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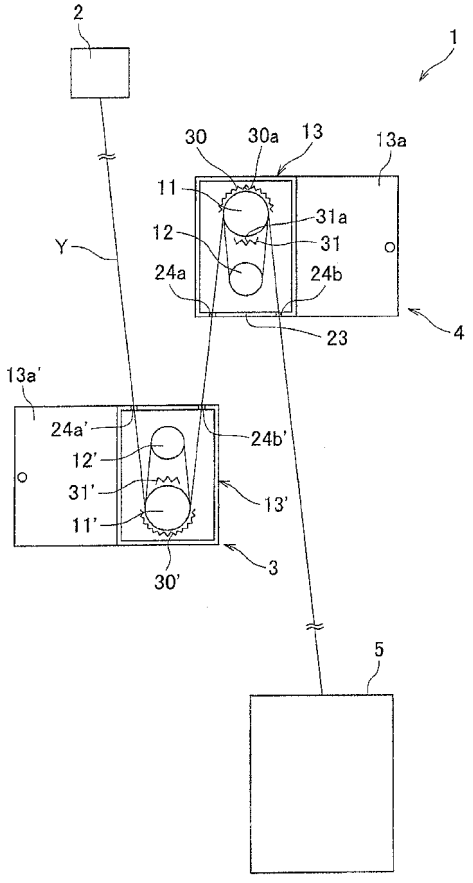
(54) Yarn heater

(57) A yarn is sufficiently heated on account of improved efficiency in heating the yarn. A roller unit 4 has a godet roller 11 and a separate roller 12 in a thermal insulation box 13. In the thermal insulation box 13, yarns Y are wound plural times onto the godet roller 11 and the separate roller 12 without overlapping one another, and are heated by the godet roller 11. The roller unit 4 further includes a corrugated plate 30 which opposes the outer circumference of the godet roller 11 on which the yarns Y are wound, with a gap being formed therebetween On the opposing surface of the corrugated plate 30 which surface opposes the godet roller 11 is formed a plurality of spaces defined by concave portions that are provided along the circumferential directions of the godet roller 11.

FIG.1



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Description

BACKGROUND OF THE INVENTION

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

[0002] In the field of textile machines, a yarn heater for conducting heat treatment of yarns has been used for, for example, heating and drawing yarns. As such an apparatus for heat treatment of yarns, a yarn heater disclosed by Patent Literature 1 (Japanese Unexamined Patent Publication No. 278990/1995 (Fig. 1)) is arranged so that a yarn is wound plural times onto a heating roller and a separate roller, and the yarn wound onto the rollers is heated by the heat generated by the heating roller. This yarn heater is provided with a heat radiation plate which is smooth at a surface opposing the heating roller and covers the outer circumference of the heating roller on which the yarn is wound. The radiant heat reflected on the heat radiation plate improves the heating efficiency because the yarn is heated not only from the heating roller side but also from the side opposite to the heating roller.

[0003] However, the yarn heater of Patent Literature 1, in which a smooth heat radiation plate is provided to oppose the heating roller so that the yarn wound on the heating roller is heated not only by direct heat transfer from the heating roller but also by radiant heat, involves a problem of decrease in the heating efficiency on account of an accompanying airflow generated by the rapid movement of the yarn.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is therefore to provide a yarn heater which is able to sufficiently heat a yarn thanks to improved efficiency in heating the yarn.

[0005] A yarn heater of the present invention includes: a heating roller for sending a yarn while heating the same; and a first heating accelerating member which is provided to oppose at least an outer circumference of the heating roller on which the yarn is wound, with a gap being formed between the first heating accelerating member and the outer circumference, and on an opposing surface of the first heating accelerating member which surface opposes the heating roller, a plurality of spaces divided along the circumferential directions of the heating roller being formed.

[0006] In the yarn heater of the present invention, as the yarn wound on the heating roller runs, an accompanied flow along the circumferential directions of the heating roller is generated around the yarn. In this regard, because the spaces are formed in a divided manner along the circumferential directions of the heating roller on the opposing surface of the first heating accelerating member opposing the heating roller, a turbulent flow is generated at the outer circumference of the heating roller and the heat transfer to the yarn wound on the heating roller is precipitated. Furthermore, because the opposing surface of the first heating accelerating member covers the heating roller, the radiant heat from the heating roller is reflected on the opposing surface and heats the yarn wound on the heating roller. This improves the efficiency in the heating of the yarn wound on the heating roller, and hence the yarn is sufficiently heated.

[0007] In addition to the above, preferably, the opposing surface of the first heating accelerating member being corrugated.

[0008] According to this arrangement, because the concave portions defining the spaces are formed by corrugating the plate, the heating by heat transfer to the yarn and the heating by radiation are both efficiently done.

[0009] In addition to the above, preferably, the opposing surface of the first heating accelerating member is far-infrared coated with a material that radiates a far infrared ray having a peak wavelength which falls within a range of heat absorption wavelengths determined according to a material of the yarn.

[0010] According to this arrangement, the opposing surface of the first heating accelerating member is coated with a material that radiates a far infrared ray (electromagnetic wave) having a peak wavelength which falls within a range of heat absorption wavelengths of the yarn wound on the heating roller. With this arrangement, when the opposing surface of the first heating accelerating member is heated by the heat generated by the heating roller, a far-infrared ray having a wavelength easily absorbed by the yarn is radiated from the opposing surface. As such, the efficiency in the heating of the yarn by radiation is improved.

[0011] In addition to the above, preferably, the first heating accelerating member is provided on the substantially entire circumference of the heating roller.

[0012] This makes it difficult for the heat generated by the heating roller to dissipate, and hence the heat insulating efficiency of the heating roller is improved.

[0013] In addition to the above, preferably, the yarn heater further includes a thermal insulation box that houses the heating roller, to the thermal insulation box, a plate member being attached to oppose at least the outer circumference of the heating roller on which the yarn is wound, with a gap being formed between the outer circumference and the plate member, and on an opposing surface of the plate member which surface opposes the heating roller, the spaces are formed in a divided manner.

[0014] When such a plate member is used, a plurality of spaces divided along the circumferential directions of the heating roller are easily formed by, for example, forming alternating concaves and protrusions by bending the plate member or by forming concaves by pressing. By only attaching this plate member, with which the divided spaces are easily formed, to a conventional thermal insulation box housing the heating roller, the efficiency in the heating of the yarn wound on the heating roller is improved.

[0015] In addition to the above, the yarn heater may

further include a thermal insulation box that houses the heating roller, and a part of an inner wall surface of the thermal insulation box opposing the outer circumference of the heating roller on which circumference the yarn is wound, with a gap being formed between the part and the outer circumference, and the spaces being formed on that part in a divided manner.

[0016] According to this arrangement, the capacity of the thermal insulation space formed inside the thermal insulation box is reduced, with the result that the heat insulating efficiency of the thermal insulation box is improved.

[0017] In addition to the above, preferably, the yarn heater further includes: a separate roller for heating the yarn in the same manner as the heating roller, the yarn being wound a plurality of times onto the heating roller and the separate roller at predetermined intervals; and a second heating accelerating member which is provided to oppose at least an outer circumference of the separate roller on which circumference the yarn is wound, with a gap being formed between the second heating accelerating member and the outer circumference, and on an opposing surface of the second heating accelerating member which surface opposes the separate roller, a plurality of spaces divided along the circumferential directions of the heating roller being formed.

[0018] According to this arrangement, because the second heating accelerating member is provided for the separate roller, the efficiency in the heating of the yarn wound onto the separate roller is improved in the same manner as the case where the first heating accelerating member is provided for the heating roller.

[0019] As the yarn wound on the heating roller runs, an accompanied flow along the circumferential directions of the heating roller is generated around the yarn. In this regard, because the spaces are formed in a divided manner along the circumferential directions of the heating roller on the opposing surface of the first heating accelerating member opposing the heating roller, a turbulent flow is generated at the outer circumference of the heating roller and the heat transfer to the yarn wound on the heating roller is precipitated. Furthermore, because the opposing surface of the first heating accelerating member covers the heating roller, the radiant heat from the heating roller is reflected on the opposing surface and heats the yarn wound on the heating roller. This improves the efficiency in the heating of the yarn wound on the heating roller, and hence the yarn is sufficiently heated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Fig. 1 is a schematic view of a yarn producing device according to an embodiment.
Fig. 2 is a perspective view of the roller unit of Fig. 1.
Fig. 3 is a profile of the godet roller in the thermal insulation box.
Fig. 4 is a front view of the godet roller for explaining the acceleration of heat transfer.
Fig. 5 is a front view of the godet roller for explaining radiation.
Fig. 6 is a front view of a roller unit in Modification 1.
Fig. 7 is a front view of a roller unit in Modification 2.
Fig. 8 is a front view of a roller unit in Modification 3.
Fig. 9 is a front view of a roller unit in Modification 4.
Fig. 10 is a front view of a roller unit in Modification 5.
Fig. 11 is a perspective view of a plate member in Modification 5 when viewed from the inner circumference side.
Fig. 12 is a front view of a roller unit in Modification 6.
Fig. 13 is a front view of a roller unit in Modification 7.
Fig. 14 is a perspective view of a plate member in Modification 7 when viewed from the inner circumference side.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] The following will describe a preferred embodiment of the present invention. Fig. 1 is a schematic view of a yarn producing device according to an embodiment. As shown in Fig. 1, the yarn producing device 1 includes components such as a spinning machine 2, two roller units 3 and 4 (yarn heaters), and a winder 5.

[0022] 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 draw the yarns Y which have been spun out from the spinning machine, while heating the yarns Y. The winder 5 winds, onto unillustrated bobbins, the yarns Y drawn by the roller units 3 and 4.

[0023] Among the above-described 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 focus on the roller units 3 and 4.

[0024] The roller units 3 and 4 are provided below the spinning machine 2. Fig. 2 is a perspective view of the roller unit of Fig. 1. Fig. 3 is a profile of the godet roller in the thermal insulation box. Fig. 2 shows the roller unit 4 on the downstream side in the running direction of the yarns Y, among the two roller units 3 and 4. Since the roller units 3 and 4 have similar structures, the following description will predominantly focus on the structure of the roller unit 4. As to the roller unit 3, the following will only describe differences from the roller unit 4. To clearly differentiate the descriptions on the roller unit 3 from the descriptions on the roller unit 4, each of the components of the roller unit 3 is denoted by the reference number of the same component of the roller unit 4 with a dash (e.g., godet roller 11' and separate roller 12').

[0025] As shown in Figs. 1 to 3, the roller unit 4 includes a godet roller 11, a separate roller 12, corrugated plates 30 and 31 (first heating accelerating member), and a thermal insulation box 13 housing these components. The

thermal insulation box 13 is a substantially rectangular parallelepiped box made of a heat insulating material. The thermal insulation box 13 has an openable door 13a.

[0026] The thermal insulation box 13 houses the godet roller 11 and the separate roller 12 therein. The godet roller 11 is provided on the side opposite to the door 13a of the thermal insulation box 13 and is a drive roller cantilevered by an unillustrated frame. The godet roller 11 receives a plurality of yarns Y fed from the roller unit 3 on the upstream side in the running direction (lower left in Fig. 1). The godet roller 11 is rotated by a drive motor 37 (see Fig. 3) so that the yarns Y wound thereon are fed downstream in the running direction of the yarns.

[0027] The separate roller 12 is provided below the godet roller 11 and is, in the same manner as the godet roller 11, a driven roller provided on the side opposite to the door 13a of the thermal insulation box 13 and cantilevered by an unillustrated frame. The yarns Y pulled by the godet roller 11 are wound between the godet roller 11 and the separate roller 12 plural times at predetermined intervals so as not to overlap one another. It is noted that the separate roller 12 may be a drive roller in the same manner as the godet roller 11.

[0028] As the godet roller 11 rotates and the yarns Y run, the separate roller 12 on which the yarns Y are wound is rotated. The yarns Y on the godet roller 11 are supplied to the winder 5 which is on the downstream in the running direction (the lower part of Fig. 1).

[0029] The godet roller 11 is a heating roller having a heater 15 therein (see Fig. 2), and hence the yarns Y are heated while being wound onto and looped between the godet roller 11 and the separate roller 12. As the godet roller 11 and the separate roller 12 are housed in the thermal insulation box 13 and the door 13a is closed, heat generated by the heater 15 does not leak out from the thermal insulation box 13.

[0030] Through a bottom wall 23 of the thermal insulation box 13, two slits 24a and 24b are formed on the respective sides of the rollers 11 and 12 in the crosswise directions in Fig. 2 to extend in directions substantially in parallel to the alignment directions of the yarns Y. The slit 24a is open on the door 13a side (on the side where the opening of the thermal insulation box 13 is provided) to allow the yarns Y to be inserted from the front side at the time of yarn threading onto the rollers 11 and 12. This slit 24a functions as an inlet through which the yarns Y are inserted into the thermal insulation box 13 when the yarns are wound by the winder 5.

[0031] The slit 24b is, in the same manner as the slit 24a, open at the edge on the door 13a side in order to allow the yarn Y to be inserted from the front at the time of yarn threading onto the rollers 11 and 12, but the length of the slit 24b is shorter than the length of the slit 24a. The slit 24b functions as an outlet through which the yarns Y exit from the thermal insulation box 13 when the yarns are wound by the winder 5.

[0032] The front opened parts of the slits 24a and 24b are closed by the door 13a when the door 13a is closed.

[0033] The corrugated plate 30 is arranged so that a mirror-finished stainless plate member is folded to form concave portions and protruding portions in such a way that triangular mountains each having two sides are serially formed. The corrugated plate 30 is provided above the godet roller 11 and is fixed to the thermal insulation box 13 via the supporting member 32. The corrugated plate 30 opposes the outer circumference of the godet roller 11 on which the yarn Y is wound (i.e., opposes substantially an upper half of the godet roller 11) with a gap therebetween, the gap allowing the yarn Y to run therethrough. On the corrugated plate 30, concave portions and protruding portions are alternately aligned along the circumferential directions of the godet roller 11. On the surface of the corrugated plate 30 opposing the godet roller 11 (i.e., on the inner circumference of the plate 30), a plurality of spaces 35 (see Fig. 4) defined by the concave portions aligned in the circumferential directions of the godet roller 11 are formed.

[0034] The length of the corrugated plate 30 along the axial directions of the godet roller 11 is shorter than the axial length of the godet roller 11. The godet roller 11 therefore has a protruding portion 25 which is close to the opening of the thermal insulation box 13 as compared to the corrugated plate 30. The opposing surface 30a of the corrugated plate 30, which opposes the godet roller 11, is far-infrared coated (e.g., ceramic coated).

[0035] The corrugated plate 31, which is similar to the corrugated plate 30, is arranged so that a mirror-finished stainless plate member is folded to form concave portions and protruding portions in such a way that triangular mountains each having two sides are serially formed. The corrugated plate 31 is provided below the godet roller 11 and is fixed to the thermal insulation box 13 via a supporting member (not illustrated). The corrugated plate 31 is provided between the godet roller 11 and the separate roller 12 to oppose the outer circumference of the godet roller 11 where the yarn Y is not wound (i.e., opposes a lower part of the godet roller 11) with a gap therebetween. On the corrugated plate 31, concave portions and protruding portions are alternately aligned along the circumferential directions of the godet roller 11. Also on the surface of the corrugated plate 31 opposing the separate roller 12 (i.e., the inner circumference of the plate 31), a plurality of spaces defined by the concave portions aligned in the circumferential directions of the separate roller 12 are formed.

[0036] The length of the corrugated plate 31 in the axial directions of the godet roller 11 is equal to the axial length of the godet roller 11. The opposing surface 31a of the corrugated plate 31, which opposes the godet roller 11, is far-infrared coated (e.g., ceramic coated). As such, the entirety of the godet roller 11 is circumferentially covered with the corrugated plates 30 and 31 except at the space at which the yarn Y contacts the godet roller 11 first, the space where the yarn Y leaves the roller, the space where the yarn Y moves at the time of being threaded, and the space where the yarn Y is passed to the separate roller

12.

[0037] The roller unit 3 is arranged to be upside down as compared to the roller unit 4. Furthermore, the roller units 3 and 4 are different from each other in the rotation speed of the godet roller 11, as described later.

[0038] In the yarn producing device 1 arranged as described above, the yarns Y spun out from the spinning machine 2 enter the thermal insulation box 13' through the vicinity of an edge of the slit 24a' which edge is on the side opposite to the opened part (i.e., through the vicinity of the edge far from the viewer of Fig. 1), and are then received by the godet roller 11' of the roller unit 3.

[0039] The yarns Y received by the godet roller 11' in the thermal insulation box 13' are wound more than once onto and looped between the godet roller 11' and the separate roller 12', and then leave the godet roller 11'. The yarns Y then go out from the thermal insulation box 13' through the vicinity of the opened part of the slit 24b', enter the thermal insulation box 13 through the vicinity of an edge of the slit 24a which edge is on the side opposite to the opened part (i.e., through the vicinity of the edge far from the viewer of Fig. 1), and are fed to the godet roller 11 of the roller unit 4.

[0040] Thereafter, the yarns Y received by the godet roller 11 in the thermal insulation box 13 are wound more than once onto and looped between the godet roller 11 and the separate roller 12, and then leave the godet roller 11, go out from the thermal insulation box 13 through the vicinity of the opened part of the slit 24b, and are fed to the winder 5.

[0041] In the arrangement above, the yarns Y run from the spinning machine 2 to the winder 5 at a speed of, for example, about 4000 to 6000m/min. The yarns Y are heated while running between the rollers 11 and 12 and between the rollers 11' and 12'. Furthermore, the godet roller 11 of the roller unit 4 rotates at a higher speed than the godet roller 11' of the roller unit 3, and heated yarns Y are drawn between the godet roller 11 and the godet roller 11' by a force generated on account of the difference in the rotation speed between the rollers.

[0042] In the meanwhile, in the thermal insulation box 13, the yarns Y wound onto the godet roller 11 are directly heated by heat transfer from the outer circumference of the godet roller 11 which has been heated by the heater 15.

[0043] Furthermore, as the yarn Y wound onto the godet roller 11 runs, as shown in Fig. 4, an accompanied flow 33 in parallel to the circumferential directions of the godet roller 11 is generated around the yarn Y. In this regard, the corrugated plate 30 is provided to oppose the outer circumference of the godet roller 11 where the yarn Y is wound, and this corrugated plate 30 is corrugated such that concave portions and protruding portions are alternately provided along the circumferential directions of the godet roller 11. This accompanied flow 33 collides the wall surfaces of the concave portions of the corrugated plate 30 (i.e., the wall surfaces defining the spaces 35), with the result that turbulent flows 34 are generated on the outer circumference of the godet roller 11.

[0044] These turbulent flows 34 accelerate the convective heat transfer, and hence the heat transfer to the yarn Y wound on to the godet roller 11 is precipitated. Furthermore, because a plurality of turbulent flows 34 are serially generated along the circumferential directions of the godet roller 11, the heat transfer to the yarn Y wound on the godet roller 11 and running is successively precipitated.

[0045] In addition to the above, because the opposing surface 30a of the corrugated plate 30 covers the godet roller 11, as shown in Fig. 5, the corrugated plate 30 is heated by the heat generated by the godet roller 11 and reflects an electromagnetic wave 36 thermally radiated from the godet roller 11. As a result, the yarn Y wound onto the godet roller 11 is heated by radiation and the heat loss from the surface of the godet roller 11 is reduced.

[0046] Although depending on the type of the yarn Y, the range of the heat absorption wavelengths of the yarn typically falls within the wavelengths range of far infrared rays, which is within the range of electromagnetic waves. For example, when the yarn Y is made of PET, the peak of the heat absorption wavelength is about 10μm. The wavelength of far infrared rays typically falls within the range of about 4 to 1000μm.

[0047] In this regard, when the opposing surface 30a of the corrugated plate 30 is coated with a ceramic material that radiates particularly an electromagnetic wave similar to the peak wavelength of the PET, the opposing surface 30a radiates an electromagnetic wave having a wavelength similar to the heat absorption wavelength of the yarn Y in response to the heating of the opposing surface 30a by the heat generated by the godet roller 11. Because the yarn Y tends to absorb an electromagnetic wave having this wavelength, it is possible to improve the efficiency in the heating of the yarn Y by radiation. In other words, the wavelength radiated from the ceramic material is arranged to be similar to the heat absorption wavelength of the yarn by suitably selecting the type of the ceramic material with which the opposing surface 30a is coated, according to the type of the yarn Y.

[0048] In addition to the above, because the corrugated plate 30 has the concave portions each being triangular and having two sides, the heat transfer via the yarn Y and the heating by the radiation that are described above are both efficiently carried out.

[0049] In addition to the above, because the corrugated plates 30 and 31 entirely cover the circumference of the godet roller 11 except at the space where the yarn Y is passed from the godet roller 11 to the separate roller 12, the loss of the heat generated by the godet roller 11 is restrained and the efficiency in the heat insulation of the godet roller 11 is improved, with the result that the power consumption of the heater 15 required for heating the yarn Y to a suitable temperature is reduced. Because of the above, the efficiency in the heating of the yarn Y wound on the godet roller 11 is improved and the yarn Y

is sufficiently heated. Furthermore, the number of times of winding the yarn Y onto the godet roller 11 is reduced and therefore the godet roller 11 is downsized.

[0050] In addition to the above, because the corrugated plates 30 and 31 are plate members, alternating concaves and protrusions are easily formed by simply folding the plates. Furthermore, by simply attaching such plate members that are easily shaped to a conventional thermal insulation box 13 that stores the godet roller 11, it is possible to improve the efficiency in the heating of the yarn Y wound onto the godet roller 11.

[0051] In addition to the above, an accompanied flow is typically generated around the yarn Y as the godet roller 11 rotates and the yarn Y runs. In this regard, because the corrugated plates 30 and 31 circumferentially cover the entirety of the godet roller 11 except at the space where the yarn Y is passed from the godet roller 11 to the separate roller 12, the accompanied flow is generated only between the corrugated plate 30 and the godet roller 11 and between the corrugated plate 31 and the godet roller 11, and hence the generation of an accompanied flow outside the corrugated plates 30 and 31 is restrained. As such, the corrugated plates 30 and 31 not only improve the efficiency in the heating of the yarn Y but also function as wind shields for restraining the generation of an accompanied flow. It is therefore possible to improve the quality of the yarn by restraining the vibration of the running yarn Y.

[0052] Furthermore, the godet roller 11 has the protruding portion 25 which is close to the opening of the thermal insulation box 13 as compared to the corrugated plate 30. When the yarn threading onto the godet roller 11 and the separate roller 12 is carried out, the door 13a is opened to expose the inside of the thermal insulation box 13. With this, it is possible to easily carry out the yarn threading onto the protruding portion 25 of the godet roller 11, which protrudes as compared to the corrugated plate 30. It is noted that the workability of the yarn threading is improved when the gap between the corrugated plate 30 and the rollers 11 and 12 is arranged to be wide on the yarn threading operation side (front side). In this case, the protruding portion 25 is not provided and the corrugated plate 30 is arranged to cover the entirety of the godet roller 11.

[0053] Assume that the plate member which is the corrugated plate 30 is not shaped as alternating concaves and protrusions but shaped to be smooth along the outer circumference of the godet roller 11. In such a case, when the plate member is too close to the godet roller 11, a negative pressure is generated between the plate member and the godet roller 11 as the godet roller 11 is rotated to move the yarn Y wound onto the godet roller 11, with the result that the yarn Y is drawn to the opposing surface of the plate member and a suitable tension may not be imparted to the yarn Y.

[0054] In this regard, because in the present embodiment the plate member is a corrugated plate 30 on which concaves and protrusions are alternated, generated between the plate member and the godet roller 11 is not a laminar flow but a turbulent flow 34. For this reason, the yarn Y is hardly drawn to the opposing surface 30a of the corrugated plate 30 and hence a suitable tension is imparted to the yarn Y.

[0055] Now, various modifications of the present embodiment will now be described. It is noted that the same components as in the embodiment are denoted by the same reference numerals as in the embodiment, respectively, and the description thereof will be omitted. It is also noted that modifications to the arrangement of the roller unit 4 are similarly applicable to the arrangement of the roller unit 3.

[0056] According to the present embodiment, no corrugated plate is provided for the separate roller 12 because the separate roller 12 is not a heating roller having a heater. In this regard, when, as shown in Fig. 6, the separate roller 12 is a heating roller having a heater 40, for the separate roller 12, a corrugated plate 41 may be provided to oppose the outer circumference on which the yarn Y is wound, with a gap being formed therebetween, and a corrugated plate 42 may be provided to oppose the outer circumference on which the yarn Y is not wound, with a gap being formed therebetween (Modification 1). In this case, in the similar manner as the yarn Y wound onto the above-described godet roller 11, the efficiency in the heating of the yarn Y wound onto the separate roller 12 is improved. It is noted that the corrugated plates 41 and 42 are equivalent to the second heating accelerating member of the present invention.

[0057] According to the present embodiment, the corrugated plate 30 is a plate member and is attached to the thermal insulation box 13. Alternatively, as shown in Fig. 7, an inner wall surface 63a of a part of the thermal insulation box 63 opposes the outer circumference of the godet roller 11 on which the yarn Y is wound, with a gap being formed therebetween, and this inner wall surface 63a has alternating concaves and protrusions aligned in the circumferential directions of the godet roller 11 (Modification 2). In this case, between the inner wall surface 63a and the godet roller 11, a plurality of spaces 65 divided along the circumferential directions of the godet roller 11 are formed. The cavity between the inner wall surface and the outer wall surface of the thermal insulation box 63 is preferably filled with a heat insulating material 64. This arrangement reduces the capacity of the thermal insulation space formed by the inner surfaces of the thermal insulation box 63, thereby improving the heat insulation efficiency of the thermal insulation box 63.

[0058] In addition to the above, according to the present embodiment, the yarn Y is wound plural times onto the godet roller 11 and the separate roller 12. Alternatively, the separate roller 12 is not provided and the yarn Y is wound only onto the godet roller 11 at an angle of less than 360 degrees.

[0059] In addition to the above, while in the present embodiment the opposing surface 30a of the corrugated plate 30 is ceramic coated, the surface may not be coated

with ceramic. For example, the surface is far-infrared coated by a material suitable for the type of the yarn Y.

[0060] In addition to the above, according to the present embodiment, the plate member covering the outer circumference of the godet roller 11 on which the yarn Y is wound is a corrugated plate 30 on which triangular mountains are aligned along the circumferential directions of the godet roller 11. In this regard, the plate member may be differently shaped as long as concaves and protrusions are alternated along the circumferential directions (Modification 3). For example, as shown in Fig. 8, a plate member 66 may be arranged so that rectangular concave portions 67 in each of which the bottom wall and the side wall intersect at a right angle and connecting portions 68 connecting the concave portions 67 in the circumferential directions of the godet roller 11 are alternately provided. In this case, on the opposing surface (inner circumference) of the godet roller 11 opposing the plate member 66, a plurality of spaces 69 divided along the circumferential directions of the godet roller 11 are formed.

[0061] In addition to the above, according to the present embodiment, concaves and protrusions are aligned in the circumferential directions of the godet roller 11 so that the spaces 35 are formed along the circumferential directions of the godet roller 11. In this regard, a different arrangement may be employed as long as a plurality of spaces are provided along the circumferential directions of the godet roller 11 (Modifications 4, 5, and 6).

[0062] (Modification 4) For example, as shown in Fig. 9, the plate member 70 has a smooth shape and is bended to form an arc along the circumferential directions of the godet roller 11. To the opposing surface of this plate member 70 opposing the godet roller 11, one side of each of L-shaped brackets 71 is welded. The other side of each bracket 71 which is not welded radially extends toward the center of the godet roller 11, and the brackets 71 are provided at intervals along the circumferential directions of the godet roller 11. As such, the spaces 72 divided by the brackets 71 along the circumferential directions of the godet roller 11 may be formed on the opposing surface of the plate member 70 opposing the godet roller 11.

[0063] (Modification 5) For example, as shown in Fig. 10 and Fig. 11, the plate member 76 is bended to form an arc along the circumferential directions of the godet roller 11, and rectangular column shaped protruding portions 78 which are concave radially outward from the godet roller 11 are formed on the plate member 76 by, for example, pressing from the inner circumference 77 side. The protruding portions 78 are rectangular in cross section and form a matrix with intervals in the axial directions and the circumferential directions of the godet roller 11. As such, a plurality of spaces 79 defined by concaves of the protruding portions 78 and divided along the circumferential directions of the godet roller 11 may be formed on the inner circumference 77 side of the plate member 76.

[0064] (Modification 6) For example, as shown in Fig. 12, the plate member 80 may not be corrugated as in the embodiment above but be saw-toothed such that triangular mountains, in each of which two oblique sides forming an apex are different in length, are serially formed. The side 80a which is shorter than the other side is provided on the downstream in the rotational direction of the godet roller 11 (clockwise in Fig. 12), and extends toward the rotational center of the godet roller 11. As such, a plurality of spaces 81 defined by concave portions divided along the circumferential directions of the godet roller 11 may be formed on the inner circumference side of the plate member 80. According to this arrangement, an accompanied flow along the circumferential directions of the godet roller 11 collides the oblique side 80a, and therefore a swirling flow tends to be generated in the space 81.

[0065] In addition to the above, while in the present embodiment the protruding portions and the concave portions are formed by linear lines, the protruding portions and the concave portions may be formed by curved lines (Modification 7). For example, as shown in Fig. 13 and Fig. 14, a plate member 85 is bended to form an arc along the circumferential directions of the godet roller 11, and a plurality of curved protruding portions 87 which are concave radially outward from the godet roller 11 are formed by, for example pressing from the inner circumference 86 side. The protruding portions 87 are curved in cross section, and are provided at intervals along the axial directions of the godet roller 11 and also along the circumferential directions of the godet roller 11. As such, a plurality of spaces 88 defined by the concave protruding portions 87 and divided along the circumferential directions of the godet roller 11 may be formed on the inner circumference 86 side of the plate member 85.

[0066] While in the present embodiment the godet roller 11 and the separate roller 12 are housed in the thermal insulation box 13, the thermal insulation box 13 may not be provided.

[0067] The present embodiment is arranged such that, in addition to the corrugated plate 30 provided for the outer circumference of the godet roller 11 on which the yarn Y is wound, the corrugated plate 31 is provided for the outer circumference of the godet roller 11 on which the yarn Y is not wound. In this regard, the corrugated plate 31 may not be provided.

[0068] In addition to the above, while in the present embodiment the present invention is applied to the roller unit in which the godet roller and the separate roller for drawing the yarns Y while heating the same are provided, the present invention is not limited to this arrangement and may be applied to another type of yarn heater in which a heating roller for simply heating and feeding yarns is provided in a thermal insulation box.

The following numbered items also form part of the disclosure.

1. A yarn heater comprising:

a heating roller for sending a yarn while heating the same; and
a first heating accelerating member which is provided to oppose at least an outer circumference of the heating roller on which the yarn is wound, with a gap being formed between the first heating accelerating member and the outer circumference, and
on an opposing surface of the first heating accelerating member which surface opposes the heating roller, a plurality of spaces divided along the circumferential directions of the heating roller being formed.

2. The yarn heater according to item 1, wherein, the opposing surface of the first heating accelerating member is corrugated.

3. The yarn heater according to item 1 or 2, wherein, the opposing surface of the first heating accelerating member is far-infrared coated with a material that radiates a far infrared ray having a peak wavelength which falls within a range of heat absorption wavelengths determined according to a material of the yarn.

4. The yarn heater according to any one of items 1 to 3, wherein,
the first heating accelerating member is provided on the substantially entire circumference of the heating roller.

5. The yarn heater according to any one of items 1 to 4, further comprising:

a thermal insulation box that houses the heating roller,
to the thermal insulation box, a plate member being attached to oppose at least the outer circumference of the heating roller on which the yarn is wound, with a gap being formed between the outer circumference and the plate member, and
on an opposing surface of the plate member which surface opposes the heating roller, the spaces are formed in a divided manner.

6. The yarn heater according to item 2 or 3, further comprising:

a thermal insulation box that houses the heating roller, and
a part of an inner wall surface of the thermal insulation box opposing the outer circumference of the heating roller on which circumference the yarn is wound, with a gap being formed between the part and the outer circumference, and the spaces being formed on that part in a divided manner.

7. The heating roller according to any one of items 1 to 6, further comprising:

a separate roller for heating the yarn in the same manner as the heating roller, the yarn being wound a plurality of times onto the heating roller and the separate roller at predetermined intervals; and
a second heating accelerating member which is provided to oppose at least an outer circumference of the separate roller on which circumference the yarn is wound, with a gap being formed between the second heating accelerating member and the outer circumference, and
on an opposing surface of the second heating accelerating member which surface opposes the separate roller, a plurality of spaces divided along the circumferential directions of the heating roller being formed.

Claims

1. A yarn heater comprising:

a heating roller (11) for sending a yarn while heating the same; and
a first heating accelerating member (30) which is provided to oppose at least an outer circumference of the heating roller (11) on which the yarn is wound, with a gap being formed between the first heating accelerating member and the outer circumference, and
on an opposing surface (30a) of the first heating accelerating member (30) which surface opposes the heating roller, a plurality of spaces (35) divided along the circumferential directions of the heating roller (11) being formed,
characterized in that the first heating accelerating member (30) is a plate or an inner wall surface of a part of a thermal insulation box (63) on the inner circumference side of which a plurality of spaces are defined by concaves of the protruding portions or concave protruding portions and divided along the circumferential directions of the heating roller (11).

2. The yarn heater according to claim 1, wherein the opposing surface (30a) of the first heating accelerating member is corrugated.

3. The yarn heater according to claim 1 or 2, wherein, the opposing surface (30a) of the first heating accelerating member is far-infrared coated with a material that radiates a far infrared ray having a peak wavelength which falls within a range of heat absorption

wavelengths determined according to a material of the yarn (Y).

4. The yarn heater according to any one of claims 1 to 3, wherein
the first heating accelerating member (30) is provided on the substantially entire circumference of the heating roller (11).

5. The yarn heater according to any one of claims 1 to 4, further comprising:

a thermal insulation box (13) that houses the heating roller (11),
to the thermal insulation box (13), a plate member (30) being attached to oppose at least the outer circumference of the heating roller (11) on which the yarn is wound, with a gap being formed between the outer circumference and the plate member, and
on an opposing surface of the plate member which surface opposes the heating roller, the spaces are formed in a divided manner.

6. The yarn heater according to claim 2 or 3, further comprising:

a thermal insulation box (13) that houses the heating roller, and
a part of an inner wall surface of the thermal insulation box opposing the outer circumference of the heating roller on which circumference the yarn is wound, with a gap being formed between the part and the outer circumference, and the spaces being formed on that part in a divided manner.

7. The heating roller according to any one of claims 1 to 6, further comprising:

a separate roller (12) for heating the yarn in the same manner as the heating roller, the yarn being wound a plurality of times onto the heating roller and the separate roller at predetermined intervals; and
a second heating accelerating member (41, 42) which is provided to oppose at least an outer circumference of the separate roller on which circumference the yarn is wound, with a gap being formed between the second heating accelerating member and the outer circumference, and
on an opposing surface of the second heating accelerating member (41, 42) which surface opposes the separate roller, a plurality of spaces divided along the circumferential directions of the heating roller being formed.

FIG.1

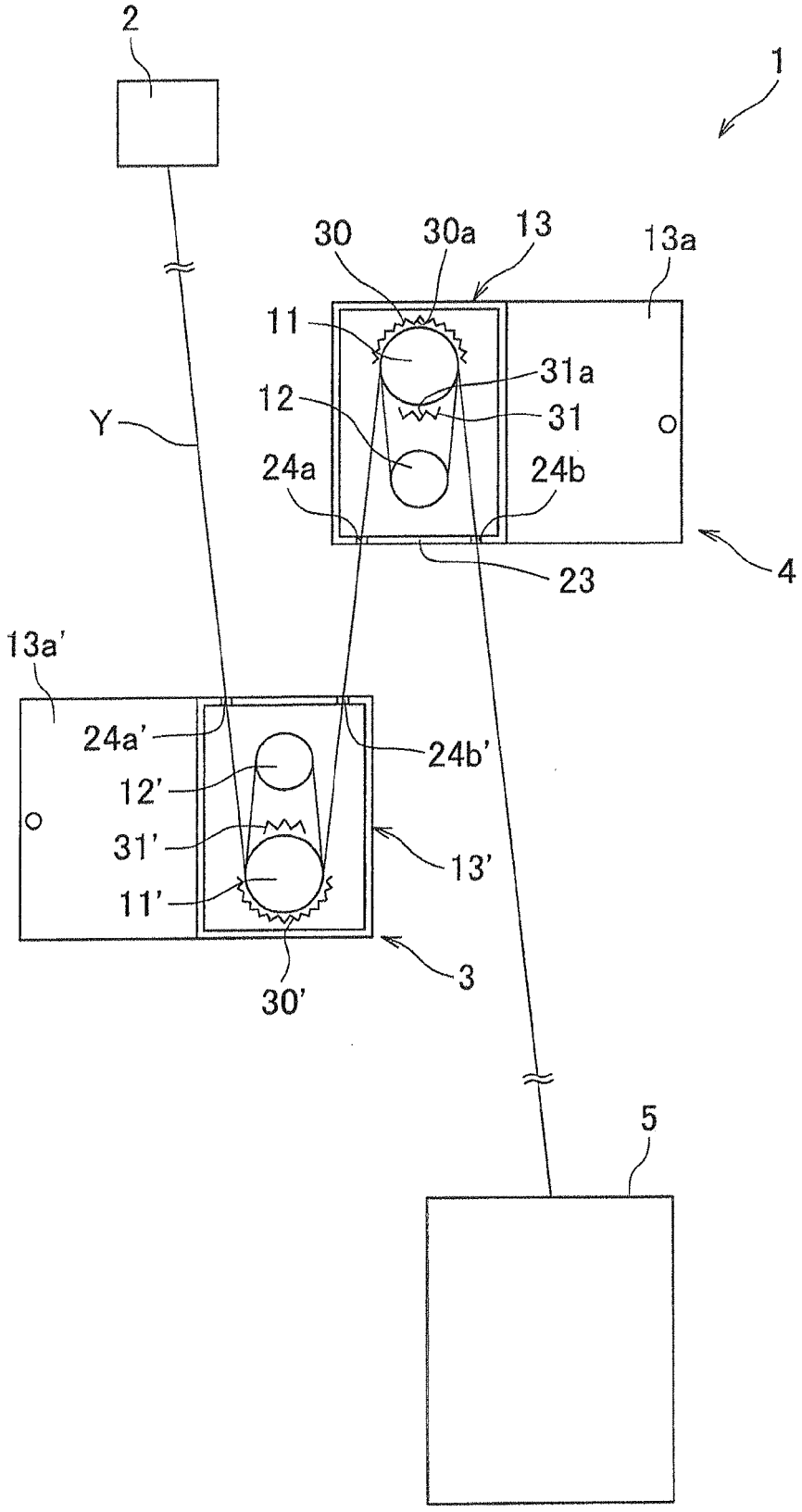
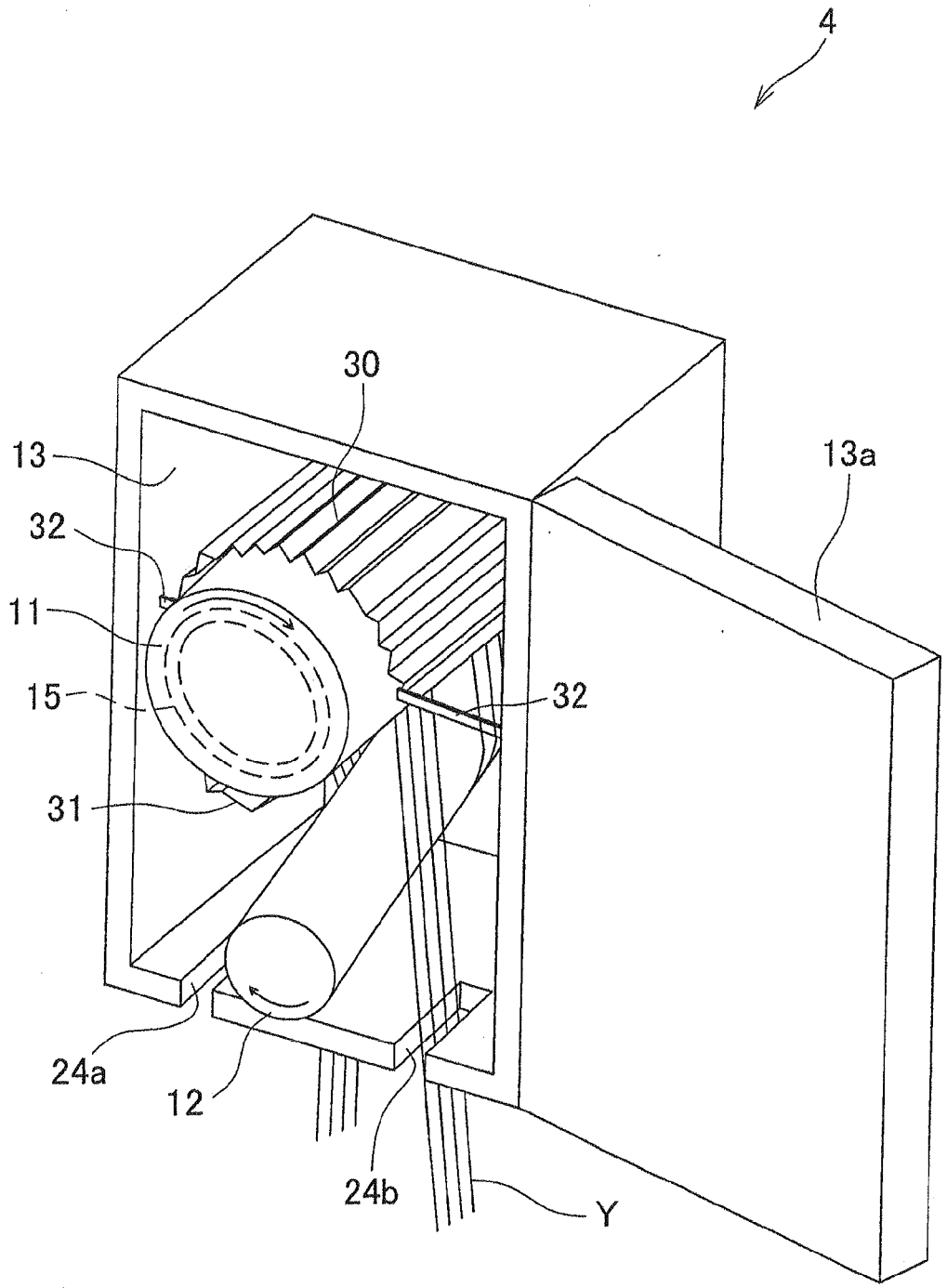

2
1
30
30a
13
13a
11
31a
12
31
Y
24a
24b
23
4
13a'
24a'
24b'
12'
31'
13'
11'
3
30'
5

FIG.2



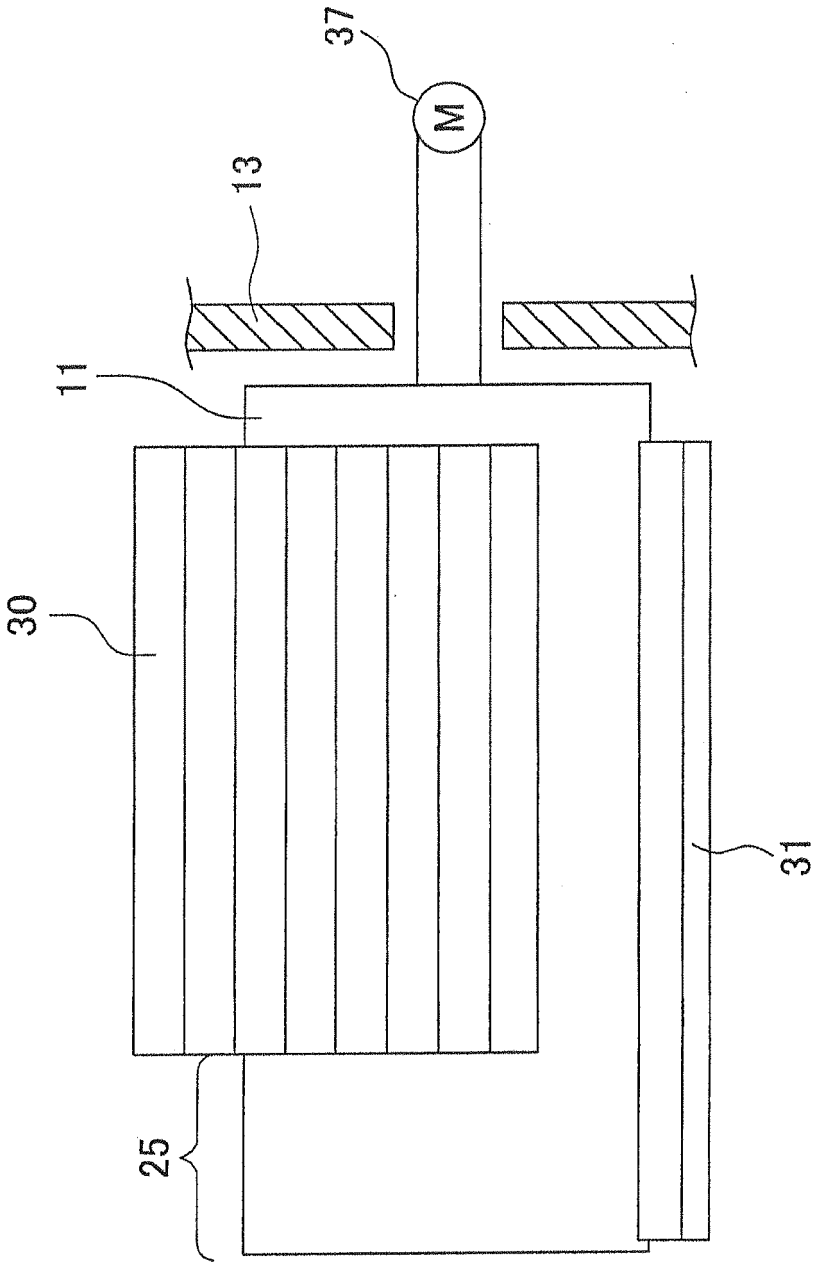


FIG.3

FIG.4

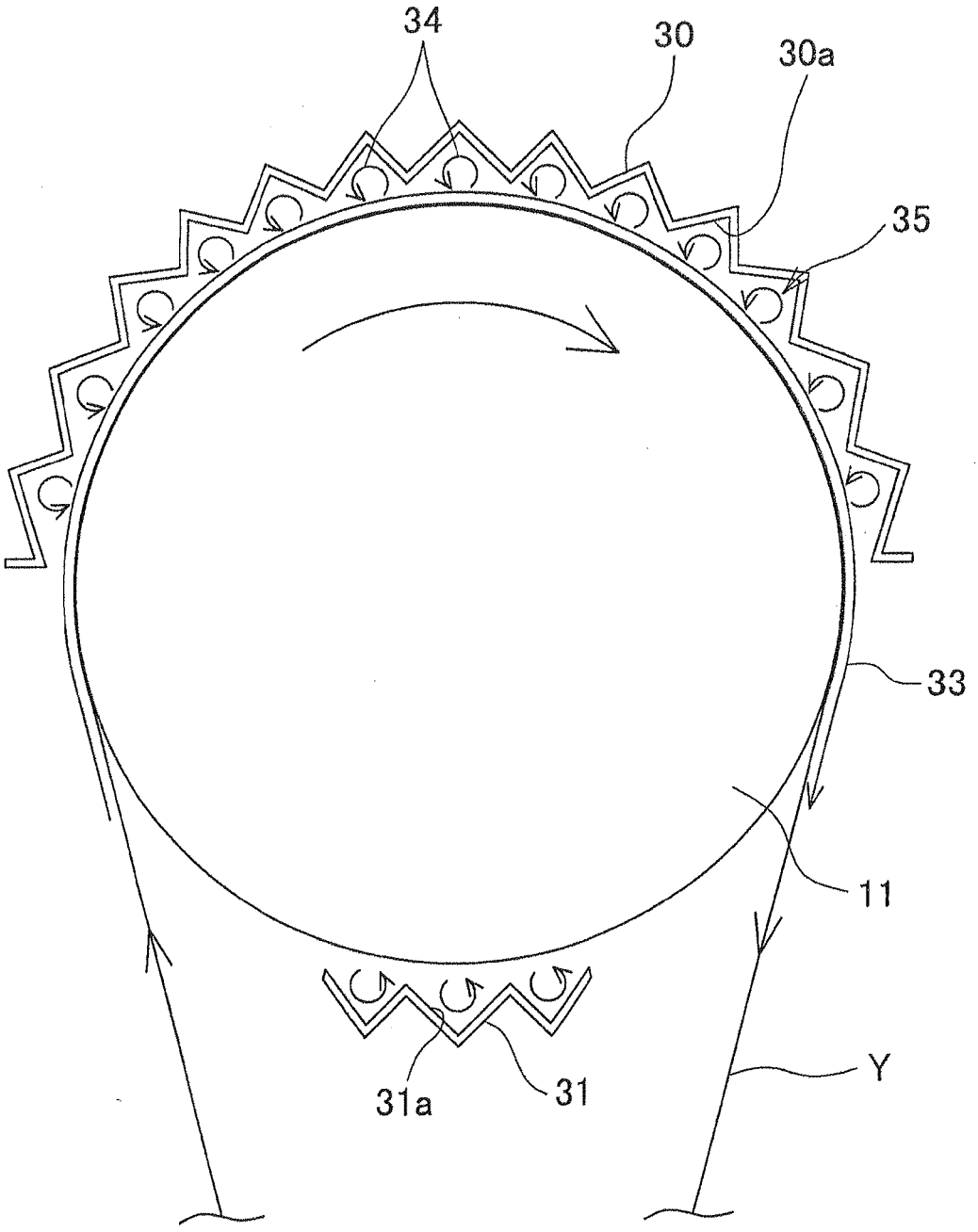


FIG.5

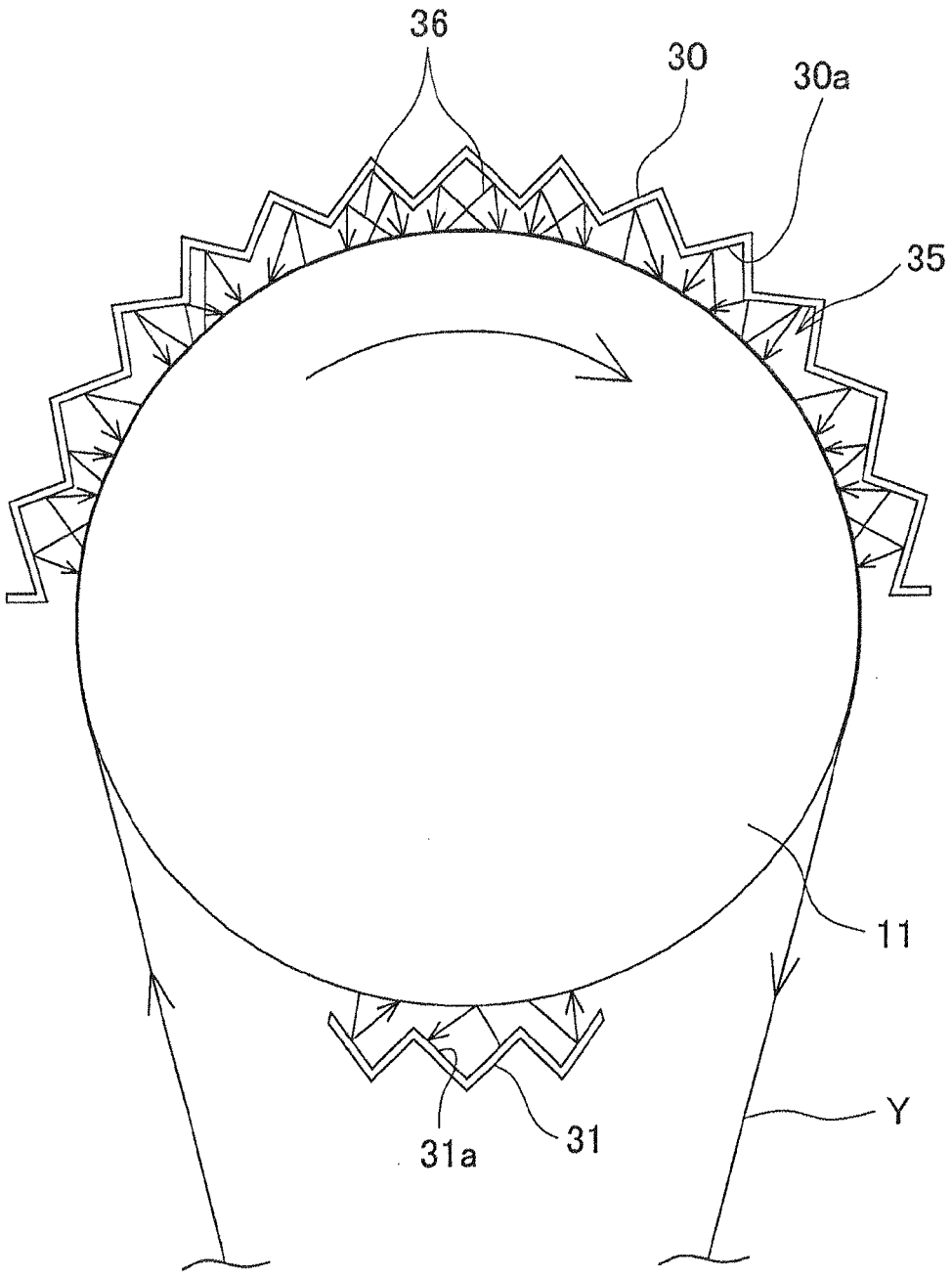


FIG.6

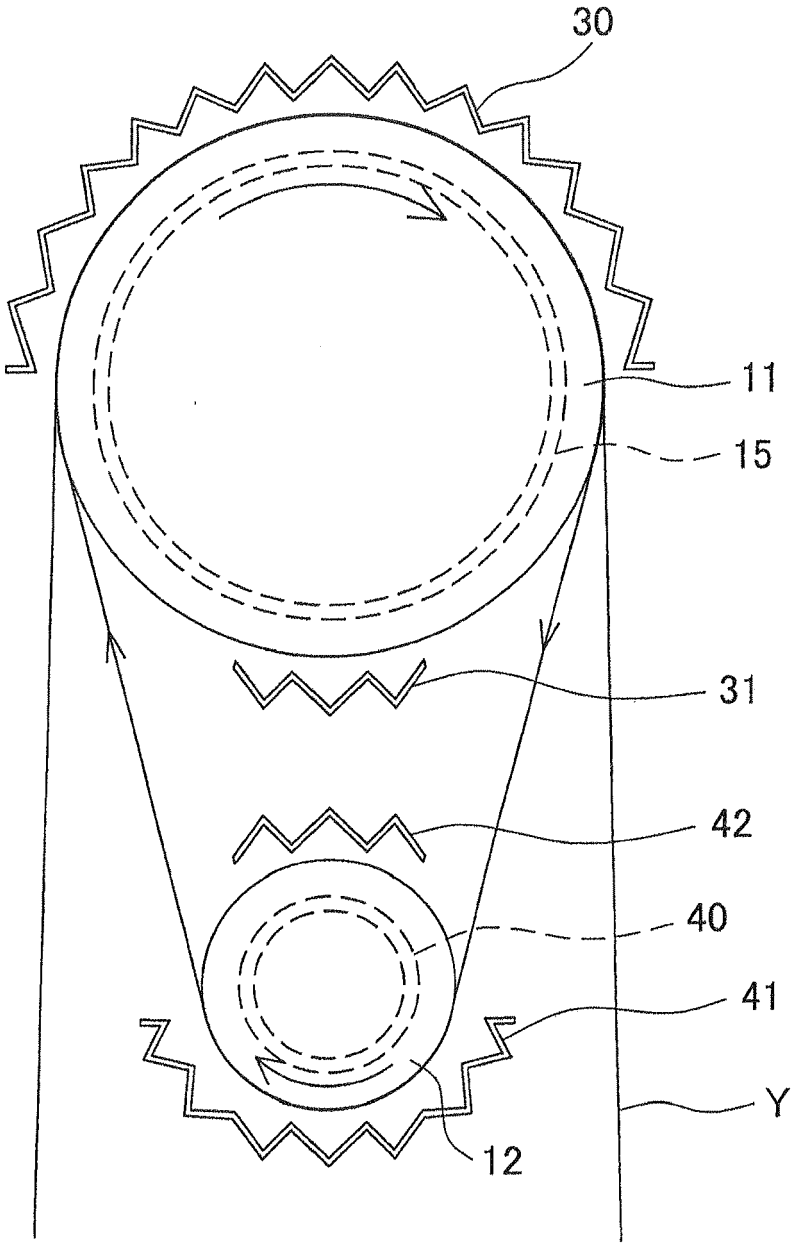


FIG.7

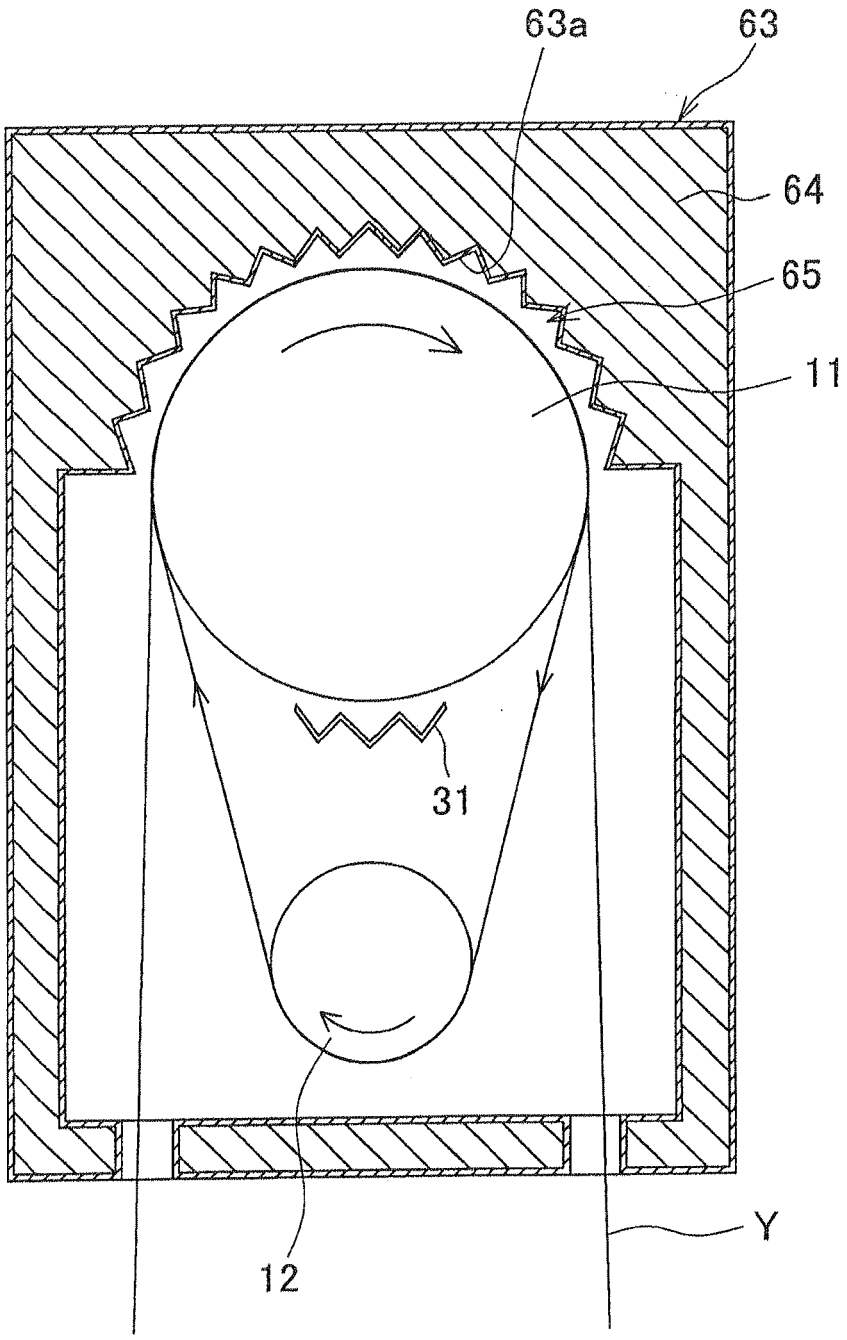


FIG.8

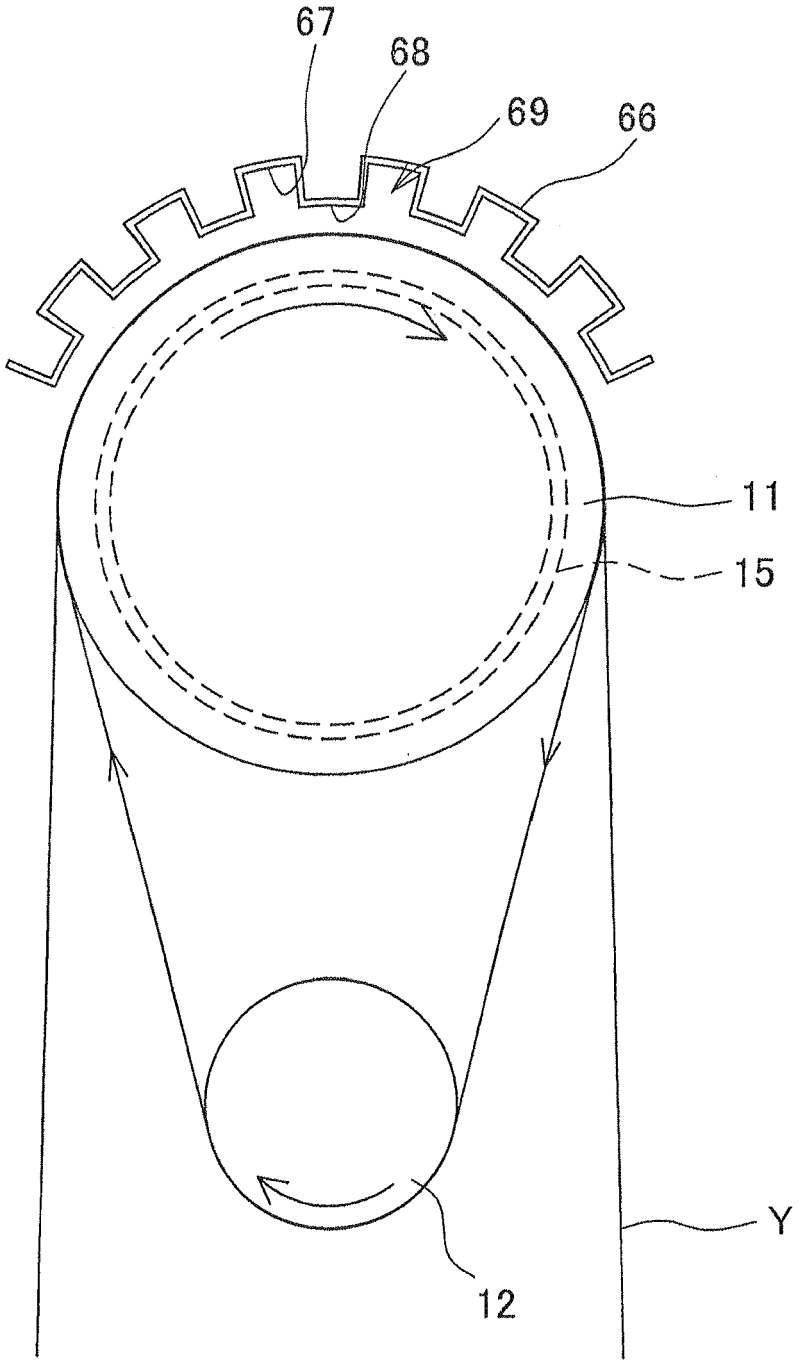


FIG.9

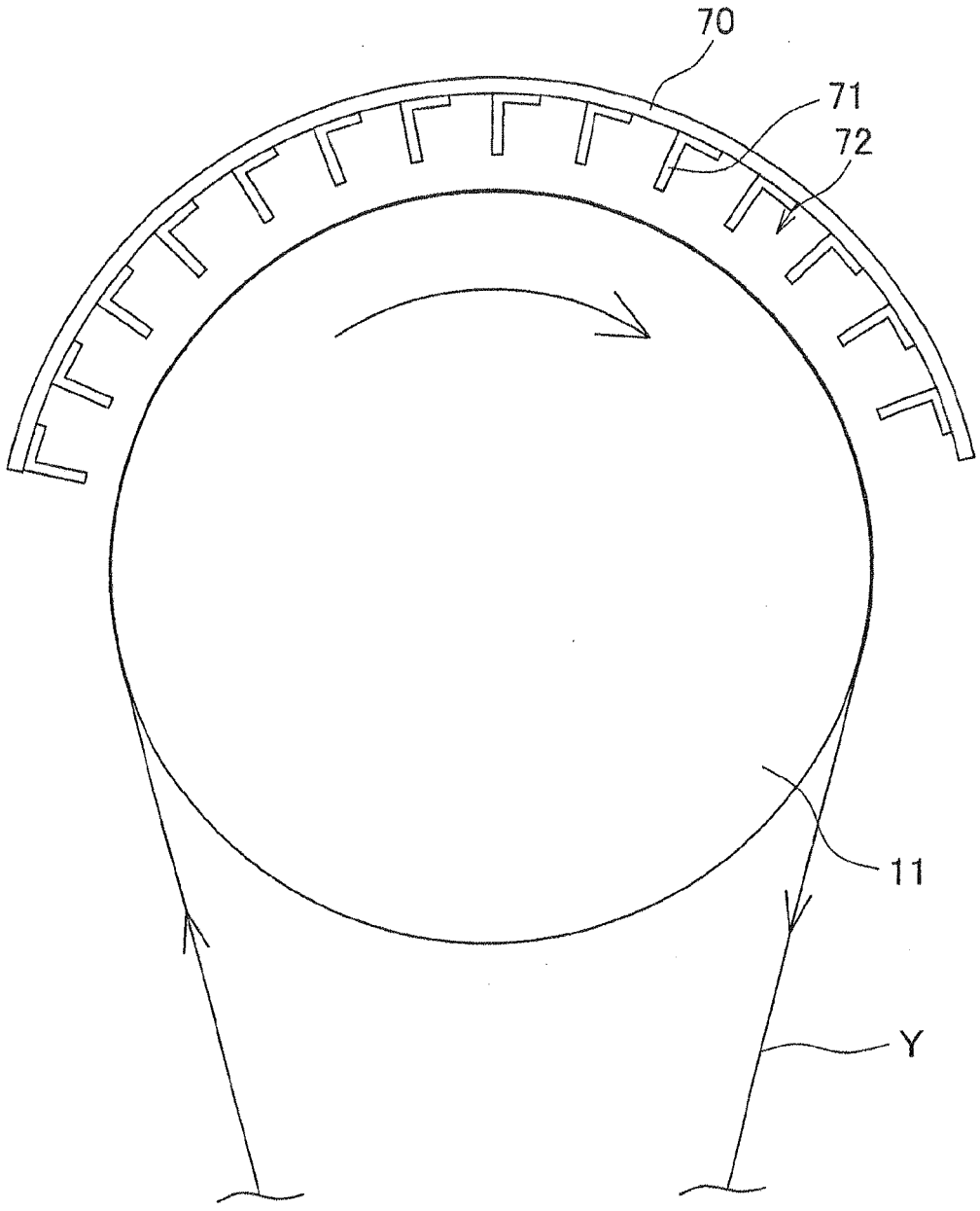


FIG.10

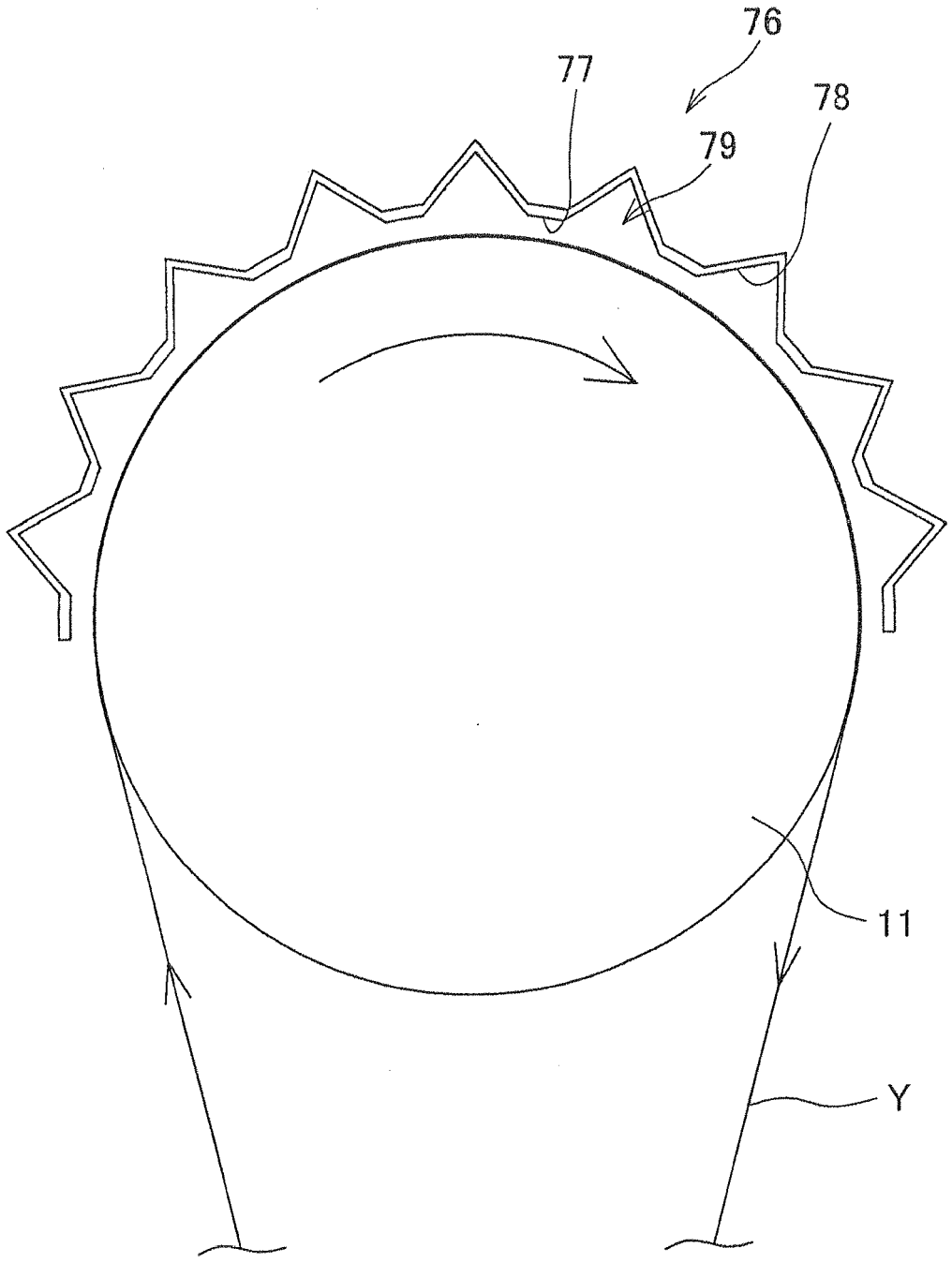


FIG.11

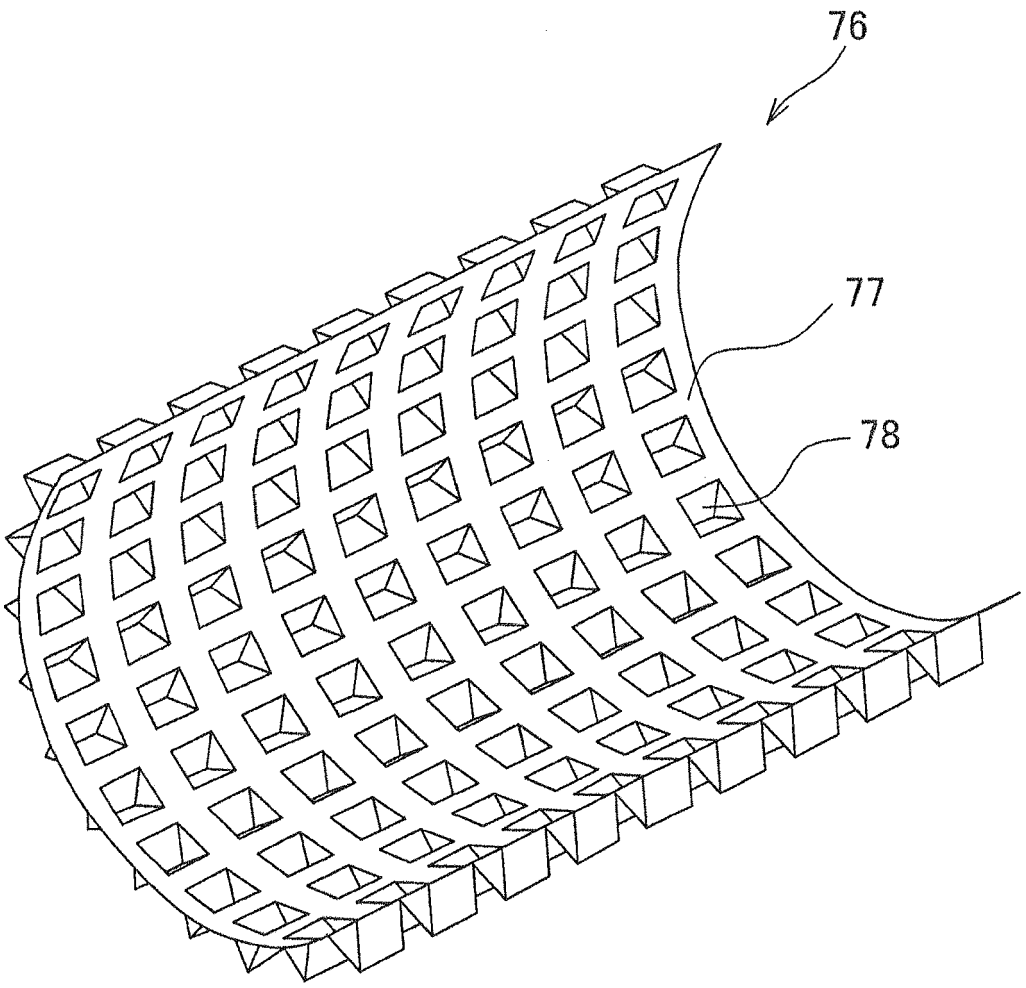


FIG.12

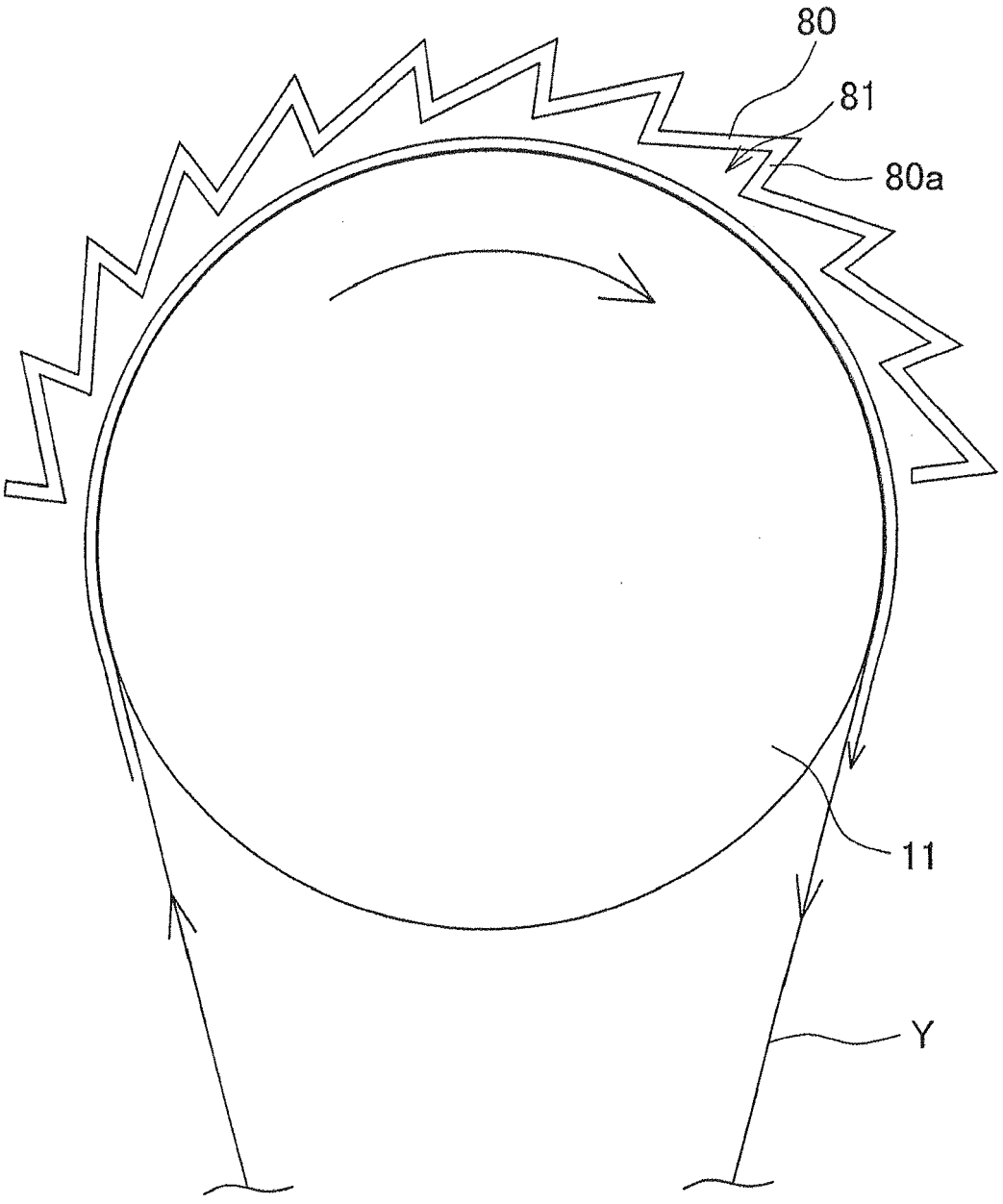


FIG.13

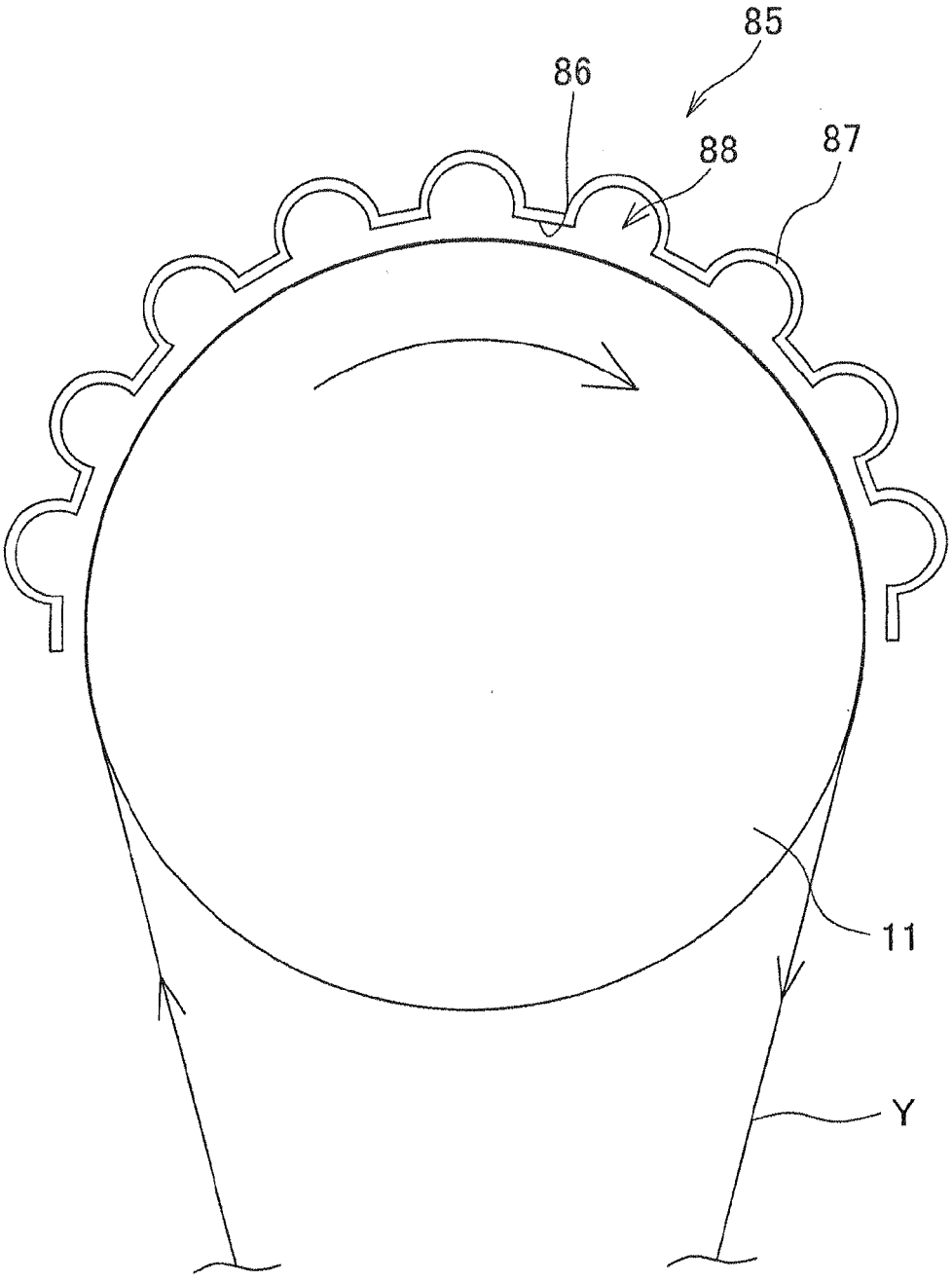
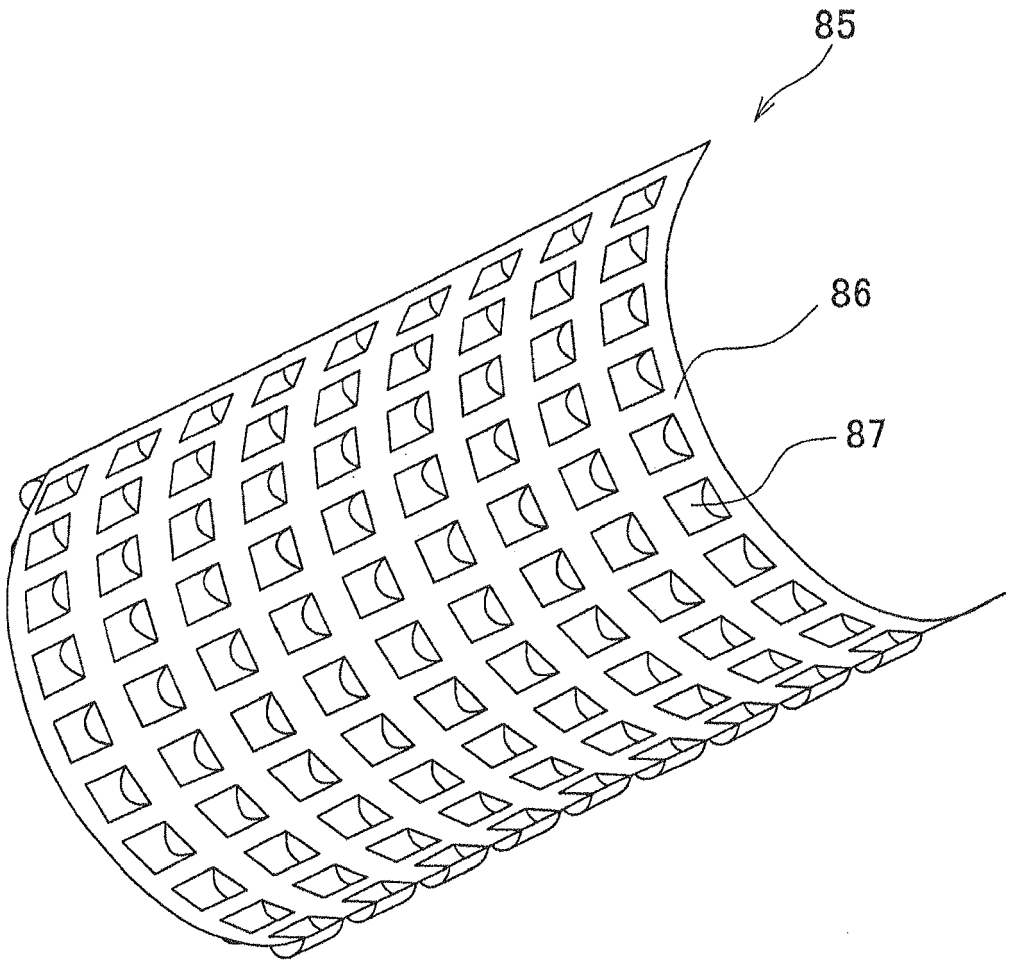


FIG.14



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Application Number
EP 12 19 6271

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Place of search	Date of completion of the search	Examiner
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