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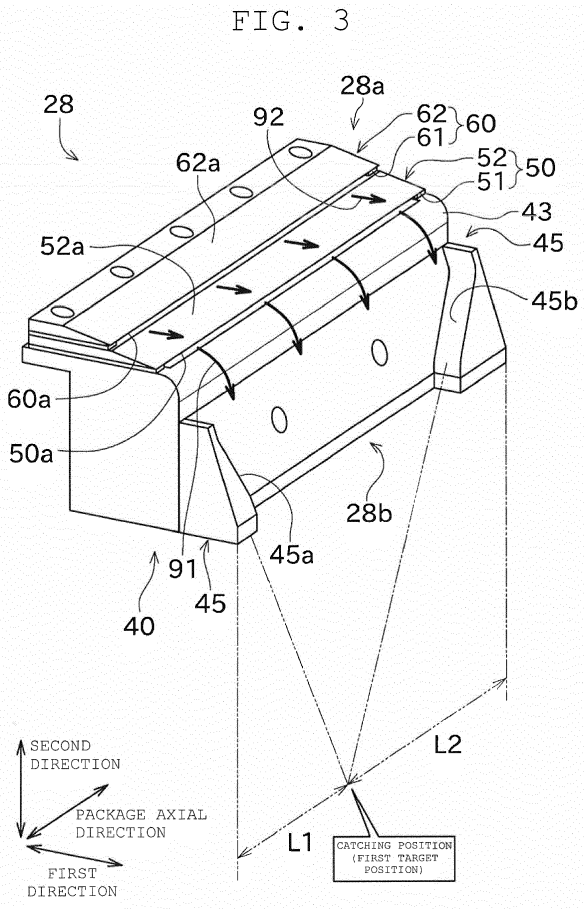
(54) **YARN WITHDRAWAL DEVICE AND YARN WINDING MACHINE**

(57) A yarn withdrawal device (28) includes a first injecting section (50) and a second injecting section (60). The first injecting section (50) is formed with a first slit (50a), and adapted to generate the first airflow (91) by air being injected from the first slit (50a). The second injecting section (60) is formed with a second slit (60a), and adapted to generate a second airflow (92) by air being injected from the second slit (60a), the second airflow being an airflow flowing in a direction different from a flow direction of the first airflow (91).

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a yarn withdrawal device adapted to withdraw a yarn from a package.

2. Description of the Related Art

[0002] A yarn withdrawal device arranged in proximity to a package and adapted to withdraw a yarn of the package to perform, for example, yarn joining operation is conventionally known. This type of yarn withdrawal device is disclosed in Japanese Patent Application Laid-open No. 2014-125348 (patent document 1), Japanese Utility Model Application Laid-open No. H5-5769 (patent document 2), and German Patent Application Publication No. 2426724 (patent document 3).

[0003] Patent document 1 discloses a yarn withdrawal device formed with one slit for injecting compressed air. Airflow generated by the compressed air injected from the slit flows along an outer wall surface of the yarn withdrawal device. Since the outer wall surface is arranged in proximity to the package, a yarn is withdrawn from the package by the airflow.

[0004] Patent documents 2 and 3 disclose yarn end withdrawal devices having a structure in which two nozzle tubes are arranged in an axial direction of the package. A plurality of nozzle holes are formed in each of the two nozzle tubes. A yarn entangled with the surface of the package can be detached (separated, removed, lifted) from the package by injecting the air from such nozzle holes.

BRIEF SUMMARY OF THE INVENTION

[0005] However, in the yarn withdrawal device of patent document 1, a range in which the airflow is acted on the package is not sufficient as only one slit is provided. As a result, there is a possibility that the yarn may not be withdrawn from the package. Furthermore, in patent documents 2 and 3, the strength of the airflow may become uneven in the axial direction of the package as the air is injected from the nozzle holes. As a result, there is a possibility that the yarn may not be withdrawn from the package.

[0006] It is a main object of the present invention to provide a yarn withdrawal device having a high possibility of succeeding in withdrawal of a yarn from a package.

[0007] According to a first aspect of the present invention, a yarn withdrawal device having the following structure is provided. That is, the yarn withdrawal device includes a first injecting section and a second injecting section. The first injecting section is formed with a first slit and adapted to generate a first airflow by air being injected from the first slit. The second injecting section is formed with a second slit along a longitudinal direction of the first slit and adapted to generate second airflow by air being injected from the second slit, the second airflow being an airflow flowing in a direction different from a direction of the first airflow.

[0008] Thus, the airflows along different flow directions are generated from the two slits, whereby the airflow can be easily acted on the package in a wide range. As a result, the probability of succeeding in withdrawal of a yarn from a package can be increased.

[0009] According to a second aspect of the present invention, a yarn withdrawal device having the following structure is provided. That is, the yarn withdrawal device includes a main body part, a first injecting section, and a second injecting section. The first injecting section includes a first spacer portion and a first cover portion, a first slit being formed by the first spacer portion being arranged between the first cover portion and the main body part, the first injecting section being adapted to generate a first airflow by air being injected from the first slit. The second injecting section includes a second spacer portion and a second cover portion, a second slit being formed by the second spacer portion being arranged between the second cover portion and the first cover portion, the second injecting section being adapted to generate a second airflow by air being injected from the second slit.

[0010] Thus, the airflow is generated from each of the two slits formed at different positions, whereby the airflows along different flow directions can easily act on the package. As a result, the probability of succeeding in withdrawal of a yarn from a package can be increased.

[0011] In the yarn withdrawal device, a thickness of at least one of the first spacer portion and the second spacer portion is preferably greater than or equal to 0.01mm and less than or equal to 5mm.

[0012] Thus, the success rate of the withdrawal of the yarn from the package can be sufficiently increased while reducing the amount of air supplied to the yarn withdrawal device.

[0013] The yarn withdrawal device preferably includes at least one of a first inclined surface and a second inclined surface, the first inclined surface being inclined so as to be continuous to a basal end of a flow of the first airflow and continuous to the first slit, and the second inclined surface being inclined so as to be continuous to a basal end of a flow of the second airflow and continuous to the second slit.

[0014] Thus, the air around the first slit and/or the second slit can be drawn into the first airflow and/or the second airflow, whereby the yarn from the package can be withdrawn while reducing the amount of air supplied to the yarn withdrawal device.

[0015] In the yarn withdrawal device, a surface adapted to guide air before being injected from the second slit preferably has an injection direction correcting surface inclined such that a height of the second slit increases

towards an end of the second slit from which the second airflow is injected.

[0016] Thus, since the second airflow flows away from the outer surface of the yarn withdrawal device, the second airflow can easily hit the package.

[0017] The yarn withdrawal device preferably includes a guiding section arranged downstream in a flow direction of the first airflow and adapted to guide the yarn withdrawn from the package towards center in a longitudinal direction of the first slit.

[0018] The position of the yarn withdrawn from the package by the yarn withdrawal device is thereby defined, and thus a next process can be easily carried out.

[0019] The yarn withdrawal device preferably has the following structure. That is, the yarn withdrawal device includes a first outer surface and a second outer surface. The first outer surface is provided with the first slit and the second slit. The second outer surface is arranged downstream in the flow direction of the first airflow with respect to the first outer surface. The guiding section is provided on the second outer surface.

[0020] Thus, the surface (first outer surface) for withdrawing the yarn from the package, and the surface (second outer surface) for guiding the withdrawn yarn can be separated, whereby the size of the yarn withdrawal device can be reduced.

[0021] The yarn withdrawal device preferably has the following structure. That is, a first guiding surface and a second guiding surface are formed on the guiding section and arranged to protrude from the second outer surface and to face one another. An interval between the first guiding surface and the second guiding surface increases towards the first outer surface.

[0022] Thus, the yarn withdrawn from the package is easily guided by the guiding section. Furthermore, as the yarn is guided to a narrow range by the guiding section, the next process can be easily carried out.

[0023] The yarn withdrawal device preferably includes a curved surface smoothly connecting the first outer surface and the second outer surface and being curved to project outward. Thus, the second airflow easily flows in the direction different from the flow of the first airflow.

[0024] According to a third aspect of the present invention, a yarn winding machine having the following configuration is provided. That is, the yarn winding machine includes the yarn withdrawal device and a winding section. The winding section is adapted to rotate a winding tube in a winding direction to form the package by winding the yarn. A longitudinal direction of the first slit is along an axial direction of the package. Thus, the yarn can be withdrawn from the package by the yarn withdrawal device.

[0025] The yarn winding machine preferably has the following structure. That is, a flow direction of the first airflow is set to guide the yarn withdrawn from the package to a first target position, and a flow direction of the second airflow is set towards the package.

[0026] Thus, since the functions of the first airflow and the second airflow can be differed from each other, the yarn can be withdrawn from the package and the withdrawn yarn can be guided to the first target position.

[0027] The yarn winding machine preferably has the following structure. That is, the winding section is configured to rotate the package also in a reverse rotational direction, which is a direction opposite to the winding direction. The second slit is formed downstream of the first slit in the reverse rotational direction of the package.

[0028] Thus, the yarn is detached (separated, removed, lifted) from the package or the detaching of the yarn is assisted by the second airflow, and the detached yarn can be fed downstream by the first airflow.

[0029] The yarn winding machine preferably has the following structure. That is, the yarn winding machine includes a first catching member adapted to catch the yarn withdrawn from the package by the yarn withdrawal device. The first target position is a catching position of the first catching member.

[0030] The success rate of the catching of the yarn by the first catching member thus can be increased.

[0031] The yarn winding machine preferably has the following structure. That is, the first catching member is adapted to catch the yarn by sucking the yarn and to guide the caught yarn to a second target position. A suction force of the first catching member is set such that a suction force when catching the yarn is greater than a suction force when guiding the yarn to the second target position.

[0032] This can lower the probability of failing in catching of the yarn and can also lower the probability of yarn breakage when guiding the yarn.

[0033] The yarn winding machine preferably includes a second catching member adapted to receive the caught yarn from the first catching member and to guide the yarn to a third target position,

[0034] Thus, the yarn can be guided to the target position while reducing the size and/or movable range of each catching member.

[0035] The yarn winding machine preferably has the following structure. That is, the yarn winding machine includes a plurality of winding units and a service vehicle. The winding units each includes at least the winding section. The service vehicle is adapted to be movable with respect to the plurality of the winding units. The service vehicle includes the yarn withdrawal device.

[0036] Thus, the cost of the yarn winding machine can be reduced by arranging one yarn withdrawal device with respect to the plurality of winding units.

[0037] The yarn winding machine preferably has the following structure. That is, the yarn winding machine includes a plurality of winding units, each including at least the winding section. The yarn withdrawal device is arranged in each of the plurality of the winding units.

[0038] Thus, when the withdrawal of the yarn from the package becomes necessary in a winding unit, the yarn can be immediately withdrawn from the package, and hence the production efficiency of the package can be

enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039]

FIG. 1 is a front view of an automatic winder according to an embodiment of the present invention;
FIG. 2 is a side view illustrating a schematic structure of a winding unit;
FIG. 3 is a perspective view of an outer appearance of a yarn withdrawal device;
FIG. 4 is an exploded perspective view of the yarn withdrawal device;
FIG. 5 is a side view of the yarn withdrawal device and a package; and
FIG. 6 is a side cross-sectional view of a proximity of a first slit and a second slit.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0040] Exemplary embodiments of the present invention will be described in detail below with reference to the accompanying drawings.

[0041] As illustrated in FIG. 1, an automatic winder (yarn winding machine) 1 includes a plurality of winding units 10 arranged in line, a doffing device 5, and a main control device 100.

[0042] Each of the winding units 10 is adapted, while traversing a yarn 20 unwound from a yarn supplying bobbin 21, to wind the yarn 20 around a winding tube 22 supported by a cradle (winding tube supporting section) 23 to form a package 30.

[0043] When the package 30 is fully wound in any of the winding units 10, the doffing device 5 travels up to the position of the relevant winding unit 10, discharges the fully wound package 30 from the winding unit 10 (doffing operation), and supplies a winding tube 22, around which the yarn 20 is not wound, to the winding unit 10.

[0044] The main control device 100 includes a machine setting section 101 and a machine display section 102. The machine setting section 101 can carry out setting with respect to each of the winding units 10 by enabling an operator to input predetermined set values, select an appropriate control method, and the like. The machine display section 102 can display a winding status of the yarn 20 in each of the winding units 10, content of trouble that occurred, and the like.

[0045] A structure of the winding unit 10 will now be specifically described with reference to FIG. 2.

[0046] The winding unit 10 includes a yarn unwinding assisting device 12, a tension applying device 13, a yarn joining device 14, a clearer 15, and a winding section 18 arranged in such order from the yarn supplying bobbin 21 on a yarn travelling path between the yarn supplying bobbin 21 and the winding tube 22.

[0047] The yarn unwinding assisting device 12 includes a regulating member 25 placed over a core tube of the yarn supplying bobbin 21. The yarn unwinding assisting device 12 assists in the unwinding of the yarn 20 from the yarn supplying bobbin 21 by lowering the regulating member 25 accompanying the unwinding of the yarn 20 from the yarn supplying bobbin 21. The regulating member 25 is brought into contact with a balloon formed at an upper part of the yarn supplying bobbin 21 by rotation and a centrifugal force of the yarn 20 unwound from the yarn supplying bobbin 21 to control the balloon to an appropriate size, thus assisting the unwinding of the yarn 20. A sensor (not illustrated) adapted to detect a chase portion (upper end of yarn layer) of the yarn supplying bobbin 21 is arranged in proximity to the regulating member 25. When this sensor detects lowering of the chase portion, the regulating member 25 is lowered by, for example, an air cylinder (not illustrated).

[0048] The tension applying device 13 applies a predetermined tension on the travelling yarn 20. For example, a gate-type tension applying device, in which movable comb teeth are arranged with respect to fixed comb teeth, is used as the tension applying device 13. The movable comb teeth can be swung by a rotary solenoid to cause the movable comb teeth to be in an engaged state or in a released state with the fixed comb teeth. Other than the gate type tension applying device, a disk-type tension applying device, for example, can also be used as the tension applying device 13.

[0049] The yarn joining device 14 joins a yarn 20 (lower yarn) from the yarn supplying bobbin 21 and a yarn 20 (upper yarn) from the package 30 when yarn cutting is performed upon detection of a yarn defect by the clearer 15 or when yarn breakage occurs during the unwinding of the yarn 20 from the yarn supplying bobbin 21. The yarn joining device 14 can be of a mechanical type or of a type that uses fluid such as compressed air.

[0050] The clearer 15 includes a sensor (not illustrated) adapted to detect, for example, the thickness of the yarn 20 and/or presence or absence of foreign substances in the yarn 20. The clearer 15 detects yarn defects, such as slub, by monitoring a yarn thickness signal output by the sensor. A cutter 39 is arranged in proximity to the clearer 15 to cut the yarn 20 immediately when the clearer 15 detects a yarn defect.

[0051] A lower yarn catching member 33 is arranged below the yarn joining device 14, and adapted to catch the lower yarn from the yarn supplying bobbin 21 and guide the lower yarn to the yarn joining device 14. An upper yarn catching member (first catching member) 36 is arranged above the yarn joining device 14, and adapted to catch the upper yarn from the package 30 and guide the upper yarn to the yarn joining device 14.

[0052] The lower yarn catching member 33 is swingable with a shaft 34 as a center. The upper yarn catching member 36 is swingable with a shaft 37 as a center. Each of the lower yarn catching member 33 and the upper yarn catching member 36 is connected to an appropriate negative pressure source (not illustrated). Thus, a suction

flow can be generated at an opening of a distal end of the lower yarn catching member 33 to suck and catch the lower yarn with the lower yarn catching member 33. A suction flow can also be generated at an opening of a distal end of the upper yarn catching member 36 to suck and catch the upper yarn with the upper yarn catching member 36. At least one of the lower yarn catching member 33 or the upper yarn catching member 36 is not limited to a configuration of catching the yarn 20 by generating the suction flow, and may have a configuration of catching the yarn 20 using a member adapted to clamp the yarn 20.

[0053] The winding section 18 includes the cradle 23 adapted to detachably support the winding tube 22, and a contact roller 29 adapted to be rotatable while making contact with an outer peripheral surface of the winding tube 22 or an outer peripheral surface of the package 30.

[0054] The cradle 23 is supported to be swingable in a direction approaching the contact roller 29 and in a direction away from the contact roller 29. Increase in the diameter of the yarn layer of the package 30 accompanying the winding of the yarn 20 on the winding tube 22 can be absorbed by the swinging of the cradle 23.

[0055] The contact roller 29 is arranged to oppose the winding tube 22 and to make contact with the winding tube 22 or the package 30. Therefore, by rotating the contact roller 29, the winding tube 22 or the package 30 can be rotated. A traverse groove (not illustrated) is formed on the outer peripheral surface of the contact roller 29, and the yarn 20 can be traversed within a predetermined width by the traverse groove. Accordingly, the winding unit 10 can wind the yarn 20 around the winding tube 22 while traversing the yarn 20 to form the package 30.

[0056] The traverse method of the yarn 20 is not limited to the traverse groove, and may be a traverse mechanism (rod-type traverse device, arm-type traverse device, or belt-type traverse device) independently arranged from the contact roller 29. In this case, in place of the configuration in which the contact roller 29 is driven and the winding tube 22 or the package 30 is rotated following the rotation of the contact roller 29, the winding tube 22 or the package 30 may be driven and the contact roller 29 may be rotated following the rotation of the winding tube 22 or the package 30.

[0057] A yarn withdrawal device 28 is arranged in proximity to the contact roller 29 and the package 30. The yarn withdrawal device 28 is a device adapted to withdraw the yarn 20 from the package 30. When the yarn 20 between the yarn supplying bobbin 21 and the package 30 is disconnected, the yarn withdrawal device 28 injects air to generate an airflow to withdraw the yarn 20 from the package 30. A case in which the yarn 20 is disconnected includes, for example, a case in which the yarn 20 is broken and/or a case in which the yarn 20 is cut with a cutter 39 upon detection of a yarn defect by the clearer 15, and the like.

[0058] The timing for the yarn withdrawal device 28 to start the injection of air may be when the package 30 is rotating in a reverse rotational direction (unwinding direction), which is a direction opposite to the winding direction, or when the package 30 stops rotating in the winding direction and starts rotating in the reverse rotational direction. The yarn withdrawal device 28 may inject air while the package 30 decelerates from the state of rotating in the winding direction to prevent the yarn 20 from attaching to the package 30. Thus, the yarn withdrawal device 28 can more reliably withdraw the yarn 20 from the package 30. When withdrawing the yarn 20 from the package 30, the winding section 18 reversely rotates the package 30. When failing in the withdrawal of the yarn 20 from the package 30, the reverse rotation of the package 30 is stopped, and the package 30 is rotated several times in the winding direction. In this case, the airflow may be injected from the yarn withdrawal device 28. Thus, when carrying out the withdrawal of the yarn 20 from the package 30 the second time, the probability of withdrawal of the yarn 20 from the package 30 increases. The yarn 20 (upper yarn) withdrawn from the package 30 in such a manner is caught by the upper yarn catching member 36, and guided to the yarn joining device 14 (second target position). The upper yarn guided to the yarn joining device 14 is joined with the lower yarn caught and guided by the lower yarn catching member 33 by the yarn joining device 14.

[0059] The upper yarn catching member 36 is set such that the suction force when sucking and catching the yarn 20 becomes greater than the suction force when guiding the sucked yarn 20 to the yarn joining device 14. Thus, the probability of failing in catching at the time of catching the yarn 20 can be lowered, and the probability of yarn breakage at the time of guiding the yarn 20 can be lowered. However, the suction force of the upper yarn catching member 36 may be a constant suction force from the time of catching to the time of guiding.

[0060] A structure of the yarn withdrawal device 28 will be hereinafter described in detail with reference to FIGS. 3 to 6.

[0061] As illustrated in FIG. 3, the yarn withdrawal device 28 has a substantially rectangular parallelpiped shape, and includes a first outer surface 28a and a second outer surface 28b. As illustrated in FIG. 5, the yarn withdrawal device 28 is arranged such that the first outer surface 28a and the second outer surface 28b are located in proximity to the package 30. The first outer surface 28a is arranged at an angle along the surface of the package 30 (angle close to a tangential direction of the package 30). The yarn withdrawal device 28 detaches the yarn 20 from the package 30 and feeds the yarn 20 toward the second outer surface 28b by the airflow (specifically, first airflow 91 and second airflow 92 to be described later) generated on the first outer surface 28a to withdraw the yarn 20 from the package 30. The second outer surface 28b is arranged at an angle to lie along a radial direction of the package 30. The second outer surface 28b is located on a downstream side of the first outer surface 28a in a flow direction of the airflow. The yarn

withdrawal device 28 guides the yarn 20 detached from the package 30 along the second outer surface 28b to an opening (catching position, first target position) of the upper yarn catching member 36 arranged at a catching position (position of chain double dashed line in FIG. 2) .

[0062] As illustrated in FIG. 3, the yarn withdrawal device 28 includes a main body part 40, a first injecting section 50, and a second injecting section 60. In the following description, as illustrated in FIGS. 3 and 4, an axial direction of the package 30 (winding tube 22) is referred to as "package axial direction". When seen in the package axial direction (i.e., in side view such as FIG. 5), a direction along the first outer surface 28a (more precisely, a direction along a portion not formed with an inclined surface) is referred to as a "first direction". A direction perpendicular to the first direction when seen in the package axial direction is referred to as a "second direction".

[0063] The main body part 40 is attached in proximity to the winding section 18 by an attachment mechanism (not illustrated). The main body part 40 may be movable between a position in proximity to the package 30 and a position spaced apart from the package 30. An air supplying tube 81 adapted to supply compressed air is attached to the main body part 40. The main body part 40 is provided with a first air supplying path 41, a second air supplying path 42, a curved surface 43, and a guiding section 45.

[0064] The first air supplying path 41 and the second air supplying path 42 are spaces formed inside the main body part 40, and are paths through which the compressed air supplied through the air supplying tube 81 flows. The compressed air flows along the second direction (specifically, toward a side where the first injecting section 50 and the second injecting section 60 are arranged) through the first air supplying path 41 and the second air supplying path 42. The first air supplying path 41 is formed on one side (specifically, a side close to the second outer surface 28b) of the second air supplying path 42 in the first direction. The compressed air supplied through the first air supplying path 41 is injected from the first injecting section 50 to generate the first airflow 91. The compressed air supplied through the second air supplying path 42 is injected from the second injecting section 60 to generate the second airflow 92. The first air supplying path 41 and the second air supplying path 42 are not divided into different sections by a partition and the like, and are connected. Therefore, the first airflow 91 and the second airflow 92 have a common air supplying path.

[0065] The curved surface 43 is a surface exposed to the exterior of the yarn withdrawal device 28. The curved surface 43 is a surface curved to smoothly connect the first outer surface 28a and the second outer surface 28b and to project outward.

[0066] The guiding section 45 is provided on the second outer surface 28b. The guiding section 45 is adapted to guide the yarn 20 withdrawn from the package 30 by the yarn withdrawal device 28 toward the first target position. The guiding section 45 includes two members protruding out in the first direction from respective ends in the package axial direction (package width direction) of the second outer surface 28b. One of the two members is provided with a first guiding surface 45a, and the other member is provided with a second guiding surface 45b.

[0067] The first guiding surface 45a and the second guiding surface 45b are arranged to face toward a center side in the package width direction so as to face one another. The first guiding surface 45a and the second guiding surface 45b are surfaces substantially perpendicular to the second outer surface 28b. An interval between the first guiding surface 45a and the second guiding surface 45b increases toward the first outer surface 28a (toward the curved surface 43). In other words, the interval between the first guiding surface 45a and the second guiding surface 45b becomes narrower toward the downstream side in the guiding direction of the yarn 20. At a position located closer toward the downstream side in the guiding direction of the yarn 20, the first guiding surface 45a and the second guiding surface 45b are respectively inclined so as to become closer toward the center side in the package axial direction.

[0068] As illustrated in FIG. 3, the first target position is not the center in the package axial direction, but is closer to the first guiding surface 45a (L1<L2 of FIG. 3) in the present embodiment. Thus, inclination angles of the first guiding surface 45a and the second guiding surface 45b of the present embodiment are different. Specifically, provided that a first length (thickness, width) of the guiding section 45 is a length between the first guiding surface 45a and the other end of the guiding section 45 located opposite to the center in the package axial direction, and a second length (thickness, width) of the guiding section 45 is a length between the second guiding surface 45b and the other end of the other guiding section 45 located opposite to the center in the package axial direction, when comparing at positions located downstream from an upstream end of the respective guiding section 45 by a predetermined length in the guiding direction of the yarn 20, the first length is shorter than the second length. When the first target position is the center in the package axial direction or the like, the inclination angles of the first guiding surface 45a and the second guiding surface 45b may be the same. The guiding section 45 may be a different member to be attached to the main body part 40, or may be integrally configured with the main body part 40.

[0069] The first injecting section 50 includes a first spacer portion 51 and a first cover portion 52. The first spacer portion 51 and the first cover portion 52 are plate-shaped members, which configure one part of the first outer surface 28a and are attached to the main body part 40 in the same direction (specifically, so that the thickness direction (height direction) becomes the same as the second direction).

[0070] The first spacer portion 51 is formed with a cut-

out 51a, air passing holes 51b, and attachment holes 51c. The cutout 51a is a portion in which an end in the first direction (specifically, an end on the second outer surface 28b side) is cut out to a rectangular shape. The cutout 51a is formed at a position overlapping the first air supplying path 41 when seen in the second direction (a flow direction of compressed air). Thus, the compressed air supplied through the first air supplying path 41 passes the cutout 51a.

[0071] The air passing holes 51b are through-holes formed on the other side (specifically, an opposite side of the second outer surface 28b, upstream in the flow direction of the second airflow 92) of the cutout 51a in the first direction. The air passing holes 51b are formed in plurals and arranged along the package axial direction. The air passing holes 51b are formed at positions overlapping the second air supplying path 42 when seen in the second direction. Thus, the compressed air supplied through the second air supplying path 42 passes the air passing holes 51b.

[0072] The attachment holes 51c are through-holes for attaching the first spacer portion 51 to the main body part 40. In the longitudinal direction of the first spacer portion 51, a plurality of (five in the present embodiment) attachment holes 51c are arranged alternately with the air passing holes 51b, and furthermore, a plurality of (five in the present embodiment) attachment holes 51c are formed on the other side in the first direction of the first spacer portion 51. In the present embodiment, the air passing hole 51b is larger than the attachment hole 51c.

[0073] The first cover portion 52 is formed with a plurality of attachment holes 52c. The attachment holes 52c are also through-holes. In the longitudinal direction of the first cover portion 52, a plurality of (five in the present embodiment) attachment holes 52c are arranged alternately with the air passing holes 52b, and furthermore, a plurality of (five in the present embodiment) attachment holes 52c are formed on the other side in the first direction of the first cover portion 52.

[0074] The second spacer portion 61 is formed with a plurality of attachment holes 61b along the longitudinal direction. The second cover portion 62 is formed with a plurality of attachment holes 62c along the longitudinal direction. The attachment holes 61b and the attachment holes 62c are through-holes.

[0075] A plurality of attachment holes (recesses) are formed in the main body part 40. Along the longitudinal direction of the main body part 40, a plurality of (five in the present embodiment) attachment holes are arranged alternately with the second air supplying path 42, and furthermore, a plurality of (five in the present embodiment) attachment holes are formed on the other side in the first direction of the main body part 40.

[0076] At a central part in the first direction of the yarn withdrawal device 28, a fixing tool such as a bolt is inserted with positions of following holes aligned, i.e. the plurality of attachment holes of the main body part 40 (attachment holes arranged alternately with the second air supplying path 42), the attachment holes 51c of the first spacer portion 51 (attachment holes arranged alternately with the air passing holes 51b), and the attachment holes 51 of the first cover portion 52 (attachment holes arranged alternately with the air passing holes 52b). Furthermore, on the other side in the first direction of the yarn withdrawal device 28, a fixing tool such as a bolt is inserted with positions of following holes aligned, i.e. the attachment holes of the main body part 40, the attachment holes 51c of the first spacer portion 51, the attachment holes 52c of the first cover portion 52, the attachment holes 61b formed in the second spacer portion 61, and the attachment holes 62c formed in the second cover portion 62.

[0077] Thus, the first spacer portion 51 is attached to the main body part 40 with the first cover portion 52, the second injecting section 60, and the like. Since the main body part 40, the first injecting section 50, and the second injecting section 60 are fixed with a plurality of fixing tools, air leakage can be prevented.

[0078] The first cover portion 52 is attached to the main body part 40 with the first spacer portion 51 therebetween and so as to cover the first spacer portion 51. Since the cutout 51a is formed in the first spacer portion 51, the first cover portion 52 is attached with respect to the main body part 40 with a spacing therebetween. Thus, a gap is formed on the inner side of the first cover portion 52, and this gap serves as the first slit 50a. Therefore, the longitudinal direction of the first slit 50a is the same as the package axial direction. The width (height, length in a shorter direction) of the first slit 50a is dependent on the thickness of the first spacer portion 51. The thickness of the first spacer portion 51 is preferably greater than or equal to 0.01 mm and less than or equal to 5 mm, and more preferably greater than or equal to 0.03 mm and less than or equal to 2 mm, or greater than or equal to 0.03 mm and less than or equal to 0.2 mm. The compressed air supplied through the first air supplying path 41 passes through the cutout 51a and is guided by the first cover portion 52 (specifically, a surface facing the main body part 40 side, an inner surface) to be injected from the first slit 50a. The first airflow 91 is thereby generated. The first airflow 91 mainly flows along the curved surface 43, and then flows along the second outer surface 28b. The first airflow 91 detaches the yarn 20 from the package 30, and guides the yarn 20 detached from the package 30.

[0079] The first cover portion 52 is formed with a first inclined surface 52a, the air passing holes 52b, and the attachment holes 52c. The first inclined surface 52a is formed on a surface (outer surface) facing the side opposite to the main body part 40. The first inclined surface 52a is formed from the first slit 50a to the other side of the first direction. The first inclined surface 52a is inclined toward one side of the first direction to approach the first spacer portion 51 (an inner side of the main body part 40). In other words, the first inclined surface 52a is inclined so as to be continuous to a basal end of the flow

of the first airflow 91. According to such a configuration, a first auxiliary airflow 93 (FIG. 5) is easily generated around the first slit 50a, and thus the air around the first slit 50a can be effectively drawn into the first airflow 91. In this manner, the yarn 20 of the package 30 can be more reliably withdrawn while reducing the flow volume of the airflow injected from the first slit 50a.

[0080] The air passing holes 52b are through-holes formed in plurals and arranged in the package axial direction. The air passing holes 52b are formed at a position overlapping the second air supplying path 42 and the air passing holes 51b when seen in the second direction. Thus, the compressed air supplied through the second air supplying path 42 passes through the air passing holes 51b and the air passing holes 52b.

[0081] The second injecting section 60 includes a second spacer portion 61 and a second cover portion 62. The second spacer portion 61 and the second cover portion 62 are plate-shaped members, and configure one part of the first outer surface 28a. The second spacer portion 61 and the second cover portion 62 are attached to the main body part 40 in the same direction (specifically, so that the thickness direction (height direction) becomes the same as the second direction) with the first injecting section 50 therebetween.

[0082] The second spacer portion 61 is formed with a cutout 61a and attachment holes 61b. The cutout 61a is a portion in which an end in the first direction (specifically, an end on the second outer surface 28b side, an end on the first slit 50a side) is cut out to a rectangular shape. The cutout 61a is formed at a position overlapping the second air supplying path 42 when seen in the second direction. Thus, the compressed air supplied through the second air supplying path 42, the air passing holes 51b, and the air passing holes 52b passes through the cutout 61a. The thickness (height) of the second spacer portion 61 is preferably greater than or equal to 0.01 mm and less than or equal to 5 mm, and more preferably greater than or equal to 0.03 mm and less than or equal to 2 mm, or greater than or equal to 0.03 mm and less than or equal to 0.2 mm.

[0083] The second cover portion 62 is attached to the main body part 40 with the second spacer portion 61 therebetween and so as to cover the second spacer portion 61. Since the cutout 61a is formed in the second spacer portion 61, the second cover portion 62 is attached with respect to the first cover portion 52 with a spacing therebetween. Thus, a gap is formed on the inner side of the second cover portion 62, and this gap serves as the second slit 60a. The compressed air supplied through the second air supplying path 42 and the like passes through the cutout 61a, and is guided by the second cover portion 62 (specifically, a surface facing the main body part 40 side, an inner surface) to be injected from the second slit 60a. The second airflow 92 is thereby generated.

[0084] The second cover portion 62 is formed with a second inclined surface 62a, an injection direction correcting surface 62b, and the attachment holes 62c. The second inclined surface 62a is formed on a surface (an outer surface) facing the side opposite to the main body part 40. The second inclined surface 62a is formed from the second slit 60a to the other side of the first direction. The second inclined surface 62a is inclined toward one side of the first direction to approach the second spacer portion 61 (an inner side of the main body part 40). In other words, the second inclined surface 62a is inclined so as to be continuous to a basal end of the flow of the second airflow 92. According to such a configuration, a second auxiliary airflow 94 is easily generated, and thus the air around the second slit 60a can be effectively drawn into the second airflow 92.

[0085] The injection direction correcting surface 62b is an inner surface of the second cover portion 62, and is particularly an inclined surface formed in proximity to the second slit 60a. As illustrated in FIG. 6, the injection direction correcting surface 62b is a surface inclined to be away from the main body part 40, the second spacer portion 61 and the like (so that the height of the second slit 60a increases) toward the second slit 60a. In other words, the injection direction correcting surface 62b is an inclined surface formed so that the plate thickness becomes thinner toward the second slit 60a, assuming that the outer surface (second inclined surface 62a) is flat.

[0086] The second airflow 92 generated by the compressed air injected from the second slit 60a is guided by the injection direction correcting surface 62b so as to mainly flow away from the first cover portion 52 and toward the package 30. In particular, in the present embodiment, the second slit 60a is arranged upstream of the first inclined surface 52a and not on the first inclined surface 52a of the first cover portion 52. Thus, the second airflow 92 is less likely to flow along the first inclined surface 52a toward the second outer surface 28b, whereby the second airflow 92 easily flows toward the package 30. The second airflow 92 is an airflow flowing toward the package 30 and thus easily hits the package 30. Therefore, the yarn 20 is easily detached from the package 30. The second airflow 92 flows in a direction different from the first airflow 91, and thus even if the yarn 20 cannot be detached from the package 30 with the first airflow 91, the yarn 20 may be detached from the package 30 with the second airflow 92. Therefore, the probability of succeeding in the withdrawal of the yarn 20 can be increased compared to when generating only the first airflow 91.

[0087] In order to effectively act the first airflow 91 and the second airflow 92 on the package 30, the yarn withdrawal device 28 needs to be arranged near the package 30. In the present embodiment, since the curved surface 43 is formed, the yarn withdrawal device 28 is less likely to interfere with the package 30 compared to the configuration in which the curved surface 43 is a right angle. Thus, the yarn withdrawal device 28 can be arranged near the package 30. Similarly, by forming the first inclined surface 52a and the second inclined surface 62a,

the yarn withdrawal device 28 becomes less likely to interfere with the package 30. Thus, the yarn withdrawal device 28 can be arranged near the package 30. As the diameter of the package 30 becomes greater with the winding of the yarn 20, a movable member adapted to move the yarn withdrawal device 28 to a position dependent on the diameter of the package 30 is preferably arranged.

[0088] The first airflow 91 and the second airflow 92 can be more effectively acted by arranging, in particular, the first slit 50a and the second slit 60a of the yarn withdrawal device 28 near the package 30. In the present embodiment, the second slit 60a is located, in the first direction, upstream of the first slit 50a in the flow direction of the second airflow 92. The second slit 60a is located, in the second direction, on a side more distant from the main body part 40 (a side close to the package 30) than the first slit 50a. That is, a distance between the first slit 50a and the package 30 becomes longer from the first slit 50a toward the upstream side in the flow direction of the second airflow 92 along the first direction, but the second slit 60a is provided at a position protruding toward the package 30 side in the second direction to compensate for such a positional relationship. In other words, the first slit 50a and the second slit 60a are arranged in a layout that lies along the surface of the package 30. Therefore, both the first slit 50a and the second slit 60a can be arranged near the package 30.

[0089] As described above, the yarn withdrawal device 28 of the present embodiment includes the first injecting section 50 and the second injecting section 60. The first injecting section 50 is formed with the first slit 50a, and adapted to generate the first airflow 91 by air being injected from the first slit 50a. The second injecting section 60 is formed with the second slit 60a along a longitudinal direction of the first slit 50a and adapted to generate the second airflow 92 by air being injected from the second slit 60a, the second airflow being an airflow flowing in a direction different from a flow direction of the first airflow 91.

[0090] Thus, the airflows in different flow directions are respectively generated from the two slits, whereby the airflow can be easily acted on the package 30 in a wide range. As a result, the probability of succeeding in the withdrawal of the yarn 20 from the package 30 can be increased.

[0091] The yarn withdrawal device 28 of the present embodiment includes the main body part 40, the first injecting section 50, and the second injecting section 60. The first injecting section 50 includes the first spacer portion 51 and the first cover portion 52. The first slit 50a is formed by the first spacer portion 51 being arranged between the first cover portion 52 and the main body part 40, and the first airflow 91 is generated by air being injected from the first slit 50a. The second injecting section 60 includes the second spacer portion 61 and the second cover portion 62. The second slit 60a is formed by the second spacer portion 61 being arranged between the second cover portion 62 and the first cover portion 52, and the second airflow 92 is generated by air being injected from the second slit 60a.

[0092] Thus, the airflows are generated respectively from the two slits formed at different positions, whereby the airflows in different flow directions easily act on the package 30. As a result, the probability of succeeding in the withdrawal of the yarn 20 from the package 30 can be increased.

[0093] In the yarn withdrawal device 28 of the present embodiment, a thickness of at least one of the first spacer portion 51 and the second spacer portion 61 (specifically, both) is preferably greater than or equal to 0.01mm and less than or equal to 5mm.

[0094] Thus, the success rate of the withdrawal of the yarn 20 from the package 30 can be sufficiently increased while reducing the amount of air supplied to the yarn withdrawal device 28.

[0095] The yarn withdrawal device 28 of the present embodiment is provided with at least one of (specifically, both) the first inclined surface 52a and the second inclined surface 62a. The first inclined surface 52a is inclined so as to be continuous to a basal end of a flow of the first airflow 91 and continuous to the first slit 50a, and the second inclined surface 62a is inclined so as to be continuous to a basal end of a flow of the second airflow 92 and continuous to the second slit 60a. Either one of the first inclined surface 52a or the second inclined surface 62a may be omitted.

[0096] Thus, the air around the first slit 50a and/or the second slit 60a can be taken into the first airflow 91 and/or the second airflow 92, whereby the yarn 20 from the package 30 can be withdrawn while reducing the flow volume of the airflow supplied to the yarn withdrawal device 28.

[0097] In the yarn withdrawal device 28 of the present embodiment, a surface adapted to guide air before being injected from the second slit 60a includes an injection direction correcting surface 62b inclined such that a height of the second slit 60a increases towards an end of the second slit 60a from which the second airflow 92 is injected.

[0098] Thus, the second airflow 92 flows away from the outer surface (first outer surface 28a) of the yarn withdrawal device 28, whereby the second airflow 92 easily hits the package 30.

[0099] The yarn withdrawal device 28 of the present embodiment includes a guiding section 45 arranged downstream in the flow direction of the first airflow 91, and adapted to guide the yarn 20 withdrawn from the package 30 toward the center in the longitudinal direction of the first slit 50a.

[0100] Thus, the position of the yarn 20 withdrawn from the package 30 by the yarn withdrawal device 28 is defined, and hence a next process can be easily carried out.

[0101] The yarn withdrawal device 28 of the present embodiment includes the first outer surface 28a and the second outer surface 28b. The first outer surface 28a is provided with the first slit 50a and the second slit 60a.

The second outer surface 28b is provided downstream in the flow direction of the first airflow 91 with respect to the first outer surface 28a. The guiding section 45 is provided on the second outer surface 28b.

[0102] Thus, a surface (first outer surface 28a) for withdrawing the yarn 20 from the package 30 and a surface (second outer surface 28b) for guiding the withdrawn yarn 20 can be separated, whereby the size of the yarn withdrawal device 28 can be reduced.

[0103] In the yarn withdrawal device 28 of the present embodiment, the first guiding surface 45a and the second guiding surface 45b are formed on the guiding section 45 and arranged to protrude from the second outer surface 28b and to face one another. An interval between the first guiding surface 45a and the second guiding surface 45b becomes wider toward the first outer surface 28a.

[0104] Thus, the yarn 20 withdrawn from the package 30 is easily guided by the guiding section 45. Furthermore, since the yarn 20 is guided to a narrow range by the guiding section 45, the next process can be easily carried out.

[0105] The yarn withdrawal device 28 of the present embodiment includes the curved surface 43 smoothly connecting the first outer surface 28a and the second outer surface 28b and being curved to project outward. The second airflow 92 thus easily flows in a direction different from the flow of the first airflow 91.

[0106] The automatic winder 1 of the present embodiment includes the yarn withdrawal device 28 and the winding section 18. The winding section 18 is adapted to rotate the winding tube 22 in the winding direction to form the package 30 by winding the yarn 20. The flow direction of the first airflow 91 is set to guide the yarn 20 withdrawn from the package 30 to the first target position, and the flow direction of the second airflow 92 is set towards the package 30.

[0107] Thus, the functions of the first airflow 91 and the second airflow 92 can be differed from each other, whereby the yarn 20 can be withdrawn from the package 30 and the withdrawn yarn 20 can be guided to the first target position (catching position).

[0108] In the automatic winder 1 of the present embodiment, the second slit 60a is formed downstream of the first slit 50a in the reverse rotational direction of the package 30.

[0109] Thus, the yarn 20 is detached from the package 30 or the detaching of the yarn 20 is assisted by the second airflow 92, and the detached yarn 20 can be fed downstream by the first airflow 91.

[0110] The automatic winder 1 of the present embodiment includes the upper yarn catching member 36 adapted to catch the yarn 20 withdrawn by the yarn withdrawal device 28. The first target position is a catching position of the upper yarn catching member 36.

[0111] Thus, the success rate of the catching of the yarn 20 by the upper yarn catching member 36 can be increased.

[0112] In the automatic winder 1 of the present embodiment, the upper yarn catching member 36 catches the yarn 20 by sucking the yarn 20, and guides the caught yarn 20 to the second target position (yarn joining device 14). The suction force of the upper yarn catching member 36 is set such that the suction force when catching the yarn 20 becomes greater than the suction force when guiding the sucked yarn 20 to the second target position.

[0113] The probability of failing in catching of the yarn 20 thus can be lowered, and the probability of yarn breakage at the time of guiding the yarn 20 can be lowered.

[0114] The preferred embodiment of the present invention has been described above, but the structure described above may be modified as below.

[0115] In the embodiment described above, the yarn joining device 14 is provided for every winding unit 10. However, a service vehicle movable in a direction in which the winding units 10 are arranged may be provided, and the yarn joining device 14 may be provided in the service vehicle. In this case, the yarn withdrawal device 28 may be arranged on the service vehicle. The upper yarn catching member 36 and the lower yarn catching member 33 may also be arranged on the service vehicle. Alternatively, the yarn withdrawal device 28 may be arranged on the doffing device 5 (service vehicle). In this case, the doffing device 5 may withdraw the yarn 20 from the package 30 by the yarn withdrawal device 28 when the doffing device 5 is not carry out the doffing operation. However, while carrying out the doffing operation for a certain winding unit 10, the doffing device 5 may withdraw the yarn 20 from the package 30 of another winding unit 10 by the yarn withdrawal device 28. In case of arranging the yarn withdrawal device 28 on the doffing device 5, the yarn joining device 14 may be arranged on each winding unit 10. The upper yarn catching member 36 may be arranged on either one of the doffing device 5 or each winding unit 10.

[0116] The cutout 51a, the air passing holes 51b, the air passing holes 52b, and the cutout 61a may have shapes other than the shapes illustrated in the embodiment described above as long as the compressed air can pass therethrough. For example, the cutout 51a and the cutout 61a may be formed in a concave-convex shape (comb tooth shape). The air passing holes 51b and the air passing holes 52b may be one long hole that is long in the package axial direction.

[0117] In the embodiment described above, the first injecting section 50 and the second injecting section 60 are integrally configured by being attached to the same main body part 40. Instead, the first injecting section 50 and the second injecting section 60 may be separately configured.

[0118] In the embodiment described above, the yarn 20 withdrawn from the package 30 by the yarn withdrawal device 28 is guided to the yarn joining device 14 via the upper yarn catching member 36. Instead, the yarn 20 from the package 30 may be guided to the yarn joining device 14 via still another catching member (second

catching member) after the upper yarn catching member 36. The second catching member is, for example, a tubular member capable of sucking the yarn 20, and is a member movable between a position of catching the yarn 20 from the upper yarn catching member 36 and a position of guiding the caught yarn 20 to the yarn joining device 14. With this configuration, the catching position of the second catching member corresponds to the second target position, and the yarn joining device 14 corresponds to a third target position. In this case, the yarn withdrawal device 28 and the upper yarn catching member 36 may be arranged on the service vehicle, and the second catching member, the yarn joining device 14, and the lower yarn catching member 33 may be arranged on each winding unit 10. The final guiding destination of the yarn 20 may not be the yarn joining device 14, and may be a different position.

[0119] The yarn withdrawal device 28 of the present invention is not limited to being arranged in the automatic winder and can also be applied to other yarn winding machines, such as re-winding machines and fine spinning machines (e.g., air spinning machines, open-end spinning machines, etc.). The yarn withdrawal device 28 can also be applied to a fine spinning machine having a configuration in which a yarn joining device is arranged for every winding unit as described above. Alternatively, the yarn withdrawal device 28 can also be applied to a fine spinning machine having a configuration in which one yarn joining device is arranged for every predetermined number of winding units. The air spinning machine includes a draft device adapted to draft a fiber bundle with a plurality of pairs of draft rollers, a spinning device adapted to spin the fiber bundle with a whirling airflow to produce a yarn, and a winding device adapted to wind the yarn to form a package. In such air spinning machine, the winding device may be arranged on the upper side or the draft device may be arranged on the upper side in the machine height direction. The yarn joining device of the fine spinning machine is not limited to a mechanical configuration (e.g., knotter) or a configuration using fluid such as compressed air (splicer), and may be a piecer. When the yarn joining device is a piecer, the yarn 20 withdrawn from the package 30 by the yarn withdrawal device 28 is reversely fed to the spinning device. When the yarn withdrawal device 28 is arranged on the fine spinning machine, the yarn withdrawal device 28 may be arranged on the doffing cart. In such alternative embodiments as well, the yarn withdrawal device 28 may be configured as in the above-described embodiment and/or alternative embodiment.

Claims

1. A yarn withdrawal device (28) adapted to withdraw a yarn (20) from a package (30), the yarn withdrawal device (28) comprising:

   a first injecting section (50) in which a first slit (50a) is formed and adapted to generate a first airflow (91) by air being injected from the first slit (50a); and

   a second injecting section (60) in which a second slit (60a) is formed along a longitudinal direction of the first slit (50a) and adapted to generate a second airflow (92) by air being injected from the second slit (60a), the second airflow (92) being an airflow flowing in a direction different from a direction of the first airflow (91).

2. The yarn withdrawal device (28) as claimed in claim 1, comprising a main body part (40), wherein

   the first injecting section (50) includes a first spacer portion (51) and a first cover portion (52), the first slit (50a) being formed by the first spacer portion (51) being arranged between the first cover portion (52) and the main body part (40), and

   the second injecting section (60) includes a second spacer portion (61) and a second cover portion (62), the second slit (60a) being formed by the second spacer portion (61) being arranged between the second cover portion (62) and the first cover portion (52) .

3. The yarn withdrawal device (28) as claimed in claim 2, wherein a thickness of at least one of the first spacer portion (51) and the second spacer portion (61) is greater than or equal to 0.01mm and less than or equal to 5mm.

4. The yarn withdrawal device (28) as claimed in any one of claims 1 to 3, comprising at least one of a first inclined surface (52a) and a second inclined surface (62a),

   the first inclined surface (52a) being inclined so as to be continuous to a basal end of a flow of the first airflow (91) and continuous to the first slit (50a), and

   the second inclined surface (62a) being inclined so as to be continuous to a basal end of a flow of the second airflow (92) and continuous to the second slit (60a).

5. The yarn withdrawal device (28) as claimed in any one of claims 1 to 4, wherein a surface adapted to guide air before being injected from the second slit (60a) has an injection direction correcting surface (62b) inclined such that height of the second slit (60a) increases towards an end of the second slit (60a) from which the second airflow is injected.

6. The yarn withdrawal device (28) as claimed in any one of claims 1 to 5, comprising a guiding section (45) arranged downstream in a flow direction of the first airflow (91) and adapted to guide the yarn (20) withdrawn from the package (30) towards the center in a longitudinal direction of the first slit (50a).

7. The yarn withdrawal device (28) as claimed in claim 6, comprising:

a first outer surface (28a) provided with the first slit (50a) and the second slit (60a); and
a second outer surface (28b) arranged downstream in the flow direction of the first airflow (91) with respect to the first outer surface (28a),
wherein the guiding section (45) is provided on the second outer surface (28b).

8. The yarn withdrawal device (28) as claimed in claim 7, wherein a first guiding surface (45a) and a second guiding surface (45b) are formed on the guiding section (45) and arranged to protrude from the second outer surface (28b) and to face one another, and
an interval between the first guiding surface (45a) and the second guiding surface (45b) increases towards the first outer surface (28a)

9. The yarn withdrawal device (28) as claimed in claim 7 or 8, comprising a curved surface (43) smoothly connecting the first outer surface (28a) and the second outer surface (28b) and being curved to project outward.

10. A yarn winding machine (1) comprising:

the yarn withdrawal device (28) as claimed in any one of claims 1 to 9; and
a winding section (18) adapted to rotate a winding tube (22) in a winding direction to form the package (30) by winding the yarn (20),
wherein a longitudinal direction of the first slit (50a) is along an axial direction of the package (30).

11. The yarn winding machine (1) as claimed in claim 10, wherein a flow direction of the first airflow (91) is set to guide the yarn (20) withdrawn from the package (30) to a first target position, and
a flow direction of the second airflow (92) is set towards the package (30).

12. The yarn winding machine (1) as claimed in claim 10 or 11, wherein the winding section (18) is configured to rotate the package (30) also in a reverse rotational direction, which is a direction opposition to the winding direction, and
the second slit (60a) is formed downstream of the first slit (50a) in the reverse rotational direction of the package (30).

13. The yarn winding machine (1) as claimed in any one of claims 10 to 12, comprising a first catching member (36) adapted to catch the yarn (20) withdrawn from the package (30) by the yarn withdrawal device (28),
wherein the first target position is a catching position of the first catching member (36).

14. The yarn winding machine (1) as claimed in claim 13, wherein the first catching member (36) is adapted to catch the yarn (20) by sucking the yarn (20) and to guide the caught yarn (20) to a second target position (14), and
a suction force of the first catching member (36) is set such that a suction force when catching the yarn (20) is greater than a suction force when guiding the yarn (20) to the second target position (14).

15. The yarn winding machine (1) as claimed in claim 13 or 14, comprising a second catching member adapted to receive the caught yarn (20) from the first catching member (36) and to guide the yarn (20) to a third target position (14).

16. The yarn winding machine (1) as claimed in any one of claims 10 to 15, comprising:

a plurality of winding units (10), each including at least the winding section (18), and
a service vehicle (5) adapted to be movable with respect to the plurality of the winding units (10), the service vehicle (5) including the yarn withdrawal device (28).

17. The yarn winding machine (1) as claimed in any one of claims 10 to 15, comprising a plurality of winding units (10), each including at least the winding section (18),
wherein the yarn withdrawal device (28) is arranged in each of the plurality of the winding units (10).

FIG. 1

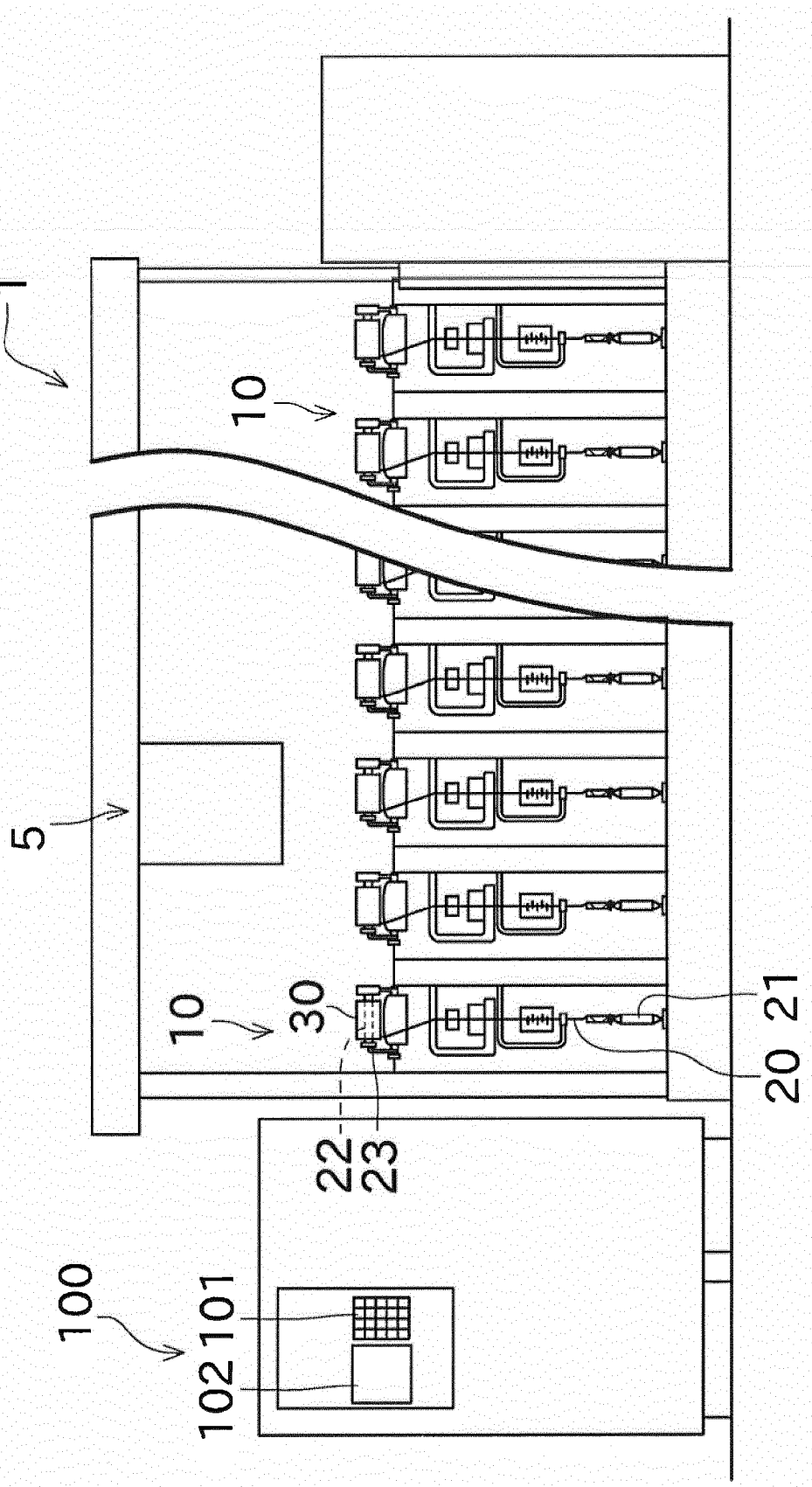


FIG. 2

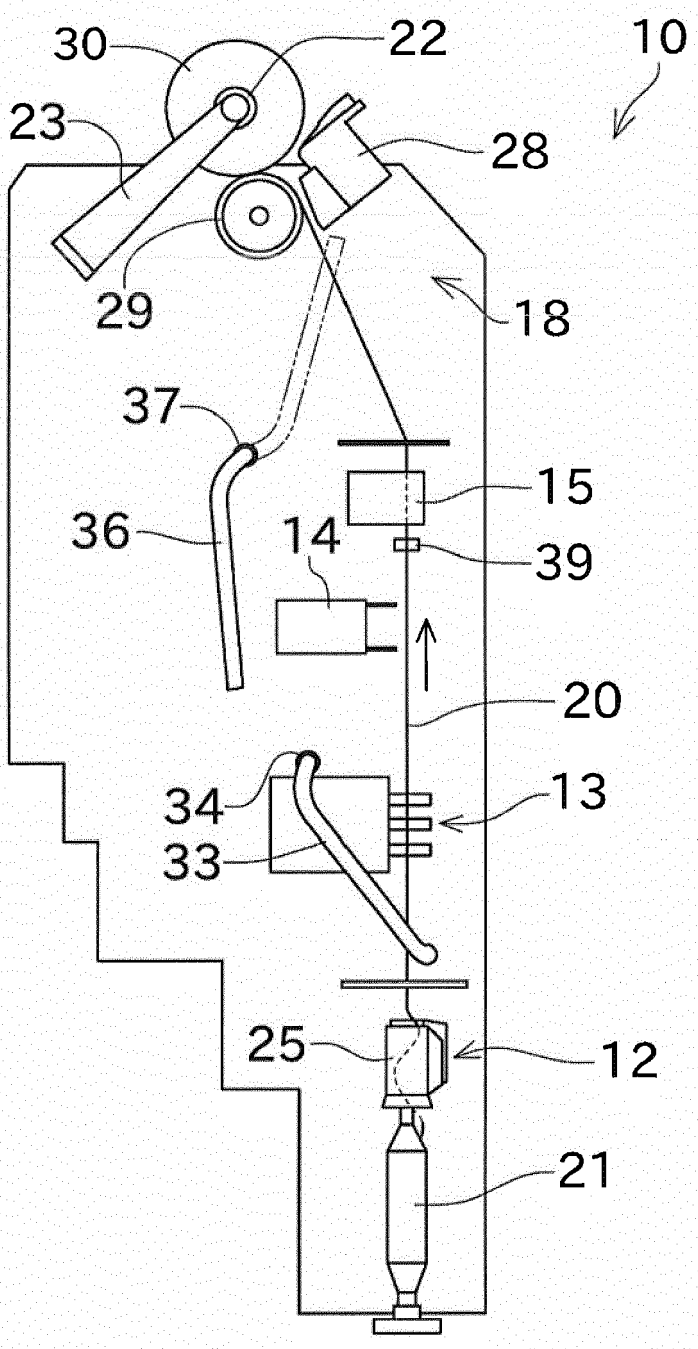
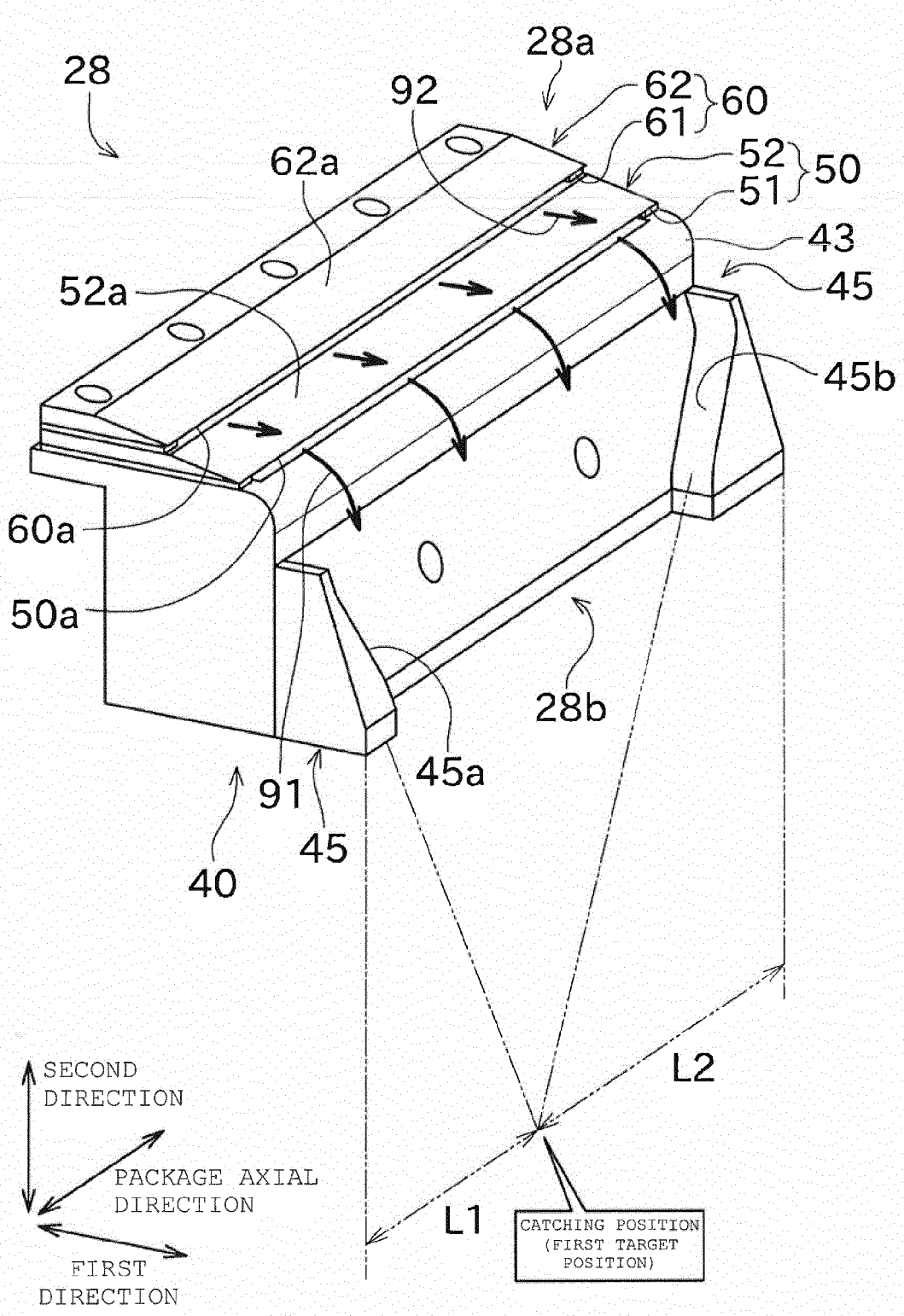


FIG. 3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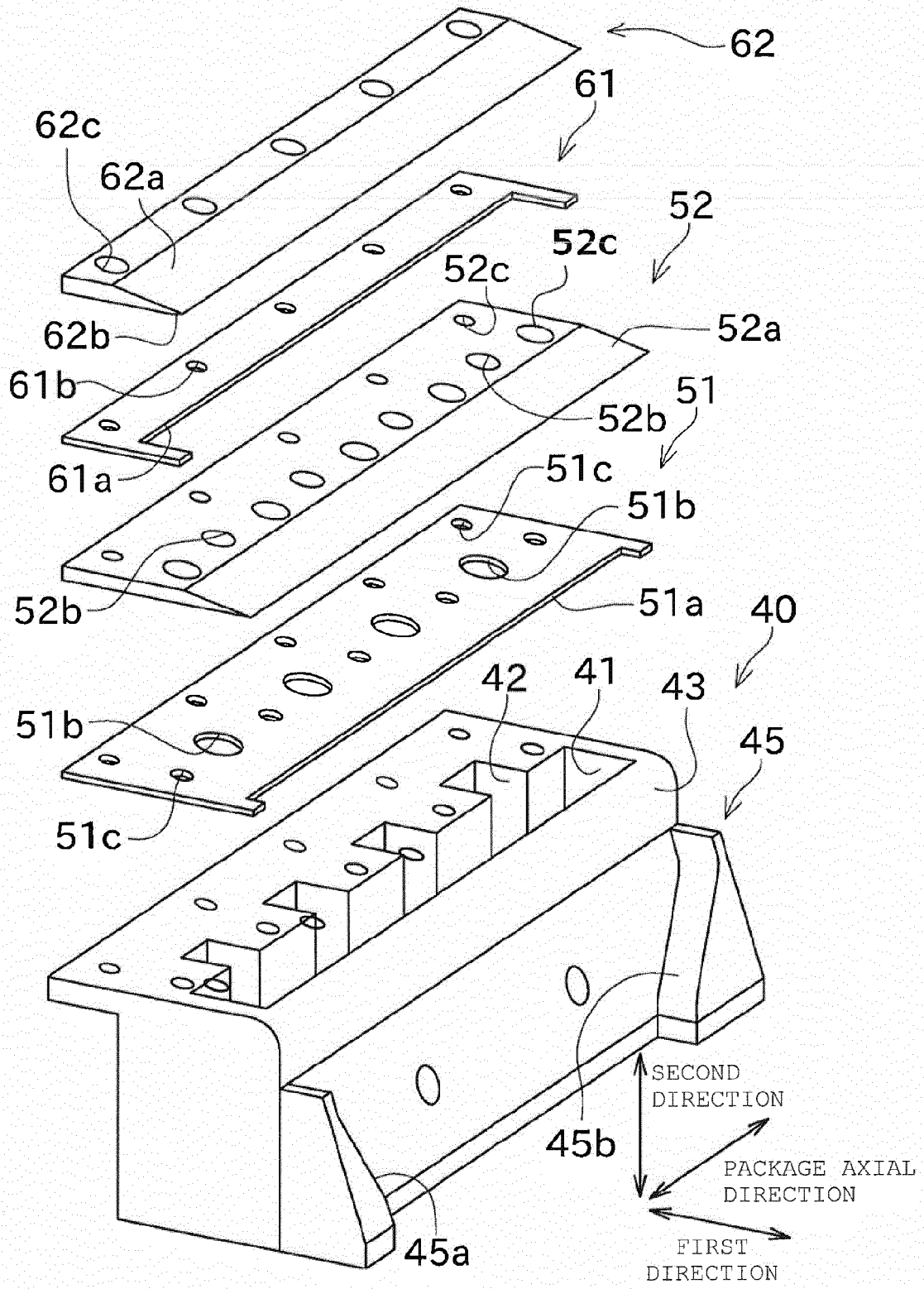
28a
92
62
61
60
62a
52
51
50
43
52a
45
45b
60a
50a
28b
45a
91
45
40
L2
L1
SECOND DIRECTION
PACKAGE AXIAL DIRECTION
FIRST DIRECTION
CATCHING POSITION (FIRST TARGET POSITION)

FIG. 4


62
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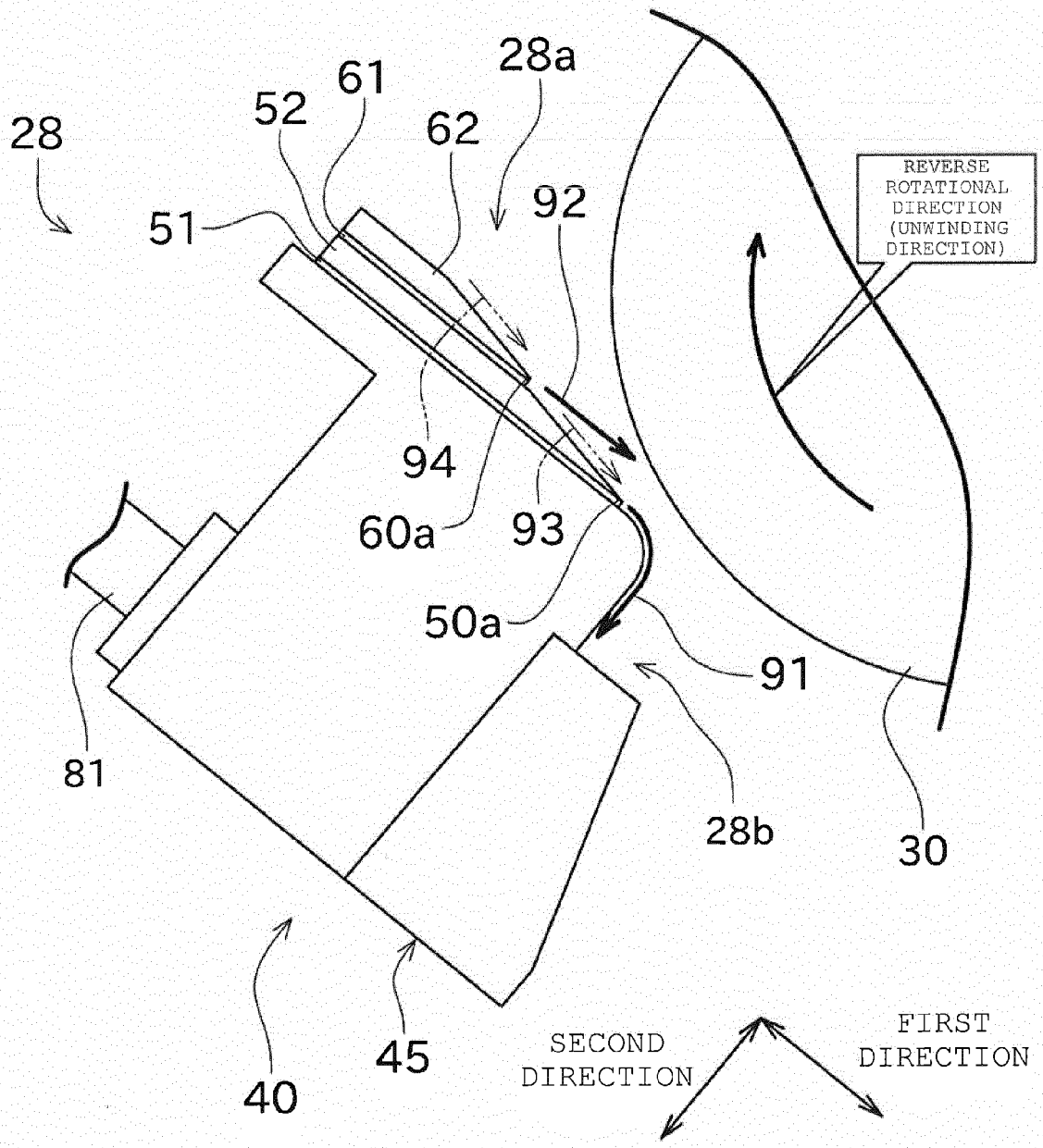
52c
52c
62b
52a
61b
52b
51
61a
51c
51b
52b
51a
40
42
41
43
45
51b
51c
45b
SECOND DIRECTION
PACKAGE AXIAL DIRECTION
FIRST DIRECTION
45a

FIG. 5


28
28a
61
52
62
51
92
REVERSE ROTATIONAL DIRECTION (UNWINDING DIRECTION)
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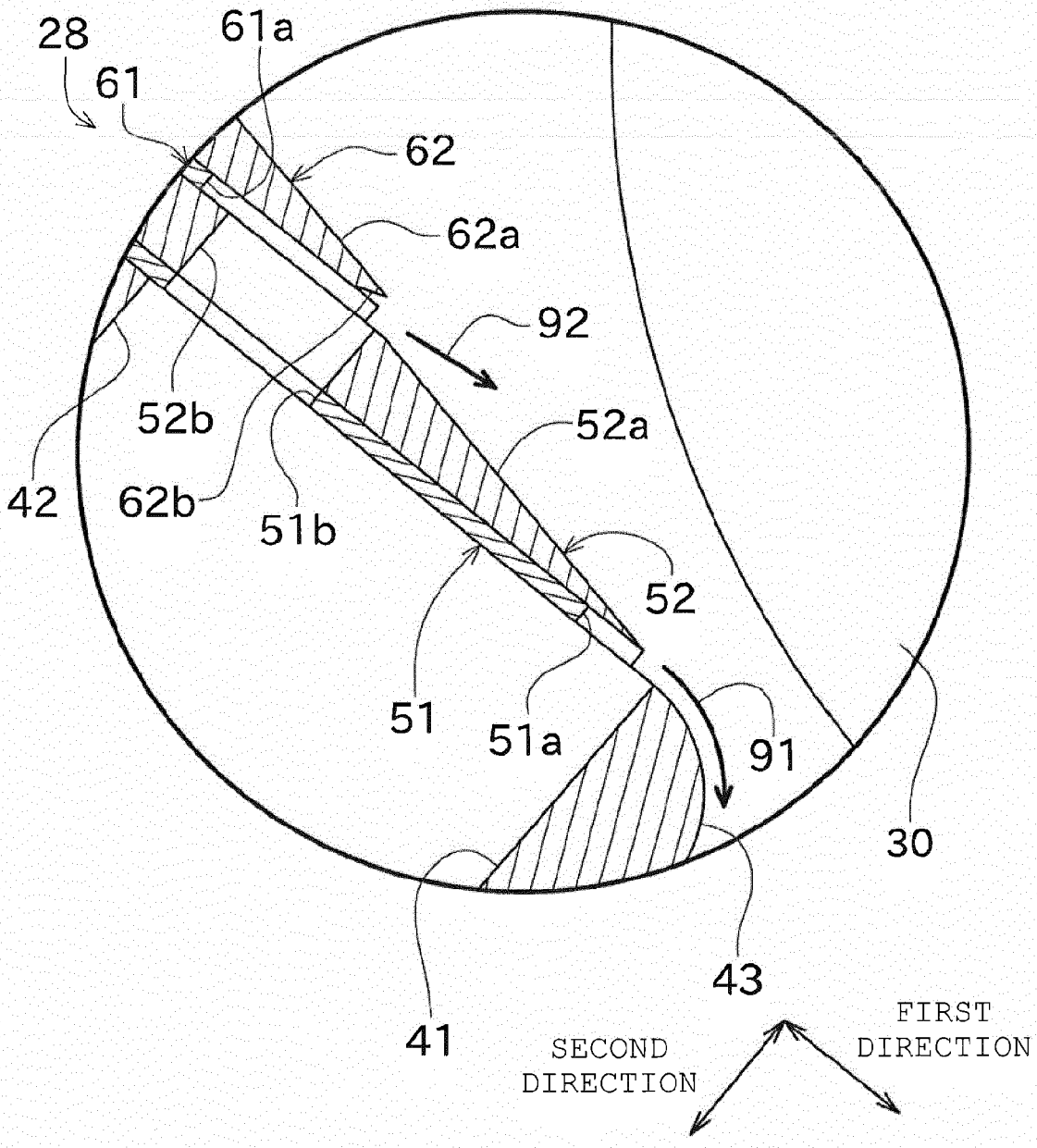
60a
93
50a
91
81
28b
30
40
45
SECOND DIRECTION
FIRST DIRECTION

FIG. 6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41
SECOND DIRECTION
FIRST DIRECTION

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 1647

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 0 983 955 A2 (MURATA MACHINERY LTD [JP]) 8 March 2000 (2000-03-08) * paragraphs [0011], [0017], [0020], [0024]; figures *	1,4, 10-17 2,3,5-9	INV. B65H67/08
Y A	JP H08 245081 A (MURATA MACHINERY LTD) 24 September 1996 (1996-09-24) * paragraph [0014]; figures *	1,4 2,3,5-9	
Y,D	JP H05 5769 U (-) 26 January 1993 (1993-01-26) * figures *	10-17	
A,D	JP 2014 125348 A (MURATA MACHINERY LTD) 7 July 2014 (2014-07-07) * figures * & EP 2 749 516 A2 (MURATA KIKAI KK) 2 July 2014 (2014-07-02) * paragraphs [0025], [0029], [0039]; figures *	1-17	
A,D	DE 24 26 724 B1 (PALITEX PROJECT CO GMBH) 3 July 1975 (1975-07-03) * column 7, line 15 - column 8, line 17; figures *	1-17	TECHNICAL FIELDS SEARCHED (IPC) B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 December 2018	Lemmen, René

CATEGORY OF CITED DOCUMENTS

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