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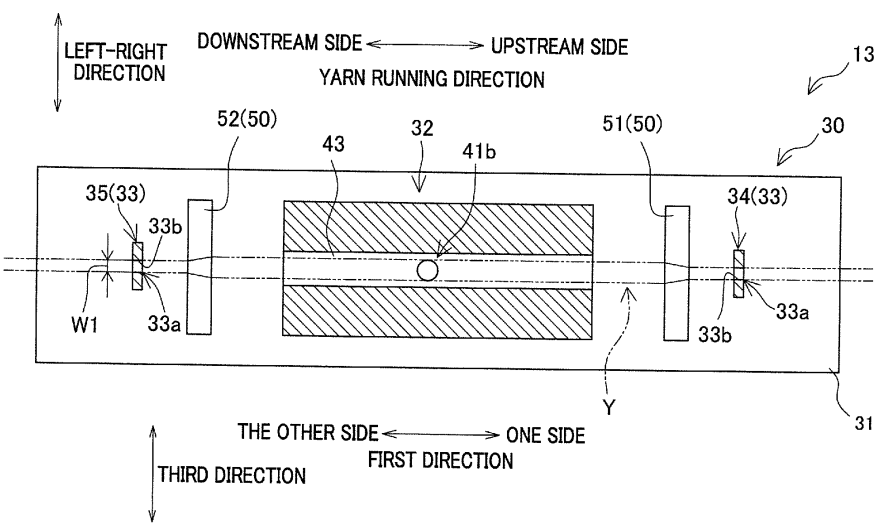
(54) ## INTERLACING DEVICE AND YARN WINDER

(57) An object of the present invention is to increase the efficiency of interlacing a yarn without increasing the pressure or flow amount of fluid.

An interlacing device 30 includes an interlacing portion 32, a regulatory guide 33 (i.e., regulatory portion), and a widening guide 50 (i.e., enlarging portion). The interlacing portion 32 includes a yarn running space 43 which allows a yarn Y to run in a predetermined first direction. An injection hole 41a for injecting compressed air (i.e., fluid) to the yarn running space 43 is formed in the interlacing portion 32. The compressed air is injected in a second direction intersecting with the first direction. The regulatory guide 33 is provided to be separated from the interlacing portion 32 in the first direction, and configured to restrict movement of the yarn Y in a third direction. The third direction intersects with the second direction when viewed in the first direction. The widening guide 50 is provided between the interlacing portion 32 and the regulatory guide 33 in the first direction, and configured to widen the yarn Y in the third direction. The yarn Y runs in the yarn running space 43.

FIG.3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an interlacing device and a yarn winder including the interlacing device.

[0002] A spun yarn take-up apparatus (i.e., yarn winder) of Patent Literature 1 (Japanese Laid-Open Patent Publication No. 2016-160550) includes an interlacing device configured to interlace a yarn by means of fluid. The yarn is formed of plural filaments. The interlacing device includes a yarn running space which is provided in a predetermined direction and an interlacing portion provided with an injection hole for injecting the fluid to the yarn running space. A first regulatory portion (i.e., regulatory portion) is provided to both sides of the interlacing portion in the predetermined direction. The regulatory portion is provided so that the yarn is in the center of the yarn running space when viewed in the predetermined direction. In such the interlacing device, as the fluid flows through the injection hole and is injected to the yarn running space, the yarn is opened and rotated. Because of this, an area (i.e., interlacing point) where filaments are interlaced with one another is provided at substantially-regular pitches.

SUMMARY OF THE INVENTION

[0003] It has been known that distances between adjacent interlacing points are different from one another to some degree because the complete control of a distance between each pair of adjacent interlacing points is difficult. Among those distances, when there is a long distance between one adjacent interlacing points in the yarn (i.e., there is a part at which filaments tend to be separated), the following problem may occur. For example, when the yarn forms a package by being wound onto a bobbin, the yarn on the outer layer of the package may tend to be hooked by the yarn on the inner layer of the package. Because of this, the yarn may not be properly unwound from the package. In order to solve this problem, the yarn needs to be interlaced in a more efficient way. However, when only the pressure of fluid or the flow amount of fluid is increased, the force acting on the yarn becomes excessive. As a result, because the yarn may make contact with an inner wall surface facing a yarn running space, the yarn quality may be decreased and/or running costs may be increased.

[0004] An object of the present invention is to increase the efficiency of interlacing a yarn without increasing the pressure or flow amount of fluid.

[0005] According to a first aspect of the invention, an interlacing device is configured to interlace a running yarn formed of filaments and includes: an interlacing portion including a yarn running space for allowing the yarn to run in a predetermined first direction and an injection hole for injecting fluid to the yarn running space in a second direction intersecting with the first direction, the interlacing portion being configured to interlace the yarn by means of the fluid injected to the yarn running space through the injection hole; a regulatory portion which is provided to be separated from the interlacing portion in the first direction and which is configured to regulate movement of the yarn in a third direction, the third direction intersecting with the second direction when viewed in the first direction; and an enlarging portion which is provided between the interlacing portion and the regulatory portion in the first direction and which is configured to widen, in the third direction, the yarn running in the yarn running space.

[0006] In the present invention, the center of the yarn in the third direction can be defined by the regulatory portion. In addition to that, the yarn running in the yarn running space is widened in the third direction by the enlarging portion. Because of this, the fluid which is injected in the second direction through the injection hole efficiently hits the yarn. As a result, because the fluid can effectively influence the yarn without increasing the pressure or flow amount of the fluid, the yarn is efficiently opened and rotated. Therefore, the efficiency of interlacing the yarn is increased without increasing the pressure or flow amount of the fluid.

[0007] According to a second aspect of the invention, the interlacing device of the first aspect is arranged such that the enlarging portion is configured to widen at least one part of the yarn in the third direction so that the width of the at least one part of the yarn is larger than the width of another part of the yarn, the at least one part of the yarn running in the yarn running space, and the another part of the yarn being regulated by the regulatory portion.

[0008] In the present invention, the width of the yarn widened by the enlarging portion in the third direction is large as compared to a yarn widened by the regulatory portion in known cases. Because of this, the fluid which is injected through the injection hole efficiently hits the yarn.

[0009] According to a third aspect of the invention, the interlacing device of the first or second aspect is arranged such that the enlarging portion is configured to widen the yarn so as to decrease difference between the width of the yarn in the third direction and a size of the injection hole in the third direction.

[0010] In the present invention, the fluid which is injected through the injection hole hits the yarn in the most efficient manner.

[0011] According to a fourth aspect of the invention, the interlacing device of any one of the first to the third aspects is arranged such that the enlarging portion includes a rod-shaped widening guide extending in the third direction.

[0012] In the present invention, the yarn is widened in the third direction in such a way that the bar widening guide imparts resistance to the yarn running in the first direction. With this arrangement, the yarn is widened with a simple structure.

[0013] According to a fifth aspect of the invention, the interlacing device of any one of the first to fourth aspects is arranged such that the enlarging portion is provided so that a contact part of the enlarging portion which is in contact with the yarn overlaps the yarn running space at least in part when viewed in the first direction.

[0014] The contact part of the enlarging portion which is in contact with the yarn is not necessarily provided to overlap the yarn running space when viewed in the first direction. However, in this case, another guide needs to be provided between the interlacing portion and the enlarging portion in the first direction so as to properly guide the yarn to the yarn running space. In the present invention, the enlarging portion functions also as the guide for properly guiding the yarn to the yarn running space. The structure of the interlacing device is therefore simplified.

[0015] According to a sixth aspect of the invention, the interlacing device of any one of the first to fifth aspects is arranged such that the contact part of the enlarging portion which is contact with the yarn is curved.

[0016] In the present invention, damage to the running yarn caused by the enlarging portion is reduced as compared to cases where the contact part has corners. Therefore, yarn breakage is suppressed.

[0017] According to a seventh aspect of the invention, the interlacing device of any one of the first to sixth aspects is arranged such that the enlarging portion is not rotatable.

[0018] When the enlarging portion is rotated in accordance with the running of the yarn, the efficiency of imparting resistance to the yarn is decreased. As a result, the yarn is less likely to be widened. In the present invention, because the enlarging portion cannot be rotated, the resistance is efficiently imparted to the yarn. Therefore, the yarn is efficiently widened.

[0019] According to an eighth aspect of the invention, a yarn winder includes: the interlacing device of any one of the first to seventh aspects; and a winding unit configured to form a package by winding a yarn, the yarn being interlaced by the interlacing device.

[0020] In the present invention, the package is formed by using the yarn which is stably interlaced. Because of this, an error in unwinding of the yarn is suppressed. The error occurs because the yarn on the outer layer of the package is hooked by the yarn on the inner layer of the package.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a profile of a spun yarn take-up machine including an interlacing device of an embodiment.
FIG. 2 is a side cross sectional view of the interlacing device in cross section.
FIG. 3 is a cross section taken along a line III-III in FIG. 2.
FIG. 4 is a cross section taken along a line IV-IV in FIG. 2.
FIG. 5(a) shows an interlacing point of a yarn, and FIG. 5(b) shows the yarn in cross section.
FIG. 6 is a cross section of an interlacing device of a comparative example 1.
FIG. 7 is a cross section of an interlacing device of a comparative example 2.
FIG. 8(a) shows a cross sectional shape of the yarn in an Example, and FIG. 8(b) and FIG. 8(c) show cross sectional shapes of yarns in comparative examples.
FIG. 9 is a table showing evaluation results each of which is related to a distance between interlacing points.
FIG. 10 is a cross section of an interlacing device, which is taken along a direction orthogonal to a first direction in a modification.
FIG. 11 is a cross section of the interlacing device, which is taken along a direction orthogonal to a left-right direction in the modification.
FIG. 12 is a cross section taken along a line XII-XII in FIG. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] The following will describe an embodiment of the present invention. Hereinafter, directions shown in FIG. 1 will be consistently used as an up-down direction and a front-rear direction, for convenience of explanation. The up-down direction is a vertical direction in which the gravity acts. The front-rear direction is a direction which is orthogonal to the up-down direction and in which bobbins B (described later) are aligned. A direction orthogonal to both the up-down direction and the front-rear direction is referred to as a left-right direction. A direction in which each yarn Y (described later) runs will be referred to as a yarn running direction.

(Spun Yarn Take-Up Machine)

[0023] The following will outline a spun yarn take-up machine 1 (i.e., a yarn winder of the present invention) of an embodiment, with reference to FIG. 1. FIG. 1 is a profile of the spun yarn take-up machine 1 including each interlacing device 30 (described later) of the present embodiment. The spun yarn take-up machine 1 is configured to take up yarns Y spun out from a spinning apparatus 2, to wind the yarns Y onto the respective bobbins B, and to form packages P. Each yarn Y is a multi-filament yarn formed of plural filaments f (see FIG. 5(a) and FIG. 5(b)). Each filament f is a synthetic fiber made of, e.g., polyester.

[0024] The spun yarn take-up machine 1 includes a take-up unit 3 and a winding unit 4. The take-up unit 3 is configured to take up the yarns Y spun out from the spinning apparatus 2. For example, the take-up unit 3 includes a drawing device 10, a first godet roller 11, a second godet roller 12, and an interlacing unit 13. The drawing device 10 is provided below the spinning apparatus

2. The drawing device 10 includes unillustrated drawing rollers, and is configured to draw the yarns Y. The first godet roller 11 is a roller having a rotational axis substantially in parallel to the left-right direction. The first godet roller 11 is provided below the drawing device 10. The first godet roller 11 is rotationally driven by an unillustrated motor. The yarns Y spun out from the spinning apparatus 2 are sent to the second godet roller 12 while being arranged in the left-right direction and wound onto the first godet roller 11. The second godet roller 12 is a roller having a rotational axis substantially in parallel to the left-right direction. The second godet roller 12 is provided above and rearward of the first godet roller 11. The second godet roller 12 is rotationally driven by an unillustrated motor. The yarns Y are sent from the first godet roller 11 to the second godet roller 12. After that, the yarns Y are sent to the winding unit 4. A yarn path of each yarn running from the first godet roller 11 to the second godet roller 12 extends upward and rearward. The yarn path includes both components in the up-down direction and the front-rear direction, and is substantially orthogonal to the left-right direction. The interlacing unit 13 is, for example, provided between the drawing device 10 and the first godet roller 11 in the yarn running direction. Alternatively, the interlacing unit 13 may be provided between the first godet roller 11 and the second godet roller 12 in the yarn running direction. The interlacing unit 13 is configured to interlace each of the yarns Y (as described later).

[0025] The winding unit 4 is configured to form the packages P by winding the yarns Y onto the bobbins B. The winding unit 4 is provided below the take-up unit 3. The winding unit 4 includes: fulcrum guides 21; traverse guides 22; a turret 23; two bobbin holders 24; and a contact roller 25.

[0026] Each of the fulcrum guides 21 is a guide about which a corresponding yarn Y is traversed by each traverse guide 22. The fulcrum guides 21 are provided for the respective yarns Y. The fulcrum guides 21 are aligned in the front-rear direction. The traverse guides 22 is provided for the respective yarns Y in the same manner as the fulcrum guides 21. The traverse guides 22 are aligned in the front-rear direction. Each of the traverse guides 22 is configured to traverse a corresponding yarn Y in the front-rear direction by being driven by, e.g., an unillustrated traverse motor. The turret 23 is a disc-shaped member having a rotational axis substantially parallel to the front-rear direction. The turret 23 is rotationally driven by an unillustrated turret motor. Each of the two bobbin holders 24 has a rotational axis substantially in parallel to the front-rear direction. The bobbin holders 24 are rotatably supported at an upper end portion and a lower end portion of the turret 23. To each bobbin holder 24, the bobbins B provided for the respective yarns Y are attached to be lined up in the front-rear direction. The bobbins B are rotatably supported by each of the two bobbin holder 24. Each of the two bobbin holders 24 is independently rotated and driven by an unillustrated winding motor. The contact roller 25 is a roller having a rotational axis substantially parallel to the front-rear direction, and is provided immediately above the upper bobbin holder 24. The contact roller 25 is configured to make contact with the surfaces of the packages P supported by the upper bobbin holder 24. With this, the contact roller 25 applies a contact pressure to the surfaces of the unfinished packages P, to adjust the shape of each package P.

[0027] In the winding unit 4 structured as described above, when the upper bobbin holder 24 is rotationally driven, the yarns Y traversed by the traverse guides 22 are wound onto the bobbins B, with the result that the packages P are formed. When the formation of the packages P is completed, the turret 23 is rotated to switch over the upper and lower positions of the two bobbin holders 24. As a result, the bobbin holder 24 having been at the lower position is moved to the upper position, which allows the yarns Y to be wound onto the bobbins B attached to the bobbin holder 24 having been moved to the upper position, to form packages P. The bobbin holder 24 to which the fully-formed packages P are attached is moved to the lower position. The fully-formed packages P are then collected by, e.g., an unillustrated package collector.

(Interlacing Unit)

[0028] The following will describe the structure and function of the interlacing unit 13 with reference to FIG. 2 to FIG. 5. FIG. 2 is a cross section of each later-described interlacing device 30, which is taken along a direction orthogonal to the left-right direction. FIG. 3 is a cross section taken along a line III-III in FIG. 2. FIG. 4 is a cross section taken along a line IV-IV in FIG. 2. FIG. 5(a) shows each interlacing point Pi (described later) of a yarn Y. FIG. 5(b) shows the yarn Y in cross section as an example. In FIG. 2 to FIG. 12, because each yarn Y is thick, each yarn Y is expressed by two two-dot chain lines (as described later) .

[0029] The interlacing unit 13 is configured to interlace each of the yarns Y by means of, e.g., compressed air (i.e., fluid of the present invention). Roughly speaking, to "interlace" is to make filaments f tangled with one another so that the filaments f (see broken lines in FIG. 5(a) and FIG. 5(b)) forming each yarn Y are not far from one another.

[0030] In the present embodiment, the interlacing unit 13 is assumed to include interlacing devices 30, for conveniences of explanation. In the present embodiment, each of the interlacing devices 30 interlaces one yarn Y. The following will describe only one of the interlacing device 30. Hereinafter, a longitudinal direction of a later-described interlacing portion 32 will be referred to as a first direction. In this regard, a right side portion of the sheet of FIG. 2 is one side in the first direction, and a left side portion of the sheet of FIG. 2 is the other side in the first direction. In the spun yarn take-up machine 1, the first direction is substantially in parallel to the yarn path of the yarn Y running from the drawing device 10 to the first godet roller 11 (see FIG. 1). A direction orthogonal to both the first direction and the left-right direction is referred to as a height direction of the interlacing device 30 (hereinafter, this direction will be simply referred to as the height direction). In this regard, an upper portion of the sheet of FIG. 2 is one side in the height direction, and a lower portion of the sheet of FIG. 2 is the other side in the height direction. A direction intersecting with the first direction, i.e., a nozzle extending direction in which a later-described injection hole 41b extends is referred to as a second direction. In the present embodiment, the left-right direction may be referred to as a third direction. The third direction is orthogonal to (i.e., intersects with) the second direction when viewed in the first direction (see FIG. 4).

[0031] As shown in FIG. 2, the interlacing device 30 includes a base member 31, the interlacing portion 32, and two regulatory guides 33 (i.e., regulatory guides 34 and 35; a regulatory portion of the present invention). The base member 31 is, e.g., a plate-shaped member extending in the first direction and the left-right direction (i.e., third direction). The interlacing portion 32 and the regulatory guides 34 and 35 are fixed to a surface of the base member 31 on one side in the height direction. In the base member 31, a path 31a in which compressed air flows is formed. The path 31a is connected to an unillustrated compressed air source.

[0032] As shown in FIG. 2, the interlacing portion 32 extends in the first direction. For example, the interlacing portion 32 includes a first interlacing piece 41 and a second interlacing piece 42 (see FIG. 2 and FIG. 4). The first interlacing piece 41 is substantially rectangular parallelepiped in shape. The first interlacing piece 41 extends in the first direction. The first interlacing piece 41 is fixed to the base member 31. A concave portion 41a is formed at a part of the first interlacing piece 41 on one side in the height direction (i.e., a part which is far from the base member 31 in the height direction). The concave portion 41a is substantially U-shaped when viewed in the first direction (see FIG. 4) . The length of the concave portion 41a in the first direction is identical with the length of the first interlacing piece 41 in the first direction. The second interlacing piece 42 is substantially rectangular parallelepiped in shape. The second interlacing piece 42 extends in the first direction. The second interlacing piece 42 is fixed to a surface of the first interlacing piece 41 on one side in the height direction (i.e., a surface which is far from the base member 31 in the height direction). A concave portion 42a is formed at a part of the second interlacing piece 42 on the other side in the height direction (i.e., a part which is close to the base member 31 in the height direction). The concave portion 42a is substantially U-shaped when viewed in the first direction (see FIG. 4). The length of the concave portion 42a in the first direction is identical with the length of the second interlacing piece 42 in the first direction. The concave portion 41a of the first interlacing piece 41 and the concave portion 42a of the second interlacing piece 42 form a yarn running space 43 in which the yarn Y is runnable in the first direction. The first interlacing piece 41 and the second interlacing piece 42 form a slit 44 extending in the first direction. When the yarn Y is threaded to the interlacing device 30 (i.e., when yarn threading is performed), the yarn Y is inserted into the yarn running space 43 from the external space through the slit 44.

[0033] As shown in FIG. 2, for example, the injection hole 41b penetrating the first interlacing piece 41 at least in the height direction is formed at the center of the first interlacing piece 41 in the first direction and at a part of the first interlacing piece 41 on the other side in the height direction (i.e., a surface which is close to the base member 31 in the height direction). The nozzle extending direction (i.e., second direction) in which the injection hole 41b extends includes, e.g., a component in the height direction and a component in the first direction. The injection hole 41b is connected to both the path 31a and the yarn running space 43.

[0034] The two regulatory guides 33 (i.e., regulatory guides 34 and 35) are configured to restrict movement of the yarn Y in the third direction. Each regulatory guide 33 is, e.g., a plate-shaped member extending in the height direction. Each regulatory guide 33 is fixed to the surface of the base member 31 on one side in the height direction. Each regulatory guide 33 is provided to be separated from the interlacing portion 32 in the first direction. The regulatory guide 34 is provided on one side in the first direction (i.e., on the upstream side in the yarn running direction) as compared to the interlacing portion 32. The regulatory guide 35 is provided on the other side in the first direction (i.e., on the downstream side in the yarn running direction) as compared to the interlacing portion 32. For example, each regulatory guide 33 includes a groove 33a which is substantially U-shaped when viewed in the first direction. On the respective sides of the groove 33a in the left-right direction, side surfaces 33b (see FIG. 3) are provided. For example, the width of the groove 33a in the third direction (i.e., distance between two side surfaces 33b in the third direction) is W1 (see FIG. 3) . The guide groove 33a restricts the movement of the yarn Y in the third direction. Because of this, the center of the yarn Y running in the yarn running space 43 is defined in the third direction.

[0035] In the interlacing device 30 described as above, as the compressed air supplied from the compressed air source flows through the path 31a and is injected into the yarn running space 43 from the injection hole 41b, the ejected stream hits the yarn Y (i.e., filaments f) running in the yarn running space 43. The filaments f are separated (i.e., opened) and rotated by the ejected stream in the yarn running space 43. As a result, an area (i.e., interlacing point Pi; see FIG. 5) where the filaments f are tangled with one another is provided. As the yarn Y runs, a position of each interlacing point Pi varies to the downstream side in the yarn running direction. The filaments f are opened and rotated again by using one interlacing point Pi as a convergence point, and tangled with one another again at another interlacing point Pi. As these operations are repeated, interlacing points Pi are provided in the yarn Y at substantially-regular pitches.

[0036] In this regard, it has been known that distances between adjacent interlacing points Pi are different from one another to some degree because the complete control of a distance between each pair of adjacent interlacing points Pi is difficult. Among those distances, when there is a long distance between one adjacent interlacing points Pi (i.e., there is a part at which the filaments f tend to be separated from one another), the following problem may occur. For example, when the yarn Y forms a package P by being wound onto a bobbin B, the yarn Y on the outer layer of the package P (i.e., outer layer of the package P in the radial direction of the package P) may tend to be hooked by the yarn Y on the inner layer of the package P (i.e., inner layer of the package P in the radial direction of the package P). Because of this, the yarn Y may not be properly unwound from the package P in the following processes. In order to solve this problem, the yarn Y needs to be interlaced in a more efficient way. However, when only the pressure of the compressed air or the flow amount of the compressed air is increased, the force acting on the yarn Y becomes excessive. As a result, because the yarn Y makes contact with an inner wall surface facing the yarn running space 43, the yarn quality is decreased or running costs are increased. In the present embodiment, because the interlacing device 30 structured as above is arranged as described below, the efficiency of interlacing the yarn Y is increased without increasing the pressure or flow amount of the compressed air.

(Widening Guide)

[0037] As shown in FIG. 2 and FIG. 3, the interlacing device 30 includes two widening guides 50 (i.e., widening guides 51 and 52; an enlarging portion of the present invention). The widening guides 51 and 52 are, e.g., round-bar members (i.e., bar members) extending in the third direction. The widening guides 51 and 52 are attached to the base member 31 not to be rotatable. The widening guide 51 is provided on the other side in the first direction (i.e., on the downstream side in the yarn running direction) as compared to the regulatory guide 34 and on one side in the first direction (i.e., on the upstream side in the yarn running direction) as compared to the interlacing portion 32. In other words, the widening guide 51 is provided between the regulatory guide 34 and the interlacing portion 32 in the first direction. The widening guide 52 is provided on the other side in the first direction (i.e., on the downstream side in the yarn running direction) as compared to the interlacing portion 32 and on one side in the first direction (i.e., on the upstream side in the yarn running direction) as compared to the regulatory guide 35. In other words, the widening guide 52 is provided between the interlacing portion 32 and the regulatory guide 35 in the first direction. When viewed in the first direction, the widening guides 51 and 52 are provided to overlap the yarn running space 43 in part. Because of this, the widening guides 51 and 52 make contact with the running yarn Y. That is, the widening guides 51 and 52 are provided so that end portions of the widening guides 51 and 52 on one side in the height direction (i.e., end portions which are far from the base member 31 in the height direction) make contact with the yarn Y. The yarn Y is bent by the widening guides 51 and 52. The cross sections of the widening guides 51 and 52 are taken along a direction orthogonal to the third direction as shown in FIG. 2 and are, e.g., substantially circular in shape. In other words, a contact part 51a of the widening guide 51 and a contact part 52a of the widening guide 52 are convex. The contact parts 51a and 52a make contact with the yarn Y. When viewed in the first direction, the widening guide 51 is provided so that at least a part of the contact part 51a overlaps the yarn running space 43. Similarly, when viewed in the first direction, the second widening guide 52 is provided so that at least a part of the contact part 52a overlaps the yarn running space 43. Because of this, the widening guides 51 and 52 function also as guides for properly guiding the yarn Y to the yarn running space 43.

[0038] As the running yarn Y makes contact with the widening guide 51 provided on the upstream of the interlacing portion 32 in the yarn running direction, the widening guide 51 imparts resistance to the yarn Y. Because of this, the yarn Y is widened in the third direction. To be more specific, a part of the yarn Y running on the downstream of the widening guide 51 and on the upstream of the widening guide 52 in the yarn running direction is widened in the third direction (see FIG. 2 to FIG. 4). A specific shape of the yarn Y in the yarn running space 43, i.e., the entire cross sectional shape of the yarn Y formed of the filaments f is a flat shape which is long in the third direction and short in the second direction (see FIG. 4). The yarn Y running in the yarn running space 43 is preferably widened by the widening guides 50 so that the width of the yarn Y in the third direction is larger than the width of a part of the yarn Y in the third direction, which is restricted by the regulatory guides 33 (e.g., above-described W1). When the size of the injection hole 41b in the third direction is W2 (see FIG. 4) which is larger than W1, the yarn Y is preferably widened so that the width of the yarn Y in third direction of the yarn running space 43 is substantially identical with W2 (i.e., close to W2).

[0039] As such, because the yarn Y is widened, the area of a part of the yarn Y running in the yarn running space 43 is large. The part faces the injection hole 41b in the second direction. Because of this, it is possible to efficiently cause the compressed air to hit the yarn Y. Therefore, the ejected stream of the compressed air can effectively influence the yarn Y without increasing the pressure or flow amount of the compressed air. The present inventors assumed that the yarn Y was therefore opened and rotated more effectively than in a conventional interlacing device so that the efficiency of interlacing the yarn Y was increased.

(Evaluation of Efficiency of Interlacing)

[0040] The present inventors performed evaluations as follows, in order to confirm whether the efficiency of interlacing the yarn Y by the interlacing device 30 was increased. In summary, the present inventors prepared two different interlacing devices (i.e., Examples 1 and 2; as described later) as Examples and two different interlacing devices (i.e., comparative examples 1 and 2; as described later) as comparative examples. The present inventors caused four different interlacing devices above to form four different yarns Y, in a spun yarn take-up machine having the same structure as that of the spun yarn take-up machine 1. The present inventors evaluated the efficiency of interlacing, by counting the number of interlacing points Pi across a predetermined length in each of the yarns Y.

[0041] The evaluations will be detailed with reference to FIG. 6 to FIG. 9. FIG. 6 is a cross section of an interlacing device 100 of a comparative example 1. FIG. 7 is a cross section of an interlacing device 100 of a comparative example 2. FIG. 8(a) shows a cross sectional shape of a yarn Y in the Examples 1 and 2. FIG. 8(b) shows a cross sectional shape of a yarn Y in the comparative example 1. FIG. 8(c) shows a cross sectional shape of a yarn Y in the comparative example 2. FIG. 9 is a table showing evaluation results each of which is related to the efficiency of interlacing a corresponding yarn Y.

[0042] To begin with, the interlacing devices of the Examples and the comparative examples will be detailed. Each of the interlacing devices of the Examples 1 and 2 has the same structure as that of the interlacing device 30. In each of the Examples 1 and 2, the yarn Y in the yarn running space 43 is widened in the third direction (see FIG. 8 (a)) . The cross sectional shape of this yarn Y is referred to as a "lateral flat shape" (see FIG. 9) for convenience of explanation. The differences between the Example 1 and the Example 2 are as follows. In the Example 1, the width (i.e., W1) of the groove 33a of each regulatory guide 33 in the third direction is 0.5 mm (see FIG. 9) . In the example 2, W1 is 1.0 mm (see FIG. 9) and is larger than W1 of the Example 1.

[0043] The interlacing device of the comparative example 1 does not include the widening guides 50. The structure of this interlacing device is the same as that of the interlacing device 100 shown in FIG. 6. The structure of the interlacing device 100 is substantially identical with that of an interlacing device 30 from which the widening guides 50 are removed. In the comparative example 1, the yarn Y is not widened (see FIG. 6 and FIG. 8(b)). In the comparative example 1, W1 is 0.5 mm and is identical with W1 of the Example 1. The interlacing device of the comparative example 2 has the same structure as that of the interlacing device 100 shown in FIG. 7. In the comparative example 2, as shown in FIG. 7, the entire interlacing device 100 is inclined from the yarn path from the first godet roller 11 to the second godet roller 12, with respect to the left-right direction. That is, the first direction is not orthogonal to the left-right direction. In this regard, the inclination angle is approximately 7°. Because of this, in the comparative example 2, the yarn Y is pressed onto the side surfaces 33b of each regulatory guide 33. That is, the side surfaces 33b impart resistance to the yarn Y. Therefore, in the comparative example 2, the yarn Y is widened (see FIG. 8(c)) in a direction orthogonal to the third direction. The cross sectional shape of this yarn Y is referred to as a "longitudinal flat shape" for the comparison between the comparative example 2 and the Examples 1 and 2. In the comparative example 2, W1 is 0.5 mm and is identical with W1 of the Example 1.

[0044] Except the above-described differences between the interlacing devices, conditions of making a yarn Y are common among the Examples 1 and 2 and the comparative examples 1 and 2. The following describes the common conditions. Each yarn Y is a polyester yarn. The thickness of the yarn Y is 83 dtex. The number of filaments forming the yarn Y is 36. The pressure of compressed air supplied to each interlacing device is 0.35 MPa. These common conditions are defined for comparison of the efficiency of interlacing and for convenience of explanation. Therefore, it is noted that similar comparison results are obtained even when these common conditions are changed.

[0045] The following will describe the method of evaluating the efficiency of interlacing the yarn Y. The present inventors counted the number of interlacing points Pi across a predetermined length (i.e., 1000 m) in each of the four yarns Y, and measured a pitch between each pair of adjacent interlacing points Pi. To be more specific, the number of interlacing points Pi was counted as follows and a pitch between each pair of adjacent interlacing points Pi was measured as follows. The interlacing points Pi of the yarn Y which runs after being unwound from the formed package P ware detected by "ITEMAT+ (Registered Trademark)" which is an interlacing detection device made by Textechno. In addition to that, information regarding the number of the interlacing points Pi and information regarding a pitch between each pair of adjacent interlacing points Pi were stored in an unillustrated computer. By using these sets of information, the efficiency of interlacing was evaluated.

[0046] FIG. 9 shows the number of interlacing points Pi per a unit length (1 m; hereinafter, this number will be referred to as an average interlacing number) in regard to each of the Examples 1 and 2 and the comparative examples 1 and 2. When the average interlacing number is large, it is evaluated that (i) an average distance between each pair of adjacent interlacing points Pi is short and (ii) the yarn Y is efficiently interlaced. The average interlacing number in the Example 1 is 18.5 per meter. The average interlacing number in the Example 2 is 19.2

per meter. The average interlacing number in the comparative example 1 is 18.3 per meter. The average interlacing number in the comparative example 2 is 17.2 per meter.

[0047] According to these results, at least two conclusions are drawn. Firstly, when the Example 1 is compared with the comparative examples 1 and 2 that are identical with the Example 1 in terms of the aforesaid W1, the larger average interlacing number is, the larger the width of the yarn Y in the third direction is. This is because the yarn Y efficiently hits the ejected stream by being widened in the third direction. Secondly, when the Example 1 is compared with the Example 2 that is larger in W1 than the Example 1, the average interlacing number of the Example 2 is larger than that of the Example 1. This is because, when the width of the yarn Y which is not widened yet is relatively large in the third direction, the yarn Y is further easily widened by the widening guides 50.

[0048] As described above, the center of the yarn Y in the third direction can be defined by the regulatory guides 33. In addition to that, the yarn Y is runnable in the yarn running space 43 while being widened in the third direction by the widening guides 50. Because of this, the compressed air which is injected in the second direction through the injection hole 41b efficiently hits the yarn Y. As a result, because the compressed air can effectively influence the yarn Y without increasing the pressure or flow amount of the compressed air, the yarn Y is efficiently opened and rotated. Therefore, the efficiency of interlacing the yarn Y is increased without increasing the pressure or flow amount of the compressed air.

[0049] In the third direction, the width of the yarn Y widened by the widening guides 50 in the third direction is large as compared to a yarn Y widened by the regulatory guides 33 in known cases. Because of this, the compressed air which is injected through the injection hole 41b efficiently hits the yarn Y.

[0050] The widening guides 50 are configured to widen the yarn Y so that the width of the yarn Y in the third direction is substantially identical with the size (i.e., W2) of the injection hole 41b in the third direction (i.e., so as to decrease the difference between (i) the width of the yarn Y in the third direction and (ii) W2). Because of this, the compressed air which is injected through the injection hole 41b hits the yarn Y in the most efficient manner.

[0051] The yarn Y is widened in the third direction in such a way that the bar widening guides 50 impart resistance to the yarn Y running in the first direction. With this arrangement, the yarn Y is widened with a simple structure.

[0052] When viewed in the first direction, the contact part 51a of the widening guide 51 and the contact part 52a of the widening guide 52 are provided to overlap the yarn running space 43. Because of this, the widening guides 51 and 52 function also as the guides for properly guiding the yarn Y to the yarn running space 43. The structure of the interlacing device 30 is therefore simplified.

[0053] The contact part 51a of the widening guide 51 which is in contact with the yarn Y and the contact part 52a of the widening guide 52 which is in contact with the yarn Y are curved. Because of this, damage to the running yarn Y caused by the widening guides 50 is reduced as compared to cases where the contact parts 51a and 52a have corners. Therefore, yarn breakage is suppressed.

[0054] The widening guides 50 cannot be rotated. Because of this, resistance is imparted to the yarn Y more efficiently than cases where the widening guides 50 are rotated in accordance with the running of the yarn Y. Therefore, the yarn Y is efficiently widened.

[0055] The spun yarn take-up machine 1 including the interlacing device 30 is configured to form a package P by using the yarn Y which is stably interlaced. Because of this, an error in unwinding of the yarn Y is suppressed. The error occurs because the yarn Y on the outer layer of the package P is hooked by the yarn Y on the inner layer of the package P.

[0056] The following will describe modifications of the above-described embodiment. The members identical with those in the embodiment above will be denoted by the same reference numerals, and the explanations thereof are not repeated.

(1) In the embodiment above, the widening guides 51 and 52 are provided so that the end portions of the widening guides 51 and 52 on one side in the height direction (i.e., end portions which are far from the base member 31 in the height direction) make contact with the yarn Y. However, the disclosure is not limited to this. The widening guides 51 and 52 may be provided so that one or both of end portions of the widening guides 51 and 52 on the other side in the height direction (i.e., end portions which are close to the base member 31 in the height direction) make contact with the yarn Y. The yarn Y is provided with resistance also in this case so that the yarn Y is widened in the third direction.

(2) While in the embodiment above the widening guides 50 cannot be rotated, the disclosure is not limited to this. For example, the widening guides 50 may be rollers which are rotatable in a passive manner by using the third direction as a rotational axis direction. In this case, when the widening guides 50 are rotatable at a circumferential speed which is the same as the running speed of the yarn Y, the yarn Y is unlikely to be widened because resistance is unlikely to be imparted to the yarn Y. Therefore, in this case, it is preferable to provide a resistance imparting unit (not illustrated) configured to impart resistance to the rotation of the widening guides 50. With this arrangement, the yarn Y is widened in the third direction while wearing of the widening guides 50 because of friction with the yarn Y is suppressed.

(3) In the embodiment above, the contact part 51a

of the widening guide 51 which is in contact with the yarn Y and the contact part 52a of the widening guide 52 which is in contact with the yarn Y are curved. However, the disclosure is not limited to this. For example, the contact parts 51a and 52a may have corners as long as damage to the yarn Y is minimal.

(4) In the embodiment above, when viewed in the first direction, at least a part of the contact part 51a of the widening guide 51 is provided to overlap the yarn running space 43. However, the disclosure is not limited to this. The contact part 51a is not necessarily provided to overlap the yarn running space 43 when viewed in the first direction. The same applies to the contact part 52a of the widening guide 52. In this case, a guide member (not illustrated) for properly guiding the yarn Y to the yarn running space 43 needs to be provided between the interlacing portion 32 and the widening guide 51 (or the widening guide 52) in the first direction.

(5) In the embodiment above, the widening guides 50 are configured to widen the yarn Y so that the width of the yarn Y in the third direction is substantially identical with the size (i.e., W2) of the injection hole 41b in the third direction (i.e., so as to decrease the difference between (i) the width of the yarn Y in the third direction and (ii) W2). However, the disclosure is not limited to this. The width of the yarn Y, which is widened by the widening guides 50, in the third direction may be smaller than W2.

(6) While in the embodiment above the widening guides 50 are provided on the respective sides of the interlacing portion 32 in the first direction (i.e., on the upstream side and downstream side in the yarn running direction), the disclosure is not limited to this. For example, one winding guide 50 may be provided only on the upstream of the interlacing portion 32 in the yarn running direction (i.e., only the widening guide 51 may be provided as the enlarging portion of the present invention). The yarn Y running in the yarn running space 43 is widened to some degree also in this case. Alternatively, one winding guide 50 may be provided only on the downstream of the interlacing portion 32 in the yarn running direction (i.e., only the widening guide 52 may be provided).

(7) In the embodiment above, the interlacing unit 13 includes plural interlacing devices 30, and one of the interlacing devices 30 is described. However, the disclosure is not limited to this. For example, the interlacing unit 13 may include one interlacing device 60 (see FIG. 10 to FIG. 12) configured to simultaneously interlace plural yarns Y. FIG. 10 is a cross section of the interlacing device 60, which is taken along a direction orthogonal to a first direction. FIG. 11 is a cross section of the interlacing device 60, which is taken along a direction orthogonal to the left-right direction. FIG. 12 is a cross section taken along a line XII-XII in FIG. 11. The definitions of a first direction, a left-right direction, and a height direction in the present modification are the same as those in the embodiment above. The left-right direction is an arrangement direction (see FIG. 10) in which the yarns Y are arranged. In this regard, a left side portion of the sheet of FIG. 10 is one side in the arrangement direction, and a right side portion of the sheet of FIG. 10 is the other side in the arrangement direction. FIG. 10 and FIG. 12 show only a part of the interlacing device 60 in the arrangement direction (as described later). As described later, the definitions of a nozzle extending direction (i.e., second direction) and a third direction in the interlacing device 60 of the present modification are different from those in the interlacing device 30 of the embodiment above.

[0057] The interlacing device 60 will be detailed. As shown in FIG. 10 and FIG. 11, the interlacing device 60 includes a base member 61, interlacing pieces 62 (i.e., an interlacing portion of the present invention), two regulatory guides 63 (see FIG. 11; the regulatory portion of the present invention), and two widening guides 64 (see FIG. 11; the enlarging portion of the present invention). In the base member 61, a path 61a and supply ports 61b are formed. The path 61a extends in the arrangement direction, and is connected to an unillustrated compressed air source. The supply ports 61b are formed at an end portion of the base member 61 on one side in the height direction. The supply ports 61b are aligned in the arrangement direction. The supply ports 61b are connected to the path 61a. Each of the supply ports 61b is connected to a later-described supply path 73. Each of the interlacing pieces 62 extends in the first direction and the height direction. The interlacing pieces 62 are fixed to a surface of the base member 61 on one side in the height direction. The interlacing pieces 62 are aligned in the arrangement direction. As shown in FIG. 10, a yarn running space 71, a slit 72, the supply path 73, and an injection hole 74 are formed in each of the interlacing pieces 62. The yarn running space 71 penetrates the interlacing piece 62 in the first direction. The slit 72 is formed at an end portion of the interlacing piece 62 on one side in the arrangement direction, and extends in the first direction. The slit 72 is connected to the yarn running space 71. The center of the slit 72 in the height direction is substantially the same as that of the yarn running space 71 in the height direction. The supply path 73 is provided behind the yarn running space 71 on the other side in the arrangement direction (i.e., provided to oppose the slit 72 over the yarn running space 71 in the arrangement direction). The supply path 73 extends across the interlacing piece 62 from the other side to one side in the height direction (i.e., from the end portion of the interlacing piece 62 which is close to the base member 61 to the end portion of the interlacing piece 62 which is far from the base member 61 in the height direction). The supply path 73 is connected to a corresponding supply port 61b in the base member 61. The injection hole 74 is formed at an end portion of the interlacing piece 62 on the other side in the arrangement direction (i.e., formed to face the yarn running space 71 over the supply path 73 in the arrangement direction). The injection hole 74 is connected to the supply path 73. In the height direction, the injection hole 74 is formed substantially at the same place with the slit 72. In other words, the center of the injection hole 74 in the height direction is substantially the same as that of the yarn running space 71 in the height direction. The injection hole 74 is formed at the center of the interlacing piece 62 in the first direction (see FIG. 11). The injection hole 74 extends substantially in parallel to the arrangement direction. That is, the nozzle extending direction (i.e., second direction) in which the injection hole 74 extends is different from a direction in which the above-described injection hole 41b (see FIG. 2, etc.) extends. In the present modification, the third direction is a direction substantially in parallel to the height direction when viewed in the first direction (see FIG. 10). That is, the third direction is substantially orthogonal to (i.e., intersects with) the arrangement direction. In the arrangement direction, the injection hole 74 formed in one interlacing piece 62 (e.g., interlacing piece 62A) is adjacent to the slit 72 formed in another interlacing piece 62 (e.g., interlacing piece 62B). In this regard, the interlacing piece 62B is provided to be adjacent to the interlacing piece 62A on the other side in the arrangement direction (i.e., provided to face the supply path 73 over the slit 72 in the arrangement direction). That is, the compressed air injected through the injection hole 74 formed in the interlacing piece 62A is injected to the yarn running space 71 formed in the interlacing piece 62B. As such, an interlacing piece 62 (e.g., interlacing piece 62B) in which a corresponding yarn running space 71 is formed may be different from an interlacing piece 62 (e.g., interlacing piece 62A) in which a corresponding injection hole 74 connected to the yarn running space 71 is provided. A slit 75 extending in the first direction is formed between an end face of the interlacing piece 62A on the other side in the arrangement direction and an end face of the interlacing piece 62B on one side in the arrangement direction (i.e., between two end faces opposing each other in the arrangement direction). The slit 75 is connected to the slit 72, and extends in the height direction. When the yarns Y are threaded to the interlacing device 60, each yarn Y is inserted into the yarn running space 71 from the external space through the slit 75 and the slit 72.

[0058] The two regulatory guides 63 (i.e., regulatory guides 81 and 82; see FIG. 11 and FIG. 12) are configured to restrict movement of the yarns Y in the third direction. The regulatory guide 81 is provided on one side in the first direction (i.e., on the upstream side in the yarn running direction) as compared to the interlacing pieces 62. The regulatory guide 82 is provided on the other side in the first direction (i.e., on the downstream side in the yarn running direction) as compared to the interlacing pieces 62. The shape of each regulatory guide 63 is the same as, e.g., that of each regulatory guide 33 described above. Each regulatory guide 63 may have a groove 63a which is identical with the groove 33a of each regulatory guide 33. Each regulatory guide 63 may include side surfaces 63b which are identical with the side surfaces 33b of each regulatory guide 33. The regulatory guides 63 (and regulatory guides 33) may be differently arranged as long as the regulatory guides 63 (and regulatory guides 33) restrict the movement of the yarns Y (or yarn Y) at least toward one of both sides in the third direction. In this modification, for example, the grooves 63a restrict the movement of the yarns Y at least toward the other side in the height direction (i.e., toward the side close to the base member 61 in the height direction). In this regard, the regulatory guides 63 (and regulatory guides 33) are preferably configured not to widen the yarns Y (or yarn Y) in a direction different from the third direction. In this modification, for example, the side surfaces 63b restrict the movement of the yarns Y toward both sides in the arrangement direction. This suppresses the yarns Y from being widened in the second direction. The shape of each regulatory guide 63 is not limited to this. For example, a cylindrical regulatory guide (not illustrated) which extends in the arrangement direction may be provided instead of each regulatory guide 63. In other words, regulatory guides may be similar to the above-described widening guides 50 (see FIG. 2, etc.) in shape. Such regulatory guides can regulate the movement of the yarns Y in the third direction. In this case, regulating grooves (not illustrated) configured to suppress the yarns Y from being widened in the second direction are preferably formed on the respective outer circumferences of the regulatory guides.

[0059] The two widening guides 64 (i.e., widening guides 91 and 92; see FIG. 11 and FIG. 12) are configured to widen the yarns Y in the third direction (i.e., height direction in this modification). The widening guide 91 is provided between the regulatory guide 81 and the interlacing pieces 62 in the first direction. The widening guide 92 is provided between the interlacing pieces 62 and the regulatory guide 82 in the first direction. Each widening guide 64 may be, e.g., a round-bar member extending in the height direction. That is, the shape of each widening guide 64 may be identical with the shape of each widening guide 50 described above. With this arrangement, contact parts (i.e., contact parts 91a and 92a) of the widening guides 64 which are in contact with the yarns Y can impart resistance to the yarns Y. Therefore, the yarns Y can be widened in the height direction (i.e., the third direction; see FIG. 11 and FIG. 12).

[0060] The positional relationship between the regulatory guides 63, the widening guides 64, and each yarn running space 71 is as follows. As shown in FIG. 12, in the second direction, the center of a position between the side surfaces 63b of the regulatory guide 81 and the contact part 91a of the widening guide 91 is substantially the same as the center of the yarn running space 71. In the second direction, the center of a position between the side surfaces 63b of the regulatory guide 82 and the contact part 92a of the widening guide 92 is also substantially the same as the center of the yarn running space 71. With this arrangement, the yarns Y which are widened (i.e., become flat) by the widening guides 64 pass through the substantial center of the yarn running space 71 in the second direction.

[0061] The shapes of the widening guides 64 (and the above-described widening guides 50) may be differently arranged as long as the widening guides 64 (and the above-described widening guides 50) widen the yarns Y (or yarn Y) in the third direction. For example, U-shaped guides (not illustrated) which are plate-shaped members and which are similar to the regulatory guides 63 in shape may be provided as the widening guides 64. In this case, the position and/or size of a groove (not illustrated) formed in each U-shaped guide should be carefully considered so that the movement of the yarns Y is not restricted in the third direction. Only one widening guide 64 may be provided on the upstream or downstream of the interlacing pieces 62 in the yarn running direction, in the same manner as the modification described in (6).

[0062] (8) The interlacing devices 30 and 60 may be applied to a textile machine configured to handle running yarns Y, except the spun yarn take-up machine 1.

Claims

1. An interlacing device (30) configured to interlace a running yarn (Y) formed of filaments (f), the interlacing device (30) comprising:

   an interlacing portion (32) including a yarn running space (43) for allowing the yarn (Y) to run in a predetermined first direction and an injection hole (41b) for injecting fluid to the yarn running space (43) in a second direction intersecting with the first direction, the interlacing portion (32) being configured to interlace the yarn (Y) by means of the fluid injected to the yarn running space (43) through the injection hole (41b);
   a regulatory portion (33) which is provided to be separated from the interlacing portion (32) in the first direction and which is configured to regulate movement of the yarn (Y) in a third direction, the third direction intersecting with the second direction when viewed in the first direction; and
   an enlarging portion (50) which is provided between the interlacing portion (32) and the regulatory portion (33) in the first direction and which is configured to widen, in the third direction, the yarn (Y) running in the yarn running space (43).

2. The interlacing device (30) according to claim 1, wherein, the enlarging portion (50) is configured to widen at least one part of the yarn (Y) in the third direction so that the width of the at least one part of the yarn (Y) is larger than the width of another part of the yarn (Y), the at least one part of the yarn (Y) running in the yarn running space (43), and the another part of the yarn (Y) being regulated by the regulatory portion (33).

3. The interlacing device (30) according to claim 1 or 2, wherein, the enlarging portion (50) is configured to widen the yarn (Y) so as to decrease difference between the width of the yarn (Y) in the third direction and a size of the injection hole (41b) in the third direction.

4. The interlacing device (30) according to any one of claims 1 to 3, wherein, the enlarging portion (50) includes a rod-shaped widening guide (51, 52) extending in the third direction.

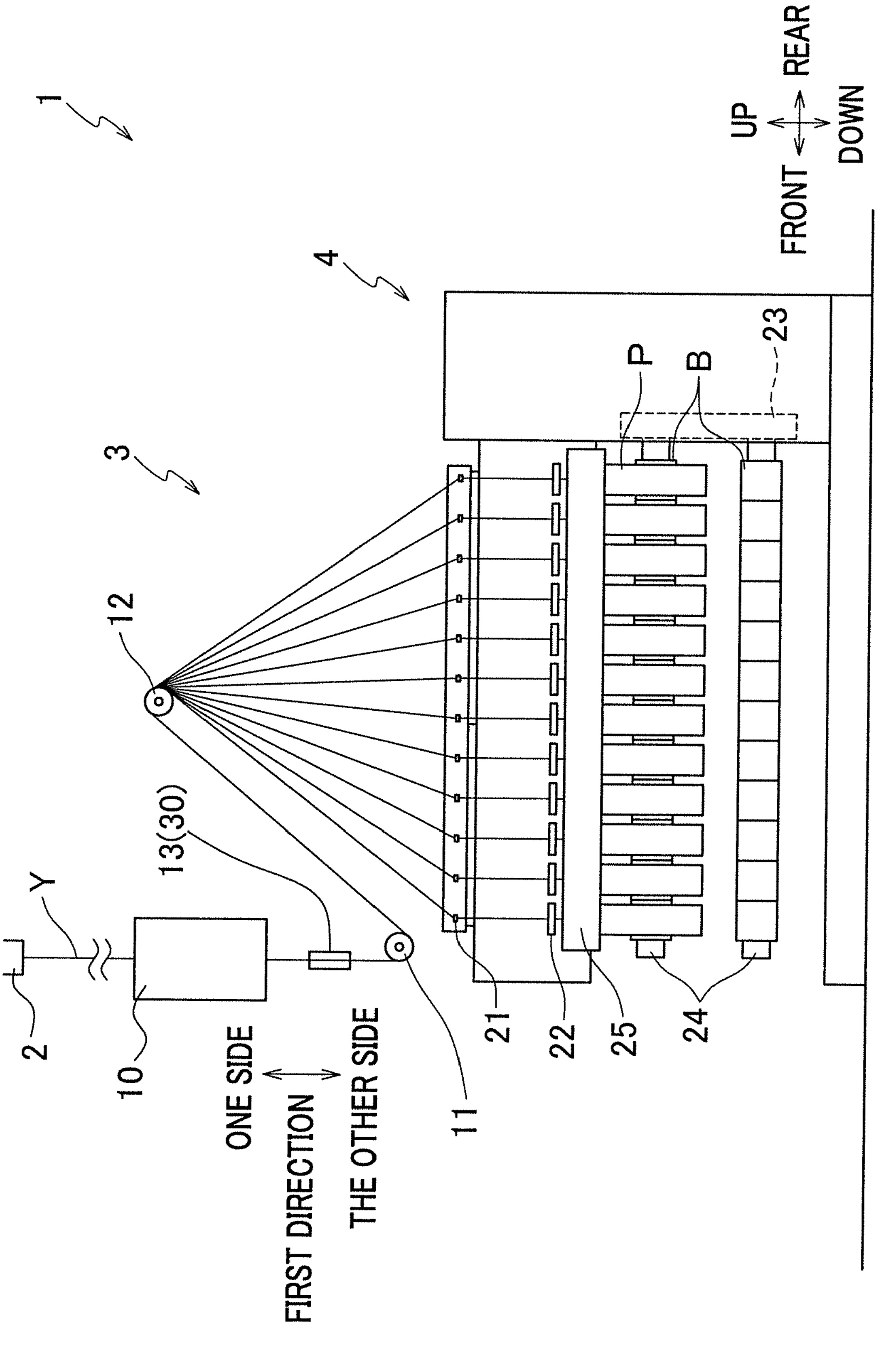
5. The interlacing device (30) according to any one of claims 1 to 4, wherein, the enlarging portion (50) is provided so that a contact part (51a, 52a) of the enlarging portion (50) which is in contact with the yarn (Y) overlaps the yarn running space (43) at least in part when viewed in the first direction.

6. The interlacing device (30) according to any one of claims 1 to 5, wherein, the contact part (51a, 52a) of the enlarging portion (50) which is in contact with the yarn (Y) is curved.

7. The interlacing device (30) according to any one of claims 1 to 6, wherein, the enlarging portion (50) is not rotatable.

8. A yarn winder (1) comprising: the interlacing device (30) according to any one of claims 1 to 7; and
   a winding unit (4) configured to form a package (P) by winding a yarn (Y), the yarn (Y) being interlaced by the interlacing device (30).

FIG.1


1
2
Y
10
13(30)
11
12
3
4
21
22
25
24
P
B
23
ONE SIDE
FIRST DIRECTION
THE OTHER SIDE
UP
DOWN
FRONT
REAR

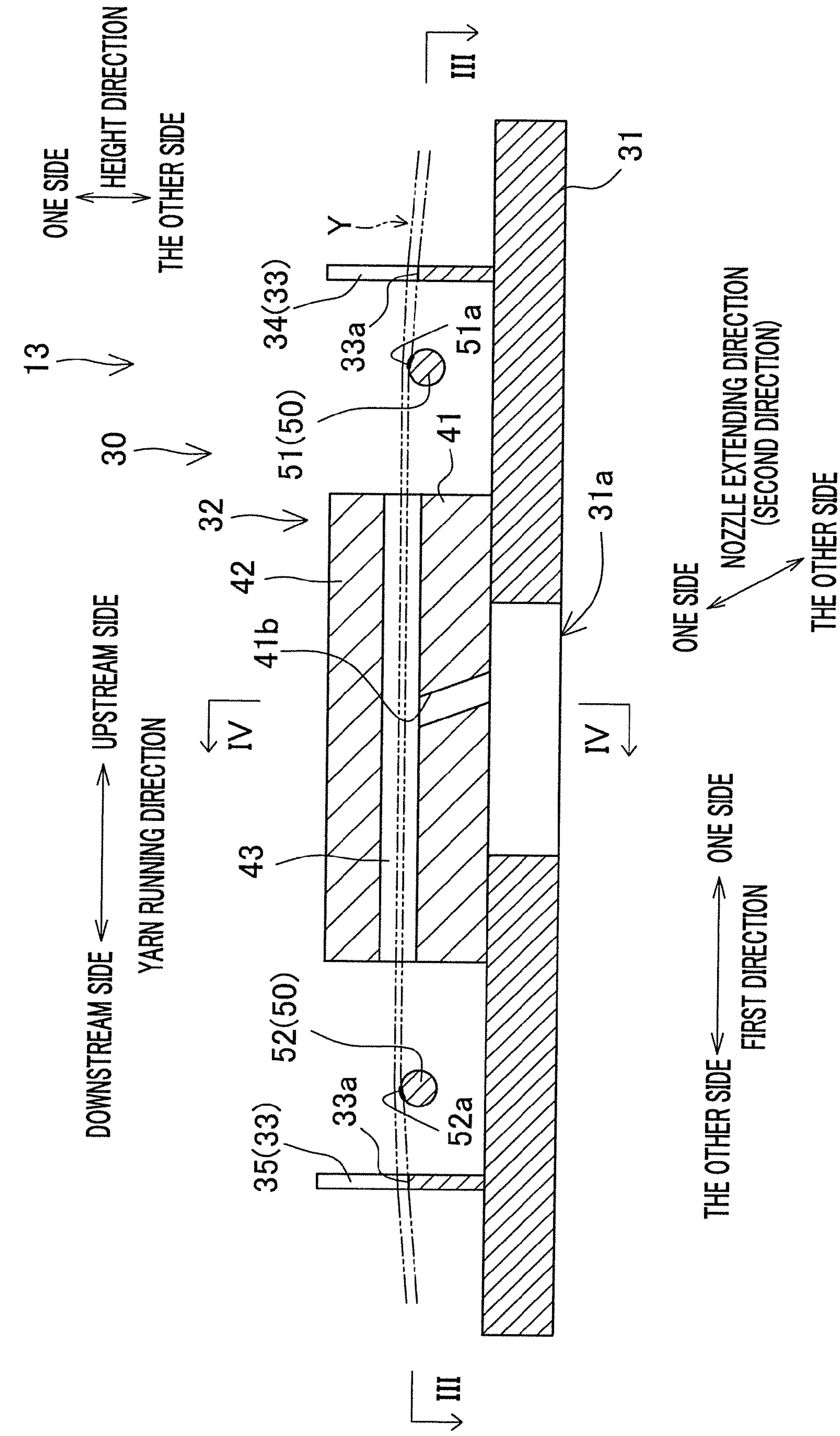

ONE SIDE
HEIGHT DIRECTION
THE OTHER SIDE
III
31
Y
34(33)
33a
51a
13
51(50)
41
30
31a
32
NOZZLE EXTENDING DIRECTION
(SECOND DIRECTION)
ONE SIDE
THE OTHER SIDE
42
41b
UPSTREAM SIDE
YARN RUNNING DIRECTION
DOWNSTREAM SIDE
IV
IV
43
ONE SIDE
FIRST DIRECTION
THE OTHER SIDE
52(50)
33a
52a
35(33)
III

FIG.2

FIG.3

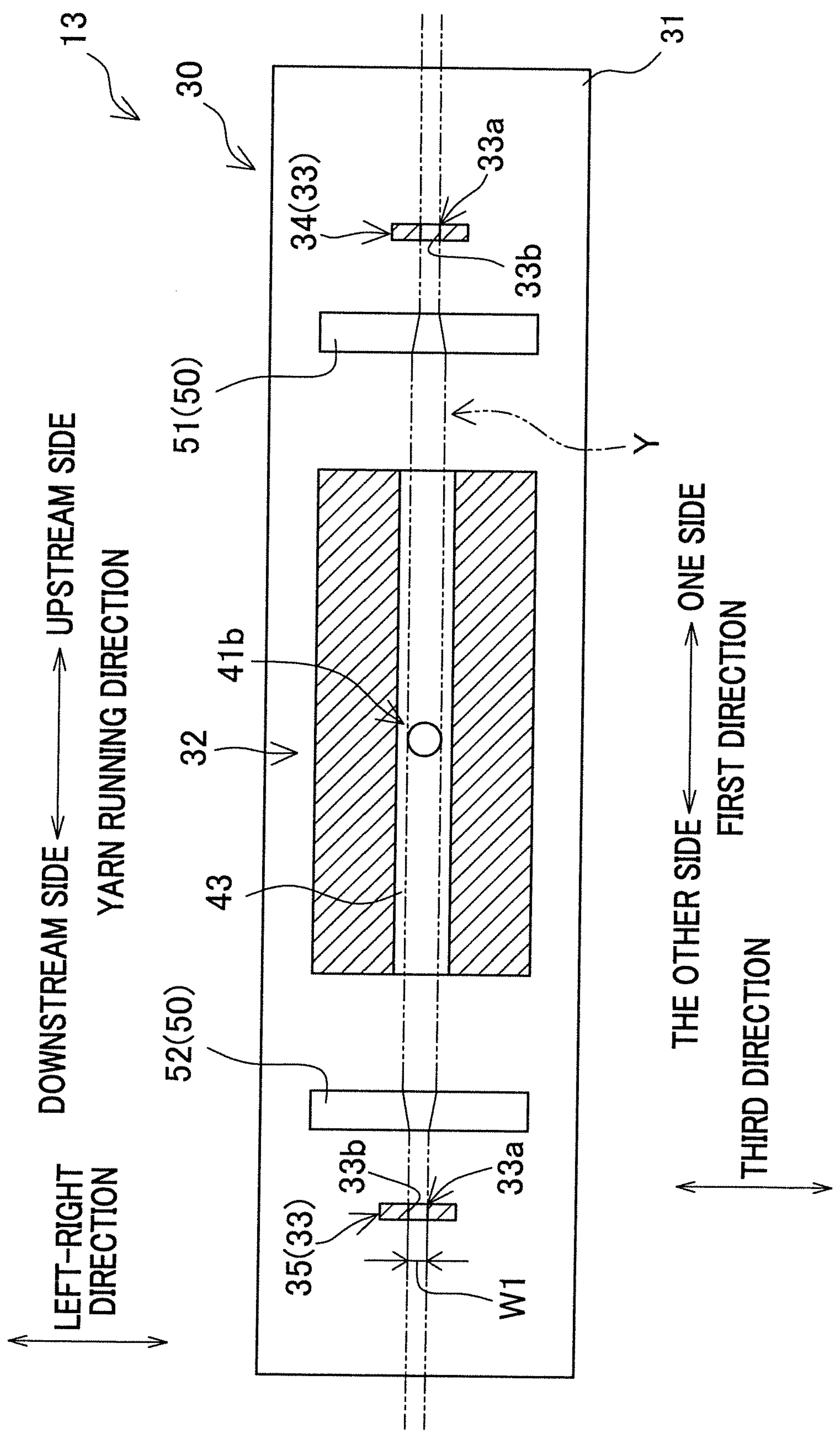

13
30
31
34(33)
33a
33b
51(50)
Y
UPSTREAM SIDE
DOWNSTREAM SIDE
YARN RUNNING DIRECTION
41b
32
43
ONE SIDE
THE OTHER SIDE
FIRST DIRECTION
52(50)
THIRD DIRECTION
33b
33a
35(33)
W1
LEFT-RIGHT
DIRECTION

FIG.4

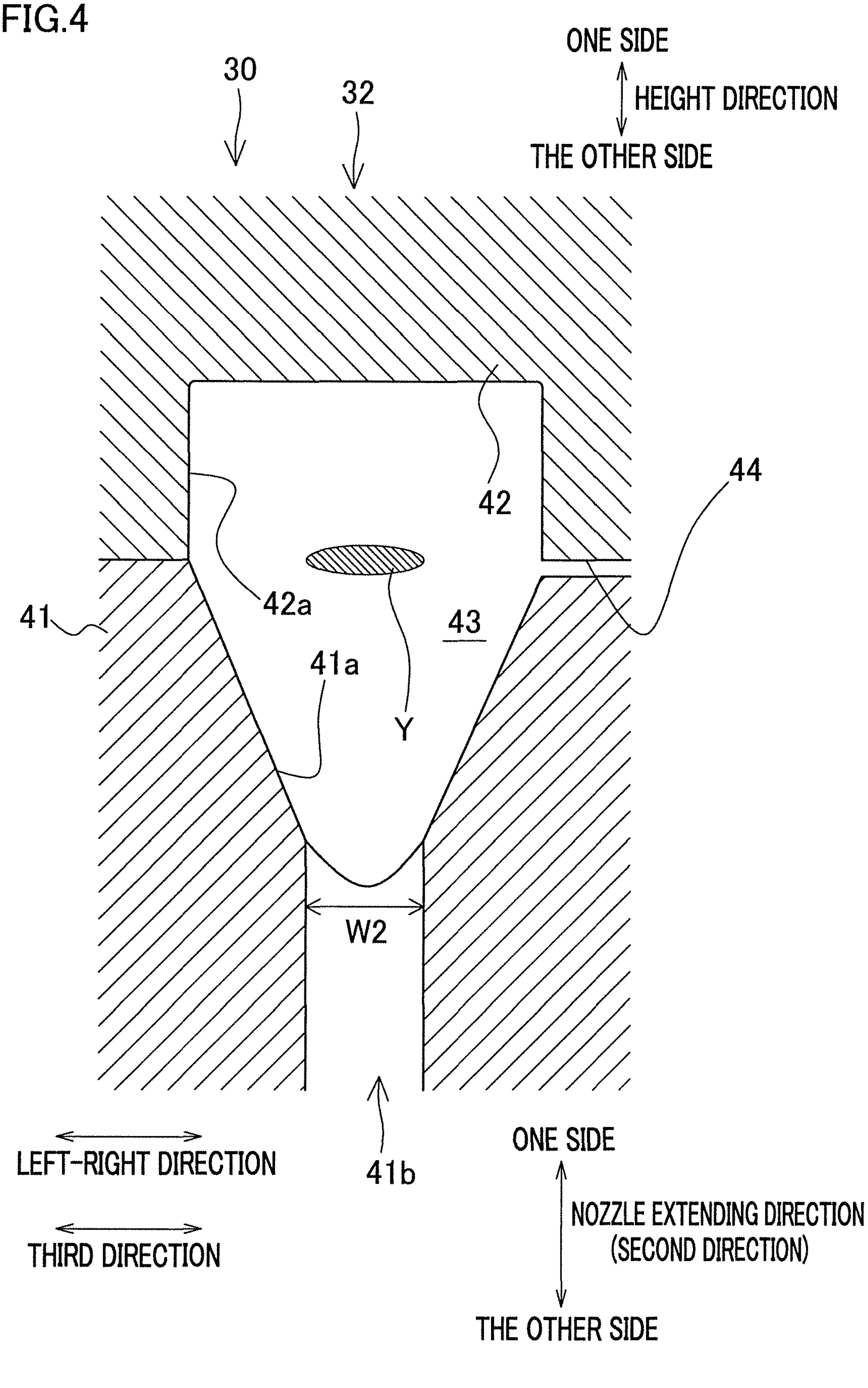

ONE SIDE
HEIGHT DIRECTION
THE OTHER SIDE
30
32
42
44
42a
41
43
41a
Y
W2
41b
LEFT-RIGHT DIRECTION
THIRD DIRECTION
ONE SIDE
NOZZLE EXTENDING DIRECTION
(SECOND DIRECTION)
THE OTHER SIDE

FIG.5

(a)

(b)

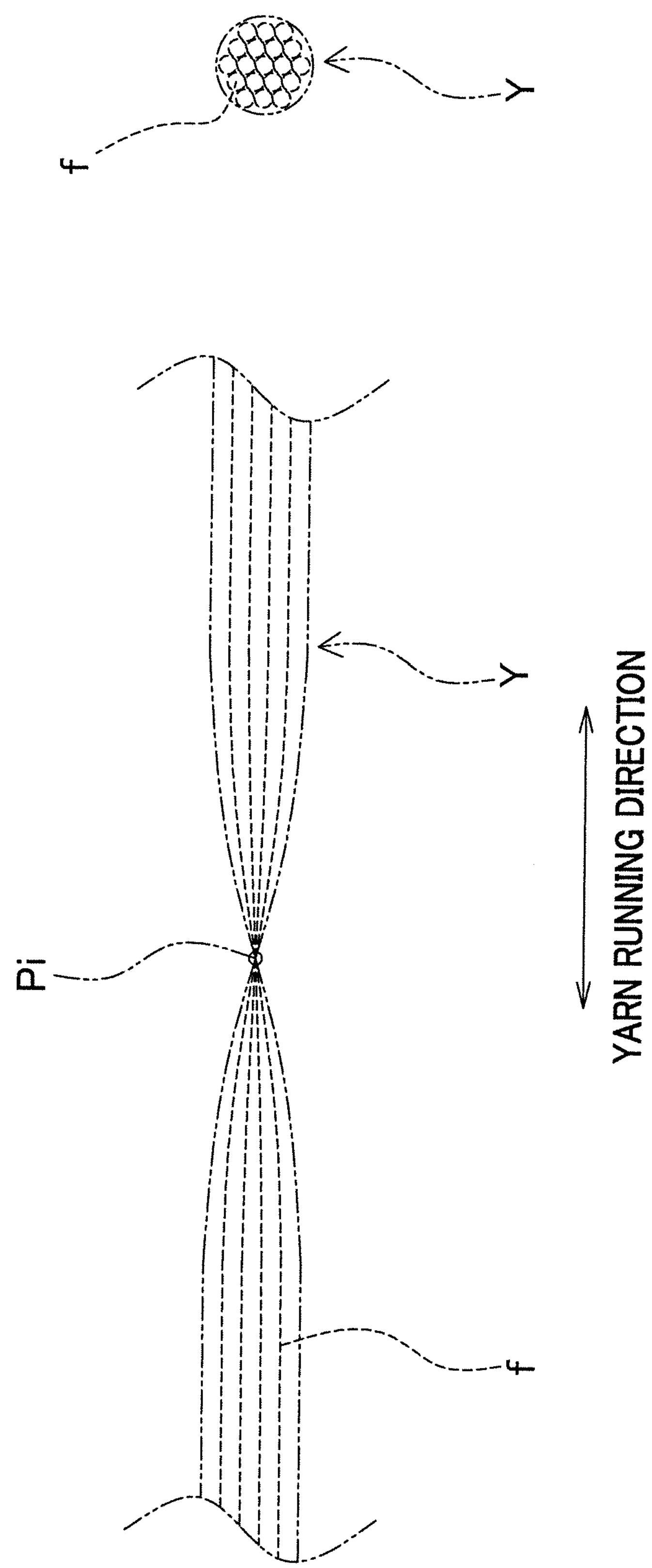


FIG.6

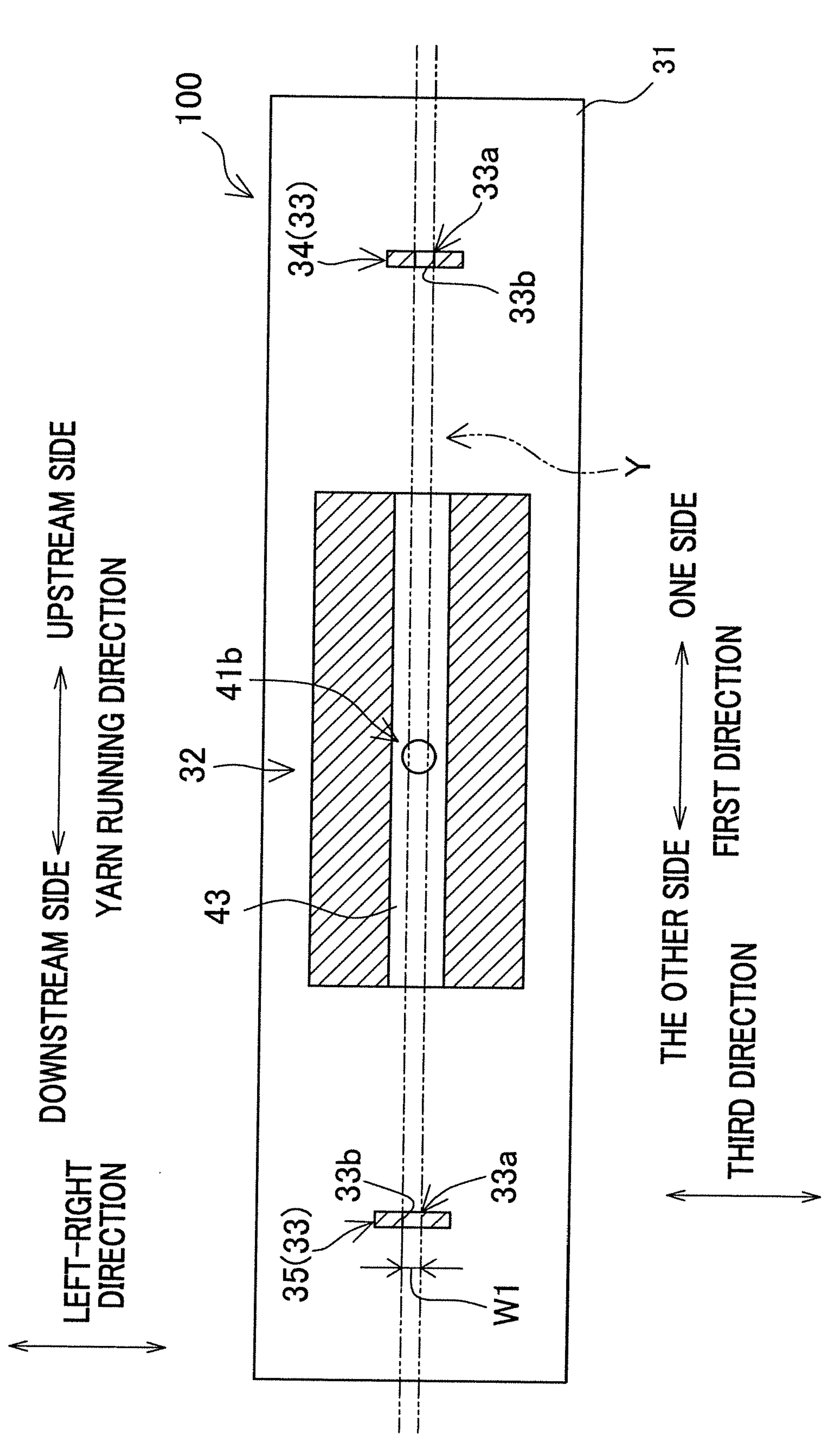

100
31
34(33)
33a
33b
Y
UPSTREAM SIDE
DOWNSTREAM SIDE
YARN RUNNING DIRECTION
41b
32
43
ONE SIDE
THE OTHER SIDE
FIRST DIRECTION
THIRD DIRECTION
35(33)
33b
33a
W1
LEFT-RIGHT DIRECTION

FIG.7

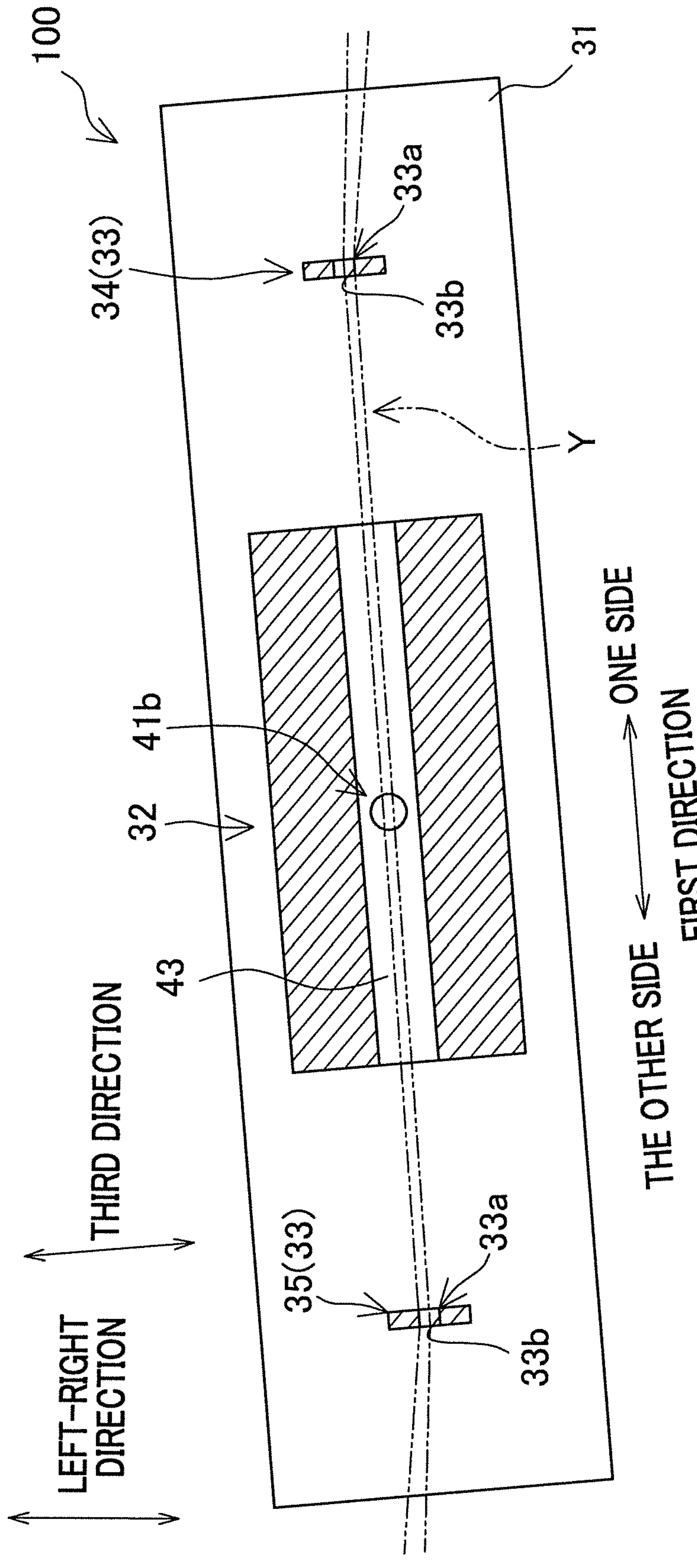

100
31
33a
34(33)
33b
Y
41b
32
43
ONE SIDE
FIRST DIRECTION
THE OTHER SIDE
THIRD DIRECTION
35(33)
33a
33b
LEFT-RIGHT DIRECTION

FIG.8

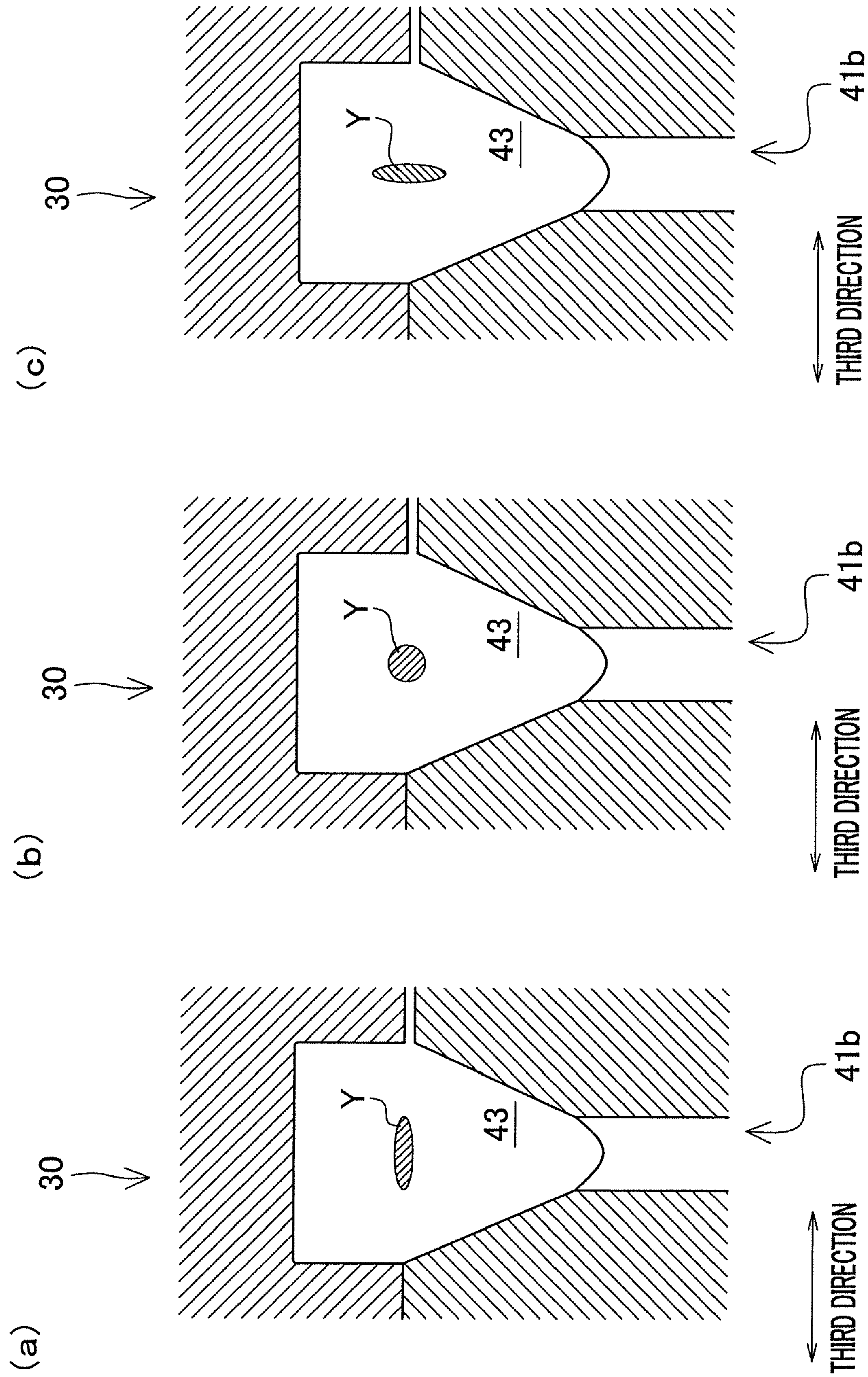
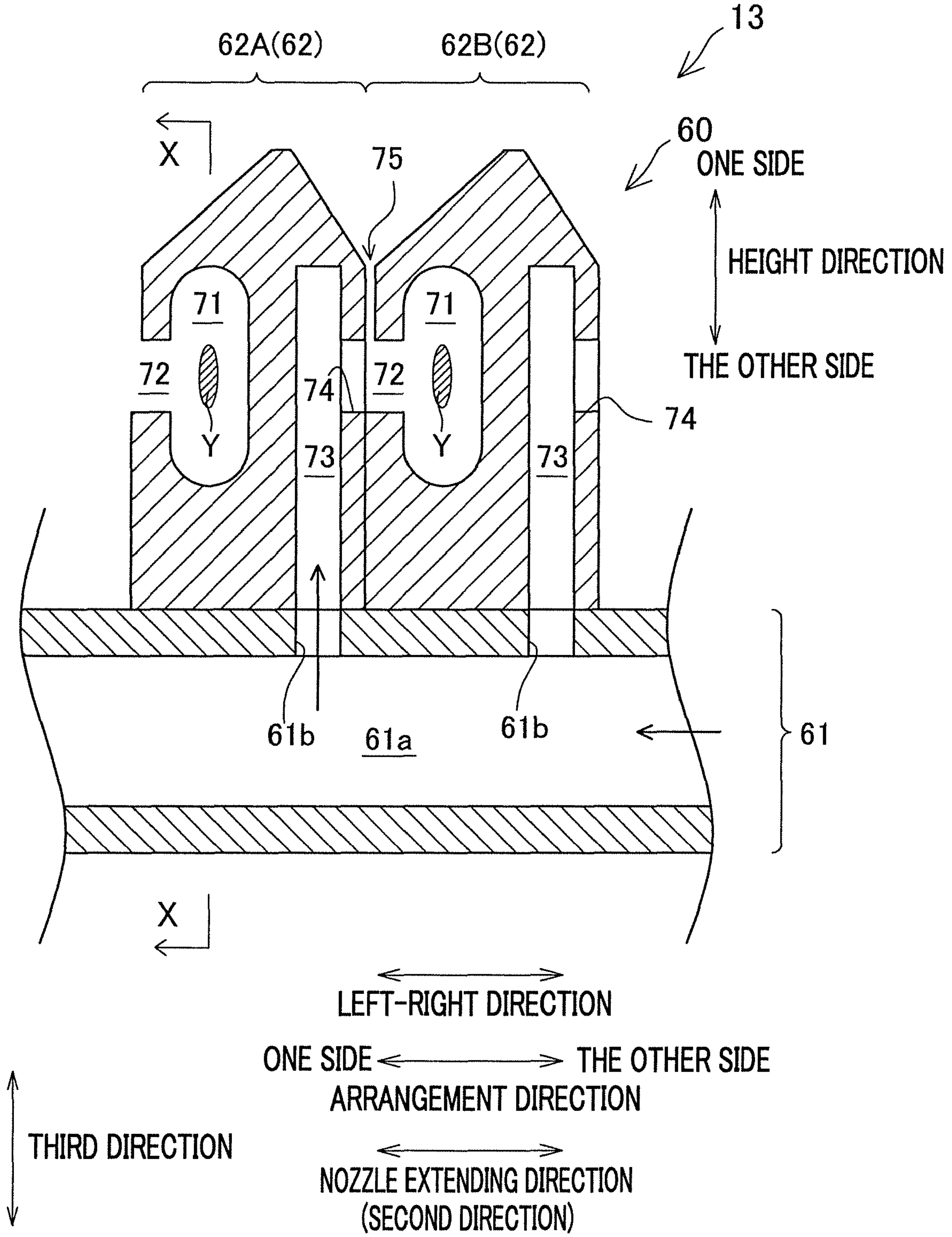

(a)
30
43
Y
41b
THIRD DIRECTION
(b)
30
43
Y
41b
THIRD DIRECTION
(c)
30
43
Y
41b
THIRD DIRECTION

FIG.9

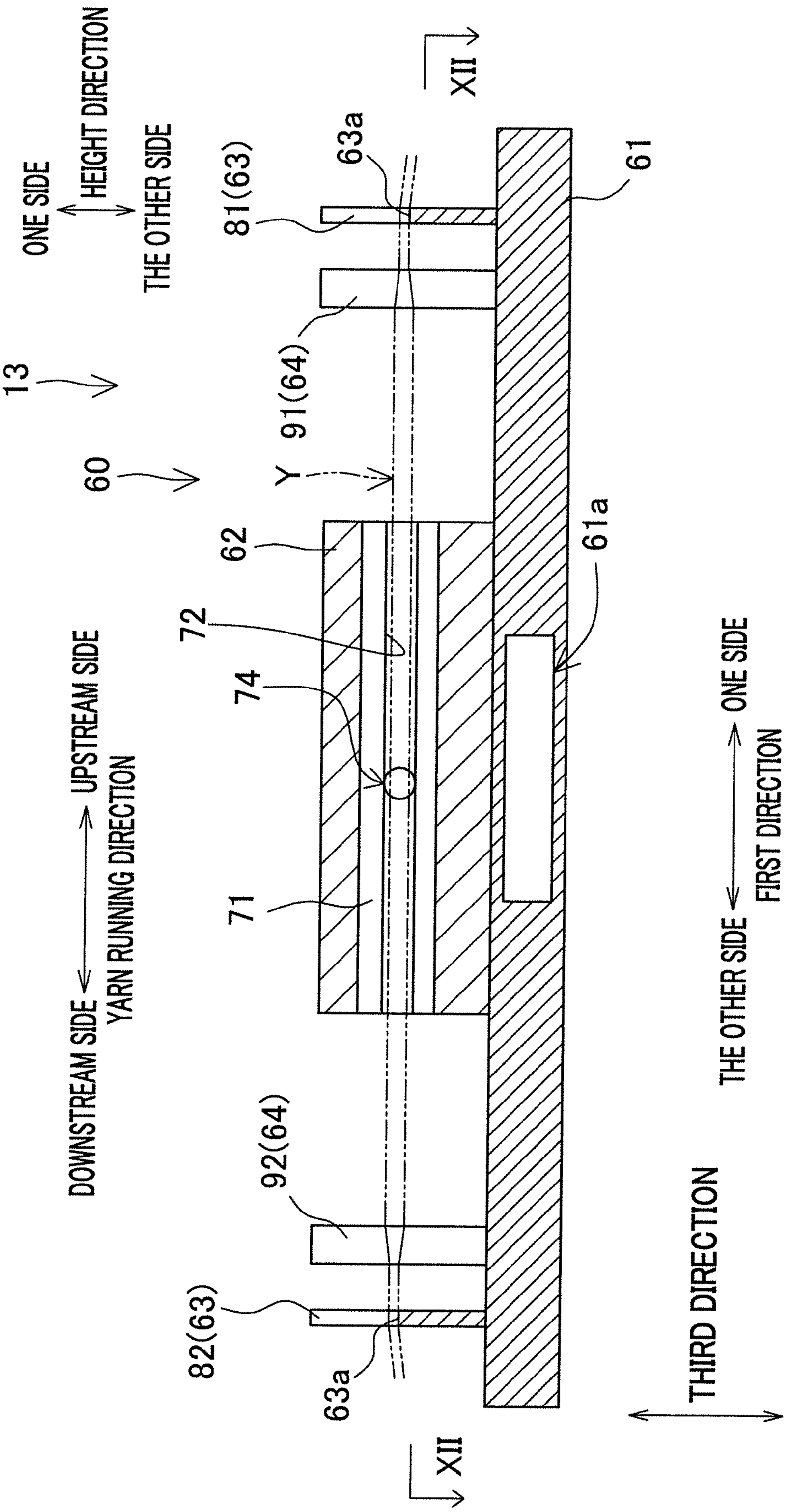
	EXAMPLE 1	EXAMPLE 2	COMPARATIVE EXAMPLE 1	COMPARATIVE EXAMPLE 2
SHAPE OF YARN IN YARN RUNNING SPACE	LATERAL FLAT SHAPE	LATERAL FLAT SHAPE	STANDARD SHAPE	LONGITUDINAL FLAT SHAPE
WIDTH OF GROOVE OF REGULATORY GUIDE (mm)	0.5	1.0	0.5	0.5
AVERAGE INTERLACING NUMBER PER METER	18.5	19.2	18.3	17.2

FIG.10



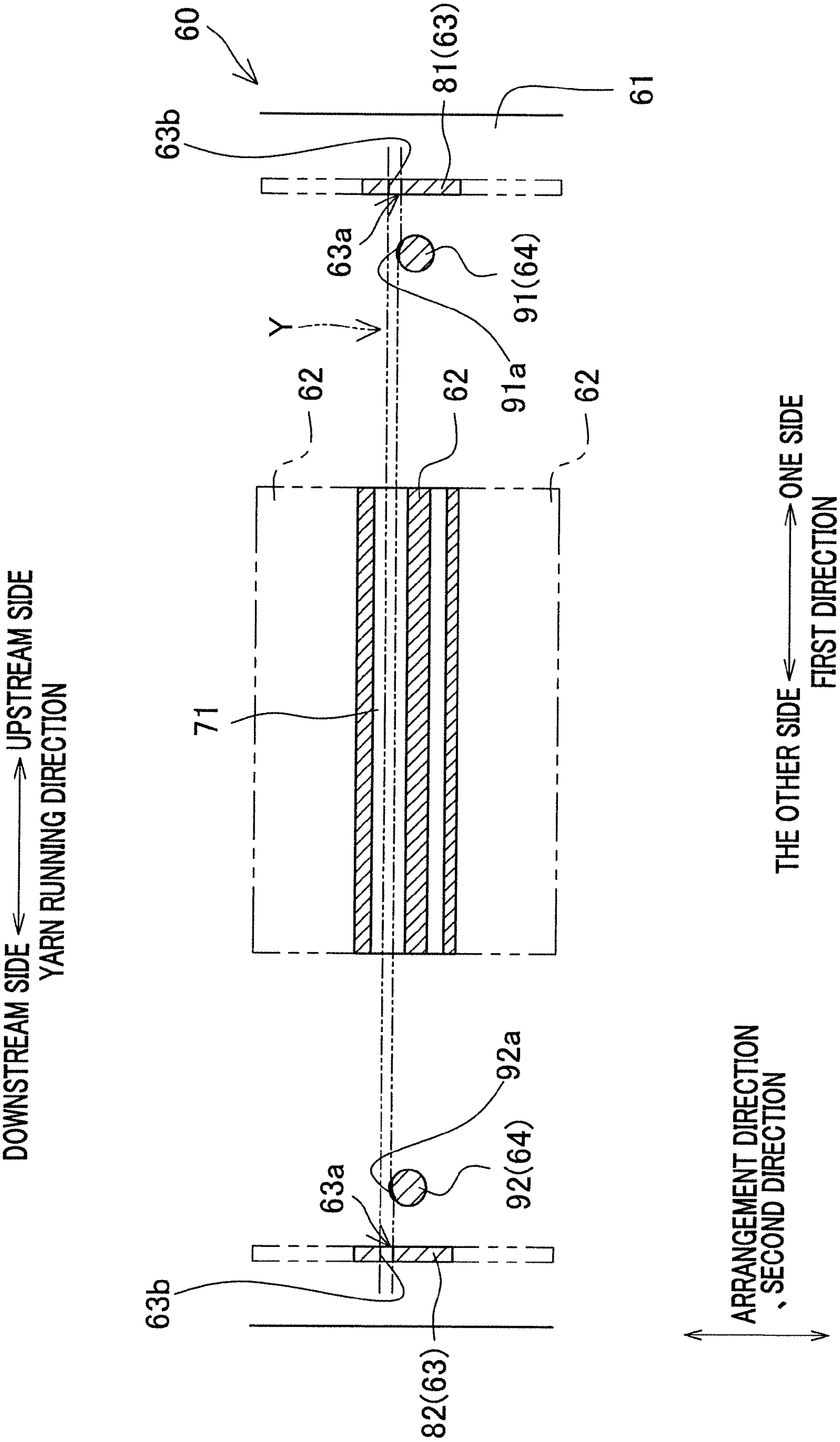
13
62A(62)
62B(62)
X
75
60
ONE SIDE
HEIGHT DIRECTION
THE OTHER SIDE
71
71
72
72
74
74
Y
Y
73
73
61b
61a
61b
61
X
LEFT-RIGHT DIRECTION
ONE SIDE
THE OTHER SIDE
ARRANGEMENT DIRECTION
THIRD DIRECTION
NOZZLE EXTENDING DIRECTION
(SECOND DIRECTION)

FIG.11



ONE SIDE
HEIGHT DIRECTION
THE OTHER SIDE
13
60
Y
81(63)
63a
91(64)
XII
61
62
72
74
71
61a
UPSTREAM SIDE
DOWNSTREAM SIDE
YARN RUNNING DIRECTION
92(64)
82(63)
63a
XII
THIRD DIRECTION
ONE SIDE
THE OTHER SIDE
FIRST DIRECTION

FIG.12


60
81(63)
61
63b
63a
91(64)
Y
91a
62
62
62
71
92a
92(64)
63a
63b
82(63)
DOWNSTREAM SIDE ⟷ UPSTREAM SIDE
YARN RUNNING DIRECTION
THE OTHER SIDE ⟷ ONE SIDE
FIRST DIRECTION
ARRANGEMENT DIRECTION
、SECOND DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 2191

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D02J
D02G

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	24 August 2022	Van Beurden-Hopkins

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