a plurality of heat collecting fins 142, and a plurality of heat radiation fins 143.

[0116] Each of the heat pipes 141 is arranged so that a metal pipe whose both ends are closed is filled with an hydraulic fluid made of water, alcohol, fluorocarbon, or the like. These heat pipes 141 extend across the entrance-side space 122, the isolated space 124, and the exit-side space 123. In the heat pipe 141, the part positioned in the exit-side space 123 is between the slits 125b and 126b and the connection port 113d. Furthermore, in the heat pipe 141, the part in the isolated space 124 is covered with a heat insulating material 144.

[0117] The heat collecting fins 142 and the heat radiation fins 143 are plate-shaped metal members aligned along the axial direction of the heat pipes 141, in the exit-side space 123 and the entrance-side space 122, respectively. The heat pipes 141 penetrate the heat collecting fins 142 and the heat radiation fin 143 so as to be connected with the respective heat collecting fins 142 and the respective heat radiation fins 143.

[0118] Now, the heat transfer by the heat exchanger 140 will be described. In the thermal insulation box 113, as described later, cool air flows into the entrance-side space 122 from the outside of the thermal insulation box 113 and warm air flows out from the thermal insulation space 121 to the exit-side space 123.

[0119] As the warm air flows out from the thermal insulation space 121 to the exit-side space 123, the heat of the air heats the hydraulic fluid filling the part of the heat pipe 141 in the exit-side space 123, with the result that the hydraulic fluid is vaporized. In response to this,

the pressure in the part of the heat pipe 141 in the exit-side space 123 becomes higher than the pressure in the part of the entrance-side space 122 in the isolated space 124. Because of this pressure difference, the hydraulic fluid in the parts of the heat pipe 141 in the entrance-side space 122 and the isolated space 124 moves toward the exit-side space 123 on account of the capillary phenomenon, so that the vaporized hydraulic fluid moves toward the entrance-side space 122.

[0120] The hydraulic fluid having moved to the exit-side space 123 is heated by the warm air in the exit-side space 123 and vaporized in the same manner as above, whereas the hydraulic fluid having moved to the entrance-side space 122 is cooled by the cool air in the entrance-side space 122 and condensed to liquid. As such, the hydraulic fluid moves in the heat pipe 41 in the same manner as above. As this movement of the hydraulic fluid is repeated, the heat in the exit-side space 123 is transferred to the entrance-side space 122.

[0121] In connection with the above, since the parts of the heat pipe 141 in the exit-side space 123 and the entrance-side space 122 are provided with the heat collecting fins 142 and the heat radiation fins 143, respectively, the heat in the exit-side space 123 is efficiently transferred to the hydraulic fluid in the heat pipe 141 and the heat in the heat pipe 141 is efficiently transferred to the entrance-side space 122.

[0122] In addition to the above, since the part of the heat pipe 141 in the isolated space 124 is covered with the heat insulating material 144, the heat transferred from the exit-side space 123 to the entrance-side space 122 does not easily escape to the isolated space 124 on the way, with the result that the heat in the exit-side space 123 is efficiently transferred to the entrance-side space 122.

[0123] The roller unit 104 includes, in the same manner as the roller unit 103, a godet roller 111, a separate roller 112, and a thermal insulation box 113.

[0124] In the roller unit 104, however, the godet roller 111 and the separate roller 112 are arranged to be upside down as compared to the roller unit 103. Furthermore, the thermal insulation box 113 of the roller unit 104 is different from the thermal insulation box 113 of the roller unit 103 in that the thermal insulation space 121, the entrance-side space 122, the exit-side space 123, and the isolated space 124 are arranged to be upside down, and hence the slits 125a and 125b are formed through the wall 113e which is at a lower part of the thermal insulation box 113.

[0125] The roller unit 104 is provided above the roller unit 103 so that the slit 125a of the roller unit 104 opposes the slit 125b of the roller unit 103.

[0126] In the yarn producing device 101 arranged as above, the yarns Y spun out for the spinning machine 102 are supplied to the roller unit 103. The yarn Y supplied to the roller unit 103 pass through the end portion 125a1 (yarn entrance) of the slit 125a and enter the entrance-side space 122, and then pass through the slit 126a and

enter the thermal insulation space 121. The yarns Y are then pulled by the godet roller 111 in the thermal insulation space 121 and reciprocate between the godet roller 111 and the separate roller 112 plural times, and pass through the slit 126b to the exit-side space 123 from the thermal insulation space 121, pass through the slit 125b (yarn exit) to go out from the thermal insulation box 113, and then are supplied to the roller unit 104.

[0127] The yarns Y supplied to the roller unit 104 are, in the same manner as above, pass through the end portion 125a1 (yarn entrance) of the slit 125a to enter the entrance-side space 122, and then pass through the slit 126a to enter the thermal insulation space 121. The yarns Y are then pulled by the godet roller 111 in the thermal insulation space 121 and reciprocate between the godet roller 111 and the separate roller 112 plural times, pass through the slit 126b to go out from the thermal insulation space 121 to the exit-side space 123, pass through the slit 125b (yarn exit) to go out from the thermal insulation box 113, and are supplied to the winder 105.

[0128] As such, the yarns Y run from the spinning machine 102 toward the winder 105 at a speed of, for example, about 4000 to 6000m/min. In so doing, the yarns Y are heated while reciprocating between the godet roller 111 and the separate roller 112 of each of the roller units 103 and 104. In connection with the above, the godet roller 111 of the roller unit 104 rotates faster than the godet roller 111 of the roller unit 103. Therefore the heated yarns Y are drawn by the force corresponding to the difference in the rotation speeds of the respective two godet rollers 111.

[0129] Now, when the yarns Y run, an air flow (accompanied flow) is typically generated around the yarns Y. For this reason, the accompanied flow generated by the running yarns Y passing through the slit 125a causes cool air outside the thermal insulation box 113 to flow into the thermal insulation space 121 via the entrance-side space 122. Also, the accompanied flow generated by the running yarns Y passing through the slit 125b causes warm air in the thermal insulation space 121 to flow out from the thermal insulation box 113 via the exit-side space 123.

[0130] In addition to the above, since in Second Embodiment the number of yarns Y is large (e.g., about 24 to 32), and the speed of the yarns Y is not low (e.g., about 4000 to 6000m/min), the accompanied flow is large and the amount of cool air flowing in from the outside of the thermal insulation box 113 to the thermal insulation space 121 and the amount of warm air flowing out from the thermal insulation space 121 to the outside of the thermal insulation box 113 are also large.

[0131] In this regard, since in Second Embodiment the thermal insulation box 113 is provided with the heat exchanger 140, a part of the heat of the warm air flowing out from the thermal insulation space 121 through the slit 126b into the exit-side space 123 on account of the accompanied flow is transferred to the entrance-side space 122 by the heat exchanger 140. In short, the heat is trans-

ferred from the yarn exit side to the yarn entrance side. Furthermore, the cool air having flown into the entrance-side space 22 via the slit 125a is heated by the heat and flows into the thermal insulation space 121. That is to say, a part of the heat of the warm air having flown out from the thermal insulation space 121 on account of the accompanied flow returns to the thermal insulation space 121. In other words, when the warm air flows out from the thermal insulation box 113, a part of the heat of the warm air does not go out from the thermal insulation box 113 and remains in the internal space 120. This restrains the temperature decrease in the thermal insulation space 121 and makes it possible to reduce the power consumption of the heater required for heating the yarns Y to suitable temperatures.

[0132] In addition to the above, the thermal insulation space 121 is separated from the entrance-side space 122 by the partition 128 to establish a vertical relation therebetween, and these spaces are connected with each other only by the slit 126a. For this reason, the cool air having flown into the entrance-side space 122 from the outside of the thermal insulation box 113 does not easily flow into the thermal insulation space 121, as compared to cases where no partition 128 is provided and the part where the slit 125a is formed is continued with the part where the godet rollers 111 and 112 are provided, in the internal space 120. With the arrangement above, the cool air having flown into the entrance-side space 122 is sufficiently heated by the heat transferred by the heat exchanger 140, and then flows into the thermal insulation space 121. It is therefore possible to further efficiently restrain the temperature decrease in the thermal insulation space 121.

[0133] In addition to the above, since the thermal insulation space 121 is separated from the exit-side space 123 by the partition 128 to establish a vertical relation therebetween and these spaces are connected with each other only by the slit 126b, an amount of the air flowing out from the thermal insulation space 121 to the exit-side space 123 is small as compared to cases where no partition 128 is provided and the part where the slit 125b is formed is continued with the part where the godet rollers 111 and 112 are provided in the internal space 120. It is therefore possible to further efficiently restrain the temperature decrease in the thermal insulation space 121.

[0134] In addition to the above, since the entrance-side space 122 is separated from the exit-side space 123 by the partitions 129 and 130 and the isolated space 124 (heat insulating material 144) to not to directly connect with each other and the partitions 129 and 130 are made of a heat insulating material, the heat transferred from the exit-side space 123 to the entrance-side space 122 by the heat exchanger 140 does not easily return to the exit-side space 123. For this reason, the heat of the warm air flowing out from the thermal insulation space 121 is efficiently returned to the thermal insulation space 121, and hence the temperature decrease in the thermal insulation space 121 is further efficiently restrained.

[0135] In addition to the above, since the partition 128 by which the thermal insulation space 121 is separated from the entrance-side space 122 and the exit-side space 123 is made of a heat insulating material, it is possible to prevent the heat in the thermal insulation space 121 from being transferred to the entrance-side space 122 and the exit-side space 123 via the partition 128.

[0136] Now, various modifications of Second Embodiment will be described. It is noted that the same components as in Second Embodiment are denoted by the same reference numerals as in Second Embodiment, respectively, and the description thereof will be omitted. It is noted that, although the following will describe modifications of the structure of the roller unit 103, the same modifications are possible for the roller unit 104.

[0137] While in Second Embodiment above the internal space 120 of the thermal insulation box 113 is divided into the thermal insulation space 121, the entrance-side space 122, the exit-side space 123, and the isolated space 124 by the partitions 128 to 130, the present invention is not limited to the arrangement in which the internal space 120 is divided into these four spaces.

[0138] According to a modification (modification 1), as shown in Fig. 15, no partition 128 is provided, and the internal space 120 is a single continuous space in which a region 120a equivalent to the thermal insulation space 121 (see Fig. 13) and regions 120b to 120d equivalent to the entrance-side space 122, the exit-side space 123, and the isolated space 124 (see Fig. 13) are directly connected to one another, and the partitions 129 and 130 identical with those described above are provided between the region 120b and the region 120d and between the region 120c and the region 120d, respectively.

[0139] According to another modification (modification 2), as shown in Fig. 16, in addition to the modification 1, the partitions 129 and 130, the heat insulating material 144, and the like are not provided, and the regions 120b and 120c are directly connected to the region 120d.

[0140] In these cases, a part of the heat of the warm air in the region 120c of the internal space 120, which escapes from the internal space 120 to the outside of the thermal insulation box 113 on account of the accompanied flow generated at around the slit 125b, is transferred to the region 120b by the heat exchanger 140. In other words, as the heat is transferred from the yarn exit side to the yarn entrance side. Therefore, the cool air flowing into the region 120b due to the accompanied flow generated at around the slit 25a is heated by the heat. For this reason, when the warm air flows out from the internal space 120 to the outside of the thermal insulation box 113, a part of the heat of this warm air does not escape from the thermal insulation box 113 and remain in the internal space 120. As a result, the temperature decrease in the internal space 120 is restrained and the power consumption of the heater 115 required for heating the yarns Y to suitable temperatures is reduced.

[0141] While in the modifications 1 and 2 the partition 128 is not provided at all and the internal space 120 is a

single continuous space, the present invention is not limited to this arrangement. For example, the modification 1 may be further modified such that only a part of the partition 128 is provided in the internal space 120 and the internal space 120 is divided into (i) a space composed of the region 120a and at least one of the regions 120b to 120d, which are connected with one another and (ii) at least one of the entrance-side space 122, the exit-side space 123, and the isolated space 124. Alternatively, the modification 2 may be further modified such that only the partition 128 among the partitions 128 to 130 is provided in the internal space 120 and the internal space 120 is divided into the thermal insulation space 121 and the other continuous space by the partition 128.

[0142] In addition to the above, while Second Embodiment above is arranged so that the two partitions 129 and 130 form the isolated space 124 which is provided between the entrance-side space 122 and the exit-side space 123 and is separated from these spaces 122 and 123, the isolated space 124 may not be provided and only one partition may be provided between the entrance-side space 122 and the exit-side space 123.

[0143] In addition to the above, while in Second Embodiment above the partitions 128 to 130 dividing the internal space 120 into the spaces 121 to 124 are made of a heat insulating material, the partitions 128 to 130 may be made of a material which is not a heat insulating material.

[0144] Also in this case, because of the presence of the partition 128 and the slits 126a and 126b, in the same manner as Second Embodiment above, the cool air having flown into the entrance-side space 122 flows into the thermal insulation space 121 after being sufficiently heated by the heat transferred by the heat exchanger 140, and the amount of air flowing from the thermal insulation space 121 to the exit-side space 123 is reduced. Furthermore, because of the presence of the partitions 129 and 130, the heat transferred from the exit-side space 123 to the entrance-side space 122 does not easily return to the exit-side space 123. It is therefore possible to efficiently restrain the temperature decrease in the thermal insulation space 121.

[0145] In addition to the above, while in Second Embodiment above the godet roller 111 and the separate roller 112 are both heating rollers each having the heater 115, only one of the godet roller 111 and the separate roller 112 may be a heating roller, e.g. only the godet roller 111 is a heating roller.

[0146] Alternatively, none of the godet roller 111 and the separate roller 112 is a heating roller and an additional heater is provided. For example, according to another modification (modification 3), as shown in Fig. 17, three rollers 161 to 163 (yarn feeding rollers) each having no heater are provided in the thermal insulation space 121, and heaters 164 and 165 are provided between the roller 161 and the roller 162 and between the roller 162 and the roller 163, respectively, to oppose the yarns Y fed between these rollers 161 to 163.

[0147] Also in this case, in the same manner as Second Embodiment above, the heat of the warm air flowing out from the thermal insulation space 121 into the exit-side space 123 via the slit 126b is transferred to the entrance-side space 122 by the heat exchanger 140 and the air flowing into the entrance-side space 122 from the outside of the thermal insulation box 113 via the slit 125a is heated by the heat above and flows into the thermal insulation space 121, with the result that a part of the heat having escaped from the thermal insulation space 121 returns to the thermal insulation space 121. Therefore the temperature decrease in the thermal insulation space 121 is restrained and the power consumption of the heaters 164 and 165 is decreased.

[0148] In addition to the above, while in the arrangements above the entrance-side space 122 and the exit-side space 123 are both provided above the thermal insulation space 121, the present invention is not limited to this. For example, according to another modification (modification 4), as shown in Fig. 18, the exit-side space 173 is provided beside the thermal insulation space 121 (i.e., to the right in Fig. 18). Furthermore, in accordance with the above, the partition 172 separating the thermal insulation space 121 from the exit-side space 173 has the slit 126c, and the side wall 113f of the thermal insulation box 113 opposing the partition 172 has the slit 125c (yarn exit) which opposes the slit 126c. The connection port 113d is formed at a part of the side wall 113c which part forms the exit-side space 173.

[0149] In addition to the above, in the thermal insulation space 121 are provided the rollers 161 to 163 and the heaters 164 and 165 in the same manner as the modification 3. However, as the positional relationship between the slit 126a and the slit 126c is different from that of the slit 126a and the slit 126b, the positions of the components 161 to 165 are different from those in the modification 3. More specifically, the positions of the rollers 161 to 163 and the heaters 164 and 165 are entirely shifted in the clockwise direction in Fig. 18, as compared to the modification 3.

[0150] In addition to the above, the isolated space 174 provided between the entrance-side space 122 and the exit-side space 173 stretches from above the thermal insulation space 121 to the lateral thereof. The heat pipes 141 of the heat exchanger 140 are bended at about 90 degrees in the middle, so as to stretch across the entrance-side space 122, the isolated space 174, and the exit-side space 173.

[0151] Also in this case, in the same manner as above, the heat of the warm air flowing into the exit-side space 173 via the slit 126c is transferred to the entrance-side space 122 by the heat exchanger 140, and the cool air flowing from the outside of the thermal insulation box 113 into the entrance-side space 122 via the slit 125a is heated by the heat and flows into the thermal insulation space 121, with the result that a part of the heat having escaped from the thermal insulation space 121 returns to the thermal insulation space 121. It is therefore possible to re-

strain the temperature decrease in the thermal insulation space 121 and to reduce the power consumption of the heaters 164 and 165.

[0152] In addition to the above, while in Second Embodiment above the exit-side space 123 is connected to the exhaust duct 109 and a part of the heat exchanger 140 which part is in the exit-side space 123 is disposed between the slits 125b and 126b and the connection port 113d of the exhaust duct 109, the heat exchanger 140 of the exit-side space 123 is not necessarily disposed at this position.

[0153] For example, according to another modification (modification 5), as shown in Fig. 19, the part of the heat exchanger 140 which is in the exit-side space 123 is provided on the side opposite to the connection port 113d in the exit-side space 123 and in proximity to the slit 126b. The heat pipe 141 is bended in the middle and extends across the entrance-side space 122, the exit-side space 123, and the isolated space 181 provided therebetween. The entirety of the isolated space 181 is covered with the heat insulating material 144.

[0154] In this case, the air flowing from the slit 126b toward the connection port 113d does not pass through the heat exchanger 140. However, since the part of the heat exchanger 140 in the exit-side space 123 is provided in proximity to the slit 126b, the heat of the warm air flowing out from the thermal insulation space 121 into the exit-side space 123 is efficiently transferred to the entrance-side space 122.

[0155] In addition to the above, the part of the heat exchanger 140 in the exit-side space 123 may be provided on the side opposite to the connection port 113d in the exit-side space 123 and to be distanced from the slit 126b.

[0156] In addition to the above, the exhaust duct 109 may not be connected to the exit-side space 123 but to, for example, the thermal insulation space 121.

[0157] In addition to the above, while in Second Embodiment above the heat exchanger 140 having the heat pipes 141, the heat collecting fins 142, and the heat radiation fin 143 is provided as a heat transfer unit for transferring heat in the exit-side space 123 to the entrance-side space 122, the heat transfer unit may be a known heat exchanger which is differently arranged as compared to the heat exchanger above.

[0158] In addition to the above, while in Second Embodiment above the present invention is applied to the roller unit having the roller such as the godet roller 111, the separate roller 112 and the rollers 161 to 163, which draw yarns while heating them, the present invention may be applied to another yarn heating apparatus which has a yarn feeding roller which feeds yarns, a heater which heats yarns heated by a yarn feeding roller, and a thermal insulation box housing a yarn feeding roller and a heater.

Claims

1. A yarn heating apparatus comprising:

a yarn feeding roller which feeds yarns;
a heater which heats the yarns fed by the yarn feeding roller; and
a thermal insulation box which houses the yarn feeding roller and the heater,
the thermal insulation box including:

a thermal insulation space in which the yarn feeding roller and the heater are provided;
a yarn entrance which is formed through a wall of the thermal insulation space and through which the yarns enter the thermal insulation space;
a yarn exit which is formed through the wall and through which the yarns exit from the thermal insulation space; and
a connecting space which is separated from the thermal insulation space by the wall and connects the yarn entrance with the yarn exit,

characterized in that the connecting space is provided with a guide which guides air from the yarn exit side toward the yarn entrance side.

2. The yarn heating apparatus according to claim 1, wherein,
the connecting space is divided into a plurality of regions by a partition which has two yarn paths corresponding to the yarn entrance and the yarn exit, respectively.

3. The yarn heating apparatus according to claim 1 or 2, wherein,
the connecting space increases in height toward the yarn entrance.

4. The yarn heating apparatus according to any one of claims 1 to 3, wherein,
the connecting space is provided with an air blower which feeds wind from the yarn exit side toward the yarn entrance side.

5. The yarn heating apparatus according to any one of claims 1 to 4, wherein,
the yarn feeding roller is a heating roller having the heater.

6. The yarn heating apparatus according to any one of claims 1 to 5, wherein,
the yarn feeding roller is a roller for drawing the yarns.

7. A yarn heating apparatus comprising:

a yarn feeding roller which feeds yarns;
 a heater which heats the yarns fed by the yarn feeding roller; and
 a thermal insulation box which houses the yarn feeding roller and the heater,
 the thermal insulation box having:

a yarn entrance through which the yarns enter an internal space of the thermal insulation box from the outside of the thermal insulation box; and

a yarn exit through which the yarns exit from the internal space to the outside of the thermal insulation box, and

the internal space being provided with a heat transfer unit which transfers heat from the yarn exit side to the yarn entrance side, **characterized in that** the heat transfer unit is a heat exchanger.

8. The yarn heating apparatus according to claim 7, wherein,
 the internal space is, by partitions, divided into:

a thermal insulation space in which the yarn feeding roller and the heater are provided;
 an entrance-side space between the thermal insulation space and the yarn entrance; and
 an exit-side space between the thermal insulation space and the yarn exit,
 the partition separating the thermal insulation space from the entrance-side space has an entrance-side connecting path which corresponds to the yarn entrance and connects the thermal insulation space with the entrance-side space,
 the partition separating the thermal insulation space from the exit-side space has an exit-side connecting path which corresponds to the yarn exit and connects the thermal insulation space with the exit-side space, and
 the heat transfer unit transfers heat from the exit-side space to the entrance-side space.

9. The yarn heating apparatus according to claim 8, wherein,
 the partitions dividing the internal space are made of a heat insulating material.

10. The yarn heating apparatus according to claim 8 or 9, wherein,
 the exit-side space is connected to an exhaust duct.

11. The yarn heating apparatus according to claim 10, wherein,
 the heat transfer unit is provided in a region which is in the exit-side space and between a connection port of the duct which connects the duct with the exit-side space and the exit-side connecting path.

12. The yarn heating apparatus according to any one of claims 8 to 11, wherein,
 the heat transfer unit has a heat pipe which extends across the entrance-side space and the exit-side space.

13. The yarn heating apparatus according any one of claims 7 to 12, wherein,
 the yarn feeding roller is a heating roller having the heater.

14. The yarn heating apparatus according to any one of claims 7 to 13, wherein,
 the yarn feeding roller is a roller for drawing the yarns.

Patentansprüche

1. Garnwärmeverrichtung mit:

einer Garnzuführrolle, die Garne zuführt;
 einem Wärmeelement, das die Garne wärmt, die durch die Garnzuführrolle zugeführt worden sind; und
 einer thermisch isolierenden Box, die die Garnzuführrolle und das Wärmeelement beinhaltet, wobei die thermisch isolierende Box aufweist:

einen thermisch isolierenden Raum, in dem die Garnzuführrolle und das Wärmeelement vorgesehen sind;
 einen Garneingang, der durch eine Wand des thermisch isolierenden Raums gebildet ist und durch den die Garne in den thermisch isolierenden Raum eintreten;
 einen Garnaussgang, der durch die Wand gebildet ist und durch den die Garne aus dem thermisch isolierenden Raum austreten; und
 einen Verbindungsraum, der von dem thermisch isolierenden Raum durch die Wand getrennt ist und den Garneingang mit dem Garnaussgang verbindet;
dadurch gekennzeichnet, dass der Verbindungsraum mit einer Führung versehen ist, die Luft von der Garnaussgangsseite zu der Garneingangsseite führt.

2. Garnwärmeverrichtung nach Anspruch 1, bei der der Verbindungsraum in mehrere Bereiche durch eine Abtrennung geteilt ist, die zwei Garnpfade aufweist, die jeweils dem Garneingang und dem Garnaussgang entsprechen.

3. Garnwärmeverrichtung nach Anspruch 1 oder 2, bei der der Verbindungsraum zu dem Garneingang hin in der Höhe zunimmt.

4. Garnwärmeverrichtung nach einem der Ansprüche 1 bis 3, bei der der Verbindungsraum mit einem Luftgebläse versehen ist, das Wind von der Garnaussgangsseite zu der Garneingangsseite zuführt. 5
5. Garnwärmeverrichtung nach einem der Ansprüche 1 bis 4, bei der die Garnzuführrolle eine Wärmerolle ist, die das Wärmeelement aufweist. 10
6. Garnwärmeverrichtung nach einem der Ansprüche 1 bis 5, bei der die Garnzuführrolle eine Rolle zum Ziehen der Garne ist. 15
7. Garnwärmeverrichtung mit:
- einer Garnzuführrolle, die Garne zuführt; einem Wärmeelement, das die Garne wärmt, die durch die Garnzuführrolle zugeführt worden sind; und einer thermisch isolierenden Box, die die Garnzuführrolle und das Wärmeelement beinhaltet, wobei die thermisch isolierende Box aufweist:
- einen Garneingang, durch den die Garne in einen internen Raum der thermisch isolierenden Box von außerhalb der thermisch isolierenden Box eintreten; und einen Garnaussgang, durch den die Garne aus dem internen Raum zu außerhalb der thermisch isolierenden Box austreten, und wobei der interne Raum mit einer Wärmeübertragungseinheit versehen ist, die Wärme von der Garnaussgangsseite zu der Garneingangsseite überträgt, **dadurch gekennzeichnet, dass** die Wärmeübertragungseinheit ein Wärmetauscher ist. 20 25 30 35 40
8. Garnwärmeverrichtung nach Anspruch 7, bei der der interne Raum durch Abtrennungen geteilt ist in:
- einen thermisch isolierenden Raum, in dem die Garnzuführrolle und das Wärmeelement vorgesehen sind; einen Eingangsseitenraum zwischen dem thermisch isolierenden Raum und dem Garneingang; und einen Ausgangsseitenraum zwischen dem thermisch isolierenden Raum und dem Garnaussgang, die Abtrennung, die den thermisch isolierenden Raum von dem Eingangsseitenraum trennt, einen Eingangsseitenverbindungs- pfad aufweist, der dem Garneingang entspricht und den thermisch isolierenden Raum mit dem Eingangssei- 45 50 55
- tenraum verbindet, die Abtrennung, die den thermisch isolierenden Raum von dem Ausgangsseitenraum trennt, einen Ausgangsseitenverbindungs- pfad aufweist, der dem Garnaussgang entspricht und den thermisch isolierenden Raum mit dem Ausgangs- seitenraum verbindet, und die Wärmeübertragungseinheit Wärme von dem Ausgangsseitenraum zu dem Eingangs- seitenraum überträgt.
9. Garnwärmeverrichtung nach Anspruch 8, bei der die Abtrennungen, die den internen Raum teilen, aus einem wärmeisolierenden Material sind.
10. Garnwärmeverrichtung nach Anspruch 8 oder 9, bei der der Ausgangsseitenraum mit einer Abgasleitung verbunden ist.
11. Garnwärmeverrichtung nach Anspruch 10, bei der die Wärmeübertragungseinheit in einem Bereich vorgesehen ist, der in dem Ausgangsseitenraum und zwischen einem Verbindungsanschluss der Lei- tung liegt, der die Leitung mit dem Ausgangssei- tenraum und dem Ausgangsseitenverbindungs- pfad verbindet.
12. Garnwärmeverrichtung nach einem der Ansprüche 8 bis 11, bei der die Wärmeübertragungseinheit ein Wärmerohr auf- weist, das sich über den Eingangsseitenraum und den Ausgangsseitenraum erstreckt.
13. Garnwärmeverrichtung nach einem der Ansprüche 7 bis 12, bei der die Garnzuführrolle eine Wärmerolle ist, die das Wärmeelement aufweist.
14. Garnwärmeverrichtung nach einem der Ansprüche 7 bis 13, bei der die Garnzuführrolle eine Rolle zum Ziehen der Garne ist.

Revendications

1. Appareil de chauffage de fil comprenant :

un rouleau d'amenée de fil qui amène des fils ;
un dispositif de chauffage qui chauffe les fils amenés par le rouleau d'amenée de fil ; et
une boîte d'isolation thermique qui loge le rou-
leau d'amenée de fil et le dispositif de chauffage,
la boîte d'isolation thermique incluant :

un espace d'isolation thermique dans lequel
le rouleau d'amenée de fil et le dispositif de

- chauffage sont disposés ;
 une entrée de fil qui est formée à travers une paroi de l'espace d'isolation thermique et à travers laquelle les fils entrent dans l'espace d'isolation thermique ;
 une sortie de fil qui est formée à travers la paroi et à travers laquelle les fils sortent de l'espace d'isolation thermique ; et
 un espace de connexion qui est séparé de l'espace d'isolation thermique par la paroi et qui relie l'entrée de fil à la sortie de fil, **caractérisé en ce que** l'espace de connexion est muni d'un guide qui guide l'air provenant du côté sortie de fil vers le côté entrée de fil.
2. Appareil de chauffage de fil selon la revendication 1, dans lequel l'espace de connexion est divisé en une pluralité de régions par une séparation qui a deux chemins de fil correspondant respectivement à l'entrée de fil et à la sortie de fil.
3. Appareil de chauffage de fil selon la revendication 1 ou 2, dans lequel l'espace de connexion augmente en hauteur vers l'entrée de fil.
4. Appareil de chauffage de fil selon l'une quelconque des revendications 1 à 3, dans lequel l'espace de connexion est muni d'un ventilateur d'air qui amène du vent provenant du côté sortie de fil vers le côté entrée de fil.
5. Appareil de chauffage de fil selon l'une quelconque des revendications 1 à 4, dans lequel le rouleau d'amenée de fil est un rouleau chauffant ayant le dispositif de chauffage.
6. Appareil de chauffage de fil selon l'une quelconque des revendications 1 à 5, dans lequel le rouleau d'amenée de fil est un rouleau pour étirer les fils.
7. Appareil de chauffage de fil comprenant :
 un rouleau d'amenée de fil qui amène des fils ;
 un dispositif de chauffage qui chauffe les fils amenés par le rouleau d'amenée de fil ; et
 une boîte d'isolation thermique qui loge le rouleau d'amenée de fil et le dispositif de chauffage, la boîte d'isolation thermique ayant :
 une entrée de fil à travers laquelle les fils entrent dans un espace interne de la boîte d'isolation thermique depuis l'extérieur de la boîte d'isolation thermique ; et
 une sortie de fil à travers laquelle les fils
- sortent de l'espace interne vers l'extérieur de la boîte d'isolation thermique, et l'espace interne étant muni d'une unité de transfert de chaleur qui transfère de la chaleur depuis le côté sortie de fil vers le côté d'entrée de fil, **caractérisé en ce que** l'unité de transfert de chaleur est un échangeur thermique.
8. Appareil de chauffage de fil selon la revendication 7, dans lequel l'espace interne est, par des séparations, divisé en :
 un espace d'isolation thermique dans lequel le rouleau d'amenée de fil et le dispositif de chauffage sont disposés ;
 un espace côté entrée entre l'espace d'isolation thermique et l'entrée de fil ; et
 un espace côté sortie entre l'espace d'isolation thermique et la sortie de fil, la séparation séparant l'espace d'isolation thermique de l'espace côté entrée a un chemin de connexion côté entrée qui correspond à l'entrée de fil et qui relie l'espace d'isolation thermique à l'espace côté entrée, la séparation séparant l'espace d'isolation thermique de l'espace côté sortie a un chemin de connexion côté sortie qui correspond à la sortie de fil et qui relie l'espace d'isolation thermique à l'espace côté sortie, et l'unité de transfert de chaleur transfère la chaleur depuis l'espace côté sortie vers l'espace côté entrée.
9. Appareil de chauffage de fil selon la revendication 8, dans lequel les séparations divisant l'espace interne sont faites d'une matière d'isolation thermique.
10. Appareil de chauffage de fil selon la revendication 8 ou 9, dans lequel l'espace côté sortie est relié à un conduit d'échappement.
11. Appareil de chauffage de fil selon la revendication 10, dans lequel l'unité de transfert de chaleur est disposée dans une région qui est dans l'espace côté sortie et entre un orifice de connexion du conduit qui relie le conduit à l'espace côté sortie et au chemin de connexion côté sortie.
12. Appareil de chauffage de fil selon l'une quelconque des revendications 8 à 11, dans lequel l'unité de transfert de chaleur a un tuyau de chaleur qui s'étend d'un bout à l'autre de l'espace côté entrée et de l'espace côté sortie.

13. Appareil de chauffage de fil selon l'une quelconque des revendications 7 à 12, dans lequel le rouleau d'amenée de fil est un rouleau chauffant ayant le dispositif de chauffage.

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14. Appareil de chauffage de fil selon l'une quelconque des revendications 7 à 13, dans lequel le rouleau d'amenée de fil est un rouleau pour étirer les fils.

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FIG. 1

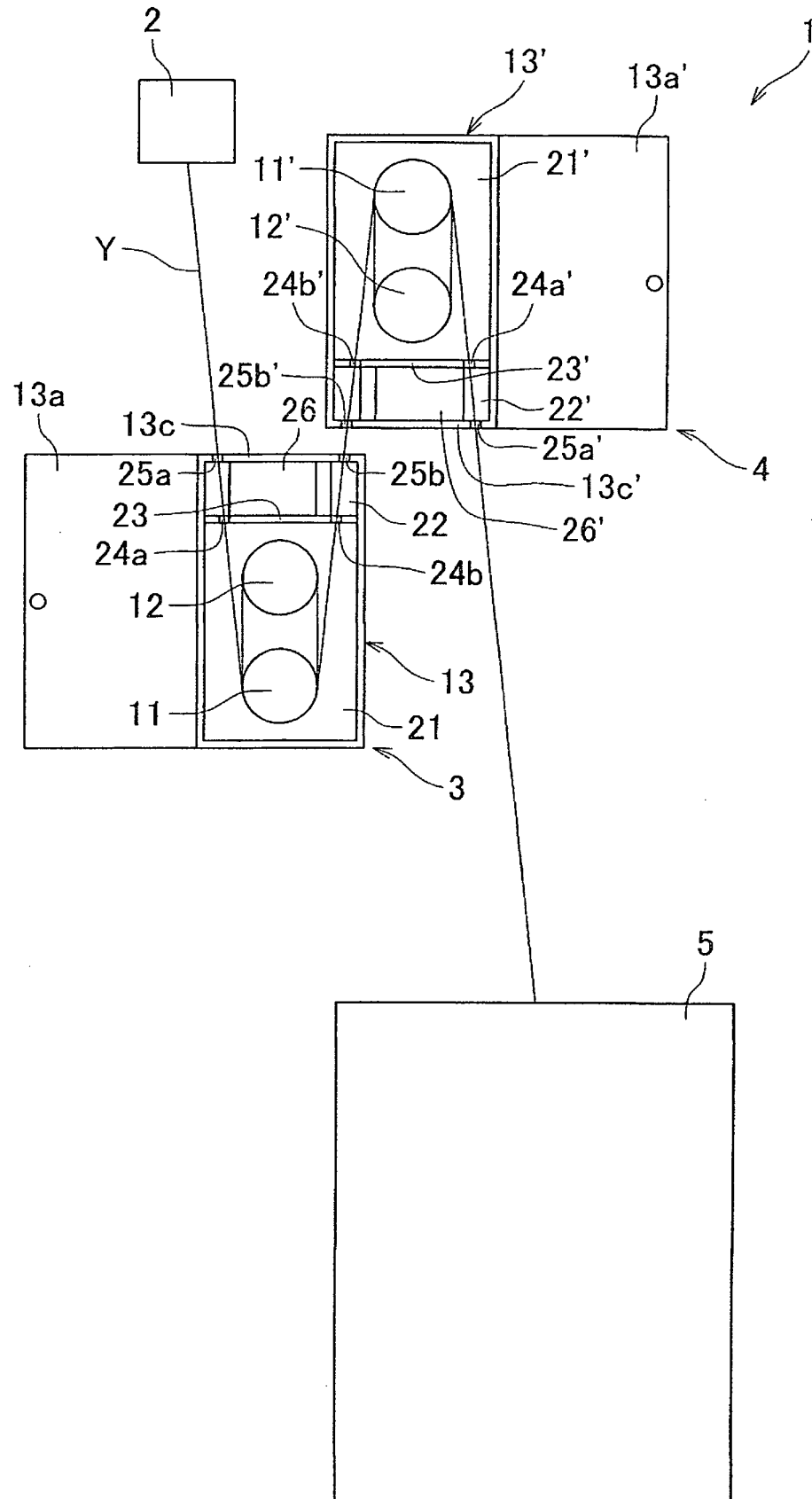


FIG.2

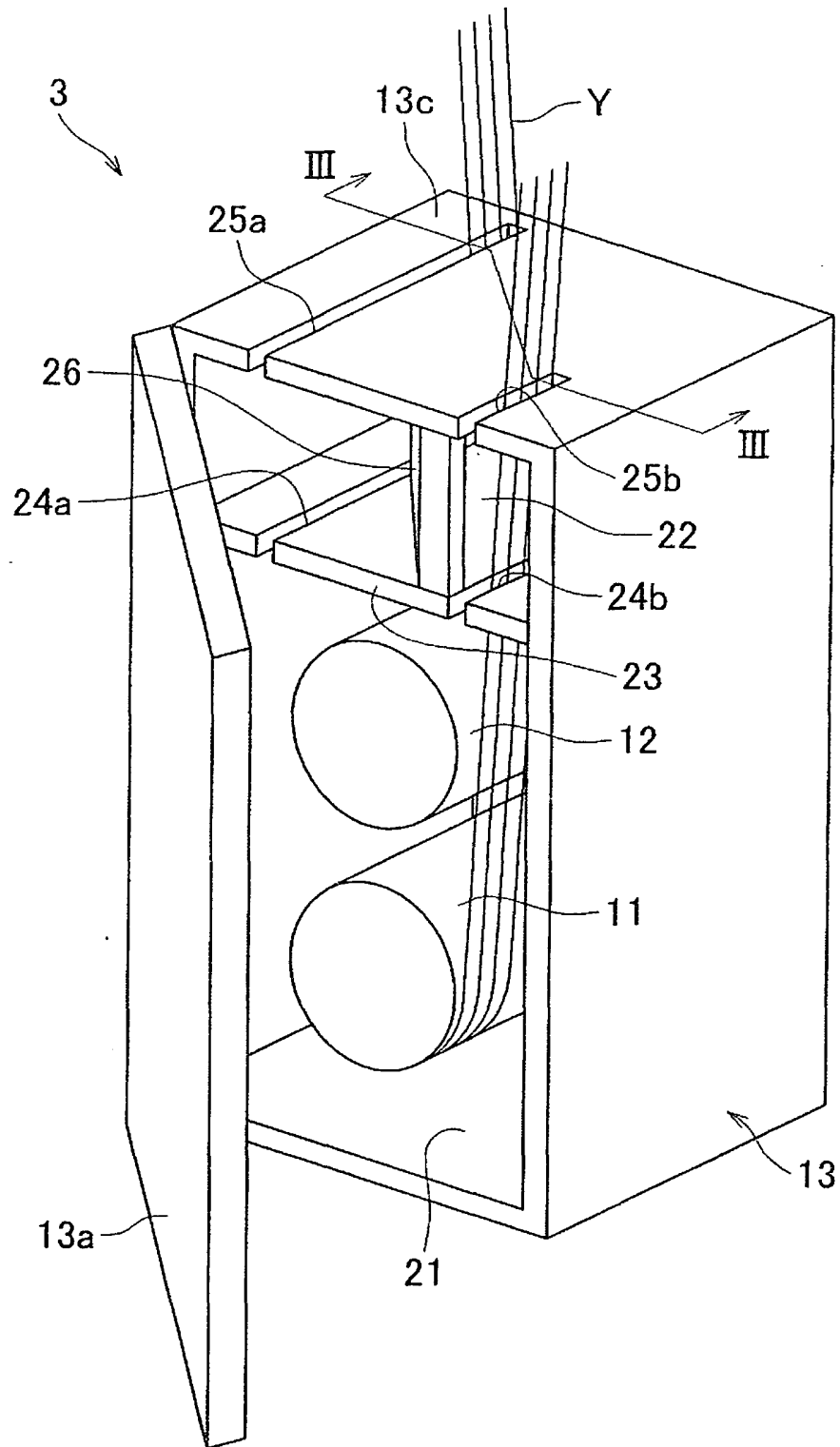


FIG.3

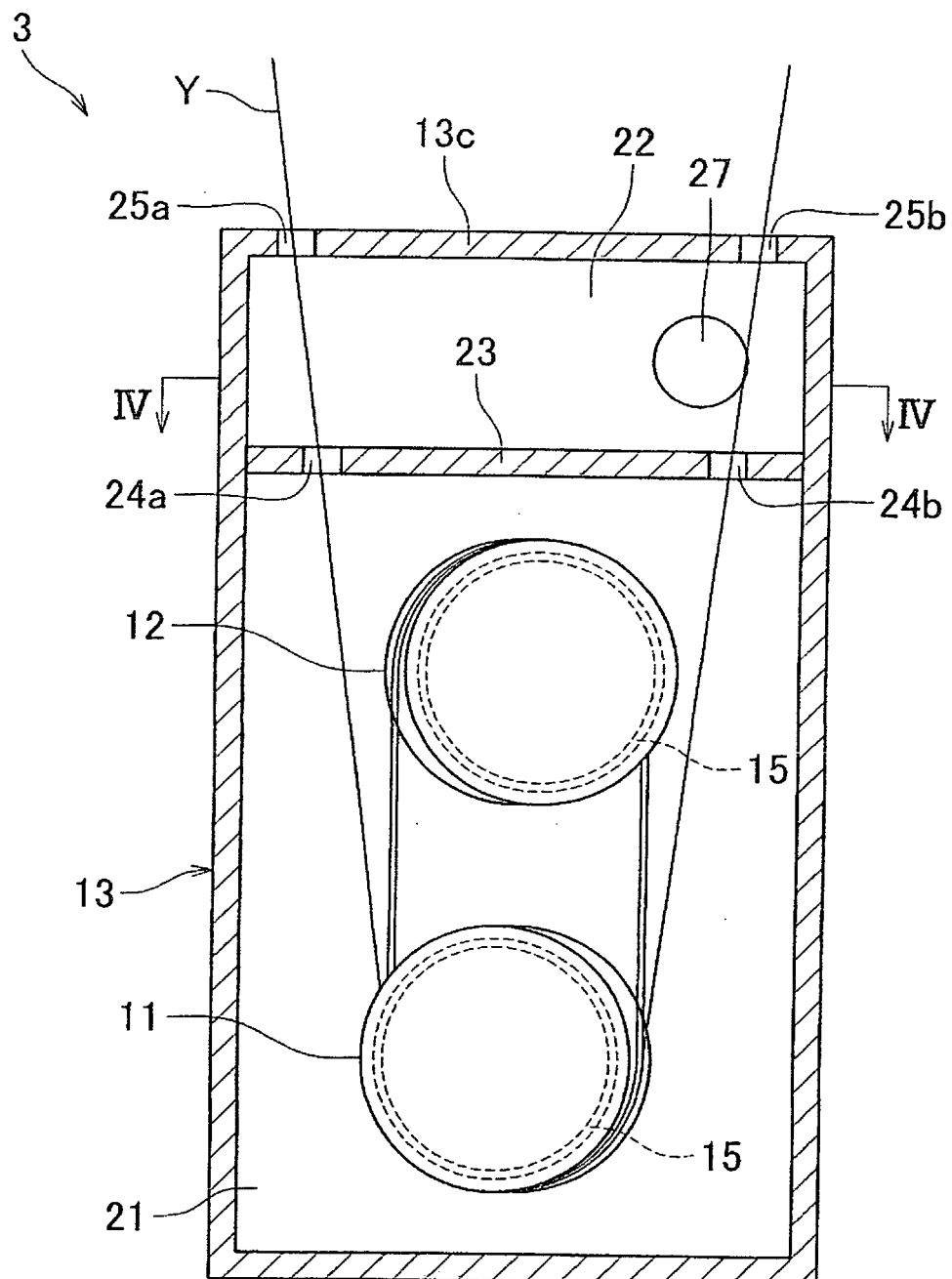


FIG.4

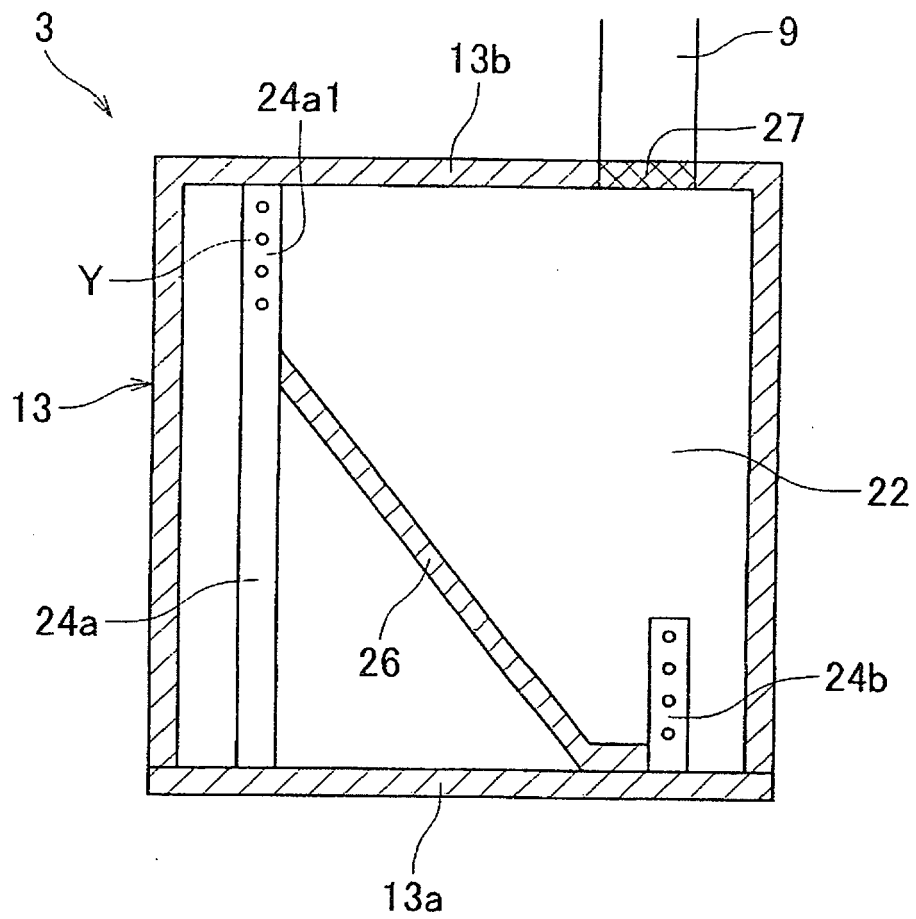


FIG.5

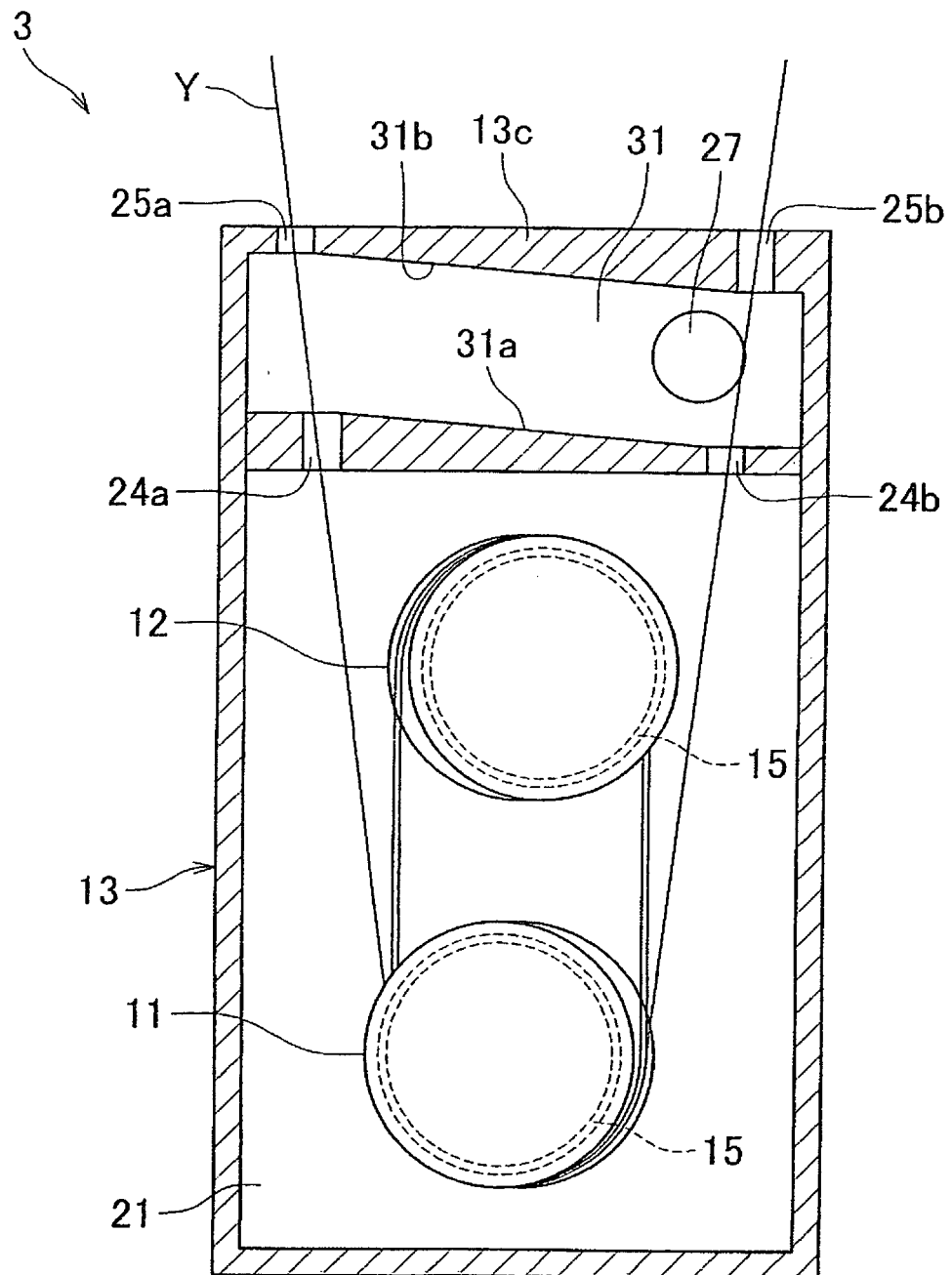


FIG.6

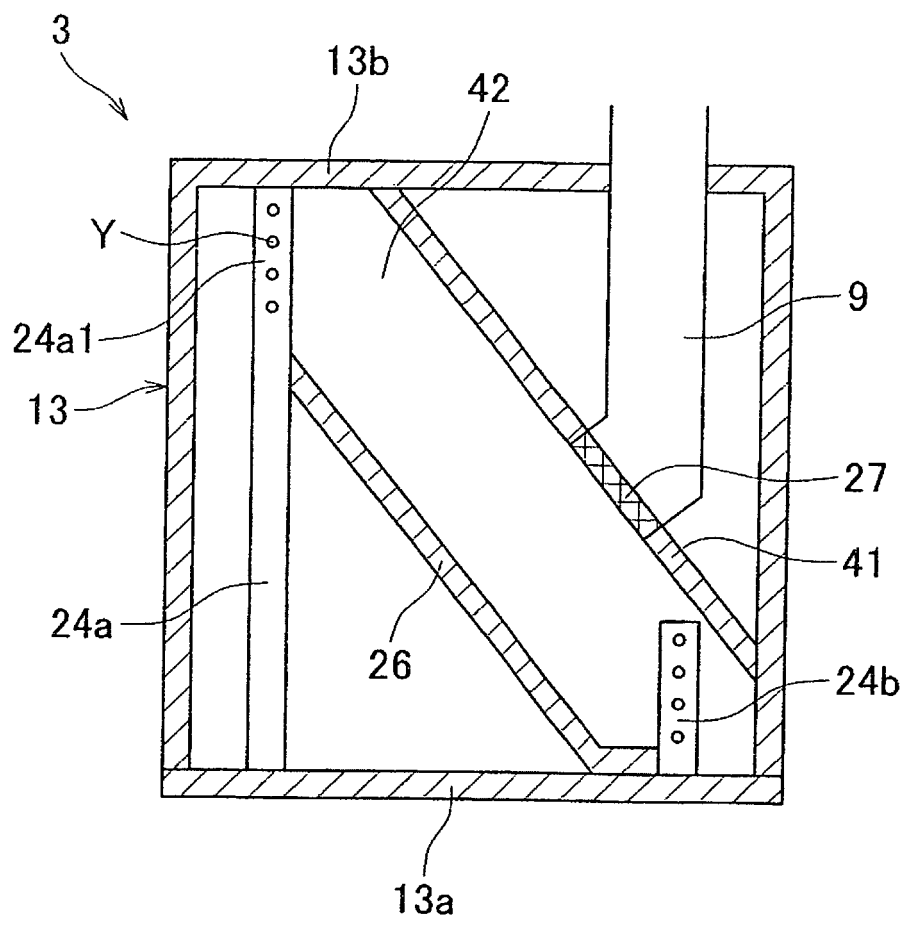


FIG.7

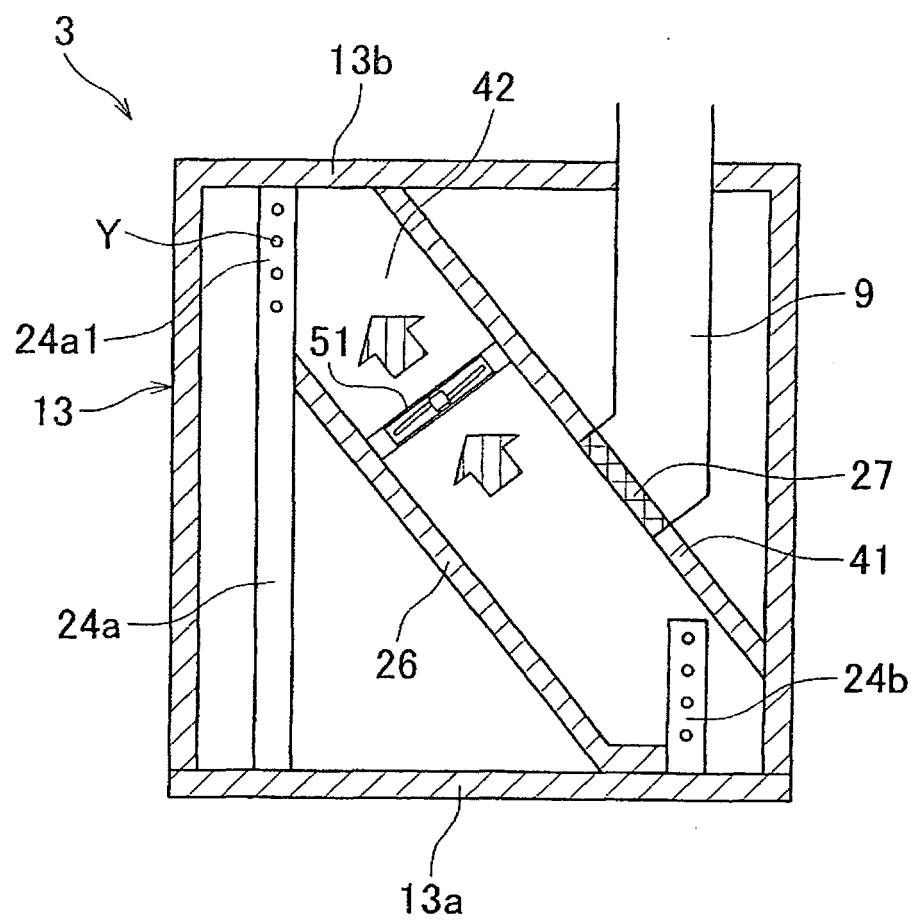


FIG.8

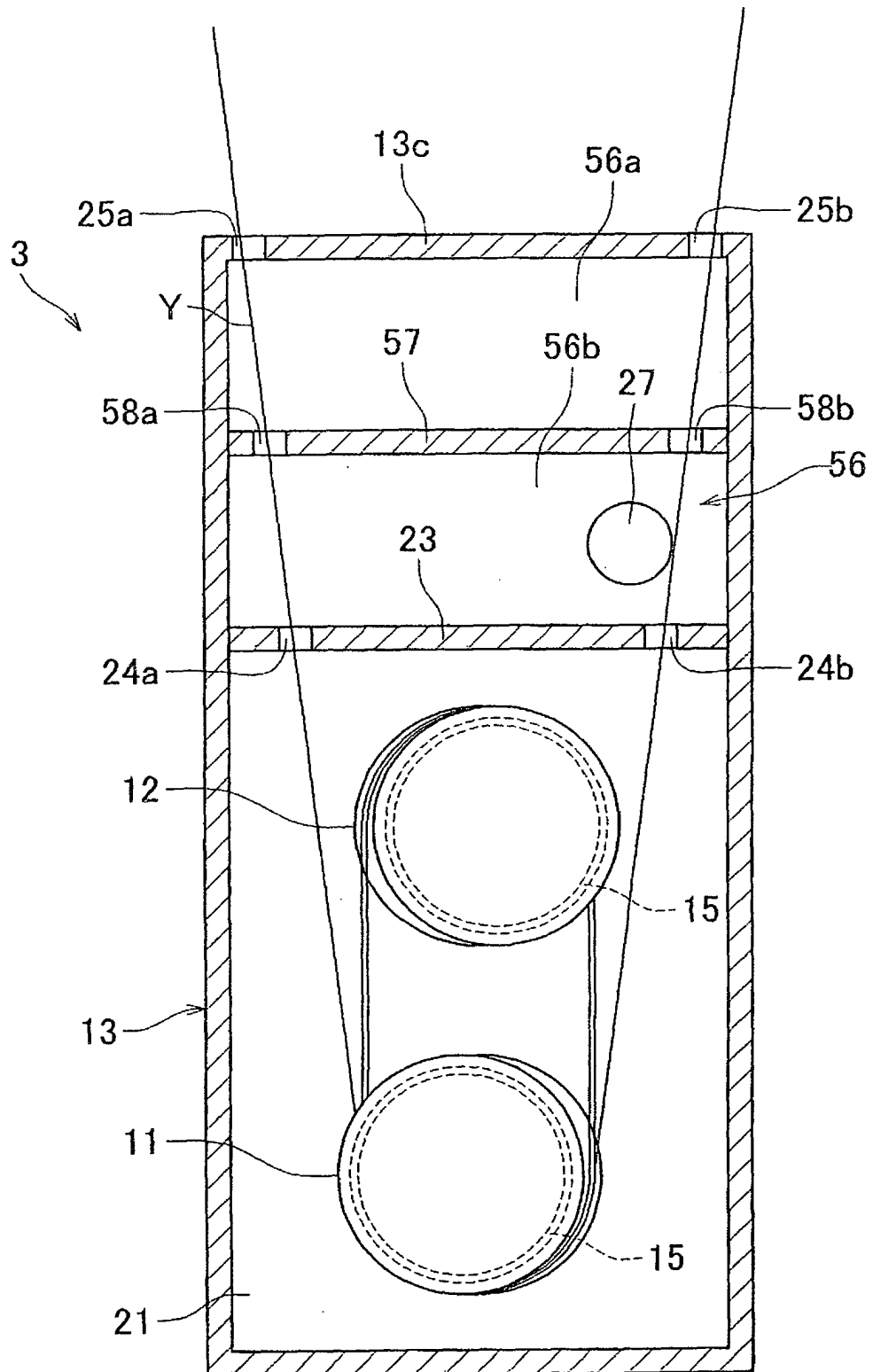


FIG.9

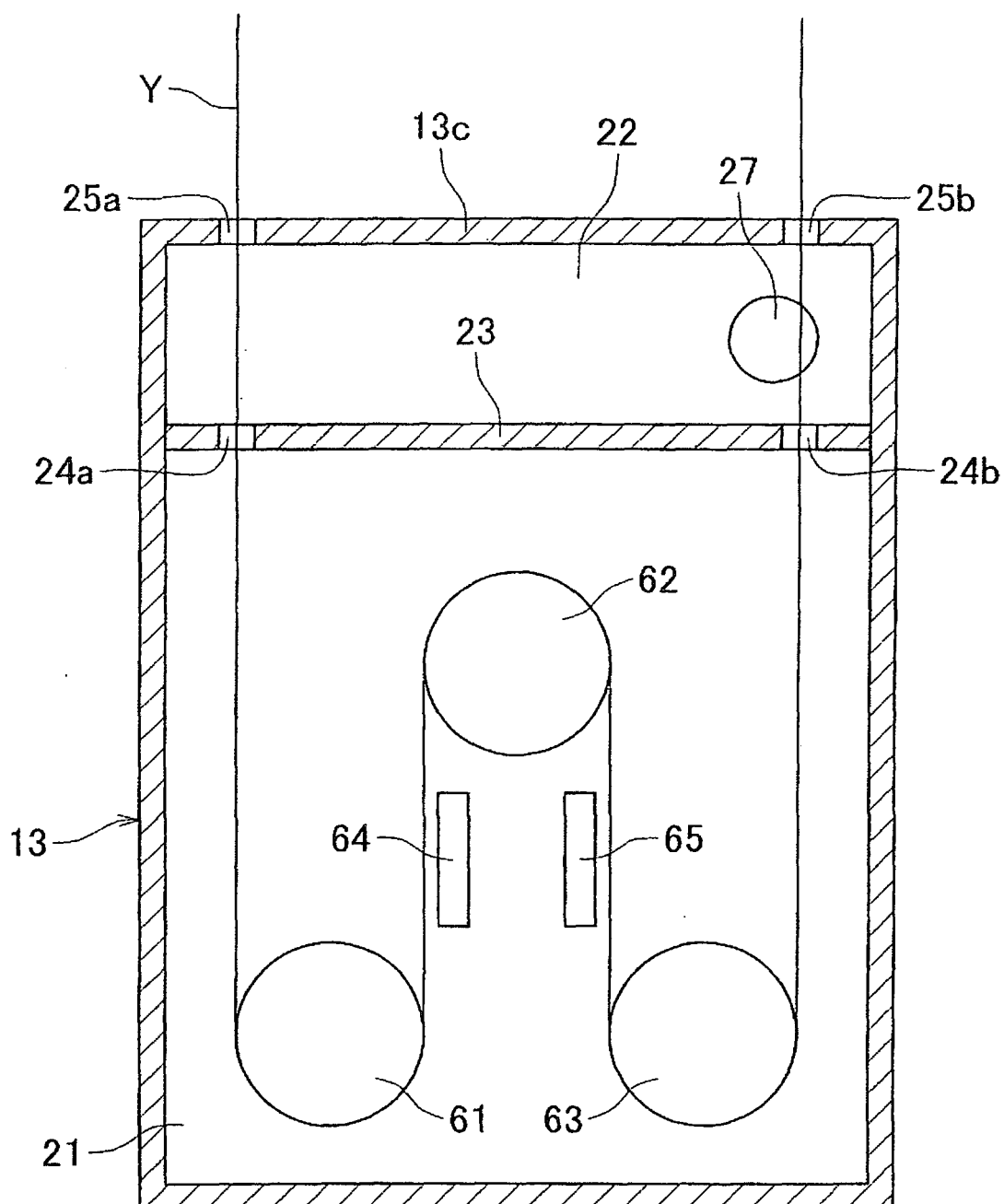


FIG.10

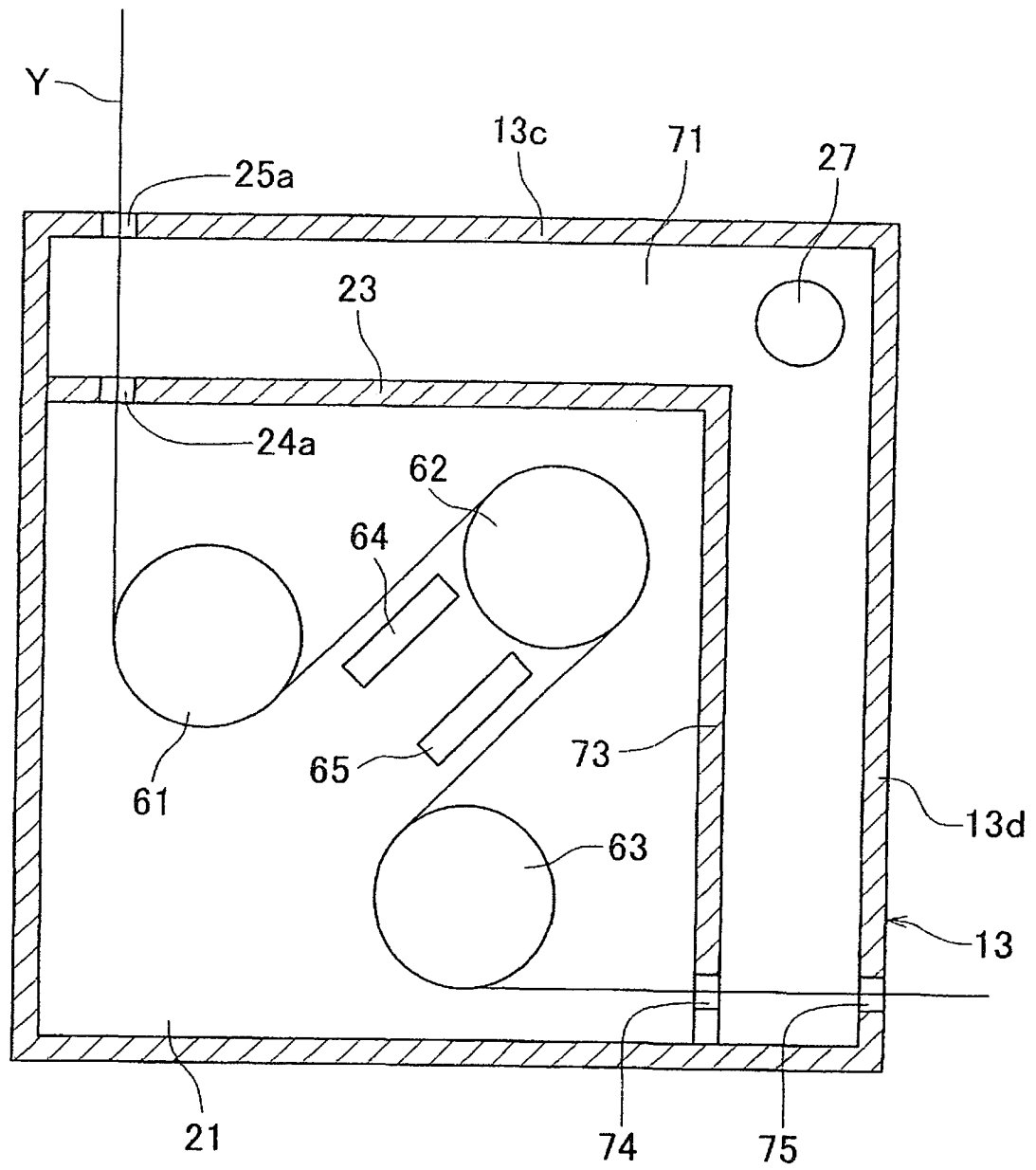


FIG.11

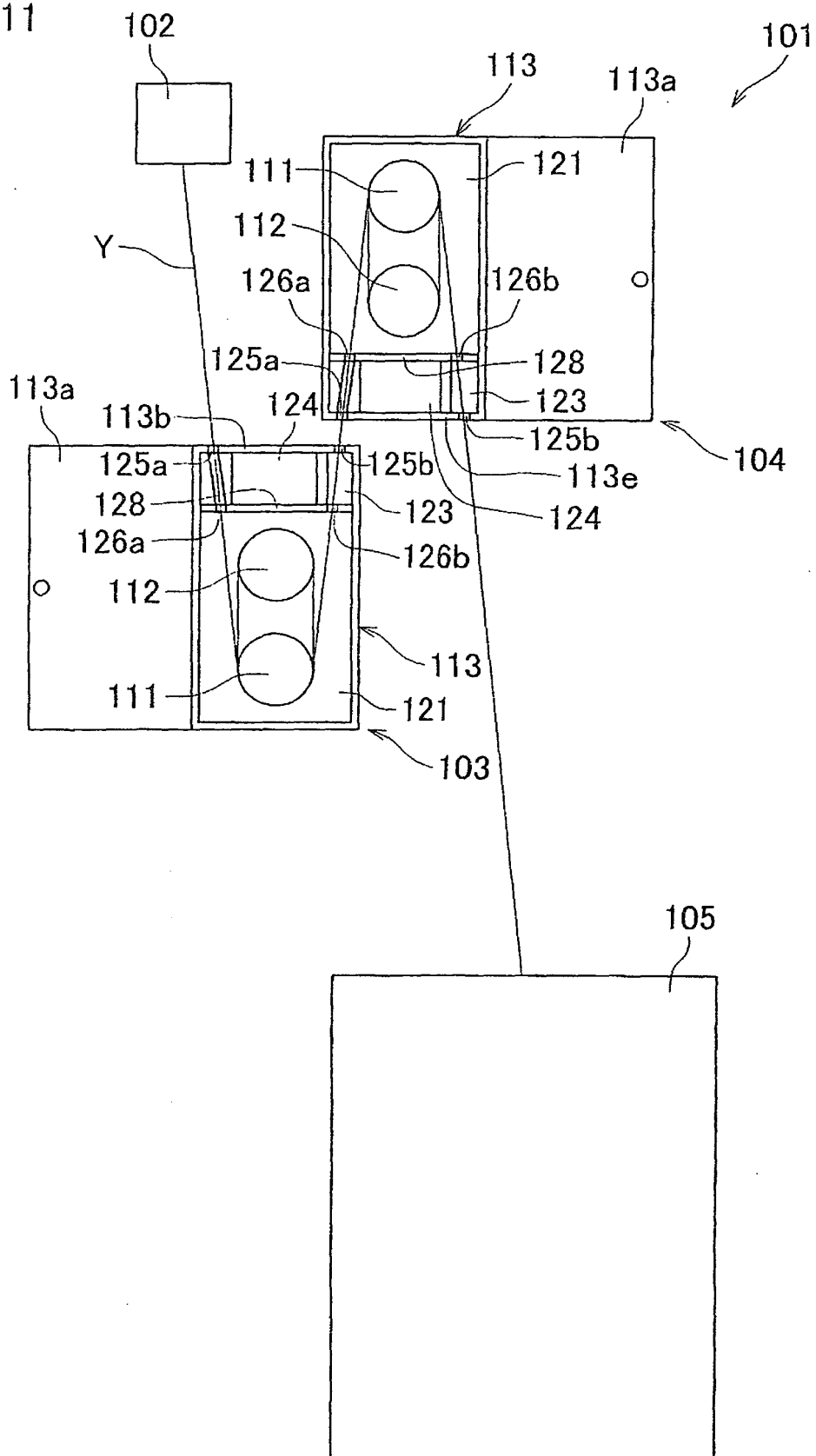


FIG.12

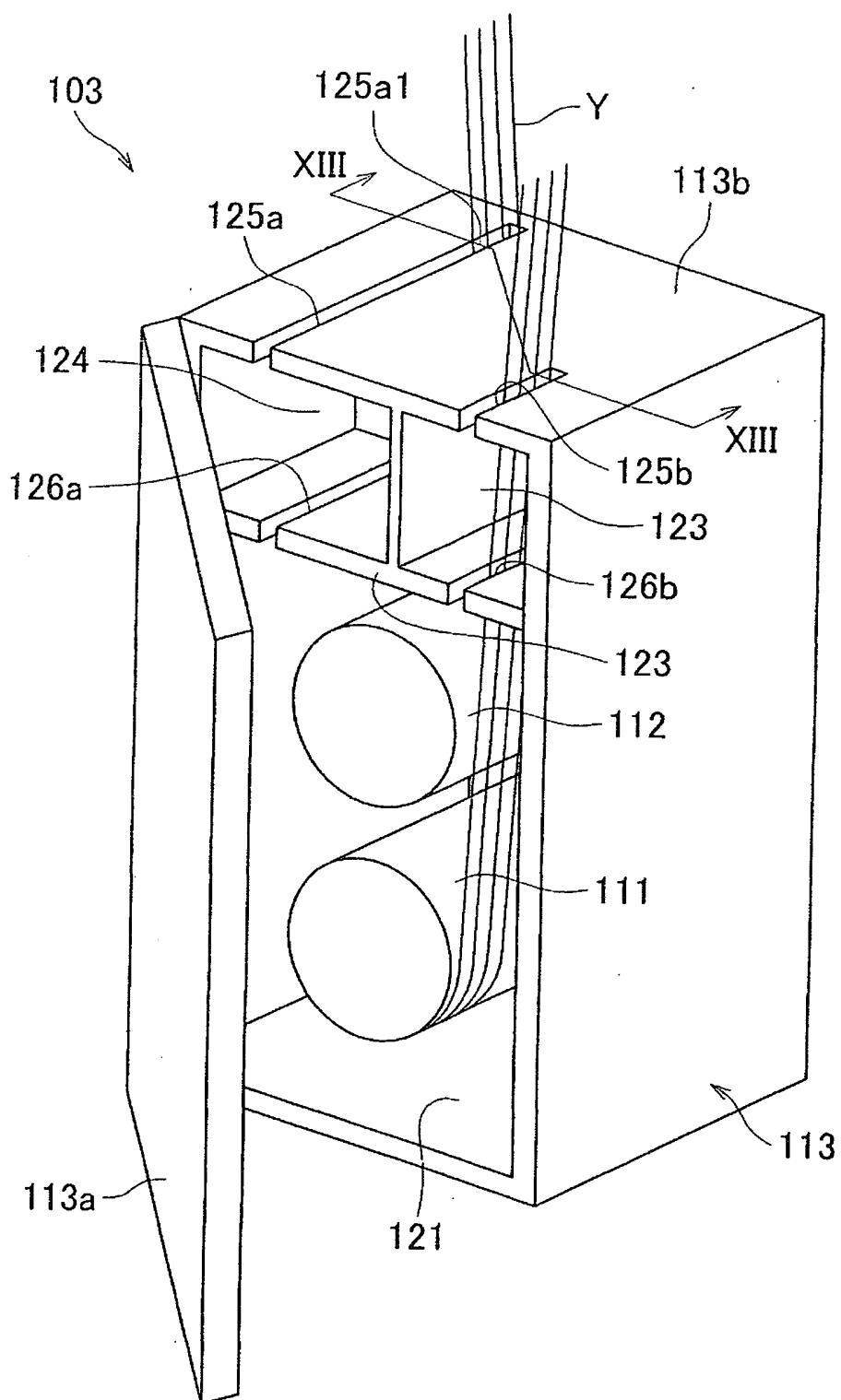


FIG.13

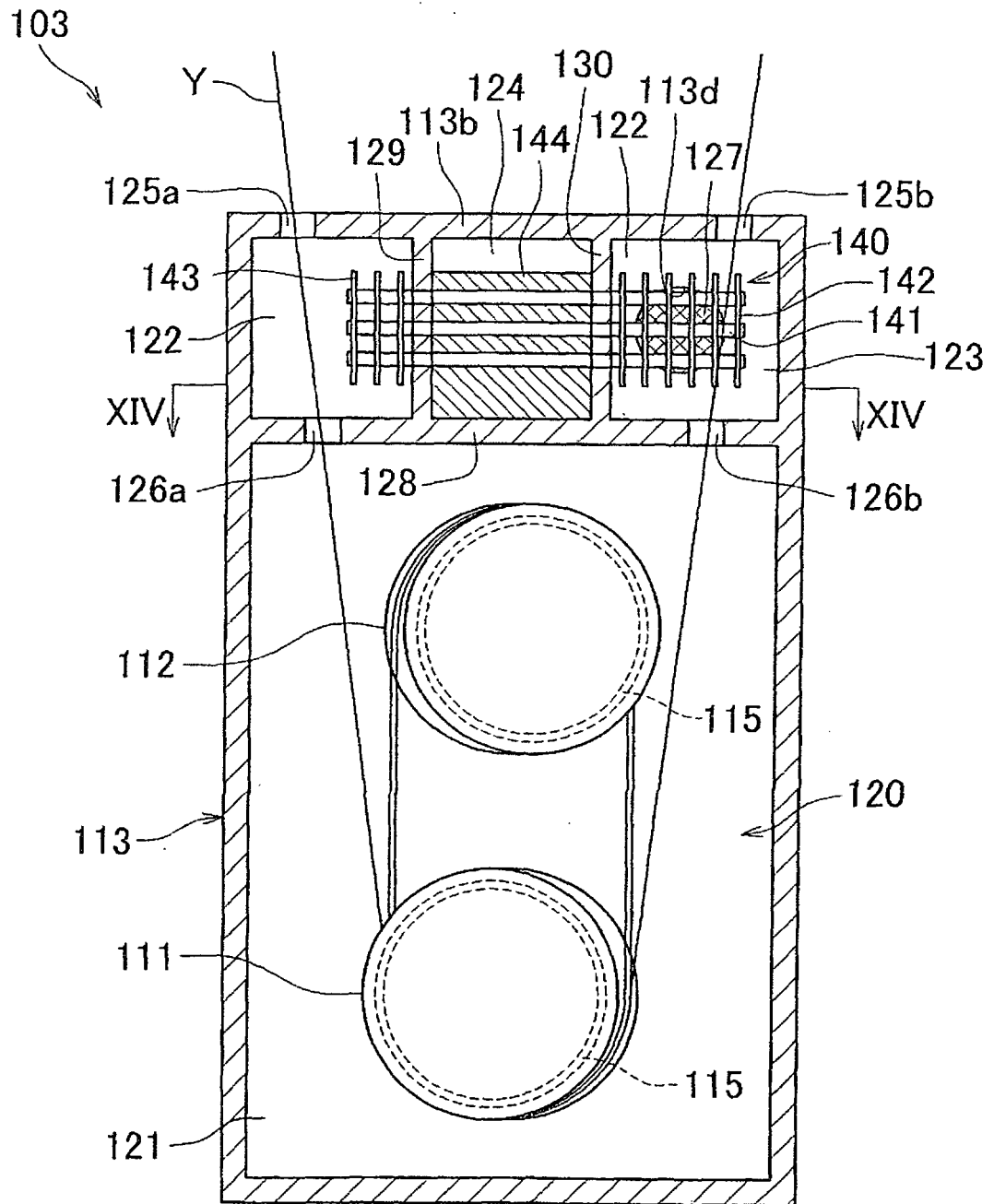


FIG.14

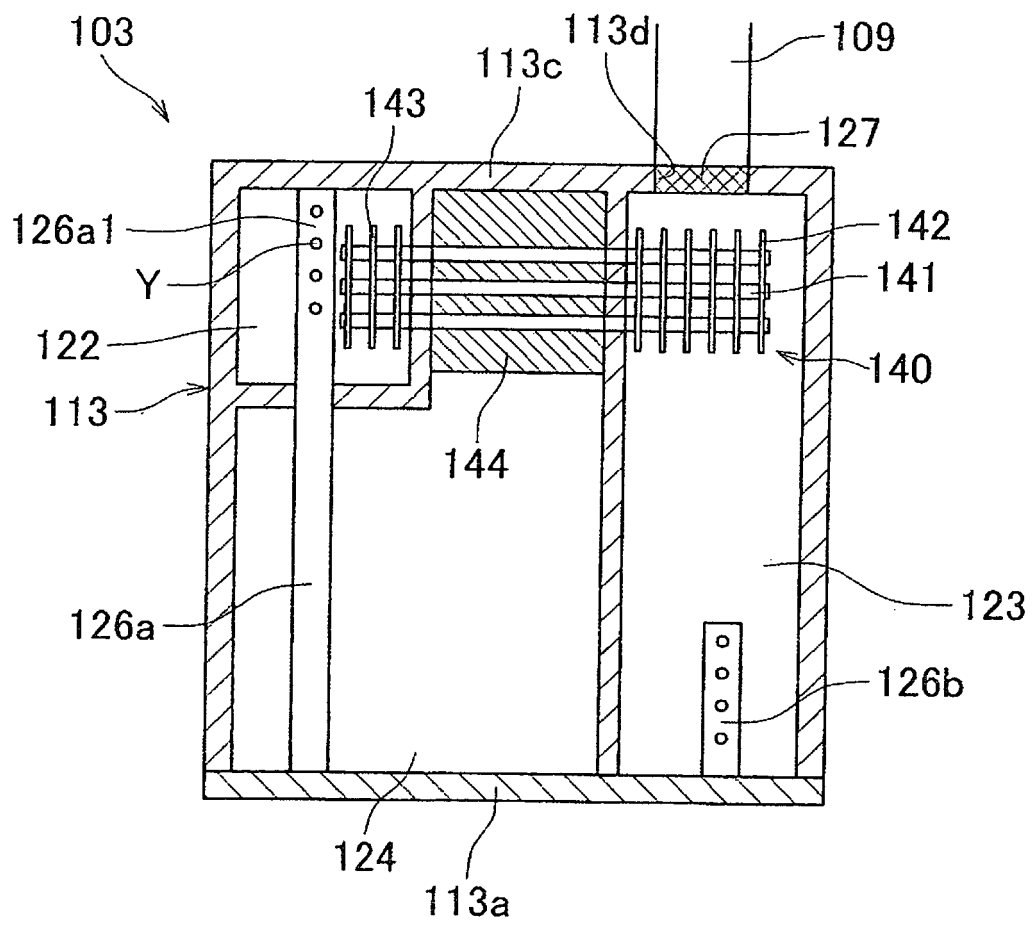


FIG.15

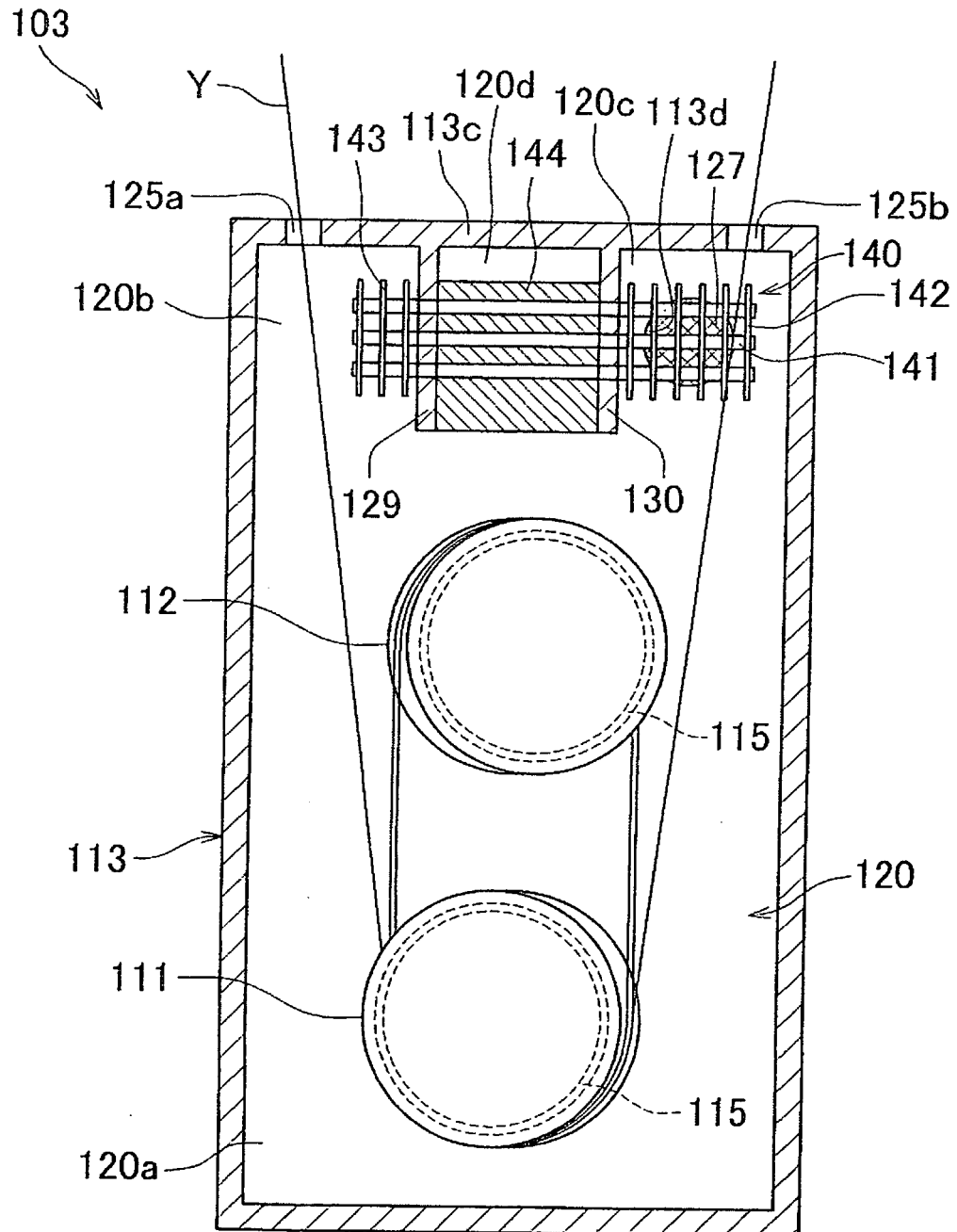


FIG.16

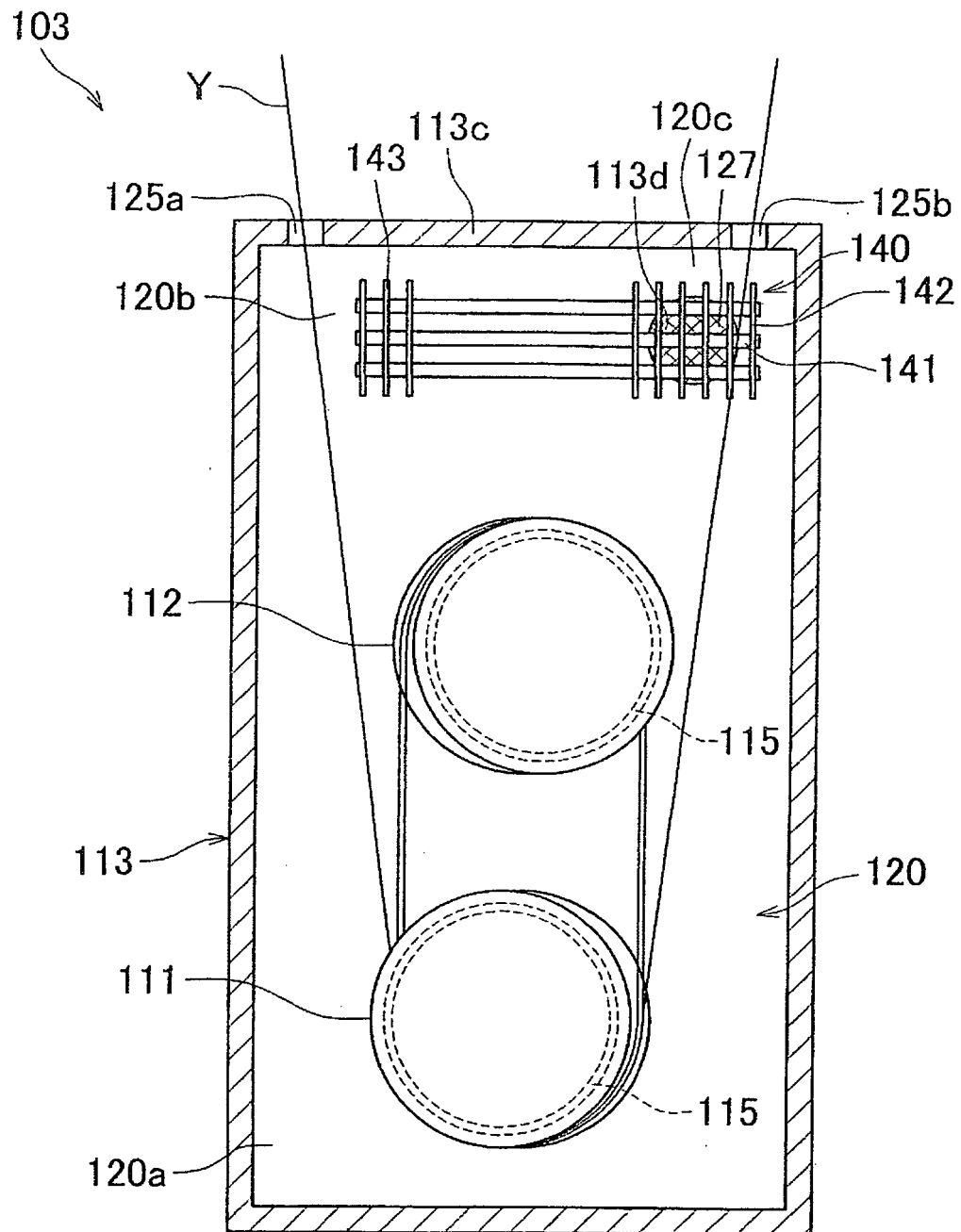


FIG.17

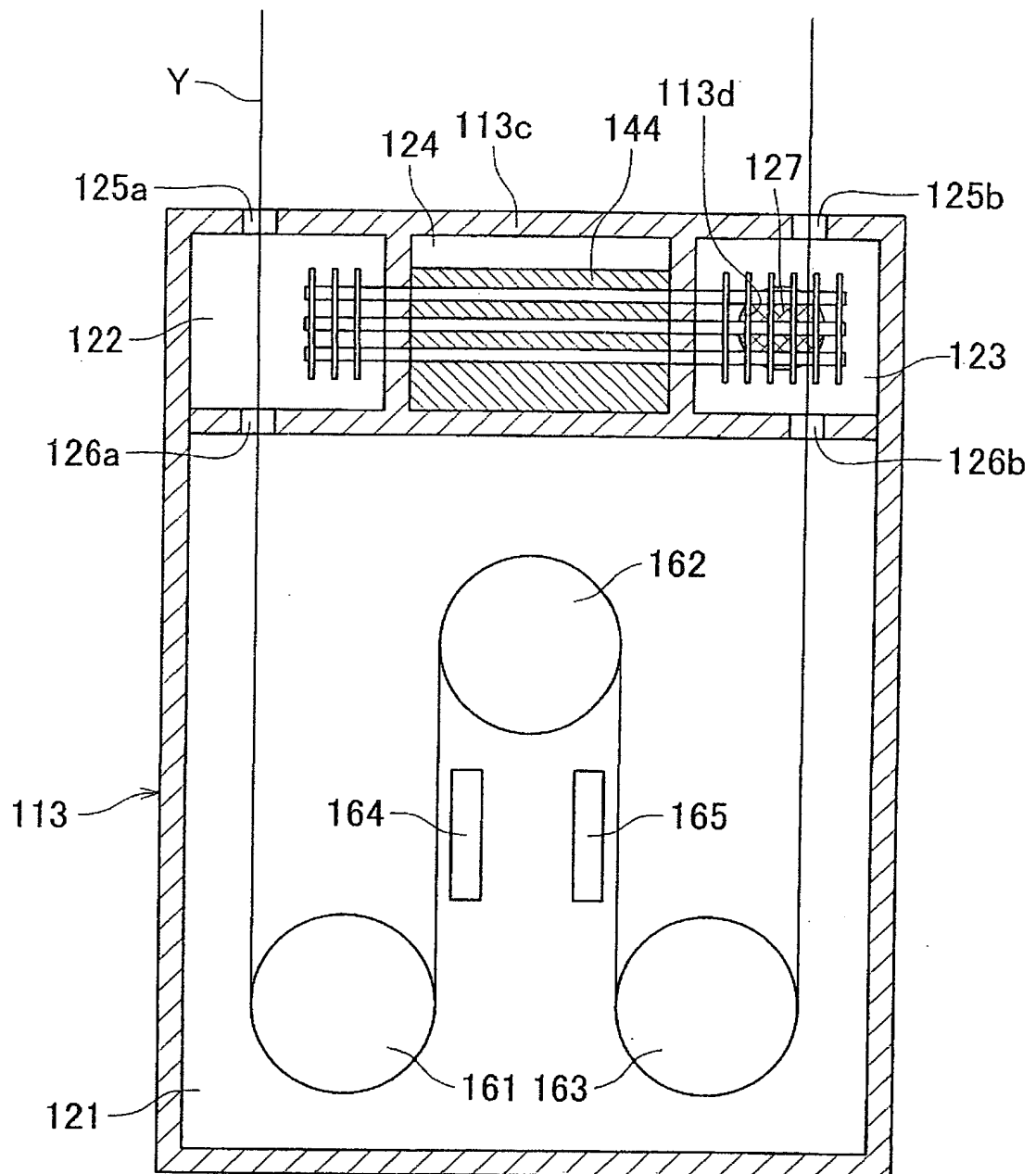


FIG.18

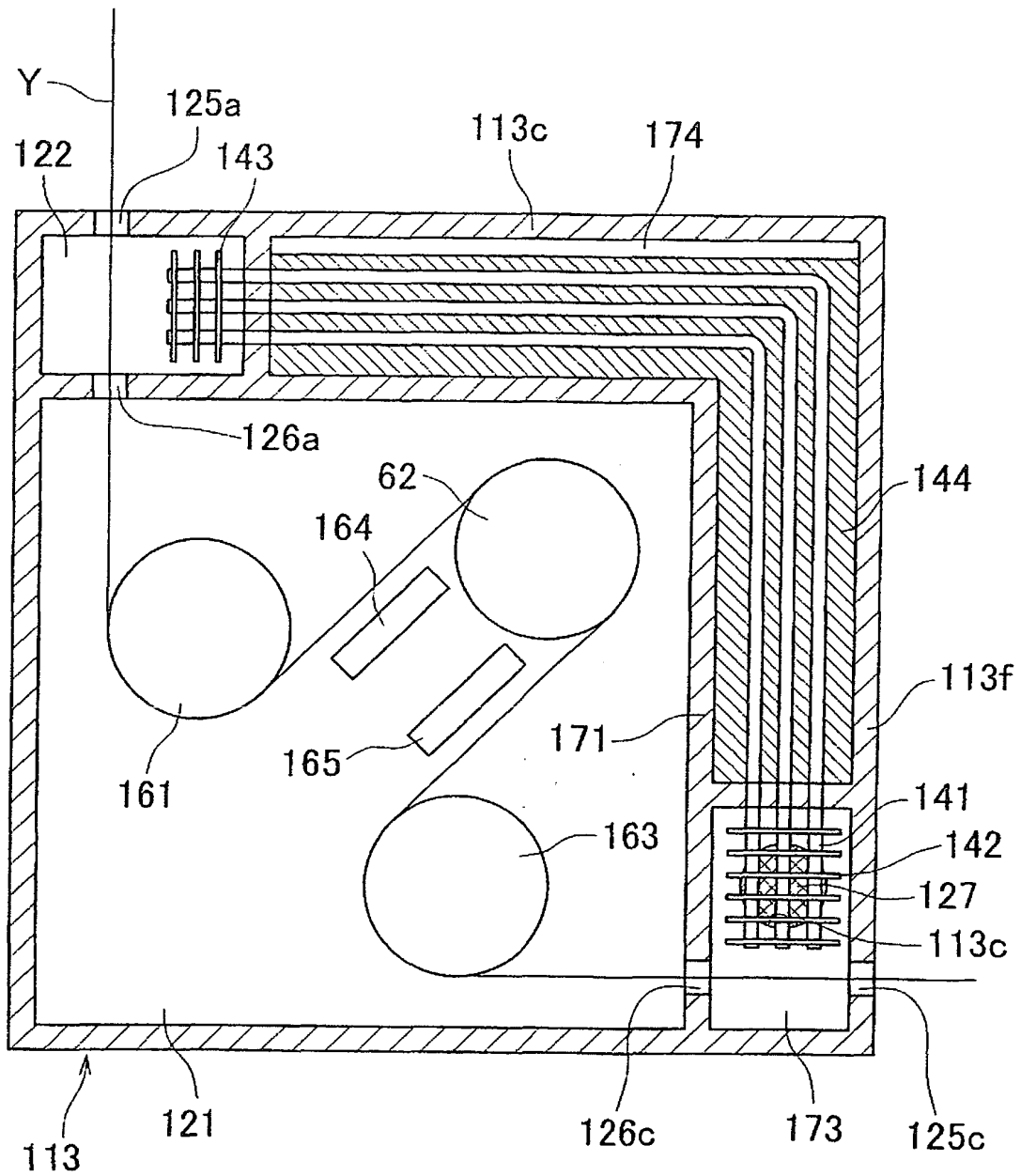
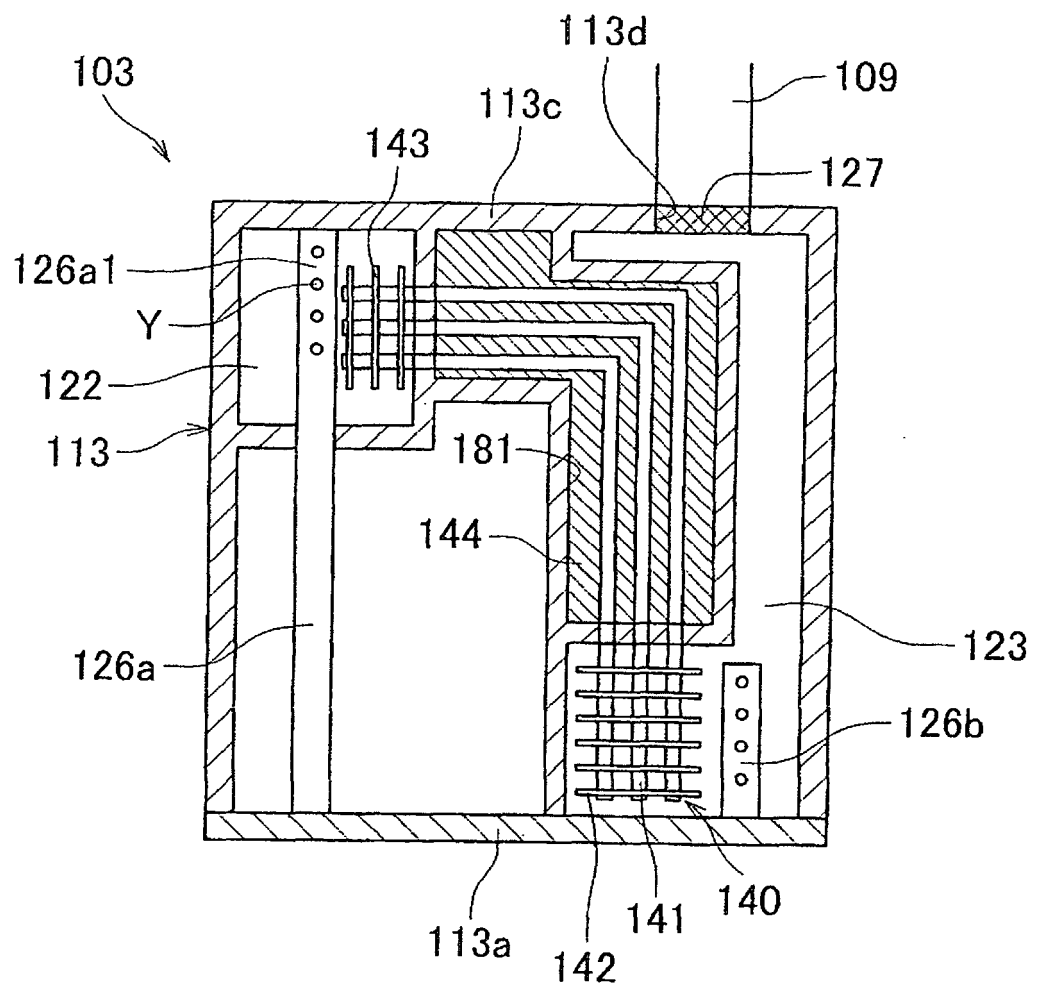


FIG.19



REFERENCES CITED IN THE DESCRIPTION

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