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(54) **YARN SUPPLYING BOBBIN CONVEYING DEVICE**

(57) Unintended sticking of a tray (T) due to a yarn (Y) that has fallen on a belt member (53) is prevented while the complexity of controlling a drive source (54) of the belt member (53) is avoided. A yarn supplying bobbin (Bs) conveying device (8) includes a flat belt (53) on which a tray (T) is placed, a plurality of belt feeding rollers (51, 52) around which a flat belt (53) is wound, and a motor (54) that rotationally drives at least one of the plurality of belt feeding rollers (51, 52). The flat belt (53) includes a plurality of protrusions (72) that support the tray (T) from below to apply to the tray (T) a frictional force for conveying the tray (T), and a base surface (73) disposed between the plurality of protrusions (72) in a width direction orthogonal to a conveying direction and a vertical direction, and below the protrusions (72) in the vertical direction.

FIG. 8A

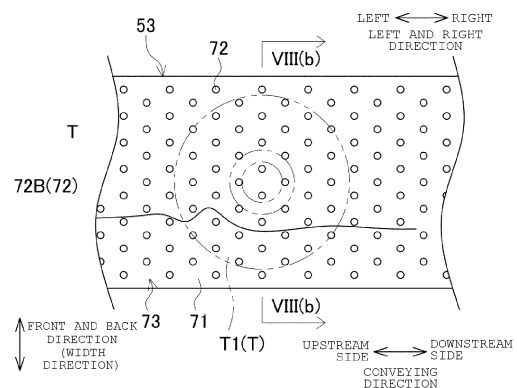
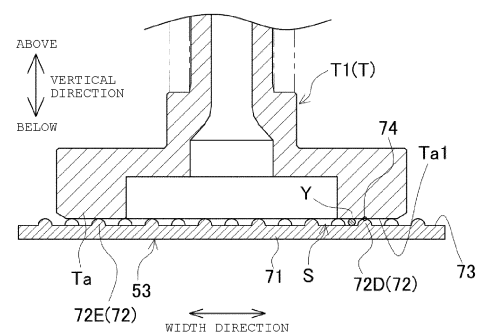


FIG. 8B



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn supplying bobbin conveying device for conveying a tray that supports a yarn supplying bobbin in an upright state.

2. Description of the Related Art

[0002] A conveying device (hereinafter, a yarn supplying bobbin conveying device) disclosed in Japanese Patent No. 3059240 is configured to convey a pallet (hereinafter, a tray) that supports a cop around which yarn is wound (hereinafter, a yarn supplying bobbin) in an upright state. More specifically, the yarn supplying bobbin conveying device includes a conveying belt (hereinafter, a belt member) on which the tray is placed, a plurality of rollers (hereinafter, pulleys) around which the belt member is wound, and a motor that drives one of the plurality of pulleys. By driving the pulley and the belt member with the motor, the tray placed on the belt member is conveyed in a predetermined conveying direction. In a part of the belt member in the conveying direction, a pusher element configured to be in contact with a side surface of the tray to push the tray in the conveying direction is formed. The yarn supplying bobbin conveying device includes a plurality of diverged conveying paths, and a merging point of the plurality of trays exists on the belt member.

[0003] When the plurality of trays come together at the merging point, a conveying speed of one or more of the trays may decrease temporarily, or one or more of the trays may be restricted from running on the belt member and stop temporarily. In this case, the yarn wound around the yarn supplying bobbin may hang down and fall on the belt member due to a factor such as speed fluctuation, and only the yarn may be dragged by the belt member and extend long in the conveying direction. When another tray rides on the yarn extending on the belt member in this manner, a problem may occur in which another tray gets caught by the yarn extending on the belt member and becomes stuck.

[0004] Here, the tray can be pushed by the pusher element provided on the belt member to forcibly move the tray in the conveying direction. However, in this case, another problem occurs. That is, depending on a machine connected to the yarn supplying bobbin conveying device, the tray may be temporarily stopped to wait to be processed on the downstream in the conveying direction. There is a possibility that when the belt member continues to be driven in such a state, the tray waiting to be processed may be unintentionally moved by the pusher element. There is also a possibility that the plurality of trays may be pressed against each other in the conveying direction, whereby the frictional force of the stopped tray is applied to the belt member, and an excessive load may

be applied to the motor. In order to avoid such a problem, it may be necessary to perform control so as to temporarily stop the driving of the belt member. This may make the control complex.

BRIEF SUMMARY OF THE INVENTION

[0005] An object of the present invention is to prevent unintended sticking of a tray due to a yarn that has fallen on a belt member while the complexity of controlling a drive source of the belt member is avoided.

[0006] A yarn supplying bobbin conveying device of a first aspect of the present invention is a yarn supplying bobbin conveying device configured to convey a tray that supports a yarn supplying bobbin around which yarn is wound in an upright state in a predetermined conveying direction, the yarn supplying bobbin conveying device including: a belt member on which the tray is placed; a plurality of pulleys around which the belt member is wound; and a drive source that rotationally drives at least one of the plurality of pulleys. The belt member includes a plurality of supports that support the tray from below to apply to the tray a frictional force for conveying the tray, and a retreated portion disposed between the plurality of supports in a width direction orthogonal to the conveying direction and a vertical direction and disposed below the supports in the vertical direction.

[0007] In the present invention, the retreated portion forms a space at a position where the support is not formed in the width direction of the belt member. Thus, when the lower surface of the tray is in contact with the support, a gap is formed between the lower surface of the tray and the retreated portion in the vertical direction. The yarn that has fallen and extended on the belt member fits in this gap, enabling the tray placed on the support to pass over the yarn without getting caught by the yarn. Therefore, it is possible to prevent the sticking of the tray due to the yarn that has fallen on the belt member.

[0008] Each support is in contact with the lower surface of the tray and is not in contact with the side surface of the tray. Thus, even when a plurality of trays are stuck on the belt member, the plurality of trays can slide on the support when being pressed against each other. As a result, even when the belt member continues to be driven, it is possible to avoid unintentional forcible movement of the stuck tray being stuck and an increase in load on the drive source.

[0009] As described above, it is possible to avoid the sticking of the tray due to the yarn that has fallen on the belt member while avoiding the complexity of controlling the drive source of the belt member.

[0010] According to a yarn supplying bobbin conveying device of a second aspect of the present invention, in the first aspect, the plurality of supports include a plurality of predetermined supports arranged at intervals in the conveying direction, and another support arranged side by side in the width direction with any one support among the plurality of predetermined supports in a cross section

orthogonal to the conveying direction and including the one support.

[0011] The lower surface of the tray may be in contact with only one of the plurality of supports, but in this case, the balance of the tray on the belt member may become unstable. In the present invention, a first support and a second support can be brought into contact with the lower surface of the tray. It is thus possible to prevent the tray from being unbalanced.

[0012] According to a yarn supplying bobbin conveying device of a third aspect of the present invention, in the second aspect, the belt member includes a base surface formed as the retreated portion and facing upward, and a plurality of protrusions formed as the plurality of supports and protruding upward from the base surface.

[0013] In the present invention, a flat belt having a base surface is used as a belt member. When the yarn falls on the flat belt, the problem of the tray being stuck is likely to occur as described above, and hence it is particularly effective that the plurality of protrusions are formed as the retreated portions as of the present invention.

[0014] According to a yarn supplying bobbin conveying device of a fourth aspect of the present invention, in the third aspect, a contact area of each of the plurality of protrusions with a lower surface of the tray is 0.1 mm² or less.

[0015] In the present invention, the contact area of each of the plurality of protrusions is small, thereby enabling an increase in the area of the retreated portion. Therefore, it is possible to effectively prevent the tray from getting caught by the yarn on the belt member.

[0016] According to a yarn supplying bobbin conveying device of a fifth aspect of the present invention, in the third or fourth aspect, when the tray is placed on the plurality of protrusions of the belt member, the lower surface of the tray is disposed in parallel with the base surface and separated from the base surface at a predetermined interval, and the interval is 0.2 mm or more and 5 mm or less.

[0017] In the present invention, the interval is large to some extent, so that it is possible to effectively lower the probability of the lower surface of the tray coming into contact with the yarn. On the other hand, when the interval is excessively wide (i.e., when the protrusion is excessively high), the protrusion is less likely to deform, so that stress concentration may occur at the boundary between the protrusion and the base surface in a portion of the flat belt that is wound around the pulley and curved, and the flat belt may be easily damaged. In the present invention, the protrusion is not excessively high, and such a risk can thus be reduced.

[0018] According to a yarn supplying bobbin conveying device of a sixth aspect of the present invention, in any one of the third to fifth aspects, the plurality of protrusions include a plurality of protrusions arranged on a predetermined first imaginary line that extends along a predetermined direction when viewed from above, and a plurality of protrusions arranged on a second imaginary line that

is parallel to the first imaginary line and is different from the first imaginary line, and arranged at positions closest to the plurality of protrusions on the first imaginary line in a direction orthogonal to the predetermined direction when viewed from above, and in the predetermined direction, one protrusion among the plurality of protrusions arranged on the second imaginary line is disposed between any two protrusions adjacent to each other among the plurality of protrusions arranged on the first imaginary line.

[0019] In the present invention, the plurality of protrusions on the first imaginary line and the plurality of protrusions on the second imaginary line are arranged in a zigzag manner. That is, the plurality of protrusions are arranged to be scattered to some extent in both the predetermined direction and the direction orthogonal to the predetermined direction. Therefore, the frictional force acting between the lower surface of the tray and the plurality of protrusions can be prevented from varying depending on the placement position of the tray. It is thus possible to prevent the conveyance of the tray from becoming unstable.

[0020] According to a yarn supplying bobbin conveying device of a seventh aspect of the present invention, in the sixth aspect, the predetermined direction is the width direction.

[0021] In the present invention, the zigzag shape can be formed by simple arrangement of the plurality of protrusions.

[0022] According to a yarn supplying bobbin conveying device of an eighth aspect of the present invention, in the seventh aspect, three imaginary line segments, formed by connecting centers of the two protrusions on the first imaginary line and the one protrusion on the second imaginary line, form an equilateral triangle when viewed from above.

[0023] In the present invention, the plurality of protrusions are uniformly arranged when viewed from above, so that it is possible to effectively prevent variation in frictional force acting between the lower surface of the tray and the plurality of protrusions depending on the placement position of the tray.

[0024] According to a yarn supplying bobbin conveying device of a ninth aspect of the present invention, in the eighth aspect, a distance in the predetermined direction between the centers of the two protrusions is 4 mm or more and 8 mm or less.

[0025] In the present invention, it is possible to effectively achieve the balance between the level of the probability that the yarn falls on the base surface and the magnitude of the frictional force acting between the lower surface of the tray and the plurality of protrusions.

[0026] According to a yarn supplying bobbin conveying device of a tenth aspect of the present invention, in any one of the third to ninth aspects, when a region surrounded by a horizontal, imaginary square with a side length of 10 cm is defined as a unit region, the plurality of protrusions are arranged at a density of 150 or more and

750 or less per unit region.

[0027] In the present invention, it is possible to effectively achieve the balance between the level of the probability that the yarn falls on the base surface and the magnitude of the frictional force acting between the lower surface of the tray and the plurality of protrusions.

[0028] According to a yarn supplying bobbin conveying device of an eleventh aspect of the present invention, in any one of the third to tenth aspects, each of the plurality of protrusions is curved to be convex upward in an arbitrary cross section extending along the vertical direction.

[0029] In the present invention, the shape of each protrusion is a dome shape or a shape similar to the dome shape. The retreated portion can be formed of the belt member having the protrusion of such a simple shape as described above. This can prevent an increase in the component cost of the belt member.

[0030] According to a yarn supplying bobbin conveying device of a twelfth aspect of the present invention, in any one of the first to eleventh aspects, a material of the belt member includes polyurethane.

[0031] In the present invention, a belt member can be formed using commonly used polyurethane as a material. This can prevent an increase in the component cost of the belt member.

[0032] According to a yarn supplying bobbin conveying device of a thirteenth aspect of the present invention, in the first aspect, the belt member includes a plurality of round belts arranged side by side in the width direction, and the retreated portion is formed between any two round belts adjacent to each other in the width direction among the plurality of round belts.

[0033] In the present invention, the retreated portion can be formed of a plurality of round belts.

[0034] According to a yarn supplying bobbin conveying device of a fourteenth aspect of the present invention, in any one of the first to thirteenth aspects, when the tray is placed on the belt member, a contact area of the lower surface of the tray in contact with the plurality of supports is smaller than a non-contact area of the lower surface of the tray without contact with the retreated portion of the belt member.

[0035] In the present invention, a wide space can be formed in the width direction by the support and the retreated portion. This can increase the probability that the yarn having fallen on the belt member fits in the space. Therefore, the sticking of the tray due to the yarn that has fallen on the belt member can be prevented more effectively.

[0036] According to a yarn supplying bobbin conveying device of a fifteenth aspect of the present invention, in the fourteenth aspect, the contact area is 20% or less of an area of the lower surface of the tray.

[0037] In the present invention, the sticking of the tray due to the yarn that has fallen on the belt member can be prevented more effectively.

[0038] According to a yarn supplying bobbin conveying device of a sixteenth aspect of the present invention, in

the fifteenth aspect, the contact area is 10% or less of the area of the lower surface of the tray.

[0039] In the present invention, the sticking of the tray due to the yarn that has fallen on the belt member can be prevented very effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0040]

FIG. 1 is a schematic plan view of yarn winding equipment that includes a yarn supplying bobbin conveying device according to the present embodiment; FIG. 2 is a block diagram illustrating an electrical configuration of the yarn winding equipment; FIG. 3 is a plan view of a bobbin processing device and a winding machine; FIG. 4 is a schematic front view of a winding unit; FIG. 5 is a cross-sectional view taken along line V-V of FIG. 3; FIG. 6A is a perspective view of a tray, and FIG. 6B is a side cross-sectional view of the tray; FIG. 7A is a plan view of a part of a flat belt, and FIG. 7B is a cross-sectional view taken along line VII(b)-VII(b) of FIG. 7A; and FIG. 8A is a plan view illustrating a state in which the tray and a yarn end are placed on the flat belt, and FIG. 8B is a cross-sectional view taken along line VIII(b)-VIII(b) of FIG. 8A.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0041] Next, an embodiment of the present invention will be described. For the convenience of description, the vertical direction of the drawing of FIG. 1 is referred to as a front and back direction. A direction orthogonal to the front and back direction (a left and right direction in the drawing of FIG. 1) is a left and right direction. A direction (vertical direction) orthogonal to both the front and back direction and the left and right direction and in which gravity acts is an up and down direction. A direction in which a tray T, to be described later, is conveyed is a conveying direction.

(Schematic configuration of yarn winding equipment)

[0042] First, a schematic configuration of yarn winding equipment 1 that includes a yarn supplying bobbin conveying device 8 (described later) according to the present embodiment will be described with reference to FIGS. 1 and 2. FIG. 1 is a schematic plan view of yarn winding equipment 1. FIG. 2 is a block diagram illustrating an electrical configuration of the yarn winding equipment 1. As illustrated in FIG. 1, the yarn winding equipment 1 includes a spinning machine 2, a bobbin processing device 3, a winding machine 4, and a machine control device 5. The yarn winding equipment 1 is a so-called link

corner type equipment in which the spinning machine 2, the bobbin processing device 3, and the winding machine 4 are connected, but is not limited thereto.

[0043] The spinning machine 2 includes a plurality of spinning units (not illustrated). Each spinning unit spins roving (not illustrated) and winds the spun yarn around a tubular bobbin to form a fully wound yarn supplying bobbin Bs. The spinning machine 2 feeds the fully wound yarn supplying bobbin Bs formed by each spinning unit to the bobbin processing device 3. The yarn supplying bobbin Bs is loaded on the tray T and fed to the bobbin processing device 3 in a substantially upright state.

[0044] The bobbin processing device 3 is configured to convey the tray T on which the yarn supplying bobbin Bs, before use, (cf. a black circle in FIG. 1) formed by the spinning machine 2, is loaded toward the winding machine 4. The bobbin processing device 3 is configured to convey the tray T on which the used yarn supplying bobbin Bs (cf. a white circle in FIG. 1) discharged from the winding machine 4 is loaded toward the spinning machine 2. The bobbin processing device 3 is disposed, for example, on the left side of the spinning machine 2 and on the right side of the winding machine 4. The bobbin processing device 3 includes a conveying path 10 for conveying the tray T on which the yarn supplying bobbin Bs is loaded. The bobbin processing device 3 performs a yarn-end finding process for the yarn end of the yarn supplying bobbin Bs before use, a removal process for the yarn (residual yarn) remaining on the yarn supplying bobbin Bs after use, and some other process. Note that the "yarn supplying bobbin Bs before use" does not necessarily mean only the unused fully wound yarn supplying bobbin Bs. The yarn supplying bobbins Bs before use also include, for example, the yarn supplying bobbin Bs that is discharged from the winding machine 4 and thereafter subjected to the yarn-end finding process for the yarn end again and supplied to the winding machine 4 again.

[0045] The winding machine 4 is disposed, for example, on the left side of the bobbin processing device 3. The winding machine 4 includes a plurality of winding units 7 arranged in the left and right direction, and a yarn supplying bobbin conveying device 8. Each winding unit 7 unwinds yarn Y from a yarn supplying bobbin Bs and winds the yarn Y around a winding bobbin Bw (cf. FIG. 4) to form a package P (cf. FIG. 4). Each winding unit 7 discharges the used yarn supplying bobbin Bs. The discharged yarn supplying bobbins Bs include an empty bobbin from which all the yarn Y has been unwound, a small amount of residual yarn bobbin in which a small amount of yarn Y remains, and some other bobbin. The yarn supplying bobbin conveying device 8 is configured to convey the tray T on which the yarn supplying bobbin Bs is loaded. The yarn supplying bobbin conveying device 8 is configured to deliver the tray T to and from each winding unit 7.

[0046] The machine control device 5 is disposed, for example, on the left side of the winding machine 4. As

illustrated in FIG. 2, the machine control device 5 is electrically connected to a controller (not illustrated) of each spinning unit of the spinning machine 2, a bobbin processing controller (not illustrated) of the bobbin processing device 3, and a unit controller 12 of each winding unit 7, and communicates with these controllers.

[0047] In the yarn winding equipment 1 having the above configuration, the yarn supplying bobbin Bs before use is supplied to each winding unit 7 of the winding machine 4 via the bobbin processing device 3. The yarn Y is unwound from the yarn supplying bobbin Bs by each winding unit 7. The used yarn supplying bobbin Bs is discharged from each winding unit 7 and returned to the spinning machine 2 via the bobbin processing device 3.

(Bobbin processing device)

[0048] Next, the configuration of the bobbin processing device 3 will be described with reference to FIG. 3. FIG. 3 is a plan view of the bobbin processing device 3 and the winding machine 4. The bobbin processing device 3 includes the conveying path 10 as described above. The conveying path 10 includes a supply path 31, a discharge path 32, a first bypass 33, and a second bypass 34. The supply path 31 is a path extending over both the left and right ends of the bobbin processing device 3 and configured to convey the yarn supplying bobbin Bs before use toward the winding machine 4. In the middle portion of the supply path 31, a yarn-end finding device 35 that performs the yarn-end finding process is disposed. The yarn-end finding process involves drawing the distal end portion of the yarn wound around the yarn supplying bobbin Bs, thereby making the yarn end portion of the yarn supplying bobbin Bs easy to capture in the winding unit 7 (cf. FIG. 4). The discharge path 32 is a path extending across the left and right ends of the bobbin processing device 3 similarly to the supply path 31 and configured to convey the used yarn supplying bobbin Bs toward the spinning machine 2.

[0049] The first bypass 33 diverges from a portion of the supply path 31 downstream of the yarn-end finding device 35 in the conveying direction. The first bypass 33 merges with the discharge path 32. The second bypass 34 diverges from a portion of the discharge path 32 downstream of a merging point with the first bypass 33 in the conveying direction. Further, the second bypass 34 merges with a portion of the supply path 31 upstream of the yarn-end finding device 35 in the conveying direction. In the middle portion of the second bypass 34, a residual yarn removing device 36 is disposed. The residual yarn removing device 36 is a device that performs a residual yarn process of removing the residual yarn from the yarn supplying bobbin Bs when a small amount of yarn remains (there is residual yarn) in the yarn supplying bobbin Bs after use. At each of a divergence point between the supply path 31 and the first bypass 33 and a divergence point between the discharge path 32 and the second bypass 34, a destination switcher (not illustrated) capable

of switching the destination of the tray T is provided. In a portion in front of the divergence point of the discharge path 32 and the second bypass 34, a residual yarn sensor 37 for detecting whether or not the yarn remains in the yarn supplying bobbin Bs is disposed. A tray sensor 38 that detects the tray T is disposed near the inlet portion of the discharge path 32.

(Winding unit)

[0050] Next, the configuration of the winding unit 7 will be briefly described with reference to FIG. 4. FIG. 4 is a schematic front view of the winding unit 7.

[0051] The winding unit 7 is configured to unwind the yarn Y from the yarn supplying bobbin Bs disposed at the lower end portion and wind the yarn Y around the winding bobbin Bw disposed at the upper end portion to form the package P. As illustrated in FIG. 4, the winding unit 7 includes a bobbin support 21, a yarn clearer 22, and a traverse drum 23 in this order from the lower side. The winding unit 7 unwinds the yarn Y from the yarn supplying bobbin Bs supported by the bobbin support 21, and winds the yarn Y around the winding bobbin Bw rotating in contact with the traverse drum 23 while monitoring the running yarn Y using the yarn clearer 22. The winding bobbin Bw is rotatably supported by a cradle 24.

[0052] The bobbin support 21 is configured to be able to support the tray T on which the yarn supplying bobbin Bs is loaded. The yarn clearer 22 is configured to be able to monitor the yarn Y, which is being unwound from the yarn supplying bobbin Bs and running, and to be able to detect a defect in the yarn Y. The yarn clearer 22 includes a cutter (not illustrated) for cutting the running yarn Y. The traverse drum 23 comes into contact with the surface of the winding bobbin Bw (the package P), and is rotationally driven by a motor (not illustrated) to cause the winding bobbin Bw to rotate while in contact. The traverse drum 23 is formed with a groove for traversing the yarn Y. Thus, the traverse drum 23 rotates the winding bobbin Bw while traversing the yarn Y, and winds the yarn Y around the winding bobbin Bw.

[0053] When the yarn is cut with the cutter of the yarn clearer 22 or yarn breakage occurs due to other causes, the winding unit 7 performs a yarn joining process of joining the yarn Y (a lower yarn Y1) from the yarn supplying bobbin Bs and the yarn Y (an upper yarn Y2) from the winding bobbin Bw. As a configuration for the yarn joining process, the winding unit 7 includes a yarn joining device 25, a lower yarn suction 26, and an upper yarn suction 27. The lower yarn suction 26 sucks and holds the lower yarn Y1 and guides the lower yarn Y1 to the yarn joining device 25. The upper yarn suction 27 sucks and holds the upper yarn Y2 and guides the upper yarn Y2 to the yarn joining device 25. The yarn joining device 25 performs the yarn joining process using, for example, compressed air. The yarn joining device 25 performs the yarn joining process by spraying the compressed air on the lower yarn Y1 and the upper yarn Y2 to once loosen both

yarn ends, and then again spraying the compressed air on both yarn ends to entangle the yarn ends to each other.

[0054] A yarn presence/absence sensor 28 and an ejector 29 are disposed near the bobbin support 21. The yarn presence/absence sensor 28 detects whether or not the yarn supplying bobbin Bs is in a state where the yarn Y can be unwound. The ejector 29 is configured to be able to discharge the yarn supplying bobbin Bs from the winding unit 7. For example, when the yarn Y drawn from the yarn supplying bobbin Bs is no longer detected by the yarn presence/absence sensor 28, the unit controller 12 determines that the yarn Y of the yarn supplying bobbin Bs has run out (has become empty) or the yarn Y of the yarn supplying bobbin Bs cannot be captured, and operates the ejector 29 to discharge the yarn supplying bobbin Bs from the winding unit 7. Furthermore, a blower (not illustrated) configured to be able to blow up the yarn end of the lower yarn Y1 to the upper side of the yarn supplying bobbin Bs is disposed near the bobbin support 21. Thus, the lower yarn Y1 can be sucked and held by the lower yarn suction 26.

[0055] As described above, the winding unit 7 includes the unit controller 12 (cf. FIG. 2). The unit controller 12 includes a central processing unit (CPU), a read-only memory (ROM), a random-access memory (RAM), and the like. The unit controller 12 is electrically connected to the yarn presence/absence sensor 28, the ejector 29, and the like (cf. FIG. 2). The unit controller 12 controls each section of the winding unit 7 by the CPU according to a program stored in the ROM. Further, the unit controller 12 communicates with the machine control device 5.

(Yarn supplying bobbin conveying device)

[0056] The yarn supplying bobbin conveying device 8 will be described with reference to FIG. 3. The yarn supplying bobbin conveying device 8 includes a conveying path 15 for conveying the tray T. The conveying path 15 includes a supply path 41, a plurality of individual paths 42, and a discharge path 43. The supply path 41 is a path for conveying the tray T on which the yarn supplying bobbin Bs before use is loaded. The supply path 41 is disposed behind the plurality of winding units 7 and extends in the left and right direction. The right end portion of the supply path 41 is connected to the left end portion of the supply path 31 of the bobbin processing device 3. A second bypass 44 disposed behind the supply path 41 and extending in the left and right direction is connected to the left end portion and the right side portion of the supply path 41. Each individual path 42 is a path diverged from the supply path 41 and extending at least forward for distributing the yarn supplying bobbin Bs before use to each winding unit 7. The discharge path 43 is a path for returning the tray T on which the used yarn supplying bobbin Bs is loaded to the bobbin processing device 3. The discharge path 43 merges with each individual path 42 and extends in the left and right direction. The right

end portion of the discharge path 43 is connected to the left end portion of the discharge path 32 of the bobbin processing device 3.

[0057] The individual path 42 is configured to be able to temporarily store the yarn supplying bobbin Bs before use. Thus, the yarn supplying bobbin Bs is stored upstream, in the conveying direction, of the yarn supplying bobbin Bs from which the yarn is being unwound (i.e., in use) by the winding unit 7. When all the individual paths 42 are full, the tray T on which the yarn supplying bobbin Bs is loaded is returned to a portion upstream of the supply path 41 in the conveying direction through the second bypass 44.

(Tray conveying mechanism)

[0058] A mechanism (conveyor mechanisms 50, 60 to be described later) for conveying the tray T will be described with reference to FIGS. 3 and 5. FIG. 5 is a cross-sectional view taken along line V-V of FIG. 3. As illustrated in FIGS. 3 and 5, the yarn supplying bobbin conveying device 8 includes a conveyor mechanism 50. The conveyor mechanism 50 is a mechanism for conveying the tray T on the discharge path 43. As illustrated in FIG. 5, the conveyor mechanism 50 includes belt feeding rollers 51, 52 (a plurality of pulleys of the present invention), a flat belt 53 (a belt member of the present invention), and a motor 54 (a drive source of the present invention).

[0059] The belt feeding rollers 51, 52 are members around which the flat belt 53 is wound. The belt feeding roller 51 is provided at the right end portion of the winding machine 4. The belt feeding roller 52 is disposed at the left end portion of the yarn supplying bobbin conveying device 8. The rotation axis direction of each of the belt feeding rollers 51, 52 is substantially parallel to the front and back direction. Instead of the belt feeding rollers 51, 52, a plurality of pulleys may be provided.

[0060] The flat belt 53 is an endless belt wound around the belt feeding rollers 51, 52. The flat belt 53 is configured such that the tray T is placed thereon. In the present embodiment, the flat belt 53 extends long in the left and right direction. That is, the left and right direction is the conveying direction of the tray T. In the conveying direction, the left side is the upstream side, and the right side is the downstream side. The front and back direction is the width direction of the flat belt 53 (hereinafter referred to simply as a width direction). The flat belt 53 is disposed at least from the discharge path 43 to an outlet 45 of the individual path 42 in the width direction (cf. FIG. 3). The flat belt 53 will be described later in more detail.

[0061] The motor 54 rotationally drives the belt feeding roller 51 (at least one of the plurality of pulleys of the present invention). The motor 54 is electrically connected to the machine control device 5 (cf. FIG. 2). When the belt feeding roller 51 is rotationally driven by the motor 54, the flat belt 53 is driven, and the belt feeding roller 52 is driven to rotate. The tray T placed on the flat belt 53 moves to the right side (in the direction of the arrow

in FIG. 5). That is, the conveyor mechanism 50 applies a rightward conveying force to the tray T.

[0062] The conveying force by the conveyor mechanism 50 also acts on the tray T located near the outlet 45 of the individual path 42. The conveying force has a component toward the downstream side in the conveying direction of the individual path 42. Therefore, when the tray T on the discharge path 43 is not in contact with the tray T on the individual path 42, the tray T on the individual path 42 is drawn to the discharge path 43 by the conveyor mechanism 50.

[0063] In the yarn supplying bobbin conveying device 8 having the above configuration, the tray T on which the yarn supplying bobbin Bs discharged from the winding unit 7 is loaded is conveyed to the discharge path 43 via the individual path 42.

[0064] As illustrated in FIGS. 3 and 5, the bobbin processing device 3 includes a conveyor mechanism 60. The conveyor mechanism 60 is a mechanism for conveying the tray T on the discharge path 32. As illustrated in FIG. 5, the conveyor mechanism 60 includes belt feeding rollers 61, 62, a flat belt 63, and a motor 64. The belt feeding roller 61 is disposed at the right end portion of the bobbin processing device 3. The belt feeding roller 62 is disposed at the left end portion of the bobbin processing device 3. The flat belt 63 is an endless belt wound around the belt feeding rollers 61, 62. The flat belt 63 is configured such that the tray T is placed thereon. The motor 64 is a motor different from the motor 54. The motor 64 rotationally drives the belt feeding roller 61. When the belt feeding roller 61 is rotationally driven by the motor 64, the flat belt 63 is driven, and the belt feeding roller 62 is driven to rotate. The tray T placed on the flat belt 63 moves rightward.

[0065] The tray T on the discharge path 43 of the yarn supplying bobbin conveying device 8 is sent to the discharge path 32 of the bobbin processing device 3. The residual yarn sensor 37 determines whether or not the yarn remains in the yarn supplying bobbin Bs on the discharge path 32. When the yarn Y does not remain in the yarn supplying bobbin Bs, the tray T is conveyed on the discharge path 32 as it is and returned to the spinning machine 2. When the yarn Y remains on the yarn supplying bobbin Bs, the tray T is conveyed to the second bypass 34. The residual yarn of the yarn supplying bobbin Bs on the second bypass 34 is removed by the residual yarn removing device 36.

(Tray)

[0066] The shape of the tray T will be described with reference to FIGS. 6A and 6B. FIG. 6A is a perspective view of the tray T. FIG. 6B is a side cross-sectional view of the tray T. The following direction (the vertical direction) is a direction when the tray T is placed on the flat belts 53, 63. As illustrated in FIGS. 6A and 6B, the tray T includes a disc portion Ta and a shaft portion Tb. The disc portion Ta is a substantially disc-shaped portion placed

on each of the flat belts 53, 63. In other words, the disc portion Ta is the base portion of the tray T. In the radial direction of the disc portion Ta, an air passage P1 penetrating in the vertical direction is provided in the inner portion of the disc portion Ta. The lower end surface (a lower surface Ta1) of the disc portion Ta has a substantially ring shape. The diameter of the disc portion Ta is, for example, 60 mm, 70 mm, or 75 mm.

[0067] The shaft portion Tb is a portion to which the yarn supplying bobbin Bs is attached. The shaft portion Tb is provided to extend upward from the center portion of the upper end surface of the disc portion Ta. The shaft portion Tb includes, for example, a large diameter portion Tb1, a small diameter portion Tb2, and a distal end portion Tb3. The large diameter portion Tb1 is configured to come into contact with the end surface of the yarn supplying bobbin Bs. The small diameter portion Tb2 is configured to come into contact (i.e., to be inserted into the yarn supplying bobbin Bs) with the inner peripheral surface of the yarn supplying bobbin Bs. The distal end portion Tb3 is a substantially conical portion disposed above the small diameter portion Tb2. A passage P2 connected to the passage P1 is provided inside the large diameter portion Tb1 and the small diameter portion Tb2 in the radial direction of the disc portion Ta. The distal end portion Tb3 is provided with an outlet P3 of the passage P2. The outlet P3 is disposed to connect the passage P2 with the space radially inside the yarn supplying bobbin Bs. The blower (not illustrated) of the winding unit 7 described above supplies air to the space formed radially inside the yarn supplying bobbin Bs through the passages P1, P2 and the outlet P3 to blow up the lower yarn Y1.

[0068] Here, in the yarn supplying bobbin conveying device 8, the merging point of the plurality of trays T (i.e., the merging point of the individual path 42 and the discharge path 43) exists on the flat belt 53. When the plurality of trays T come together at the merging point, the conveying speed of one or more of the trays T (the tray T on the individual path 42 or the tray T on the discharge path 43) may temporarily decrease, or the tray T may temporarily stop on the flat belt 53. In this case, the yarn Y wound around the yarn supplying bobbin Bs may hang down due to a factor such as vibration or impact accompanying speed fluctuation and fall on the flat belt 53, and only the yarn Y may be dragged by the flat belt 53 and extend long in the conveying direction. The yarn Y wound around the yarn supplying bobbin Bs is, for example, the yarn Y remaining on the yarn supplying bobbin Bs discharged from the winding unit 7. The yarn supplying bobbin Bs is a yarn supplying bobbin Bs determined by the unit controller 12 to be in a state where the yarn Y cannot be captured. When the yarn Y remaining on the yarn supplying bobbin Bs, as thus described, falls on the flat belt 53 and extends long in the conveying direction, another tray T may ride on the yarn Y. Then, a problem may occur in which another tray T mentioned above gets caught by the yarn Y on the flat belt 53 and becomes stuck.

[0069] Here, for example, when the pusher element described in Japanese Patent No. 3059240 is provided on the flat belt 53, the tray T can be pushed by the pusher element to forcibly move the tray T in the conveying direction. However, in this case, another problem occurs. For example, the tray T waiting to be subjected to the yarn-end finding process by the yarn-end finding device 35 may be temporarily stopped in the discharge path 32 of the bobbin processing device 3 connected to the yarn supplying bobbin conveying device 8. One reason for the temporal stop is that, for example, when there are many yarn supplying bobbins Bs from which the residual yarn needs to be removed by the residual yarn removing device 36, many trays T may be accumulated on the second bypass 34 and the discharge path 32. Alternatively, the yarn supplying bobbin Bs that has failed in the yarn-end finding process by the yarn-end finding device 35 described above is returned to the supply path 31 via the first bypass 33, the discharge path 32, and the second bypass 34. Also, when many such yarn supplying bobbins Bs are being conveyed, the tray T may become stuck on the discharge path 32.

[0070] As described above, there is a possibility that when the flat belt 53 continues to be driven in a state where many trays T are accumulated in the discharge path 43 and downstream thereof in the conveying direction, the tray T waiting to be processed may be unintentionally moved by the pusher element. There is also a possibility that when the plurality of trays T are pressed against each other in the conveying direction, an upstream force in the conveying direction may be applied to the flat belt 53, and an excessive load may be applied to the motor 54. In order to avoid such a problem, it may be necessary to perform control so as to temporarily stop the driving of the flat belt 53. This may make the control complex. Therefore, in order to prevent the sticking of the tray T due to the yarn Y that has fallen on the flat belt 53 while avoiding the complexity of control, the flat belt 53 is configured as follows.

(Shape of flat belt)

[0071] The shape of the flat belt 53 will be described with reference to FIGS. 7A and 7B. FIG. 7A is a plan view of a part of the flat belt 53. FIG. 7B is a cross-sectional view taken along line VII(b)-VII(b) of FIG. 7A.

[0072] As illustrated in FIGS. 7A and 7B, the flat belt 53 has a base 71 and a plurality of protrusions 72 (supports of the present invention). The material of the base 71 and the plurality of protrusions 72 are, for example, polyurethane. The base 71 is a portion of the flat belt 53 extending between the position of the upper end of the belt feeding roller 51 and the position of the upper end of the belt feeding roller 52 in the left and right direction. The base 71 has at least a base surface 73 (a retreated portion of the present invention) facing upward. The base surface 73 extends in the conveying direction. The base surface 73 is preferably disposed substantially horizon-

tally (i.e., facing almost directly upward), but is not limited thereto. The base surface 73 may be slightly inclined from the horizontal direction. The base surface 73 is disposed to be separated from (i.e., not in contact with) the lower surface Ta1 of the tray T in the vertical direction (cf. FIG. 8B). The base surface 73 is disposed below the plurality of protrusions 72. The base surface 73 is disposed in a region where the plurality of protrusions 72 are not formed in the horizontal direction. A part of the base surface 73 is disposed between any two protrusions 72 arranged side by side in the width direction among the plurality of protrusions 72.

[0073] The plurality of protrusions 72 are portions provided on the base 71 and protruding upward from the base surface 73. The plurality of protrusions 72 are portions in contact with the lower surface Ta1 of the tray T. In other words, the plurality of protrusions 72 are portions of the flat belt 53 on which the tray T is placed. The plurality of protrusions 72 are portions that support the tray T from below to apply to the tray T a frictional force for conveying the tray T. In the present embodiment, the shape of each of the plurality of protrusions 72 is, for example, a dome shape. That is, each of the protrusions 72 has, for example, a substantially circular shape when viewed from above (cf. FIG. 7A) and a substantially semicircular shape when viewed from the horizontal direction (cf. FIG. 7B). Note that the shape of each of the plurality of protrusions 72 is not limited to the dome shape but may be a shape similar to the dome shape. The dome shape or the shape similar to the dome shape is a shape curved to be convex upward in an arbitrary cross section extending along the vertical direction.

[0074] The plurality of protrusions 72 are preferably arranged in a zigzag manner on the base surface 73. As a more specific example, as illustrated in FIG. 7A, when the flat belt 53 is viewed from above, a first imaginary line L1 extends in the front and back direction (i.e., the width direction, a predetermined direction of the present invention). Some protrusions 72 among the plurality of protrusions 72 are arranged on the first imaginary line L1 along the front and back direction. A group including the plurality of protrusions 72 on the first imaginary line L1 may be referred to as a first protrusion group. In the example illustrated in FIG. 7A, eight protrusions 72 (a plurality of protrusions on a first imaginary line in the present invention) including a protrusion 72A and a protrusion 72B are arranged along the front and back direction to constitute the first protrusion group. In addition, seven protrusions 72 (a plurality of protrusions on a second imaginary line in the present invention) including a protrusion 72C are arranged on a second imaginary line L2 different from the first imaginary line L1 and parallel to the first imaginary line L1. A group including the plurality of protrusions 72 on the second imaginary line L2 may be referred to as a second protrusion group. The plurality of protrusions 72 on the second imaginary line L2 are arranged at positions closest to the plurality of protrusions 72 on the first imaginary line L1 in the left and right

direction (a direction orthogonal to the predetermined direction). In other words, no other protrusion 72 is disposed between the plurality of protrusions 72 on the first imaginary line L1 and the plurality of protrusions 72 on the second imaginary line L2 in the left and right direction.

[0075] In the width direction, one protrusion 72 on the second imaginary line L2 (i.e., included in the second protrusion group) is disposed between any two protrusions 72 adjacent to each other on the first imaginary line L1 (i.e., in the first protrusion group). As a specific example, one protrusion 72C is disposed between the two protrusions 72A, 72B. The protrusions 72A, 72B correspond to two protrusions of the plurality of protrusions in the first imaginary line in the present invention. The protrusion 72C corresponds to one of the plurality of protrusions on the second imaginary line in the present invention.

[0076] More preferably, when viewed from above, an equilateral triangle is preferably formed of three imaginary line segments connecting the centers of gravity (the centers) of three adjacent protrusions 72. The center of gravity and the center here both mean the geometric center of each protrusion 72 when viewed from above. For example, in the present embodiment, each protrusion 72 has a circular shape when viewed from above, and hence the center of the circle corresponds to the center of gravity. As a specific example, an equilateral triangle TR is formed of an imaginary line segment connecting the center of the protrusion 72A and the center of the protrusion 72B, an imaginary line segment connecting the center of the protrusion 72B and the center of the protrusion 72C, and an imaginary line segment connecting the center of the protrusion 72A and the center of the protrusion 72C (cf. FIG. 7A). Such an arrangement is known as a so-called 60-degree staggered arrangement. In such an arrangement, the distance between the centers of any two adjacent protrusions 72 among the plurality of protrusions 72 are preferably 4 mm or more and 8 mm or less. As a specific example, the distance between the center of the protrusion 72A and the center of the protrusion 72B is 4 mm or more and 8 mm or less. In the specific example illustrated in FIG. 7A, the distance is 6 mm.

[0077] When viewed from above, the density of the arrangement of the plurality of protrusions 72 on the surface of the flat belt 53 is preferably as follows. That is, when a region surrounded by a horizontal, imaginary square with a side length of 10 cm is defined as a unit region, the plurality of protrusions 72 are preferably arranged at a density of 150 or more and 750 or less per unit region.

[0078] In the flat belt 53, the upper end portion of each of the plurality of protrusions 72 is disposed to be in contact with the lower surface Ta1 of the tray T. A portion of each protrusion 72 in contact with the lower surface Ta1 is referred to as a contact surface 74 (cf. FIGS. 7A and 8A) for the convenience of description. A portion of each of the protrusions 72 except for the contact surface 74 is disposed to be separated from (i.e., not in contact with) the lower surface Ta1 of the tray T in the vertical direction (cf. FIG. 8B). In a predetermined cross section (cf. FIG.

7B) of the flat belt 53 orthogonal to the conveying direction, at least one (a protrusion 72D) of the plurality of protrusions 72 and the base surface 73 are arranged side by side in the width direction. The protrusion 72D is any one of the plurality of protrusions 72 (a plurality of first supports of the present invention) arranged at intervals in the conveying direction. In the predetermined cross section, in addition to the protrusion 72D, a protrusion 72E (a second support of the present invention) arranged side by side with the protrusion 72D in the width direction is provided. In the region where the protrusion 72 is formed in the vertical direction, a space S surrounded by the base surface 73, the protrusion 72, and an imaginary line L3 passing through the upper end of the protrusion 72 is formed (cf. FIG. 7B). In the present embodiment, one of the protrusions 72 and the base surface 73 are arranged side by side in the width direction in some of a plurality of cross sections orthogonal to the conveying direction. In the other of the plurality of cross sections orthogonal to the conveying direction, only the base surface 73 is disposed to extend in the width direction.

(State of tray on flat belt)

[0079] Next, the state of the tray T placed on the flat belt 53 will be described with reference to FIGS. 8A and 8B. FIG. 8A is a plan view illustrating a state in which the tray T and the yarn end of the yarn Y are placed on the flat belt 53. FIG. 8B is a cross-sectional view taken along line VIII(b)-VIII(b) in FIG. 8A.

[0080] For the convenience of description, it is assumed that the entire tray T is superimposed on the flat belt 53 when viewed from the vertical direction (cf. FIGS. 8A and 8B). The lower surface Ta1 of the tray T placed on the flat belt 53 is in contact with the upper end portions (contact surfaces 74) of some protrusions 72 among the plurality of protrusions 72. For the convenience of description, when the tray T is placed on the flat belt 53, a total value of areas of contact portions of the lower surface Ta1 in contact with the plurality of protrusions 72 (contact surfaces 74) is referred to as a contact area. In addition, an area of a non-contact portion of the lower surface Ta1 separated from (not in contact with) the base surface 73 is referred to as a non-contact area. The non-contact area is substantially equal to an area obtained by subtracting the contact area from the entire area of the lower surface Ta1. The contact area is preferably smaller than the non-contact area. The contact area is more preferably 20% or less of the entire area of the lower surface Ta1. Even more preferably, the contact area is 10% or less of the entire area of the lower surface Ta1. Each contact surface 74 and the lower surface Ta1 may be in point contact with each other. The point contact means that the area of the contact portion between the lower surface Ta1 and each contact surface 74 is, for example, 0.1 mm² or less. When the tray T is placed on the flat belt 53, the shortest distance (i.e., the distance between the lower surface Ta1 and the base surface 73

in the direction orthogonal to the base surface 73) between the lower surface Ta1 and the base surface 73 is preferably 0.2 mm or more and 5 mm or less.

5 (Movement of Yarn on Flat Belt and Tray)

[0081] Next, the movement of the yarn Y that has fallen on the flat belt 53 and the movement of the tray T placed on the flat belt 53 will be described with reference to FIGS. 8A and 8B.

[0082] For example, another tray T (not illustrated) is located upstream of the tray T (a tray T1) illustrated in FIG. 8A in the conveying direction. The yarn Y remains on the yarn supplying bobbin Bs loaded on another tray T mentioned above. Another tray T mentioned above has stopped moving or is moving at a low speed, for example, at or near the outlet 45 of the individual path 42. When the yarn Y hangs down from the yarn supplying bobbin Bs loaded on the tray T and falls onto the flat belt 53, the yarn end of the yarn Y is unwound from the yarn supplying bobbin Bs by the flat belt 53 and swept downstream in the conveying direction (cf. FIG. 8A). When the yarn Y is pulled by the yarn supplying bobbin Bs and the flat belt 53, the yarn Y stops on the flat belt 53 or moves at a speed slower than the moving speed of the flat belt 53.

[0083] Here, as described above, the space S surrounded by the base surface 73, the protrusion 72, and the imaginary line L3 is formed in the cross section orthogonal to the conveying direction (cf. FIG. 7B). Therefore, when the lower surface Ta1 of the tray T is in contact with the contact surface 74, a gap is formed between the lower surface Ta1 of the tray T and the base surface 73 in the vertical direction. The yarn Y that has fallen on the flat belt 53 fits in this gap, thereby greatly reducing the possibility of the tray T1 coming into contact with the yarn Y that has stopped moving or is moving at a low speed. This greatly reduces the possibility of the tray T1 getting caught by the yarn Y and being hindered from moving. Therefore, the tray T1 is smoothly conveyed downstream in the conveying direction.

[0084] Even when the plurality of trays T are stuck on the flat belt 53, the plurality of trays T can smoothly slide on the protrusion 72 (the contact surface 74) when being pressed against each other. As a result, even when the flat belt 53 continues to be driven by the motor 54, it is possible to avoid the unintentional forcible movement of the tray T being stuck and an increase in load on the motor 54.

[0085] As described above, the space S is formed by the base surface 73 at a position where the protrusion 72 is not formed in the width direction of the flat belt 53. Therefore, when the lower surface Ta1 of the tray T is in contact with the protrusion 72, a gap is formed between the lower surface Ta1 of the tray and the base surface 73 in the vertical direction. The yarn Y that has fallen and extended on the flat belt 53 fits in this gap, enabling the tray T placed on the protrusion 72 to pass over the yarn Y without getting caught by the yarn Y. Therefore, it is

possible to prevent the sticking of the tray due to the yarn Y that has fallen on the flat belt 53. Each of the protrusions 72 is in contact with the lower surface Ta1 of the tray T and is not in contact with the side surface of the tray T. Thus, even when the plurality of trays T are stuck on the flat belt 53, the plurality of trays T can slide on the protrusion 72 when being pressed against each other. As a result, even when the flat belt 53 continues to be driven, it is possible to avoid unintentional forcible movement of the tray T being stuck and an increase in load on the motor 54. As thus described above, it is possible to avoid the sticking of the tray T due to the yarn Y that has fallen on the flat belt 53 while avoiding the complexity of controlling the drive source of the flat belt 53.

[0086] The protrusion 72D and the protrusion 72E can be brought into contact with the lower surface of the tray T. It is thus possible to prevent the tray T from being unbalanced.

[0087] The flat belt 53 having the base surface 73 is used as the belt member of the present invention. When the yarn falls on the flat belt 53, the problem of the tray T being stuck is likely to occur as described above, and hence it is particularly effective that the plurality of protrusions are formed as the retreated portion as of the present invention.

[0088] The contact area of each of the plurality of protrusions 72 is as small as 0.1 mm² or less, thereby enabling an increase in the area of the base surface 73. Therefore, it is possible to effectively prevent the tray T from getting caught by the yarn Y on the flat belt 53.

[0089] The interval between the lower surface Ta1 of the tray T and the base surface 73 is 0.2 mm or more and is large to some extent. Hence, it is possible to effectively lower the probability of the lower surface Ta1 of the tray T coming into contact with the yarn Y that has fallen on the flat belt 53. On the other hand, when the interval is excessively wide (i.e., when the protrusion 72 is excessively high), the protrusion 72 is less likely to deform, so that stress concentration may occur at the boundary between the protrusion 72 and the base surface 73 in a portion of the flat belt 53 that is wound around the belt feeding roller 51 or 52 and curved, and the flat belt 53 may be easily damaged. In the present embodiment, the protrusion 72 is 5 mm or less and is not excessively high, so that such a risk can thus be reduced.

[0090] The plurality of protrusions 72 are arranged in a zigzag shape. That is, the plurality of protrusions 72 are arranged to be scattered to some extent in both the width direction and the conveying direction. Therefore, the frictional force acting between the lower surface Ta1 of the tray T and the plurality of protrusions 72 can be prevented from varying depending on the placement position of the tray T. It is thus possible to prevent the conveyance of the tray T from becoming unstable.

[0091] When viewed from above, three imaginary line segments formed by connecting the centers of the protrusions 72A, 72B, 72C form the equilateral triangle TR. That is, the plurality of protrusions 72 are uniformly ar-

ranged when viewed from above, so that it is possible to effectively prevent variation in frictional force acting between the lower surface Ta1 of the tray T and the plurality of protrusions 72 depending on the placement position of the tray T.

[0092] The distance between the centers of the protrusions 72A, 72B is 4 mm or more and 8 mm or less. Thus, it is possible to effectively achieve the balance between the level of the probability that the yarn Y falls on the base surface 73 and the magnitude of the frictional force acting between the lower surface Ta1 of the tray T and the plurality of protrusions 72.

[0093] The plurality of protrusions 72 are arranged at a density of 150 or more and 750 or less per unit region. Thus, it is possible to effectively achieve the balance between the level of the probability that the yarn Y falls on the base surface 73 and the magnitude of the frictional force acting between the lower surface Ta1 of the tray T and the plurality of protrusions 72.

[0094] The shape of each protrusion 72 is a dome shape or a shape similar to the dome shape. The base surface 73 (i.e., the retreated portion of the present invention) can be formed of the flat belt 53 having the protrusion 72 of such a simple shape as described above. This can prevent an increase in the component cost of the flat belt 53.

[0095] The flat belt 53 can be formed of a commonly used polyurethane as a material. This can prevent an increase in the component cost of the flat belt 53.

[0096] The contact area of the lower surface Ta1 of the tray T in contact with the plurality of protrusions 72 are smaller than the non-contact area of the lower surface Ta1 of the tray T not in contact with the base surface 73. Hence, the wide space S in the width direction can be formed by the protrusion 72 and the base surface 73. This can increase the probability that the yarn having fallen on the flat belt 53 fits in the space S. Therefore, the sticking of the tray T due to the yarn Y that has fallen on the flat belt 53 can be prevented more effectively.

[0097] With the contact area being 20% or less of the area of the lower surface Ta1 of the tray T, the sticking of the tray T due to the yarn Y that has fallen on the flat belt 53 can be prevented more effectively. With the contact area being 10% or less of the area of the lower surface Ta1 of the tray T, the sticking of the tray T due to the yarn Y that has fallen on the flat belt 53 can be prevented very effectively.

[0098] Next, a description will be given of alternative embodiments in which various modifications are made to the embodiment described above. However, components having the same configurations as those in the embodiment described above are denoted by the same reference numerals, and the description thereof will be appropriately omitted.

(1) In the above embodiment, the distance between the centers of any two adjacent protrusions 72 among the plurality of protrusions 72 have been 4

mm or more and 8 mm or less. However, the present invention is not limited thereto. The distance may be smaller than 4 mm or larger than 8 mm. In the above embodiment, the plurality of protrusions 72 have been disposed at a density of 150 or more and 750 or less per unit region described above. However, the density of the arrangement of the protrusions 72 is not limited thereto.

(2) In the embodiment described above, the arrangement direction of the plurality of protrusions 72 included in the first protrusion group and the arrangement direction of the plurality of protrusions 72 included in the second protrusion group have both been the width direction. However, the present invention is not limited thereto. The arrangement direction may be inclined with respect to the width direction.

(3) The arrangement of the plurality of protrusions 72 is not limited to that described above. That is, the plurality of protrusions 72 may not be arranged to form the equilateral triangle TR described above. Instead of the equilateral triangle TR, the plurality of protrusions 72 may be arranged to form, for example, a right-angled isosceles triangle (not illustrated). Such an arrangement is called a 45-degree staggered arrangement. The arrangement of the plurality of protrusions 72 may be an arrangement except for the 60-degree staggered arrangement and the 45-degree staggered arrangement. The plurality of protrusions 72 may be arranged in parallel, for example. Alternatively, the plurality of protrusions 72 may be arranged randomly, for example.

(4) In the embodiment described above, when the tray T is placed on the flat belt 53, the interval between the lower surface Ta1 and the base surface 73 has been 0.2 mm or more and 5 mm or less. However, the present invention is not limited thereto. The interval may be less than 0.2 mm. Alternatively, the interval may be larger than 5 mm.

(5) In the embodiment described above, the contact area described above has been smaller than the non-contact area described above. The contact area has been preferably 20% or less of the area of the lower surface Ta1 of the tray T, and more preferably 10% or less of the area of the lower surface Ta1. However, the present invention is not limited thereto. The contact area may be the same as or larger than the non-contact area. The lower surface Ta1 may not be in point contact with the protrusion 72. The contact surface 74 may have an area equal to or larger than a predetermined area.

(6) In the embodiment described above, the shape of each of the plurality of protrusions 72 has been a dome shape or a shape similar to the dome shape. However, the present invention is not limited thereto. The shape of the plurality of protrusions 72 may be, for example, a pyramid shape, a cylindrical shape, or a prismatic shape. Alternatively, the plurality of

protrusions 72 may extend long in the conveying direction. For example, the plurality of protrusions 72 may extend linearly or curvilinearly when viewed from the vertical direction. Even in this case, at least one of the plurality of protrusions 72 and the base surface 73 may be arranged side by side in the width direction in an arbitrary cross section orthogonal to the conveying direction of the flat belt 53. Here, the arbitrary cross section is a cross section at an arbitrary position where at least one of the plurality of protrusions 72 is disposed in the conveying direction. In a position where the plurality of protrusions 72 are not disposed in the conveying direction, the base surface 73 is preferably disposed over the entire length in the width direction.

(7) The material of the flat belt 53 is not limited to polyurethane. For example, the flat belt 53 may be made of polyvinyl chloride, thermoplastic polyolefin, nitrile-butadiene rubber (NBR), ethylene-propylene terpolymer (EPDM), silicon (SI), or polypropylene (PP). Alternatively, the flat belt 53 may be made of another material as long as the tray T can be conveyed.

(8) In the embodiment described above, the lower surface Ta1 of the tray T and the plurality of protrusions 72 have been in contact with each other. However, the present invention is not limited thereto. The flat belt 53 may be configured such that the lower surface Ta1 and only one protrusion 72 are in contact with each other. In such a case, the lower surface Ta1 may be inclined with respect to the base surface 73. Even in such a case, the tray T can be prevented from getting caught by the yarn Y that has fallen in the space S.

(9) In the embodiment described above, the flat belt 53 has been provided as the belt member of the present invention. However, the present invention is not limited thereto. Instead of the flat belt 53, a plurality of known round belts (not illustrated) arranged side by side in the width direction may be arranged. Even in such a configuration, a space corresponding to the space S described above can be formed. In this case, the plurality of round belts correspond to the belt member of the present invention. A portion of the round belt in contact with the lower surface Ta1 of the tray T corresponds to the support of the present invention. In the round belt, a portion not in contact with the lower surface Ta1 of the tray T (a portion disposed below the support) corresponds to the retreated portion of the present invention.

(10) The shape and size of the tray T are not limited to those described above. The tray T may have the lower surface Ta1 in contact with the contact surface 74.

(11) The yarn supplying bobbin conveying device 8 described above may be applied to any equipment other than the yarn winding equipment 1 requiring the conveyance of the yarn supplying bobbin Bs

around which the yarn Y is wound.

Claims

1. A yarn supplying bobbin conveying device (8) configured to convey a tray (T) in a predetermined conveying direction, the tray (T) supporting a yarn supplying bobbin (Bs) around which yarn (Y) is wound in an upright state, the yarn supplying bobbin conveying device (8) comprising:

a belt member (53) on which the tray (T) is to be placed;

a plurality of pulleys (51, 52) around which the belt member (53) is wound; and

a drive source (54) configured to rotationally drive at least one of the plurality of pulleys (51, 52),

wherein

the belt member (53) includes

a plurality of supports configured to support the tray (T) from below to apply to the tray (T) a frictional force for conveying the tray (T), and

a retreated portion disposed between the plurality of supports in a width direction orthogonal to the conveying direction and a vertical direction and disposed below the supports in the vertical direction.

2. The yarn supplying bobbin conveying device (8) as claimed in claim 1, wherein

the plurality of supports include

a plurality of predetermined supports arranged at intervals in the conveying direction, and

another support arranged side by side in the width direction with any one support among the plurality of predetermined supports in a cross section orthogonal to the conveying direction and including the one support.

3. The yarn supplying bobbin conveying device (8) as claimed in claim 2, wherein

the belt member (53) includes

a base surface (73) formed as the retreated portion and facing upward, and

a plurality of protrusions (72) formed as the plurality of supports and protruding upward from the base surface (73).

4. The yarn supplying bobbin conveying device (8) as claimed in claim 3, wherein a contact area of each of the plurality of protrusions (72) with a lower surface of the tray (T) is 0.1 mm² or less.

5. The yarn supplying bobbin conveying device (8) as

claimed in claim 3 or 4, wherein

when the tray (T) is placed on the plurality of protrusions (72) of the belt member (53), the lower surface of the tray (T) is disposed in parallel with the base surface (73) and separated from the base surface (73) at a predetermined interval, and

the predetermined interval is 0.2 mm or more and 5 mm or less.

6. The yarn supplying bobbin conveying device (8) as claimed in any one of claims 3 to 5, wherein

the plurality of protrusions (72) include

a plurality of protrusions arranged on a predetermined first imaginary line (L1) that extends along a predetermined direction when viewed from above, and

a plurality of protrusions arranged on a second imaginary line (L2) that is parallel to the first imaginary line (L1) and is different from the first imaginary line (L1), and arranged at positions closest to the plurality of protrusions on the first imaginary line (L1) in a direction orthogonal to the predetermined direction when viewed from above, and

in the predetermined direction, one protrusion among the plurality of protrusions arranged on the second imaginary line (L2) is disposed between any two protrusions adjacent to each other among the plurality of protrusions arranged on the first imaginary line (L1).

7. The yarn supplying bobbin conveying device (8) as claimed in claim 6, wherein the predetermined direction is the width direction.

8. The yarn supplying bobbin conveying device (8) as claimed in claim 6 or 7, wherein three imaginary line segments, formed by connecting centers of the two protrusions on the first imaginary line (L1) and the one protrusion on the second imaginary line (L2), form an equilateral triangle (TR) when viewed from above.

9. The yarn supplying bobbin conveying device (8) as claimed in claim 8, wherein a distance in the predetermined direction between the centers of the two protrusions is 4 mm or more and 8 mm or less.

10. The yarn supplying bobbin conveying device (8) as claimed in any one of claims 3 to 9, wherein when a region surrounded by a horizontal, imaginary square with a side length of 10 cm is defined as a unit region, the plurality of protrusions (72) are arranged at a

density of 150 or more and 750 or less per the unit region.

11. The yarn supplying bobbin conveying device (8) as claimed in any one of claims 3 to 10, wherein each of the plurality of protrusions (72) is curved to be convex upward in an arbitrary cross section extending along the vertical direction. 5
12. The yarn supplying bobbin conveying device (8) as claimed in any one of claims 1 to 11, wherein a material of the belt member (53) includes polyurethane. 10
13. The yarn supplying bobbin conveying device (8) as claimed in claim 1, wherein 15
- the belt member (53) includes a plurality of round belts arranged side by side in the width direction, and
- the retreated portion is formed between any two round belts adjacent to each other in the width direction among the plurality of round belts. 20
14. The yarn supplying bobbin conveying device (8) as claimed in any one of claims 1 to 13, wherein, when the tray (T) is placed on the belt member (53), a contact area of the lower surface of the tray (T) in contact with the plurality of supports is smaller than a non-contact area of the lower surface of the tray (T) without contact with the retreated portion of the belt member (53). 25 30
15. The yarn supplying bobbin conveying device (8) as claimed in claim 14, wherein the contact area is 10% or less of an area of the lower surface of the tray (T). 35

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FIG. 1

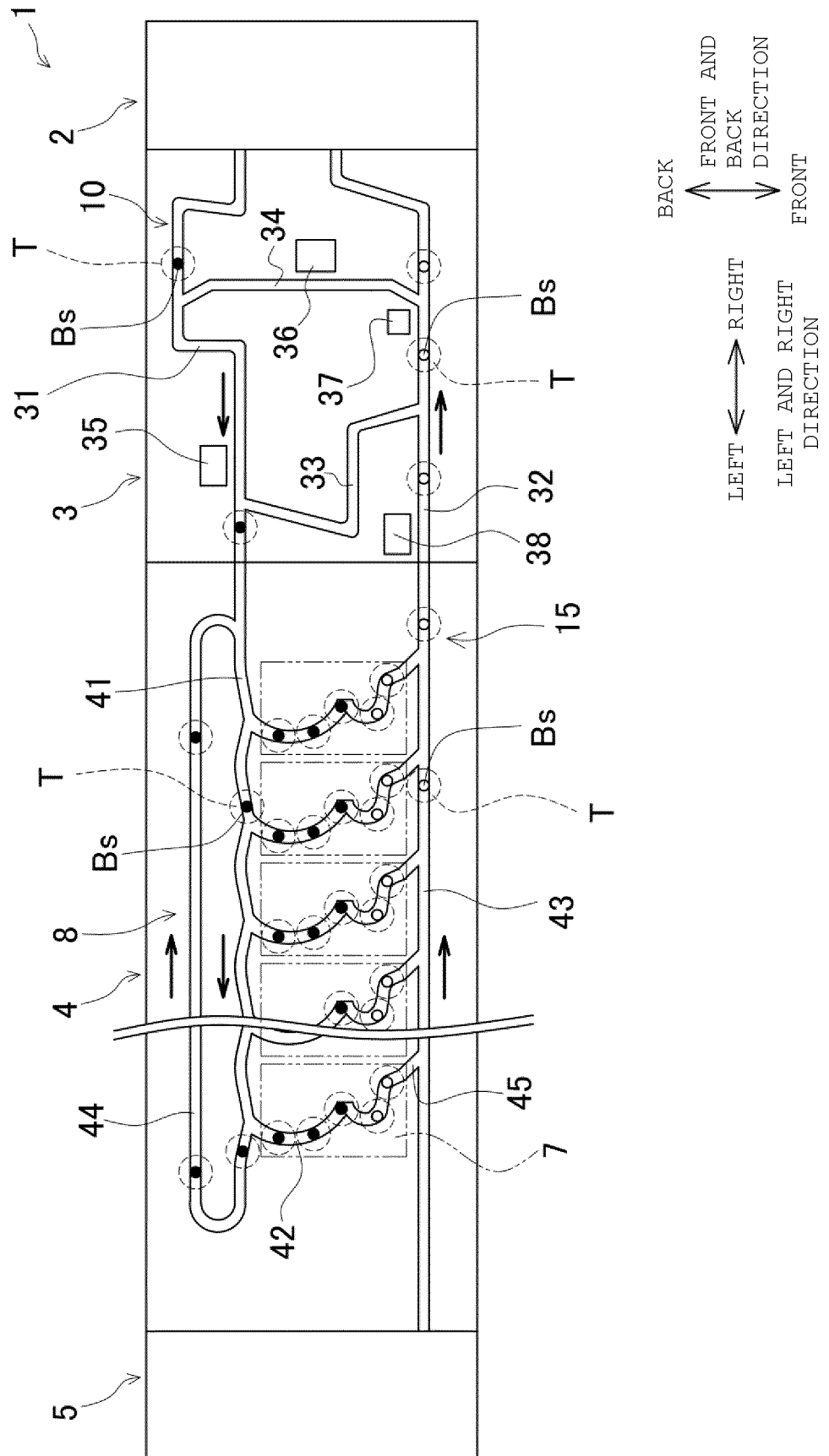


FIG. 2

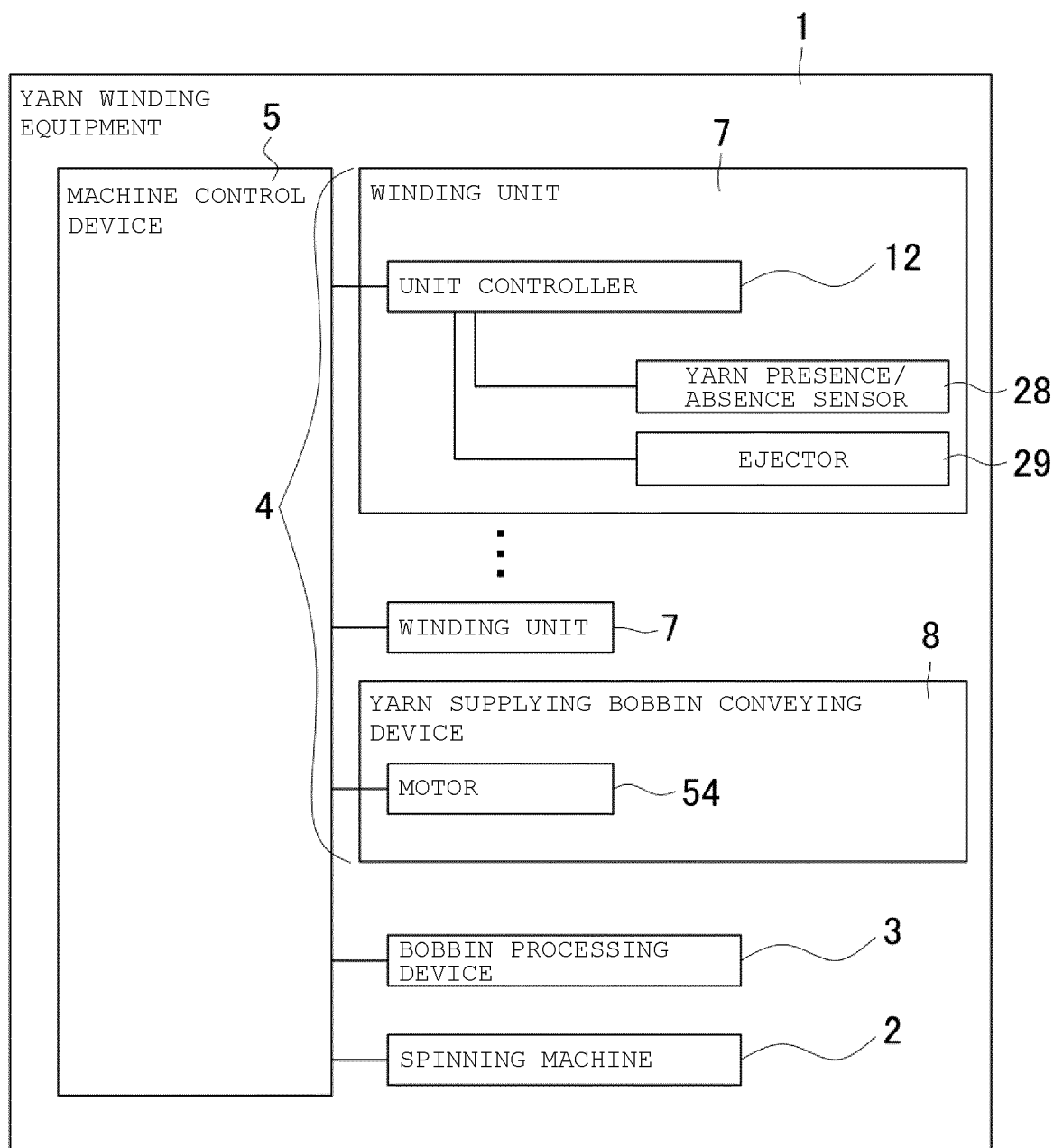


FIG. 3

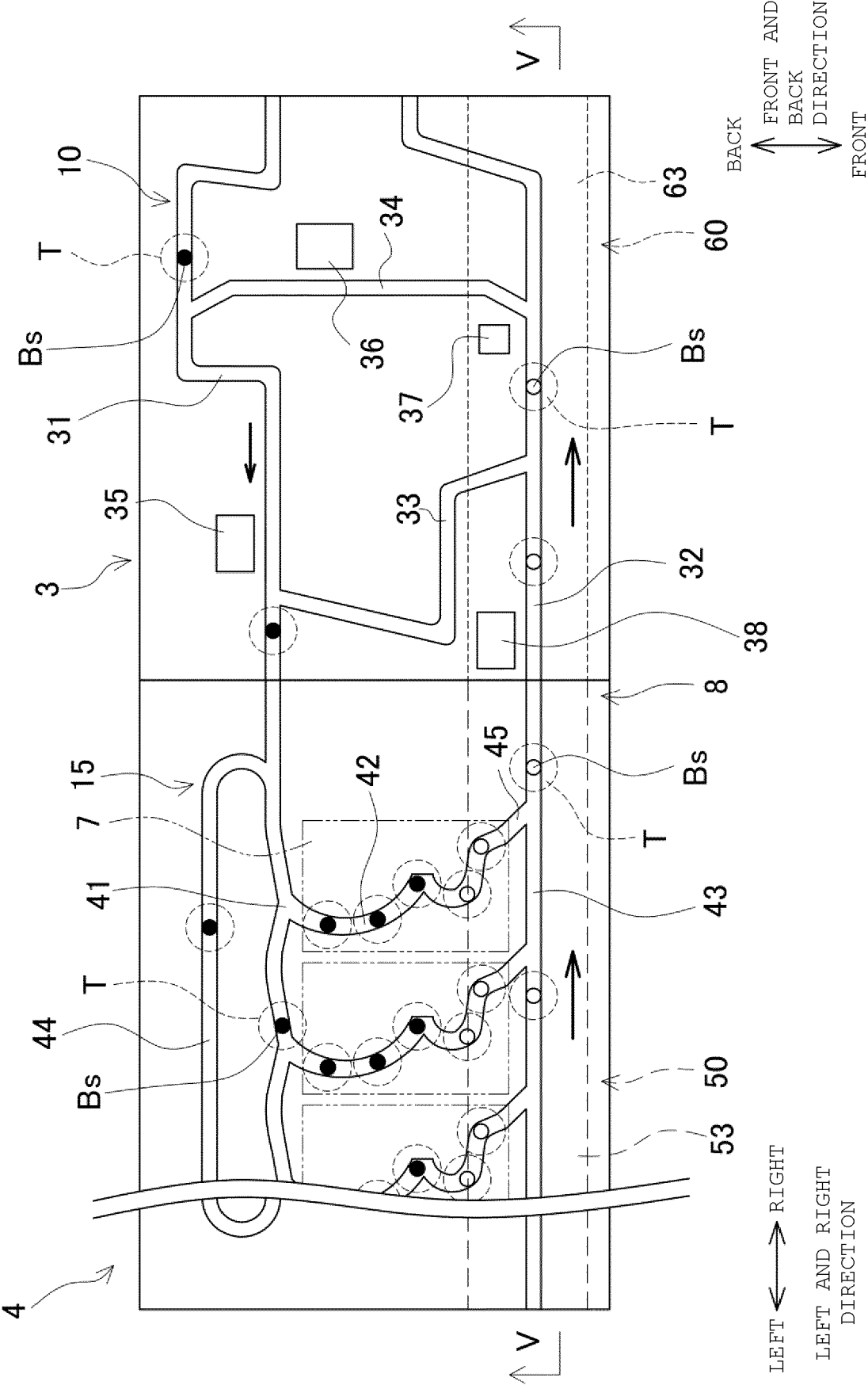


FIG. 4

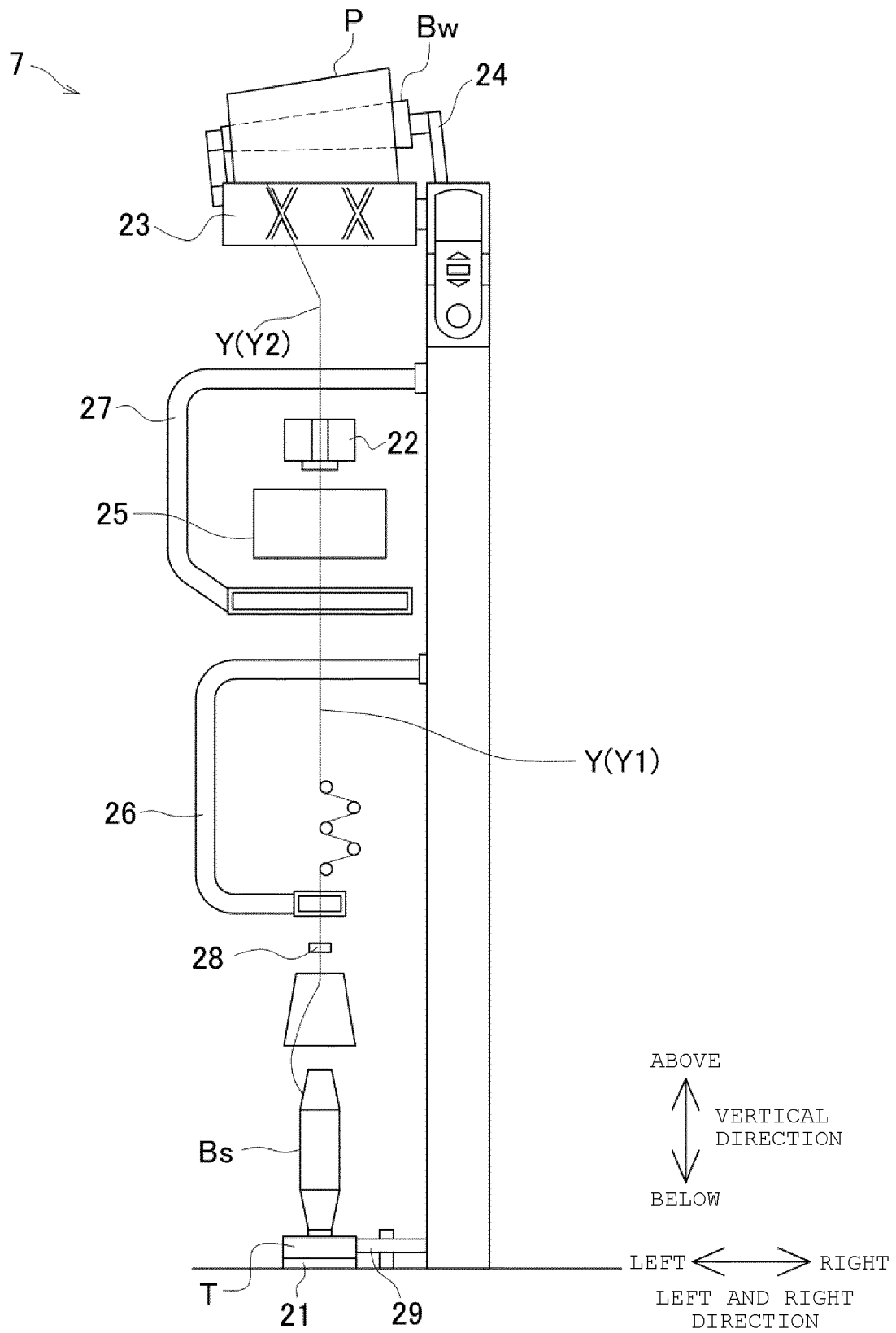


FIG. 5

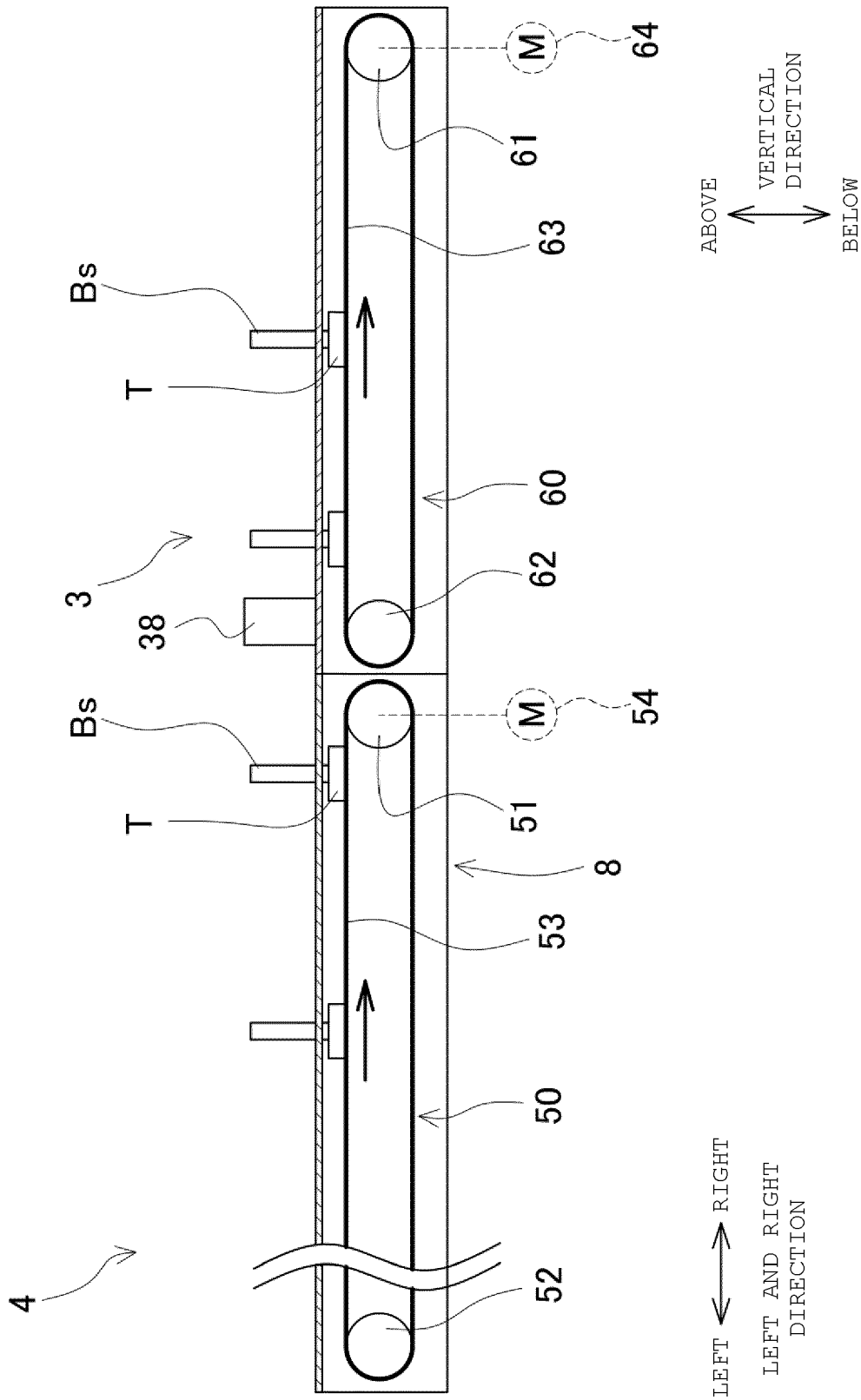


FIG. 6A

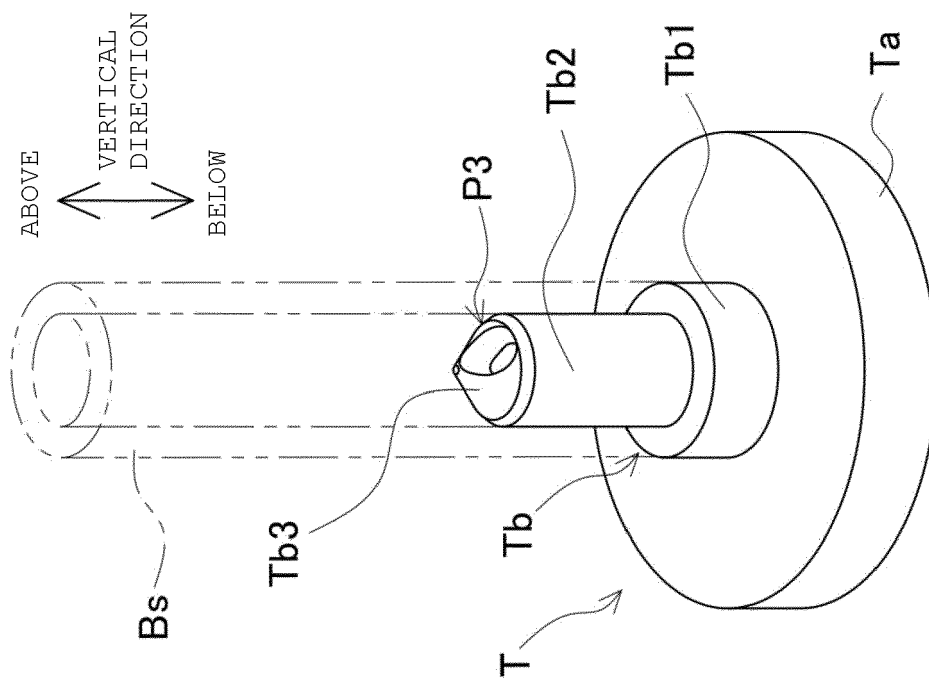


FIG. 6B

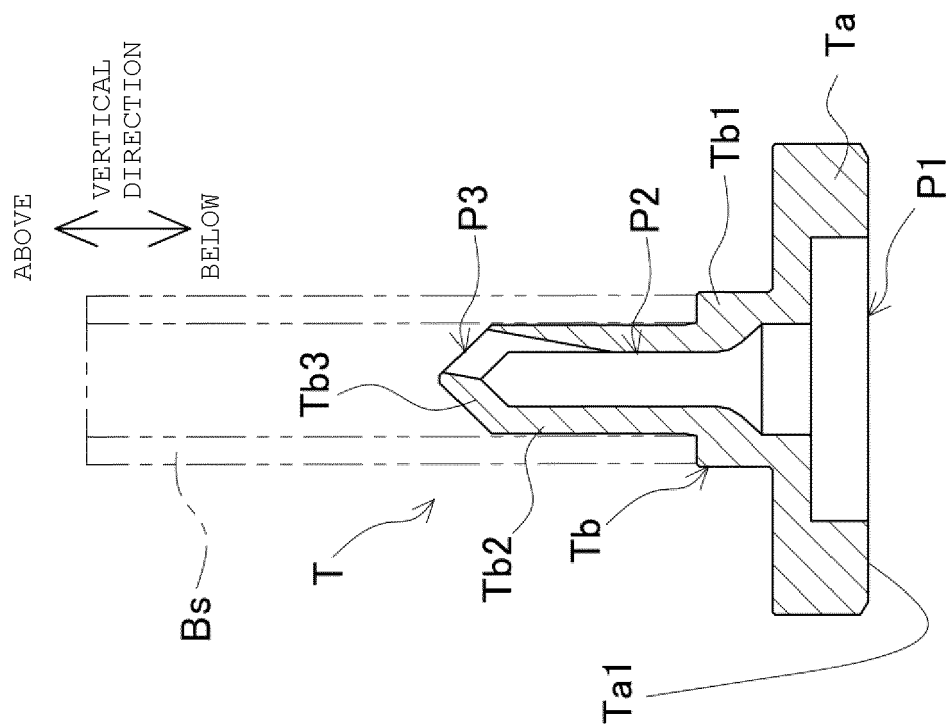


FIG. 7A

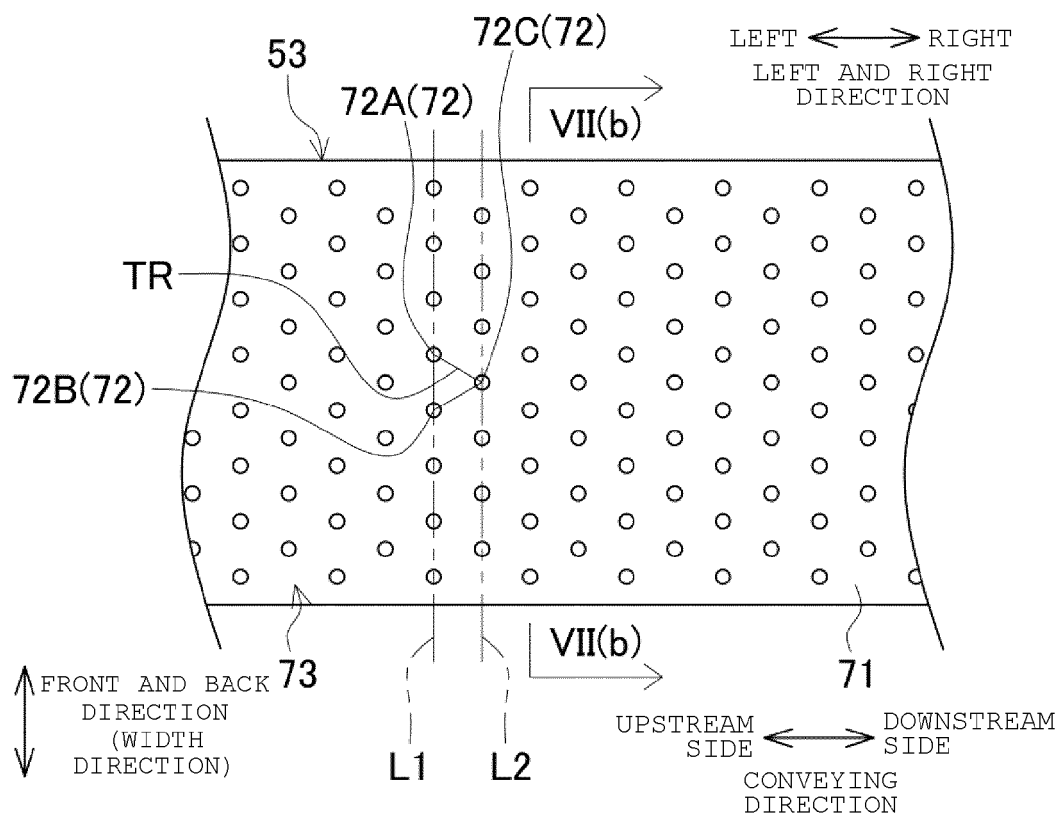


FIG. 7B

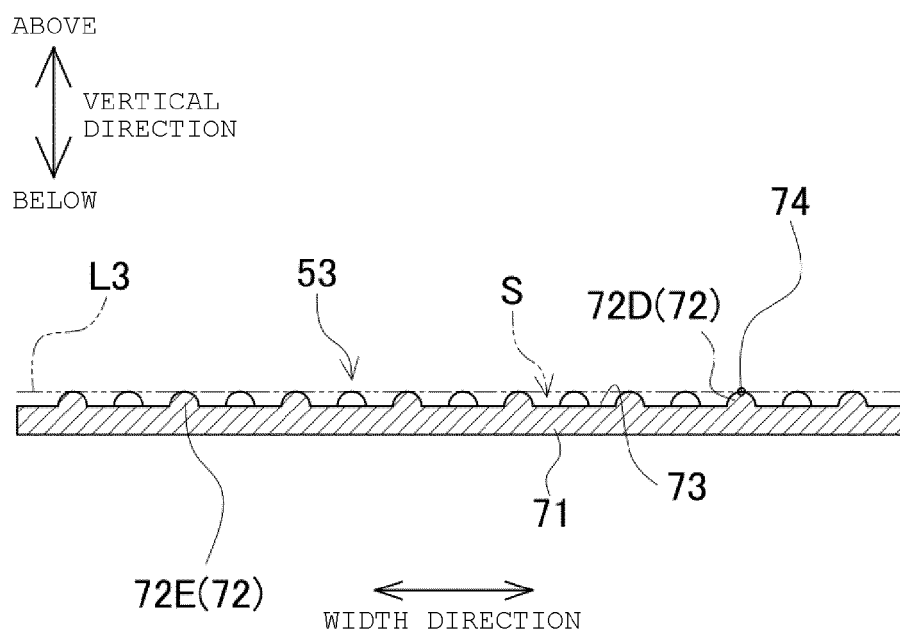


FIG. 8A

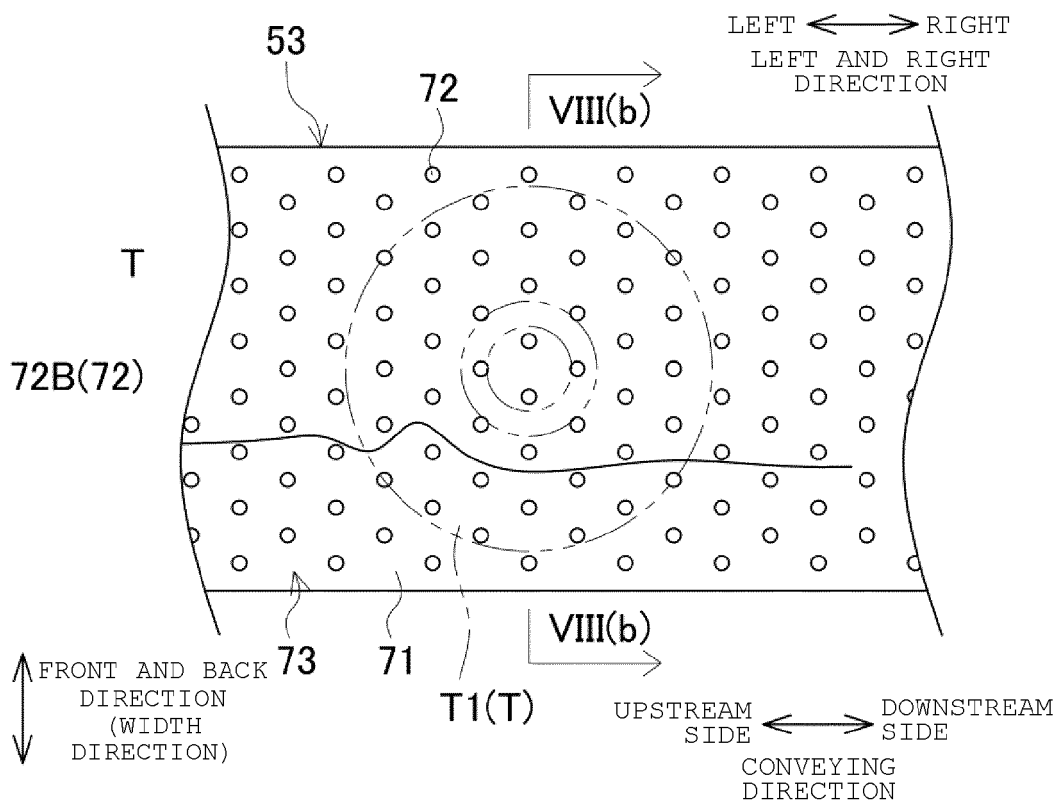
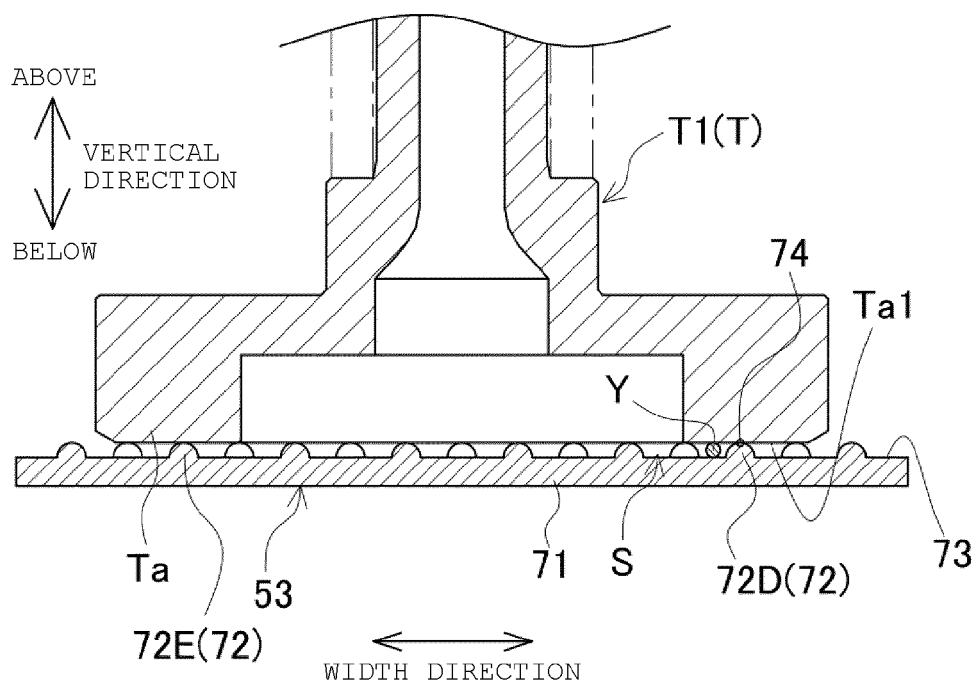


FIG. 8B





EUROPEAN SEARCH REPORT

Application Number

EP 23 18 3361

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A	* the whole document * -----	6-9	
X	JP 2008 214064 A (MURATA MACHINERY LTD) 18 September 2008 (2008-09-18) * paragraphs [0003], [0004]; figures 10, 11 *	1, 13-15	
X	JP H04 34273 U (-) 23 March 1992 (1992-03-23) * the whole document *	1, 14, 15	
X	US 5 335 776 A (BACKHAUS JUERGEN [DE]) 9 August 1994 (1994-08-09) * column 6, lines 39-61; figures 2, 9 *	1, 14	
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			B65H B65G D01H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 November 2023	Examiner Lemmen, René
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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The members are as contained in the European Patent Office EDP file on
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09-11-2023

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