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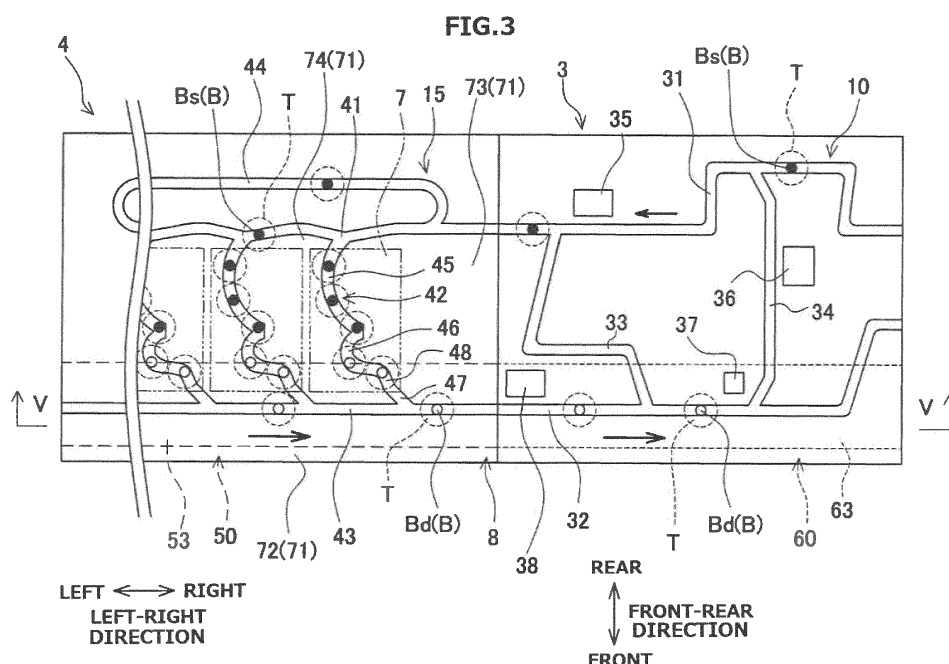
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(54) **YARN WINDING EQUIPMENT**

(57) A tray transport device (8) includes a first conveyor mechanism (50) that transports trays (T) along a first discharge path (43). A bobbin processing device (3) includes a second conveyor mechanism (60) that transports trays (T) along a second discharge path (32). A yarn winding equipment (1) includes a tray detecting section (38) that detects the trays (T) that are being transported along the second discharge path (32) and a de-

termining section (5) that determines whether the tray (T) stays on the second discharge path (32) based on a detection result obtained in the tray detecting section. A control section (5), when the determining section (5) determines that the tray (T) stays on the second discharge path (32), stops operation of the first conveyor mechanism (50) in a state that the second conveyor mechanism (60) is operating.



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding equipment.

2. Description of the Related Art

[0002] The yarn winding equipment disclosed in Japanese Patent Application Laid-Open No. 2011-20837 includes a plurality of winding units, a bobbin preparation device (hereinafter, "bobbin processing device"), and a tray transport device. Each winding unit unwinds a yarn from the pre-supply bobbin and winds the yarn on a winding bobbin. The bobbin processing device performs acts such as preparation of pre-supply bobbins to be supplied to the winding units and removal of residual yarn from the pre-supply bobbins (hereinafter, "discharged bobbin") discharged from the winding units. The tray transport device transports trays (yarn feeding trays) on which the pre-supply bobbins have been mounted and the trays (discharged trays) on which the discharged bobbins have been mounted, and transports the trays from the bobbin processing device to the winding units and vice versa.

[0003] More specifically, the tray transport device is arranged corresponding to a supply path on which the yarn feeding trays are transported, a recovery path (discharge path) on which the discharged trays are transported, and the winding units. The tray transport device includes a plurality of individual paths that serially connect the supply path and the discharge path. In other words, each individual path merges with the discharge path. A bypass path is connected to the discharge path to return some of the discharged trays from a downstream side to an upstream side in the transport direction of the discharge path.

[0004] The discharged tray is transported along the discharge path by a belt conveyor mechanism and then taken inside the bobbin processing device. From the viewpoint of cost reduction and the like, a conveyor belt used for transporting the discharged trays is shared between the tray transport device and the bobbin processing device.

[0005] Therefore, the discharged tray placed on the conveyor belt (which is a shared belt) is always transported to the bobbin processing device when the bobbin processing device is operating.

SUMMARY OF THE INVENTION

[0006] If, due to some reason (for example, the number of discharged bobbins subjected to the residual yarn removal processing is large and the like) in the bobbin processing device, a discharged tray stays on the shared belt on the bobbin processing device side, it is easy for

other discharged trays to stay on the discharge path. Specifically, in the discharge path (in particular, the downstream side in the transport direction), the discharged trays are likely to be in a bead-like state connected to each other bumper to bumper. As a result, for example, near a junction of the individual path and the discharge path, a problem that the discharged tray transported along the individual path and the discharged tray transported along the discharge path may push each other and may not move thereafter (bridge phenomenon) can occur. When this problem occurs, the discharged trays may not be transported to the bobbin processing device, and the processing efficiency of the bobbin processing device may be reduced. Also, when the discharge path is congested, as the trays cannot move from the individual path to the discharge path, the individual path can get clogged. When this happens, the trays cannot be discharged from the winding unit, and the processing of the winding units may be stopped.

[0007] Also, even if the bypass path is provided in the tray transport device, if the discharge path is congested with the discharged trays, the discharged tray may block the junction of the discharge path and the bypass path.

[0008] In view of the above discussion, one object of the present invention is to reduce the occurrence of problems due to staying of a tray in the bobbin processing device.

[0009] A yarn winding equipment according to one aspect of the present invention includes a plurality of winding units each of which unwinds a yarn from a pre-supply bobbin and winds the yarn on a winding bobbin; a tray transport device including a plurality of individual paths each capable of discharging from a corresponding one of the winding units a tray on which the pre-supply bobbin has been mounted; and a first discharge path that merges with the individual paths; a bobbin processing device including a second discharge path connected to a downstream end of the first discharge path in a transport direction in which the trays are transported and capable of processing a discharged bobbin that is the pre-supply bobbin that is discharged from the winding unit; and a control section. The tray transport device includes a first conveyor mechanism that transports the tray along the first discharge path; and a first drive source that drives the first conveyor mechanism. The bobbin processing device includes a second conveyor mechanism that transports the tray along the second discharge path; and a second drive source that drives the second conveyor mechanism. The yarn winding equipment further includes a tray detecting section that detects the trays that are being transported along the second discharge path; and a determining section that determines whether the tray stays on the second discharge path based on a detection result obtained in the tray detecting section. The control section, when the determining section determines that the tray has stayed on the second discharge path, stops operation of the first conveyor mechanism in a state that the second conveyor mechanism is operating.

[0010] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a schematic plan view of a yarn winding equipment according to one embodiment of the present invention.

FIG. 2 is a block diagram showing 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 a line V-V shown in FIG. 3.

FIG. 6A is a perspective view of a tray.

FIG. 6B is a side view of the tray.

FIG. 7 is an enlarged view of a portion around a junction of an individual path and a first discharge path.

FIG. 8 is a flowchart of a process procedure performed when a tray stays on a second discharge path.

FIG. 9A is a diagram for explaining the movement of the trays.

FIG. 9B is another diagram for explaining the movement of the trays.

FIG. 9C is still another diagram for explaining the movement of the trays.

FIG. 10A is a view for explaining the movement of trays that are in contact with each other.

FIG. 10B is another view for explaining the movement of trays that are in contact with each other.

FIG. 11A is an enlarged view of a portion near a junction of an individual path and a first discharge path according to a modification of the above embodiment.

FIG. 11B is an enlarged view of a portion near a junction of an individual path and a first discharge path according to another modification.

DETAILED DESCRIPTION

[0012] Exemplary embodiments of the present invention will be explained below with reference to FIGS. 1 to 10B. For convenience of explanation, the directions shown in FIG. 1 are referred to as a front-rear direction and a left-right direction. A direction in which the gravity acts (vertical direction), that is, a direction orthogonal to both the front-rear direction and the left-right direction, is referred to as an up-down direction.

Schematic Configuration of Yarn Winding Equipment

[0013] First, a schematic configuration of a yarn winding equipment 1 according to the present embodiment will be explained by referring to FIGS. 1 and 2. FIG. 1 is a schematic plan view of the yarn winding equipment 1 according to the present embodiment. FIG. 2 is a block diagram showing an electrical configuration of the yarn winding equipment 1. As shown in FIG. 1, the yarn winding equipment 1 includes a spinning machine 2, a bobbin processing device 3, a winding machine 4, and a main controller 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 in a row; however, the configuration is not limited to this.

[0014] The spinning machine 2 includes not-shown plurality of spinning units. Each spinning unit spins a not-shown roved yarn and winds the spun yarn on a cylindrical bobbin tube to form a pre-supply bobbin Bs. The spinning machine 2 sends the pre-supply bobbins Bs formed by the spinning units to the bobbin processing device 3. The pre-supply bobbins Bs are mounted on trays T in a substantially upright posture and sent to the bobbin processing device 3.

[0015] The bobbin processing device 3 transports to the winding machine 4 the trays T on which the pre-supply bobbins Bs (see solid circles in FIG. 1) formed by the spinning machine 2 are mounted, and transports to the spinning machine 2 the trays T on which discharged bobbins Bd (see hollow circles in FIG. 1) discharged from the winding machine 4 are mounted. Hereinafter, the pre-supply bobbins Bs and the discharged bobbins Bd are collectively referred to as yarn supplying bobbins B. The bobbin processing device 3 is arranged on the left of the spinning machine 2 and to the right of the winding machine 4. The bobbin processing device 3 includes a transport path 10 for transporting the trays T on which the yarn supplying bobbins B are mounted. The bobbin processing device 3 performs processes such as yarn end finding of the yarn wound on the pre-supply bobbin Bs, removing a yarn remaining (residual yarn) on the discharged bobbins Bd, and the like.

[0016] The winding machine 4 is arranged on the left of the bobbin processing device 3. The winding machine 4 includes a plurality of winding units 7 arranged in a row in the left-right direction and a tray transport device 8. Each winding unit 7 unwinds the yarn from the pre-supply bobbin Bs and winds the yarn on a winding bobbin Bw (see FIG. 4) to form a package P (see FIG. 4). Each winding unit 7 discharges empty pre-supply bobbins Bs as the discharged bobbins Bd. The discharged bobbin Bd refers to a bobbin tube from which all the yarn has been unwound, a bobbin on which a small amount of the residual yarn is remaining, and the like. The tray transport device 8 transports the trays T on which the yarn supplying bobbins B have been mounted, and delivers and / or receives these trays T to / from each winding unit 7.

[0017] The main controller 5 is arranged on the left of the winding machine 4. As shown in FIG. 2, the main controller 5 is electrically connected to and communicates with a not-shown control unit of each spinning unit of the spinning machine 2, a bobbin processing control unit 11 of the bobbin processing device 3, and a unit control section 12 of each winding unit 7. The main controller 5 includes a setting section 5a used by an operator when performing various setting operations, and a storage section 5b for storing therein information related to the setting.

[0018] In the yarn winding equipment 1 having the above configuration, the pre-supply bobbins Bs formed in the spinning machine 2 are supplied to the winding units 7 of the winding machine 4 after being passed through the bobbin processing device 3. The winding units 7 unwind the yarn from the pre-supply bobbins Bs. The empty pre-supply bobbins Bs are discharged from the winding units 7 as the discharged bobbins Bd and these bobbins are returned to the spinning machine 2 after being passed through the bobbin processing device 3.

Bobbin Processing Device

[0019] The configuration of the bobbin processing device 3 will be explained below by referring to FIG. 3. FIG. 3 is a plan view of the bobbin processing device 3 and the winding machine 4. As mentioned above, the bobbin processing device 3 includes the transport path 10. The transport path 10 includes a supply path 31, a discharge path 32, a feed path 33, and a return path 34. The supply path 31 is a path for transporting the pre-supply bobbins Bs to the winding machine 4 and extends across the left and right ends of the bobbin processing device 3. A yarn-end finding device 35 that performs a yarn-end finding process is arranged in the middle of the supply path 31. The yarn-end finding process includes pulling a tip of the yarn that has been wound on the pre-supply bobbin Bs to make it easy for the winding unit 7 to capture a yarn end (see FIG. 4). The discharge path 32 is a path for transporting the discharged bobbins Bd to the spinning machine 2 and, in the same manner as the supply path 31, extends across the left and right ends of the bobbin processing device 3.

[0020] The feed path 33 branches from the supply path 31 at a point that is further downstream of the yarn-end finding device 35 in the transport direction of the trays T (hereinafter, "transport direction"). The feed path 33 merges with the discharge path 32. The return path 34 branches at a point that is further downstream in the transport direction than the junction of the discharge path 32 and the feed path 33. Further, the return path 34 merges with the supply path 31 at a point that is upstream in the transport direction than the yarn-end finding device 35. A residual-yarn removing device 36 is arranged in the middle of the return path 34. The residual-yarn removing device 36 performs a residual yarn process that

includes removing the residual yarn from the discharged bobbin Bd if a small amount of yarn has remained (residual yarn is present) on the discharged bobbin Bd. A not-shown destination switching unit capable of switching the destination of the trays T is provided at a branch point between the supply path 31 and the feed path 33 and at a branch point between the discharge path 32 and the return path 34. A residual yarn sensor 37 is arranged near the branch point between the discharge path 32 and the return path 34. The residual yarn sensor 37 detects whether there is a residual yarn on the discharged bobbin Bd.

[0021] Further, as mentioned above, the bobbin processing device 3 includes the bobbin processing control unit 11 (see FIG. 2). The bobbin processing control unit 11 includes a CPU, a ROM, a RAM, and the like. The bobbin processing control unit 11 is electrically connected to the residual yarn sensor 37, the residual-yarn removing device 36, and the like (see FIG. 2). The bobbin processing control unit 11 controls various sections of the bobbin processing device 3 by using the CPU based on a computer program stored in the ROM. Also, the bobbin processing control unit 11 communicates with the main controller 5.

Winding Unit

[0022] A configuration of the winding unit 7 will be briefly explained by referring to FIG. 4. FIG. 4 is a schematic front view of the winding unit 7.

[0023] The winding unit 7 unwinds a yarn Y from the pre-supply bobbin Bs placed at a lower end thereof and winds the yarn Y on the winding bobbin Bw placed at an upper end thereof to form the package P. As shown in FIG. 4, the winding unit 7 includes a bobbin stand 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 pre-supply bobbin Bs placed on the bobbin stand 21, monitors the yarn Y with the yarn clearer 22, and winds the yarn Y on the winding bobbin Bw that rotates by being in contact with the traverse drum 23. The winding bobbin Bw is rotatably supported by a cradle 24.

[0024] The bobbin stand 21 supports the tray T on which the pre-supply bobbin Bs has been mounted. The yarn clearer 22 monitors the yarn Y that is being unwound from the pre-supply bobbin Bs and detects a defect in the yarn Y. The yarn clearer 22 includes a not-shown cutter for cutting the running yarn Y. The traverse drum 23 contacts a surface of the winding bobbin Bw (package P) and rotates the winding bobbin Bw by being rotationally driven by a not-shown motor. Grooves for traversing the yarn Y are formed in the traverse drum 23. As a result, the traverse drum 23 rotates the winding bobbin Bw, and while traversing the yarn Y, winds the yarn Y onto the winding bobbin Bw.

[0025] If the yarn is cut by the cutter of the yarn clearer 22 or a yarn breakage occurs due to other causes, the winding unit 7 performs a yarn joining process to join the

yarn Y (lower yarn Y1) from the pre-supply bobbin Bs and the yarn Y (upper yarn Y2) from the winding bobbin Bw. As a configuration for performing 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 yarn to the yarn joining device 25. The upper yarn suction 27 sucks the upper yarn Y2 and guides the yarn to the yarn joining device 25. The yarn joining device 25 performs yarn joining by using compressed air, for example. The yarn joining device 25 once blows compressed air on the lower yarn Y1 and the upper yarn Y2 to loosen the yarn ends of both the yarns, and then again blows the compressed air on the yarn ends of both the yarns so that the yarn ends entangle to each other.

[0026] A yarn detecting sensor 28 and an ejector 29 are arranged around the bobbin stand 21. The yarn detecting sensor 28 detects whether it is possible to unwind the yarn Y from the pre-supply bobbin Bs. The ejector 29 is operative to discharge the pre-supply bobbin Bs from the winding unit 7. For example, when the yarn Y drawn from the pre-supply bobbin Bs is no more detected by the yarn detecting sensor 28, the unit control section 12 determines that the pre-supply bobbin Bs is devoid of the yarn (empty) or that it is not possible to catch the yarn from the pre-supply bobbin Bs. When this happens, the unit control section 12 operates the ejector 29 to discharge the pre-supply bobbin Bs from the winding unit 7.

[0027] As mentioned above, the winding unit 7 includes the unit control section 12 (see FIG. 2). The unit control section 12 includes a CPU, a ROM, a RAM, and the like. The unit control section 12 is electrically connected to the yarn detecting sensor 28, the ejector 29, and the like (see FIG. 2). The unit control section 12 controls various sections of the winding unit 7 by using the CPU based on a computer program stored in the ROM. Also, the unit control section 12 communicates with the main controller 5.

Tray Transport Device

[0028] The tray transport device 8 will be explained in detail by referring again to FIG. 3. The tray transport device 8 includes a transport path 15 for transporting the trays T. The transport 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 transporting the trays T on which the pre-supply bobbins Bs have been mounted. The supply path 41 is arranged on the rear side of the winding units 7 and extends in the left-right direction. The right end of the supply path 41 is connected to the left end of the supply path 31 of the bobbin processing device 3. The left end and a right side portion of the supply path 41 are connected to a return path 44. The return path 44 is arranged on the rear side of the supply path 41 and extends in the left-right direction. Each individual path 42 branches from the supply path 41 and extends

at least forward. Each individual path 42 is a path for distributing the pre-supply bobbins Bs to the winding units 7. The discharge path 43 is a path for returning the trays T on which the discharged bobbins Bd have been mounted to the bobbin processing device 3. The discharge path 43 merges with each individual path 42 and extends in the left-right direction ("direction of extension" in the present invention). The right end of the discharge path 43 is connected to the left end of the discharge path 32 of the bobbin processing device 3.

[0029] The individual paths 42 temporarily store the unused pre-supply bobbins Bs. Specifically, a portion of the individual path 42 has a length sufficient for storing the pre-supply bobbins Bs. This portion will be called a pre-supply bobbin storage path 45. Thus, the pre-supply bobbins Bs are stored upstream in the transport direction than the pre-supply bobbins Bs from which the yarn is being unwound by the winding units 7. As an example, in the present embodiment, each individual path 42 can store two pre-supply bobbins Bs (see two pre-supply bobbins Bs in FIG. 3 on the rear side of a pre-supply bobbin unwinding position in the pre-supply bobbin storage path 45). In other words, the third pre-supply bobbin Bs (see FIG. 3) from the rear side is the pre-supply bobbin Bs in use by the winding unit 7. When all the individual paths 42 are full, the tray T on which the pre-supply bobbin Bs has been mounted is returned to the upstream side in the transport direction of the supply path 41 via the return path 44.

[0030] The discharge path 43 of the tray transport device 8 corresponds to a first discharge path according to the present invention. Further, the discharge path 32 of the bobbin processing device 3 corresponds to a second discharge path according to the present invention. Therefore, in the below explanation, the discharge path 43 is referred to as the first discharge path 43 and the discharge path 32 is referred to as the second discharge path 32.

[0031] In the tray transport device 8 having the above configuration, the trays T on which the discharged bobbins Bd discharged from the winding units 7 have been mounted are first transported to the first discharge path 43 via the individual paths 42, and then transported to the second discharge path 32 of the bobbin processing device 3. The residual yarn sensor 37 detects whether there is a residual yarn on the discharged bobbin Bd that is being transported along the second discharge path 32. If there is no residual yarn on the discharged bobbin Bd, the tray T on which this discharged bobbin Bd has been mounted is transported along the second discharge path 32 and returned to the spinning machine 2. If there is a residual yarn on the discharged bobbin Bd, the tray T on which this discharged bobbin Bd has been mounted is transported to the return path 34. The residual yarn on the discharged bobbin Bd that is being transported along the return path 34 is removed by the residual-yarn removing device 36.

[0032] As explained below, the tray T may stay on the

second discharge path 32 of the bobbin processing device 3. The tray T stays when a large number of trays T accumulate on the return path 34 and the second discharge path 32. This can happen, for example, when there are a large number of the pre-supply bobbins Bs from which the residual-yarn removing device 36 must remove the residual yarn. Also, the pre-supply bobbin Bs in which the yarn-end finding process by the yarn-end finding device 35 fails is returned to the supply path 31 via the feed path 33, the second discharge path 32, and the return path 34. Thus, the tray T may stay on the second discharge path 32 when a large number of such pre-supply bobbins Bs are being transported.

[0033] In a configuration in which the tray T on the second discharge path 32 of the bobbin processing device 3 and the tray T on the first discharge path 43 of the tray transport device 8 are transported by using the same transport mechanism, the problems mentioned below can arise. That is, when the tray T stays on the second discharge path 32 of the bobbin processing device 3, the discharged trays tend to congest also the first discharge path 43 of the tray transport device 8. Specifically, in the first discharge path 43 (in particular, the downstream side portion in the transport direction), the trays T are likely to be in a bead-like state connected to each other bumper to bumper. When this happens, for example, near the junction of the individual path 42 and the first discharge path 43, a problem that the tray T transported along the individual path 42 and the tray T transported along the first discharge path 43 mutually push each other and may not move (bridge phenomenon) can occur. As a result, the trays T may not be transported from the tray transport device 8 to the bobbin processing device 3, and the processing efficiency of the bobbin processing device 3 may be reduced. Also, when the first discharge path 43 is congested, the trays T cannot move from the individual path 42 to the first discharge path 43, and the individual path 42 becomes clogged. When this happens, the trays T cannot be discharged from the winding units 7, and the processing of the winding units 7 may be stopped. Therefore, in the present embodiment, the yarn winding equipment 1 has the following configuration in order to suppress the occurrence of a problem caused by staying of the tray T in the bobbin processing device 3.

Tray Transport Mechanism

[0034] A mechanism for transporting the trays T will be explained below while referring to FIGS. 3 and 5. FIG. 5 is a cross-sectional view taken along a line V-V shown in FIG. 3. As shown in FIGS. 3 and 5, the tray transport device 8 includes a first conveyor mechanism 50. The first conveyor mechanism 50 is a mechanism for transporting the trays T on the first discharge path 43. As shown in FIG. 5, the first conveyor mechanism 50 includes belt feed rollers 51 and 52, an endless belt 53, and a first motor 54 ("first drive source" according to the present invention). The belt feed roller 51 is arranged at

the right end of the winding machine 4. The belt feed roller 52 is arranged at the left end of the tray transport device 8. The endless belt 53 is wound around the belt feed rollers 51 and 52. The trays T are placed on the endless belt 53. The endless belt 53 spans at least from the first discharge path 43 to a front portion (a first partial path 47 and a second partial path 48 described later) of the individual path 42 in the front-rear direction (see FIG. 3). The first motor 54 rotationally drives the belt feed roller 51. The first motor 54 is electrically connected to the main controller 5 (see FIG. 2). When the belt feed roller 51 is rotationally driven by the first motor 54, the endless belt 53 is driven, and the belt feed roller 52 is driven to rotate. The trays T placed on the endless belt 53 move to the right (in the direction of the arrow in FIG. 5). That is, the first conveyor mechanism 50 imparts a transportation force on the trays T to the right ("one side in the direction of extension" in the present invention).

[0035] As mentioned above, the endless belt 53 spans at least from the first discharge path 43 to the front portion of the individual path 42 in the front-rear direction (see FIG. 3). That is, the transportation force also acts on the tray T located at the front portion of the individual path 42. The transportation force has a component directed to the downstream side in the transport direction of the individual path 42. Therefore, assuming that the tray T on the first 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 pushed toward the first discharge path 43.

[0036] Similarly, the bobbin processing device 3 includes a second conveyor mechanism 60. The second conveyor mechanism 60 is a mechanism for transporting the trays T on the second discharge path 32. As shown in FIG. 5, the second conveyor mechanism 60 includes belt feed rollers 61 and 62, an endless belt 63, and a second motor 64 ("second drive source" according to the present invention). The belt feed roller 61 is arranged at the right end of the bobbin processing device 3. The belt feed roller 62 is arranged at the left end of the bobbin processing device 3. The endless belt 63 is wound around the belt feed rollers 61 and 62. The trays T are placed on the endless belt 63. The second motor 64 is a separate motor from the first motor 54. The second motor 64 rotationally drives the belt feed roller 61. That is, the first conveyor mechanism 50 and the second conveyor mechanism 60 are driven by separate drive sources. The second motor 64 is electrically connected to the bobbin processing control unit 11 (see FIG. 2). When the belt feed roller 61 is rotationally driven by the second motor 64, the endless belt 63 is driven, and the belt feed roller 62 is driven to rotate. The tray T placed on the endless belt 63 moves to the right (in the direction of the arrow in FIG. 5).

[0037] A tray sensor 38 ("tray detecting section" according to the present invention) for detecting the tray T is arranged near an entry point of the second discharge path 32 (the left end of the bobbin processing device 3) (see FIGS. 3 and 5). The tray sensor 38 is, for example,

an optical sensor having a light emitting unit and a light receiving unit. The tray sensor 38 is electrically connected to the bobbin processing control unit 11 (see FIG. 2).
[0038] Further, the main controller 5 can set, by using the setting section 5a (see FIG. 2), a transport speed at which the first conveyor mechanism 50 transports the tray T and a transport speed at which the second conveyor mechanism 60 transports the tray T. Information about these transport speeds is stored in the storage section 5b (see FIG. 2).

Details of Transport Path of Tray Transport Device

[0039] A detailed configuration of the transport path 15 of the tray transport device 8 (in particular, the configuration around the junction of the individual path 42 and the first discharge path 43) is explained below while referring to FIG. 3 and FIGS. 5 to 7.

[0040] First, a configuration of the individual path 42 will be explained while referring to FIG. 3. A downstream side portion in the transport direction of the individual path 42 has a length sufficient to temporarily store the trays T on which the discharged bobbins Bd have been mounted. This portion will be called a discharged-bobbin storage path 46 ("storage path" according to the present invention). In other words, the discharged-bobbin storage path 46 is arranged between the winding unit 7 and the first discharge path 43 in the transport direction. Thus, the individual path 42 includes the discharged-bobbin storage path 46. In the present embodiment, the discharged-bobbin storage path 46 has a length sufficient to temporarily store two trays T.

[0041] Next, prior to explaining a detailed configuration of the transport path 15, the shape of the tray T will be explained by using FIGS. 6A and 6B. FIG. 6A is a perspective view of the tray T. FIG. 6B is a side view of the tray T. As shown in FIGS. 6A and 6B, the tray T has a base portion Ta and a shaft portion Tb. The base portion Ta is a substantially disc-shaped portion that can be mounted on the endless belts 53 and 63. The shaft portion Tb is a portion on which the yarn supplying bobbin B can be mounted. The shaft portion Tb is arranged at a center of an end surface on one side of the base portion Ta. The shaft portion Tb has a large diameter portion Tb1 and a small diameter portion Tb2. The large diameter portion Tb1 is in contact with the end face of the yarn supplying bobbin B. The small diameter portion Tb2 is in contact with an inner circumferential surface (the yarn supplying bobbin B is fitted) of the yarn supplying bobbin B. The base portion Ta is circular when viewed from an axial direction of the shaft portion Tb (see FIG. 7).

[0042] A detailed configuration of the transport path 15 will be explained below. This configuration is for suppressing the occurrence of the bridge phenomenon itself when the tray T transported along the individual path 42 and the tray T transported along the first discharge path 43 are in contact with each other. The transport path 15 (the individual path 42 and the first discharge path 43)

near the winding unit 7 arranged on the rightmost side will be explained.

[0043] As shown in FIG. 3 and FIGS. 5 to 7, the transport path 15 is formed by a plurality of plate members 71 (plate members 72, 73, and 74). That is, the transport path 15 is formed by the gap between the plurality of plate members 71 that are arranged in the horizontal direction. For example, a right side portion of the first discharge path 43 is formed by the plate member 72 arranged at the front end and the plate members 73 and 74 arranged on the rear side of the plate member 72 (see FIG. 3). The rightmost individual path 42 is formed by the plate member 73 and the plate member 74 arranged on the left side of the plate member 73 (see FIG. 3). The plate member 71 is arranged above the endless belt 53 so as not to interfere with the base portion Ta of the tray T placed on the endless belt 53 (see FIGS. 5 and 6B). A side surface of the plate member 71 is a guide surface 75 capable of guiding the tray T by touching the shaft portion Tb (more precisely, the large diameter portion Tb1) of the tray T (see FIGS. 6B and 7).

[0044] A configuration around the junction of the individual path 42 and the first discharge path 43 will be explained below while referring to FIG. 7. FIG. 7 is an enlarged view of a portion around the junction of the individual path 42 and the first discharge path 43. FIG. 7 is a view of the individual path 42 and the first discharge path 43 when viewed from a direction orthogonal to a plane that includes the individual path 42 and the first discharge path 43.

[0045] As shown in FIG. 7, the individual path 42 is constituted by the first partial path 47 and the second partial path 48. The first partial path 47 extends from a junction 49 of the individual path 42 and the first discharge path 43 while inclining leftward ("other side in the direction of extension" according to the present invention) and rearward. The second partial path 48 extends from the end of the first partial path 47 that is on the opposite side of the junction 49 while inclining leftward and rearward. The inclination of the second partial path 48 with respect to the first discharge path 43 is larger than the inclination of the first partial path 47 with respect to the first discharge path 43. Among the guide surfaces 75 forming the first partial path 47, the guide surface 75 formed on the right side (that is, the side on which the transportation force by the first conveyor mechanism 50 acts) will be called as a first guide surface 76. Further, among the guide surfaces 75 forming the second partial path 48, the guide surface 75 formed on the right side will be called as a second guide surface 77. A protrusion 78 is formed by the first guide surface 76 and the second guide surface 77.

[0046] Furthermore, it is assumed that the base portion Ta of the tray T (first tray T1) located on the first discharge path 43 and the base portion Ta of the tray T (second tray T2) located on the individual path 42 are mutually in contact, and that the shaft portion Tb of the second tray T2 is in contact with an apex 79 of the protrusion 78.

More precisely, the base portion Ta of the first tray T1 is in contact with the base portion Ta of the second tray T2 from the left (that is, the upstream side in the transport direction). In this state, assume a straight line that is orthogonal to a straight line 101 that connects axial centers of the first tray T1 and the second tray T2 and passes through the apex 79 of the protrusion 78. This straight line will be called as an orthogonal straight line 102. In this case, the first guide surface 76 overlaps with the orthogonal straight line 102. The second guide surface 77 is located to the right of the orthogonal straight line 102 (inclined to the right). In the present embodiment, the first guide surface 76 corresponds to "one surface" according to the present invention, and the second guide surface 77 corresponds to the "other surface" according to the present invention.

Process when Tray Stays

[0047] A process performed when the tray T stays on the second discharge path 32 of the bobbin processing device 3 will be explained while referring to FIG. 8 and FIGS. 9A to 9C. FIG. 8 is a flowchart of a process procedure performed when the tray T stays on the second discharge path 32. FIGS. 9A to 9C illustrate the movement of the trays T.

[0048] An outline of the process when the tray T stays on the second discharge path 32 is as below. A signal indicating a detection result obtained in the tray sensor 38 is transmitted to the main controller 5 via the bobbin processing control unit 11. The main controller 5 determines whether the tray T stays on the second discharge path 32 of the bobbin processing device 3 based on the detection result. Based on the result of the determination, the main controller 5 performs control of the first conveyor mechanism 50 and transmission of a signal to the unit control section 12. The main controller 5 functions as a determining section and a control section according to the present invention.

[0049] A specific processing contents will be explained below. In the initial state, as shown in FIG. 9A, the tray T on which the discharged bobbin Bd has been mounted is transported along the first discharge path 43 by the first conveyor mechanism 50 of the tray transport device 8. The tray T is transported, for example, at a transport speed (hereinafter, "first transport speed") set by the setting section 5a of the main controller 5 and stored in the storage section 5b. Also, the tray T is transported along the second discharge path 32 by the second conveyor mechanism 60 of the bobbin processing device 3.

[0050] The main controller 5 determines whether the tray T stays on the second discharge path 32 of the bobbin processing device 3 based on the detection signal output by the tray sensor 38 (Step S101). In the present embodiment, when the tray T is continuously detected by the tray sensor 38 for a predetermined time or longer (for example, 0.5 seconds or longer), the main controller 5 determines that the tray T has stayed. In a normal state

(for example, the above-mentioned initial state), the time during which the tray sensor 38 detects the tray T passing in front of the tray sensor 38 is very short. For this reason, the main controller 5 determines that the tray T has not stayed (Step S101: No). In this case, the main controller 5 continues to determine whether the tray T is staying.

[0051] For example, as explained above, if there are a large number of pre-supply bobbins Bs from which the residual yarn needs to be removed by the residual-yarn removing device 36, a large number of trays T may form a queue on the return path 34 and the second discharge path 32 of the bobbin processing device 3 (see FIG. 9B). In this case, the tray T will be detected continuously by the tray sensor 38 for 0.5 seconds or longer. As explained above, when the tray T is detected continuously, the main controller 5 determines that the tray T has stayed (Step S101: Yes). In this case, the main controller 5 stops the operation of the first conveyor mechanism 50 by stopping the first motor 54 while operating the second conveyor mechanism 60 (Step S102). Further, the main controller 5 also transmits a signal indicating that the tray T has stayed to each unit control section 12 (Step S102). Even after stopping the first conveyor mechanism 50, the operation of the second conveyor mechanism 60 is continued. Thus, the tray T on the first discharge path 43 can be made to standby without being transported until the staying of the tray T on the second discharge path 32 is resolved. For this reason, it can suppress that the trays T accumulate on the first discharge path 43 (in particular, on the downstream side in the transport direction). In the present embodiment, the main controller 5 stops the first motor 54 and transmits to each unit control section 12 the signal indicating that the tray T has stayed. Alternatively, each unit control section 12 and the main controller 5 can exchange signals in parallel in case the unit control sections 12 and the main controller 5 are capable of communicating at any time. Alternatively, one of the unit control sections 12 may stop the first motor 54 and transmit to the main controller 5 the signal indicating that the tray T has stayed.

[0052] Upon receiving the signal indicating that the tray T has stayed from the main controller 5, the unit control section 12 performs the following process. The unit control section 12 starts counting the number of trays T discharged from the winding unit 7 after receiving the above signal. When the number of trays T discharged from the winding unit 7 reaches a predetermined upper limit, the discharge of the tray T by the ejector 29 is prohibited. This prevents the individual path 42 or the junction between the individual path 42 and the first discharge path 43 from being clogged with the tray T while the operation of the first conveyor mechanism 50 is stopped. This upper limit is preferably set based on the number of trays T that can be temporarily stored on the discharged-bobbin storage path 46.

[0053] Returning to the explanation of a control by the main controller 5, after the operation of the first conveyor mechanism 50 has been stopped, the main controller 5

determines whether the staying of the tray T on the second discharge path 32 has been resolved (Step S103). For example, after stopping the operation of the first conveyor mechanism 50, the main controller 5 determines that the staying of the tray T has been resolved when the tray sensor 38 does not detect the tray T for the first predetermined time or longer. (Step S103: Yes). If the staying of the tray T has not been resolved, the main controller 5 continues to determine whether the staying of the tray T has been resolved. Also, it is preferable that the first predetermined time can be changed according to the set value of the transport speed at which the trays T are transported by the second conveyor mechanism 60. That is, if the transport speed at which the second conveyor mechanism 60 transports the tray T is fast, the tray T on the second discharge path 32 will move quickly, therefore, the first predetermined time can be set short. On the other hand, when the transport speed at which the second conveyor mechanism 60 transports the tray T is slow, the tray T on the second discharge path 32 does not move easily, therefore, it is better to lengthen the first predetermined time in order to suppress the occurrence of staying of the tray T again.

[0054] When the main controller 5 determines that the staying of the tray T on the second discharge path 32 has been resolved, the main controller 5 causes the first motor 54 to operate again, and resumes the operation of the first conveyor mechanism 50 (Step S104). When resuming the operation of the first conveyor mechanism 50, the main controller 5 sets the transport speed at which the first conveyor mechanism 50 transports the tray T to a second transport speed slower than the first transport speed (see FIG. 9C). This prevents the tray T moving from the first discharge path 43 of the tray transport device 8 to the second discharge path 32 of the bobbin processing device 3 from quickly catching another tray T remaining on the second discharge path 32. Further, the main controller 5 transmits to each unit control section 12 a signal indicating that the staying of the tray T has been resolved (Step S104). Upon receiving this signal, the unit control section 12 resets the count of the number of trays T that have been discharged from the winding unit 7. If the unit control section 12 has prohibited the trays T from being discharged from the winding unit 7 because the number of discharged trays T has reached the upper limit, upon receiving the above signal, the discharging of the trays T from the winding unit 7 is allowed.

[0055] The main controller 5, after the first conveyor mechanism 50 has resumed the operation, determines whether the state in which the staying of the tray T has been resolved has continued for the second predetermined time or longer (Step S105). If the tray T stays again (Step S106: Yes) before the second predetermined time has elapsed (Step S105: No), the process procedure is returned to Step S102. Also, the timer that measures the second predetermined time is reset. If the state in which the tray T is not staying (Step S106: No) continues for the second predetermined time or longer, that is, if the

detection interval of the trays T is longer than the set time, the main controller 5 determines that the staying of the tray T has been resolved, and also determines that the state in which the trays T are transported without a gap therebetween is also resolved (Step S105: Yes). In this case, the main controller 5 returns the transport speed at which the first conveyor mechanism 50 transports the tray T from the second transport speed to the first transport speed. As explained above, the main controller 5 performs the processing when the tray T stays on the second discharge path 32 of the bobbin processing device 3.

Suppression of Bridge Phenomenon by Configuration of Individual Path

[0056] Suppression of the bridge phenomenon by the individual path 42 of the tray transport device 8 having the first guide surface 76 and the second guide surface 77 (see FIG. 7) will be explained by referring to FIG. 7 and FIGS. 10A and 10B. FIGS. 10A and 10B are views for explaining the movement of the trays T on the individual path 42.

[0057] First, as shown in FIG. 7, the case in which the second tray T2 is in contact with the apex 79 of the protrusion 78 and the first tray T1 is in contact with the second tray T2 will be explained. Since the transportation force by the first conveyor mechanism 50 (see an arrow 103 in FIG. 7) is applied to the first tray T1, a pressing force acts on the second tray T2, which is in contact with the first tray T1, along a direction of extension of the straight line 101 (see an arrow 104 shown in FIG. 7). The second tray T2 is pressed against the guide surface 75 because of this pressing force. If the second tray T2 is pressed orthogonally against the guide surface 75, there is a possibility that the second tray T2 may not move to either the upstream side or the downstream side in the transport direction. To address this issue, in the present embodiment, the direction in which the pressing force acts and the direction of extension of the second guide surface 77 form an obtuse angle. Therefore, the second tray T2 is pushed toward the upstream side in the transport direction because of a component of the pressing force that is parallel to the second guide surface 77. Therefore, because of such a pressing force, the second tray T2 is likely to be pushed toward the upstream side in the transport direction against the transportation force imparted by the first conveyor mechanism 50 (see an arrow 105 shown in FIG. 7).

[0058] Next, as shown in FIG. 10A, the case in which the second tray T2 is located on the first partial path 47 of the individual path 42 will be explained. In this case, the shaft portion Tb of the second tray T2 is in contact with the first guide surface 76. The direction of extension of a straight line 106 connecting the axial center of the second tray T2 and the axial center of the first tray T1 (the direction in which the pressing force by the first tray T1 acts on the second tray T2) is inclined with respect to

a direction orthogonal to the direction of extension of the first guide surface 76. Therefore, the second tray T2 is pushed toward the downstream side (away from the protrusion 78) in the transport direction of the first partial path 47 because of a component of the pressing force (see an arrow 107 shown in FIG. 10A) that is parallel to the first guide surface 76. Therefore, the second tray T2 is easily pushed toward the downstream side in the transport direction because of the pressing force and the transportation force imparted by the first conveyor mechanism 50 (see an arrow 108 shown in FIG. 10A).

[0059] On the other hand, as shown in FIG. 10B, when the second tray T2 is located on the second partial path 48 of the individual path 42, the shaft portion Tb of the second tray T2 contacts the second guide surface 77. In addition, the direction of extension of a straight line 109 connecting the axial center of the second tray T2 and the axial center of the first tray T1 (the direction in which the pressing force by the first tray T1 acts on the second tray T2) is inclined with respect to a direction orthogonal to the direction of extension of the second guide surface 77. For this reason, the second tray T2 is pushed toward the upstream side (away from the protrusion 78) in the transport direction of the second partial path 48 because of a component of the pressing force (see an arrow 110 shown in FIG. 10B) that is parallel to the second guide surface 77. Therefore, because of the pressing force, the second tray T2 is likely to be pushed toward the upstream side in the transport direction against the transportation force imparted by the first conveyor mechanism 50 (see an arrow 111 shown in FIG. 10B).

[0060] Thus, when the second tray T2 on the individual path 42 is in contact with the first tray T1 on the first discharge path 43, the second tray T2 is moved away from the protrusion 78. That is, when the second tray T2 is in contact with the apex 79 of the protrusion 78 or is positioned on the second partial path 48 on the upstream side in the transport direction, the second tray T2 is pushed further toward the upstream side. Also, when the second tray T2 is positioned on the first partial path 47 on the downstream side in the transport direction, the second tray T2 is further pushed toward the downstream side. Therefore, even if the second tray T2 is located on the individual path 42, the occurrence of the bridge phenomenon is suppressed.

[0061] As explained above, the first conveyor mechanism 50 is driven by the first drive source (the first motor 54), and the second conveyor mechanism 60 is driven by the second drive source (the second motor 64). Furthermore, when it is determined that the tray T discharged from the winding unit 7 is staying on the second discharge path 32 of the bobbin processing device 3, only the operation of the first conveyor mechanism 50 is stopped. In this manner, the tray T on the first discharge path 43 of the tray transport device 8 is caused to stand by without being transported until the staying of the tray T on the second discharge path 32 is resolved as a result of operating the second conveyor mechanism 60. Therefore,

the tray T can be suppressed from accumulating on the first discharge path 43 (in particular, a downstream side portion of the transport direction), so that the occurrence of the bridge phenomenon, the operation stop of the winding unit 7, and the like can be suppressed. Therefore, it is possible to suppress the occurrence of a problem caused by the staying of the tray T in the bobbin processing device 3.

[0062] In addition, after it is determined whether the staying of the tray T on the second discharge path 32 has been resolved, the operation of the first conveyor mechanism 50 is resumed. For this reason, compared with, for example, the case in which the operation of the first conveyor mechanism 50 is resumed after the predetermined time has elapsed or by an operation performed by the operator, it is possible to avoid the occurrence of useless operation, the reduction in the production efficiency, and the like.

[0063] In addition, when the tray sensor 38 does not detect the tray T for the first predetermined time or longer, it is determined that the staying of the tray T on the second discharge path 32 has been resolved. As a result, the operation of the first conveyor mechanism 50 can be resumed while there is some open space near the tray sensor 38. Therefore, it is possible to prevent the operation of the first conveyor mechanism 50 from being stopped again in a short time after the resuming of the operation of the first conveyor mechanism 50.

[0064] The second transport speed when the operation of the first conveyor mechanism 50 is resumed is slower than the first transport speed. Therefore, it is possible to prevent the tray T that has moved from the first discharge path 43 of the tray transport device 8 to the second discharge path 32 of the bobbin processing device 3 from quickly catching another tray T remaining on the second discharge path 32. Therefore, it is possible to prevent staying again of the tray T on the second discharge path 32.

[0065] In addition, after the operation of the first conveyor mechanism 50 is resumed, if the state in which the staying of the tray T has been resolved continues for the second predetermined time or longer, the transport speed of the first conveyor mechanism 50 is returned from the second transport speed to the first transport speed. As a result, after the operation of the first conveyor mechanism 50 is resumed, it is possible to restore the transport speed at a timing at which the tray T on the second discharge path 32 can be transported smoothly to some extent. Therefore, it can be effectively prevented that the staying of the tray T is likely to occur again.

[0066] In addition, the number of trays T discharged from the winding unit 7 while the operation of the first conveyor mechanism 50 is stopped is limited. Therefore, it is possible to prevent the individual path 42 or the junction of the individual path 42 and the first discharge path 43 from being clogged with the tray T while the operation of the first conveyor mechanism 50 is stopped.

[0067] Also, the discharged-bobbin storage path 46

can temporarily store the tray T discharged from the winding unit 7 on the upstream side in the transport direction than the first discharge path 43. As a result, even while the operation of the first conveyor mechanism 50 is stopped, the unwinding of yarn from the pre-supply bobbins Bs by the winding units 7 and the discharge of the discharged bobbins Bd from the winding units 7 can be performed for a while. Therefore, a reduction in production efficiency can be suppressed. Also, the tray T can be temporarily stored on the individual path 42 with a simple structure.

[0068] Further, the first partial path 47 and the second partial path 48 that extend in different directions are provided near the downstream side end in the transport direction of the individual path 42. Further, in a state in which the base portion Ta of the first tray T1 and the base portion Ta of the second tray T2 are in contact with each other and the shaft portion Tb of the second tray T2 is in contact with the apex 79 of the protrusion 78, the first guide surface 76 overlaps the orthogonal straight line 102. Also, in this state, the second guide surface 77 is positioned on the right side of the orthogonal straight line 102. As a result, the second tray T2 is easily pushed toward the second partial path 48 by being pushed by the first tray T1. Also, by arranging the first guide surface 76 and the second guide surface 77 in this way, the second tray T2 on the first partial path 47 is easily pushed toward the first discharge path 43, and the second tray T2 on the second partial path 48 is easily pushed toward the winding unit 7. That is, regardless of the position of the second tray T2, the second tray T2 can be moved away from the apex 79 of the protrusion 78. Therefore, it can be prevented that the second tray T2 cannot move along the individual path 42. As a result, the occurrence of the bridge phenomenon near the junction 49 between the individual path 42 and the first discharge path 43 can be suppressed.

[0069] A modification of the above embodiment will be explained below. Note that, the same or similar components as in the above embodiment will be denoted with the same reference numbers and an explanation thereof will be omitted suitably.

(1) In the above embodiment, the first guide surface 76 overlaps the orthogonal straight line 102, and the second guide surface 77 is positioned on the right side of the orthogonal straight line 102 (see FIG. 7); however, the structure is not limited to this. As shown in FIG. 11A, a first guide surface 76a can be positioned to the right of the orthogonal straight line 102 and a second guide surface 77a can overlap the orthogonal straight line 102. In this configuration, in a state in which the shaft portion Tb of the second tray T2 is in contact with the apex 79 of the protrusion 78, the second tray T2 is easily pushed toward the first discharge path 43. Alternatively, as shown in FIG. 11B, both a first guide surface 76b and a second guide surface 77b may be positioned on the right

side of the orthogonal straight line 102.

(2) In the above embodiment, a part of the individual path 42 constitutes the discharged-bobbin storage path 46 as a storage path capable of temporarily storing the trays T discharged from the winding unit 7; however, the structure is not limited to this. For example, a path branching from the individual path 42 and capable of storing the trays T may be prepared.

(3) In the above embodiment, the discharged-bobbin storage path 46 capable of temporarily storing the tray T discharged from the winding unit 7 is provided; however, the structure is not limited to this. That is, the discharged-bobbin storage path 46 may not necessarily be provided. If the discharged-bobbin storage path 46 is not provided, when the unit control section 12 receives from the main controller 5 a signal indicating that the tray T is staying on the second discharge path 32 of the bobbin processing device 3, the discharging of the tray T from the winding unit 7 can be immediately prohibited.

(4) In the above embodiment, the timing at which the main controller 5 resumes the operation of the first conveyor mechanism 50 is when it is determined that the staying of the tray T on the second discharge path 32 has been resolved; however, the structure is not limited to this. For example, the main controller 5 may resume the operation of the first conveyor mechanism 50 after the predetermined time has elapsed from a timepoint at which the operation of the first conveyor mechanism 50 was stopped.

(5) In the above embodiment, when the state that the tray T is not detected by the tray sensor 38 continues for the first predetermined time or longer, the main controller 5 determines that the staying of the tray T on the second discharge path 32 is resolved; however, the structure is not limited to this. For example, the main controller 5 can immediately determine that the staying of the tray T has been resolved if the tray T is not detected by the tray sensor 38.

(6) In the above embodiment, after the operation of the first conveyor mechanism 50 has been resumed, the timing at which the transport speed of the tray T is returned from the second transport speed to the first transport speed is when the state in which the staying of the tray T is resolved continues for the second predetermined time; however, the structure is not limited to this. For example, the main controller 5 may control the transport speed based on the time interval for which the trays T are detected by the tray sensor 38. That is, after the operation of the first conveyor mechanism 50 is resumed, the transport speed is maintained at the second transport speed when the time interval is less than a predetermined value, and the transport speed is returned to the first transport speed when the time interval becomes the predetermined value or longer.

(7) In the above embodiment, the main controller 5

transmits a signal to the unit control section 12 at the timing when the staying of the tray T has been resolved, and from there onward, the unit control section 12 permits the winding unit 7 to discharge the tray T. However, the structure is not limited to this. For example, if the state that the staying of the tray T has been resolved continues for the second predetermined time (that is, when the transport speed of the tray T by the first conveyor mechanism 50 is returned from the second transport speed to the first transport speed), the main controller 5 can transmit the signal to the unit control section 12.

(8) In the above embodiment, when the staying of the tray T on the second discharge path 32 has been resolved, the main controller 5 causes the first conveyor mechanism 50 to resume the transport of the tray T at the second transport speed slower than the first transport speed; however, the structure is not limited to this. That is, when the staying of the tray T on the second discharge path 32 has been resolved, the main controller 5 can resume the operation of the first conveyor mechanism 50 so that the tray T is immediately transported at the first transport speed.

(9) In the above embodiment, the tray sensor 38 is electrically connected to the bobbin processing control unit 11, and the tray sensor 38 transmits the detection signal to the main controller 5 via the bobbin processing control unit 11; however, the structure is not limited to this. For example, the tray sensor 38 may be configured to transmit the detection signal directly to the main controller 5.

(10) In the above embodiment, the main controller 5 determines whether the tray T is staying on the second discharge path 32; however, the structure is not limited to this. For example, the bobbin processing control unit 11 can be configured to make this determination. In this configuration, the bobbin processing control unit 11 corresponds to the determining section according to the present invention. Alternatively, the tray sensor 38 may be provided with a determining section.

[0070] A yarn winding equipment according to one aspect of the present invention includes a plurality of winding units each of which unwinds a yarn from a pre-supply bobbin and winds the yarn on a winding bobbin; a tray transport device including a plurality of individual paths each capable of discharging from a corresponding one of the winding units a tray on which the pre-supply bobbin has been mounted; and a first discharge path that merges with the individual paths; a bobbin processing device including a second discharge path connected to a downstream end of the first discharge path in a transport direction in which the trays are transported and capable of processing a discharged bobbin that is the pre-supply bobbin that is discharged from the winding unit; and a control section. The tray transport device includes a first

conveyor mechanism that transports the tray along the first discharge path; and a first drive source that drives the first conveyor mechanism. The bobbin processing device includes a second conveyor mechanism that transports the tray along the second discharge path; and a second drive source that drives the second conveyor mechanism. The yarn winding equipment further includes a tray detecting section that detects the trays that are being transported along the second discharge path; and a determining section that determines whether the tray stays on the second discharge path based on a detection result obtained in the tray detecting section. The control section, when the determining section determines that the tray has stayed on the second discharge path, stops operation of the first conveyor mechanism in a state that the second conveyor mechanism is operating.

[0071] In the above aspect, the first conveyor mechanism and the second conveyor mechanism are driven by separate drive sources. When it is determined that the tray discharged from the winding unit (hereinafter, "discharged tray") is staying on the second discharge path, only the operation of the first conveyor mechanism is stopped. In this manner, the discharged tray on the first discharge path can be made to standby without being transported until the staying of the discharged tray on the second discharge path is resolved by operating the second conveyor mechanism. As a result, since the occurrence of the accumulating of the discharged tray on the first discharge path (in particular, on the downstream side in the transport direction) can be suppressed, it is possible to suppress the occurrence of the bridge phenomenon and the operation stop of the winding unit. Therefore, it is possible to suppress the occurrence of a problem caused by the staying of the tray in the bobbin processing device.

[0072] According to another aspect of the present invention, in the above yarn winding equipment, the control section, in a state that the operation of the first conveyor mechanism has been stopped, when the determining section determines that the staying of the tray on the second discharge path has been resolved, resumes the operation of the first conveyor mechanism.

[0073] For example, after the operation of the first conveyor mechanism has been stopped, the operation may be resumed after a predetermined time has elapsed or by the operation made by the operator; however, the following problems may occur. That is, if the staying of the discharged tray on the second discharge path has not been resolved, the operation of the first conveyor mechanism will be stopped immediately after being resumed, and a wasteful operation will be performed. Also, if the staying of the discharged tray on the second discharge path is resolved before the predetermined time has elapsed, the first conveyor mechanism will be stopped longer than necessary, and the production efficiency will be reduced. In the above aspect, because the operation of the first conveyor mechanism is resumed after it is determined whether the staying of the discharged tray

on the second discharge path has been resolved, the above problem can be avoided.

[0074] According to still another aspect of the present invention, in the above yarn winding equipment, the determining section, after the operation of the first conveyor mechanism has been stopped, if a state that no tray is detected by the tray detecting section continues for a first predetermined time or longer, determines that the staying of the trays on the second discharge path has been resolved.

[0075] In the above aspect, the operation of the first conveyor mechanism can be resumed while a space near the tray detecting section is open to some extent. Therefore, it is possible to prevent the operation of the first conveyor mechanism from being stopped again within a short duration after the resuming of the operation of the first conveyor mechanism.

[0076] According to still another aspect of the present invention, in the above yarn winding equipment, the control section, when resuming the operation of the first conveyor mechanism that was once stopped, controls the first conveyor mechanism so that the tray is transported at a second transport speed that is slower than a first transport speed that is a transport speed of the first conveyor mechanism before the operation of the first conveyor mechanism was stopped.

[0077] One reason for staying of the discharged trays on the second discharge path can be because a large number of discharged trays are transported on the second discharge path. In such a case, when the operation of the first conveyor mechanism is resumed, if the discharged tray is transported at the same transport speed as before the operation of the first conveyor mechanism was stopped, the tray moved from the first discharge path to the second discharge path quickly catches the discharged tray remaining on the second discharge path, and this may cause staying of the tray again. In the above aspect, since the second transport speed is slower than the first transport speed, the discharged tray moved from the first discharge path to the second discharge path can be prevented from quickly catching the discharged tray remaining on the second discharge path. Therefore, it is possible to prevent the staying of the discharged tray on the second discharge path from occurring again.

[0078] According to still another aspect of the present invention, in the above yarn winding equipment, the control section, after resuming the operation of the first conveyor mechanism, if a state that the staying of the trays has been resolved continues for a second predetermined time or longer, returns the transport speed of the first conveyor mechanism from the second transport speed to the first transport speed.

[0079] In the above aspect, after the operation of the first conveyor mechanism is resumed, it is possible to return the transport speed to the original speed at the timing at which the discharged tray on the second discharge path can be transported smoothly to some extent. Therefore, it can be effectively prevented that the staying

of the discharged tray is likely to occur again.

[0080] According to still another aspect of the present invention, the above yarn winding equipment further includes a unit control section that controls each winding unit. The unit control section, after the control section has stopped the operation of the first conveyor mechanism, if number of trays discharged from the winding units reaches a predetermined upper limit, prohibits discharge of trays from the winding units.

[0081] If trays are ejected one after another from the winding unit while the operation of the first conveyor mechanism is stopped, the individual path or the junction between the individual path and the first discharge path may be clogged with the discharged tray. In the above aspect, since the number of trays discharged from the winding units is limited while the operation of the first conveyor mechanism is stopped, it is possible to prevent the clogging of the discharged tray as mentioned above.

[0082] According to still another aspect of the present invention, the above yarn winding equipment further includes a storage path arranged between the winding unit and the first discharge path in the transport direction and capable of temporarily storing the trays discharged from the winding unit.

[0083] In the above aspect, the tray discharged from the winding units can be temporarily stored on the upstream side in the transport direction rather than the first discharge path. As a result, even during the time in which the operation of the first conveyor mechanism is stopped, the unwinding of the yarn from the pre-supply bobbin by the winding units and the discharging of the discharged bobbin from the winding units can be performed for a while. Therefore, a decrease in the production efficiency can be suppressed.

[0084] According to still another aspect of the present invention, in the above yarn winding equipment, the individual path has a length sufficient for temporarily storing at least two trays discharged from the winding unit. The storage path is a part of the individual path.

[0085] With the above aspect, temporary storage of the discharged trays on the individual path can be realized with a simple structure.

[0086] According to still another aspect of the present invention, in the above yarn winding equipment, the tray includes a shaft portion on which the discharged bobbin can be mounted; and a base portion that is circular when seen from an axial direction of the shaft portion and in a center portion of which the shaft portion is arranged. The first conveyor mechanism imparts on the tray a transportation force toward one side in a direction of extension of the first discharge path. Each of the first discharge path and the individual path has a guide surface that guides the tray by being in contact with the shaft portion of the tray. The individual path includes a first partial path that extends toward other side in the direction of extension from a junction between the first discharge path while inclining with respect to the direction of extension; and a second partial path that extends at least toward the other

side in the direction of extension from an end that is on the opposite side of the junction of the first partial path while inclining with respect to the direction of extension but having more inclination with respect to the first discharge path than the first partial path. When seen from a direction orthogonal to a plane that includes the first discharge path and the individual paths, a protrusion is formed by a first guide surface present on the one side in the direction of extension among the guide surfaces that constitute the first partial path and a second guide surface present on the one side in the direction of extension among the guide surfaces that constitute the second partial path. In a state that the base portion of a first tray among the trays present on the first discharge path and the base portion of a second tray among the trays present on the individual path are mutually in contact and the shaft portion of the second tray is in contact with an apex of the protrusion, when a straight line that is orthogonal to a straight line that connects an axial center of the first tray and an axial center of the second tray and that passes through the apex of the protrusion is taken as an orthogonal straight line, one among the first guide surface and the second guide surface overlaps with the orthogonal straight line or is located toward the one side in the direction of extension than the orthogonal straight line, and other among the first guide surface and the second guide surface is located toward the one side in the direction of extension than the orthogonal straight line.

[0087] If the individual path is linear, the base portion of the first tray and the base portion of the second tray contact each other somewhere on the individual path, and the shaft portion of the second tray on the individual path is pushed orthogonally on the guide surface of the individual path. If this happens, there is a possibility that the second tray may not move to either the upstream side or the downstream side in the transport direction. Also, it may happen that the first tray also may not move.

[0088] In the above aspect, the first partial path and the second partial path that extend in different directions from each other are provided near the downstream side end in the transport direction of the individual path. Furthermore, with the base portion of the first tray and the base portion of the second tray in contact with each other and the shaft portion of the second tray being in contact with the apex of the protrusion, one between the first guide surface and the second guide surface overlaps with the orthogonal straight line or is located on the one side in the direction of extension than the orthogonal straight line. Also, in this state, the other between the first guide surface and the second guide surface is located on the one side in the direction of extension than the orthogonal straight line. As a result, the second tray is easily pushed toward the first partial path or pushed toward the second partial path by being pushed by the first tray (details will be described in the embodiment described later). Also, by arranging the first guide surface and the second guide surface in this way, the second tray located on the first partial path can be easily pushed toward the first dis-

charge path, and the second tray located on the second partial path can be easily pushed toward the winding unit (the details will be described later). That is, regardless of the position of the second tray, the second tray can be moved away from the apex of the protrusion. Thus, it is possible to prevent the second tray from becoming stuck on the individual path. Therefore, it is possible to suppress the occurrence of the bridge phenomenon near the junction between the individual path and the first discharge path.

[0089] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

[0090] Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the scope of the claims.

Claims

1. A yarn winding equipment (1) comprising:

a plurality of winding units (7) each of which being configured to unwind a yarn from a pre-supply bobbin (Bs) and to wind the yarn on a winding bobbin (Bw);

a tray transport device (8) including

a plurality of individual paths (42) each capable of discharging from a corresponding one of the winding units (7) a tray (T) on which the pre-supply bobbin (Bs) has been mounted; and

a first discharge path (43) configured to merge with the individual paths (42);

a bobbin processing device (3) including a second discharge path (32) connected to a downstream end of the first discharge path (43) in a transport direction in which the trays (T) are transported and capable of processing a discharged bobbin (Bd) that is the pre-supply bobbin (Bs) that is discharged from the winding unit (7); and

a control section (5), wherein the tray transport device (8) includes

a first conveyor mechanism (50) configured to transport the tray (T) along the first discharge path (43); and

a first drive source (54) configured to drive the first conveyor mechanism (50),

the bobbin processing device (3) includes

a second conveyor mechanism (60) configured to transport the tray (T) along the second discharge path (32); and
a second drive source (64) configured to drive the second conveyor mechanism (60),

the yarn winding equipment (1) further includes

a tray detecting section (38) configured to detect the trays (T) that are being transported along the second discharge path (32); and
a determining section (5) configured to determine whether the tray (T) stays on the second discharge path (32) based on a detection result obtained in the tray detecting section (38), and

the control section (5) is configured to, when the determining section (5) determines that the tray (T) has stayed on the second discharge path (32), stop operation of the first conveyor mechanism (50) in a state that the second conveyor mechanism (60) is operating.

2. The yarn winding equipment (1) as claimed in Claim 1, wherein the control section (5) is configured to, in a state that the operation of the first conveyor mechanism (50) has been stopped, when the determining section (5) determines that the staying of the tray (T) on the second discharge path (32) has been resolved, resume the operation of the first conveyor mechanism (50).
3. The yarn winding equipment (1) as claimed in Claim 2, wherein the determining section (5) is configured to, after determining that the tray (T) has stayed, if a state that no tray (T) is detected by the tray detecting section (38) continues for a first predetermined time or longer, determine that the staying of the trays (T) on the second discharge path (32) has been resolved.
4. The yarn winding equipment (1) as claimed in any one of Claims 1 to 3, wherein the control section (5) is configured to, when resuming the operation of the first conveyor mechanism (50) that was once stopped, control the first conveyor mechanism (50) so that the tray (T) is transported at a second transport speed that is slower than a first transport speed that is a transport speed of the first conveyor mechanism (50) before the operation of the first conveyor mechanism (50) was stopped.
5. The yarn winding equipment (1) as claimed in Claim 4, wherein the control section (5) is configured to, after resuming the operation of the first conveyor mechanism (50), if a state that the staying of the

trays (T) has been resolved continues for a second predetermined time or longer, return the transport speed of the first conveyor mechanism (50) from the second transport speed to the first transport speed.

6. The yarn winding equipment (1) as claimed in any one of Claims 1 to 5, wherein the yarn winding equipment (1) further includes a unit control section (12) configured to control each winding unit (7), and the unit control section (12) being configured to, after the control section (5) has stopped the operation of the first conveyor mechanism (50), if number of trays (T) discharged from the winding units (7) reaches a predetermined upper limit, prohibit discharge of trays (T) from the winding units (7).
7. The yarn winding equipment (1) as claimed in any one of Claims 1 to 6, wherein the yarn winding equipment (1) further includes a storage path (46) arranged between the winding unit (7) and the first discharge path (43) in the transport direction and capable of temporarily storing the trays (Y) discharged from the winding unit (7).
8. The yarn winding equipment (1) as claimed in Claim 7, wherein the individual path (42) has a length sufficient for temporarily storing at least two trays (T) discharged from the winding unit (7), and the storage path (46) is a part of the individual path (42).
9. The yarn winding equipment (1) as claimed in any one of Claims 1 to 7, wherein the tray (T) includes
 - a shaft portion (Tb) on which the discharged bobbin (Bd) can be mounted; and
 - a base portion (Ta) that is circular when seen from an axial direction of the shaft portion (Tb) and in a center portion of which the shaft portion (Tb) is arranged,
 the first conveyor mechanism (50) is configured to impart on the tray (T) a transportation force toward one side in a direction of extension of the first discharge path (43),
each of the first discharge path (43) and the individual path (42) has a guide surface (75) configured to guide the tray (T) by being in contact with the shaft portion (Tb) of the tray (T),
the individual path (42) includes
 - a first partial path (47) that extends toward another side in the direction of extension from a junction between the first discharge path (43) while inclining with respect to the direction of extension; and
 - a second partial path (48) that extends at least

toward the other side in the direction of extension from an end that is on the opposite side of the junction of the first partial path (47) while inclining with respect to the direction of extension but having more inclination with respect to the first discharge path (43) than the first partial path (47),

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when seen from a direction orthogonal to a plane that includes the first discharge path (43) and the individual paths (42),

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a protrusion (78) is formed by a first guide surface (76) present on the one side in the direction of extension among the guide surfaces (75) that constitute the first partial path (47) and a second guide surface (77) present on the one side in the direction of extension among the guide surfaces (75) that constitute the second partial path (48),

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in a state that the base portion (Ta) of a first tray (T1) among the trays (T) present on the first discharge path (43) and the base portion (Ta) of a second tray (T2) among the trays (T) present on the individual path (42) are mutually in contact and the shaft portion (Tb) of the second tray (T2) is in contact with an apex (79) of the protrusion (78), when a straight line that is orthogonal to a straight line that connects an axial center of the first tray (T1) and an axial center of the second tray (T2) and that passes through the apex (79) of the protrusion (78) is taken as an orthogonal straight line,

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one among the first guide surface (76) and the second guide surface (77) overlaps with the orthogonal straight line or is located on the one side in the direction of extension with respect to the orthogonal straight line, and the other among the first guide surface (76) and the second guide surface (77) is located on the one side in the direction of extension with respect to the orthogonal straight line.

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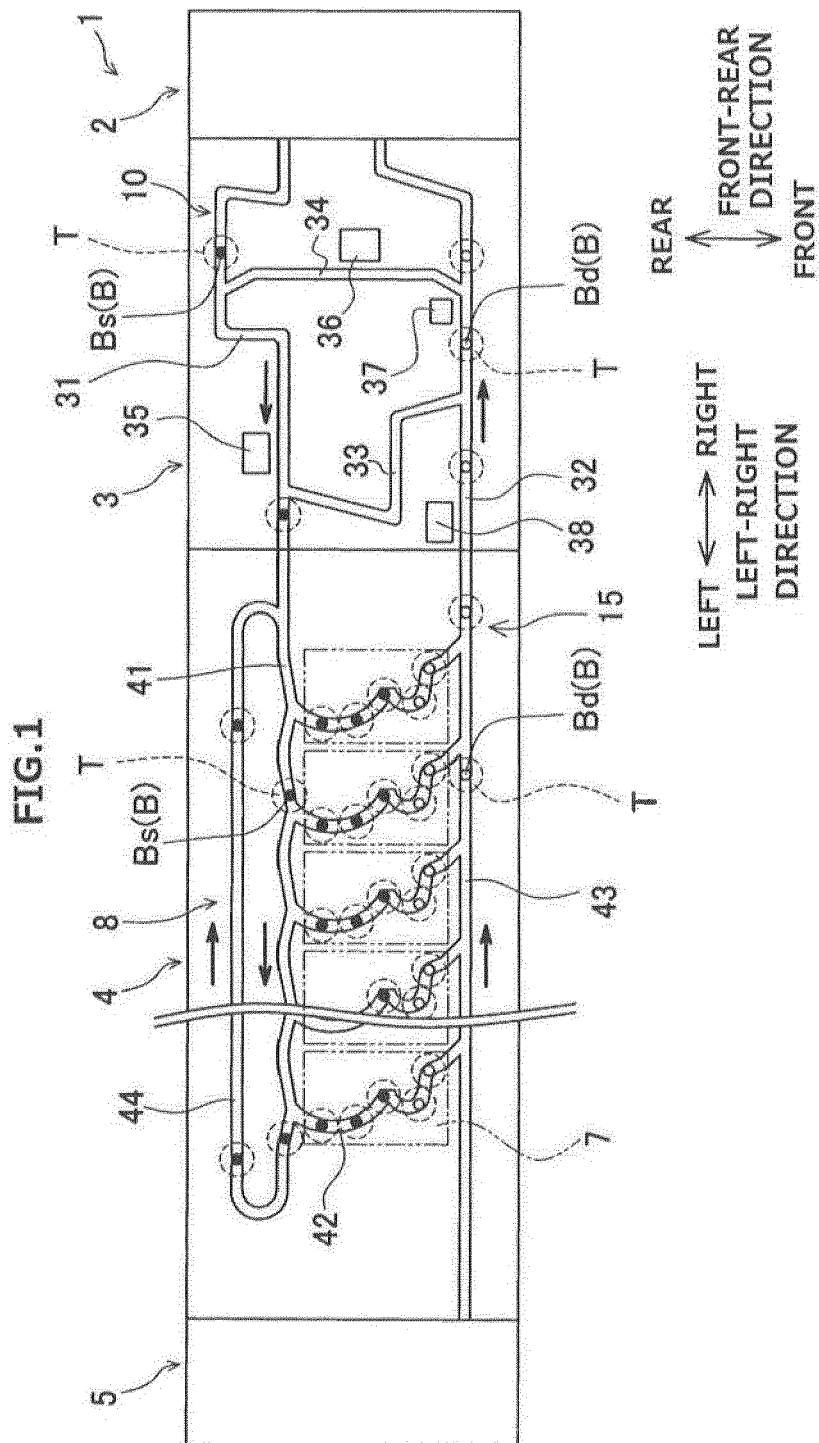
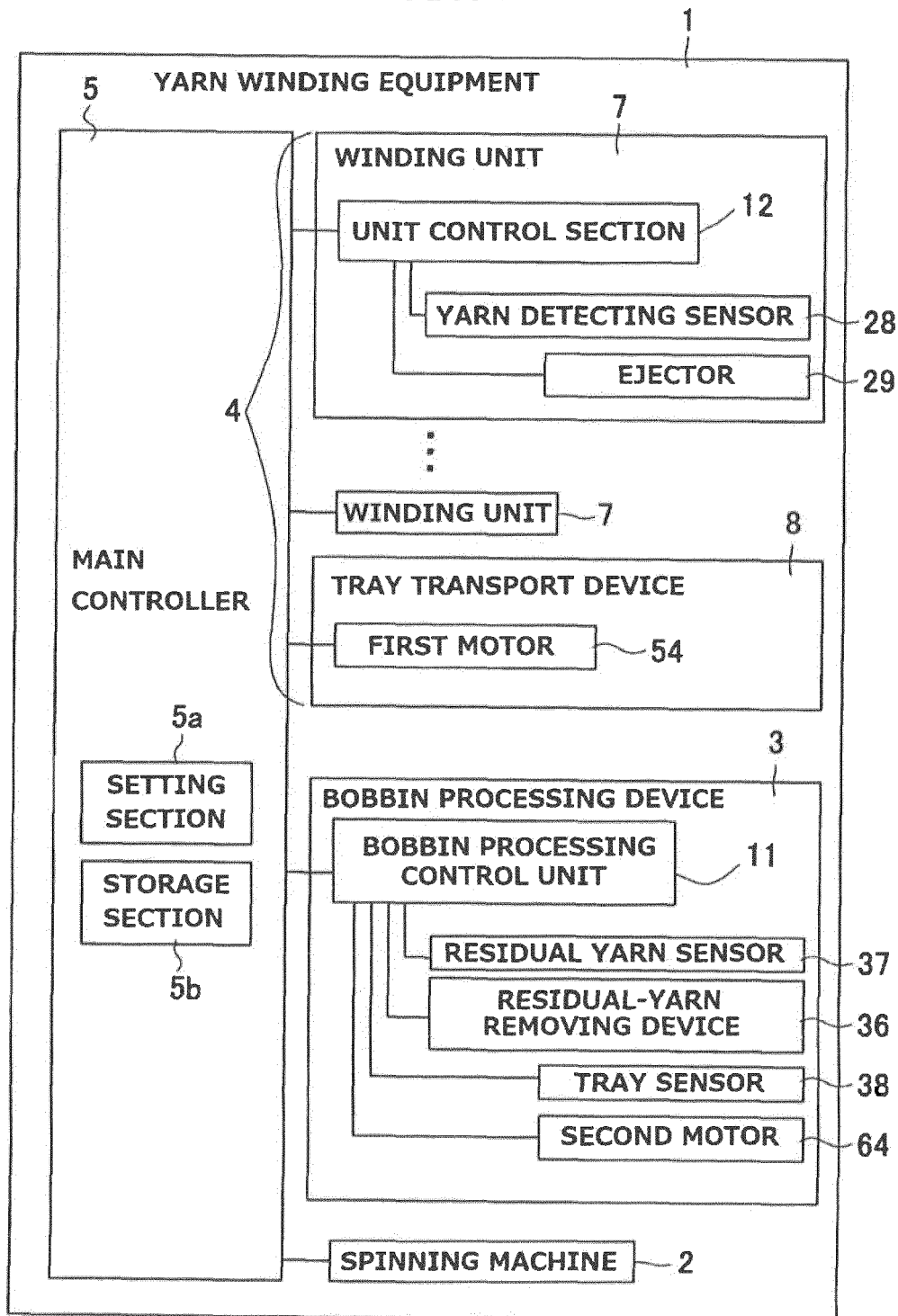


FIG.2



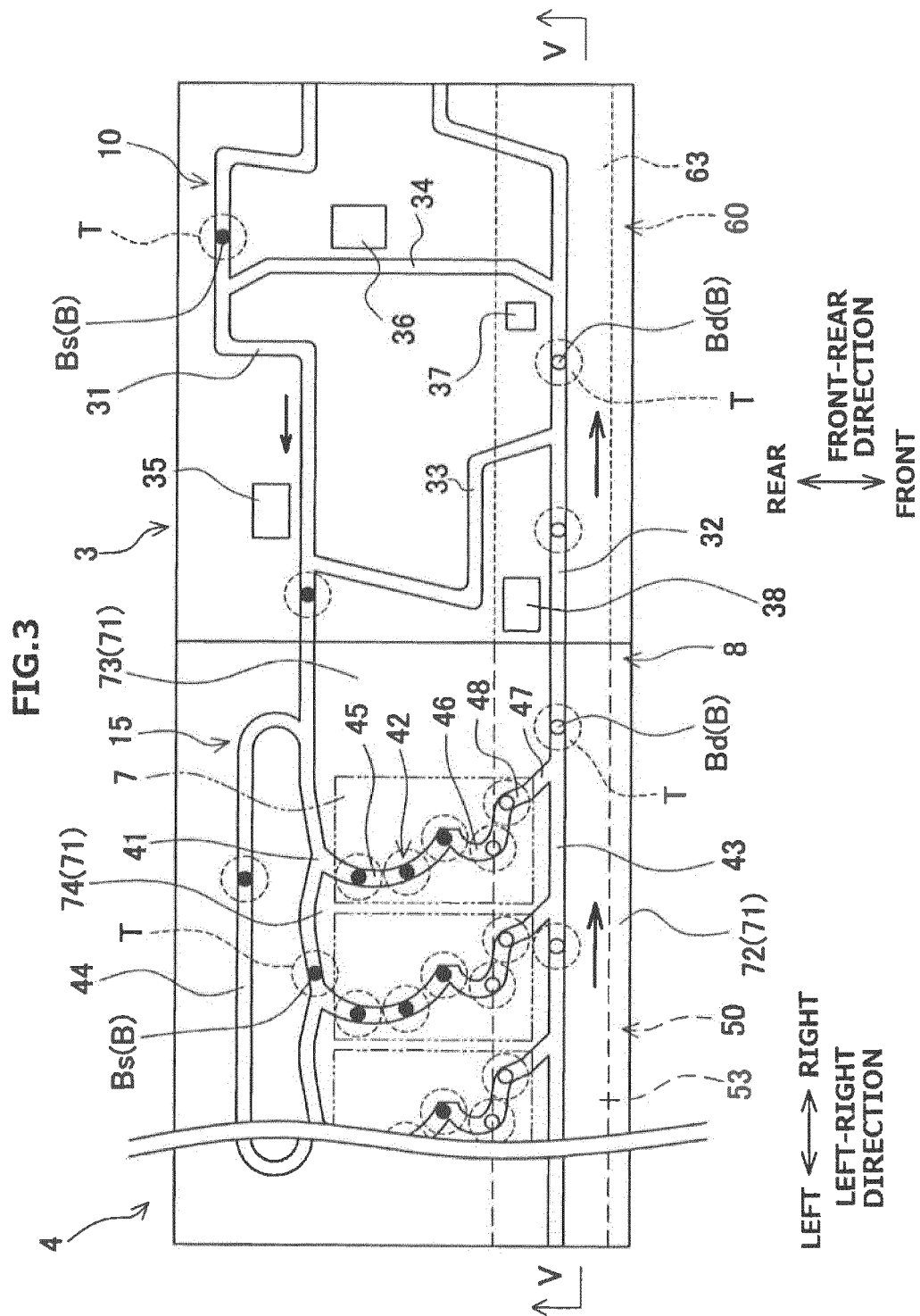
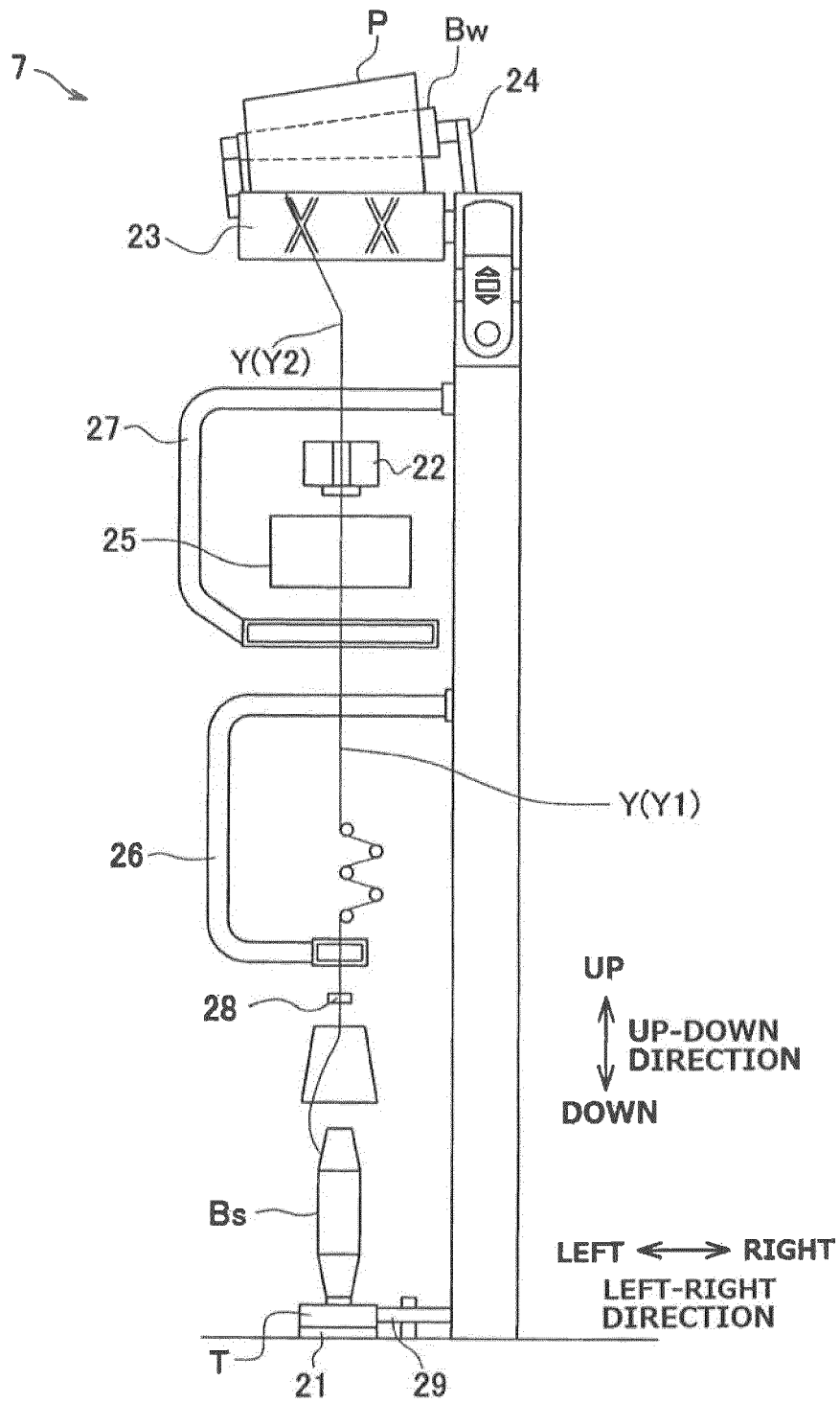
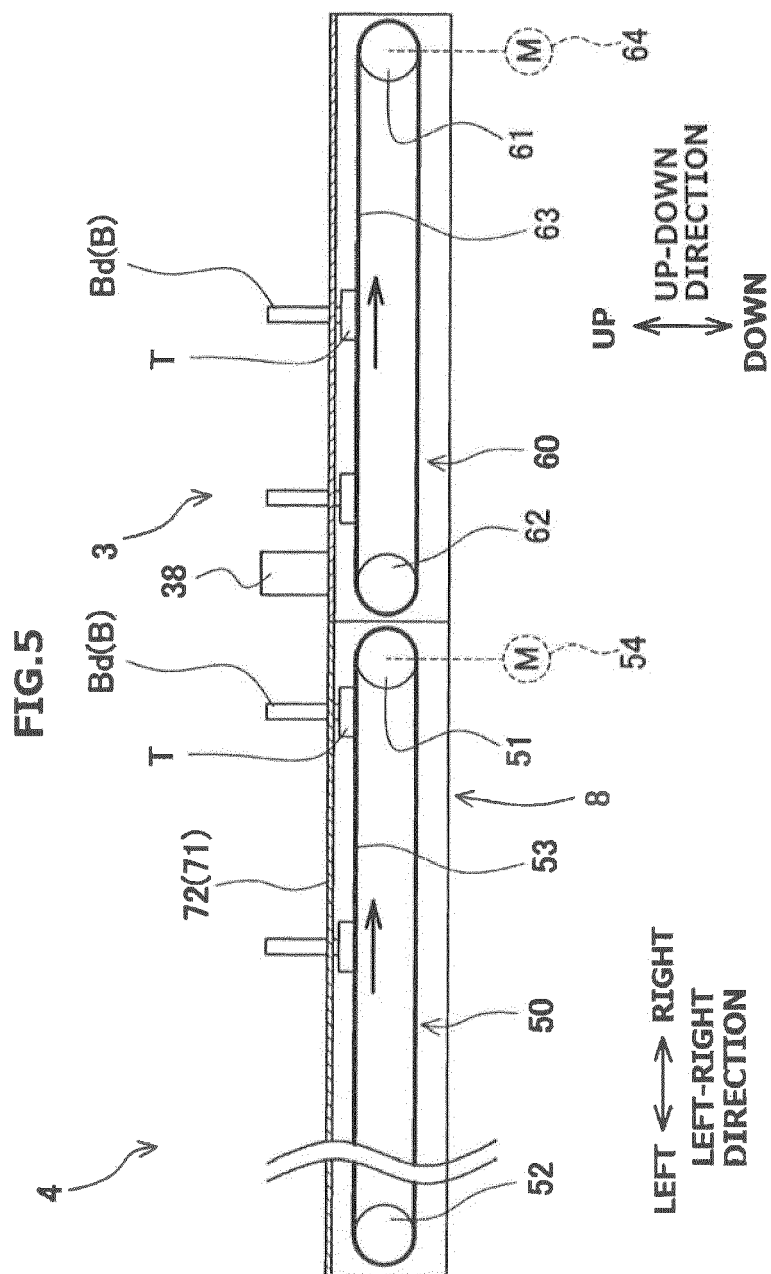
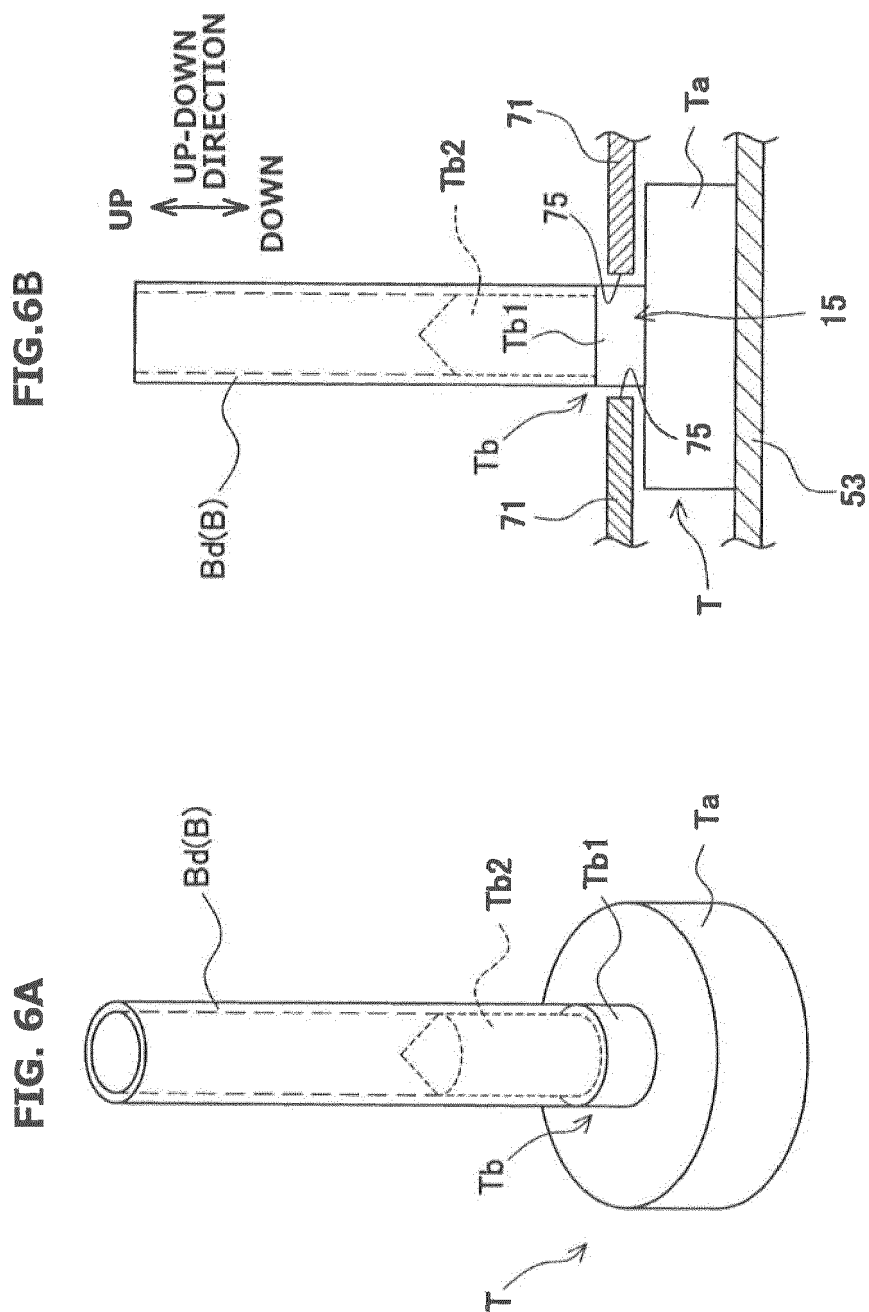


FIG.4







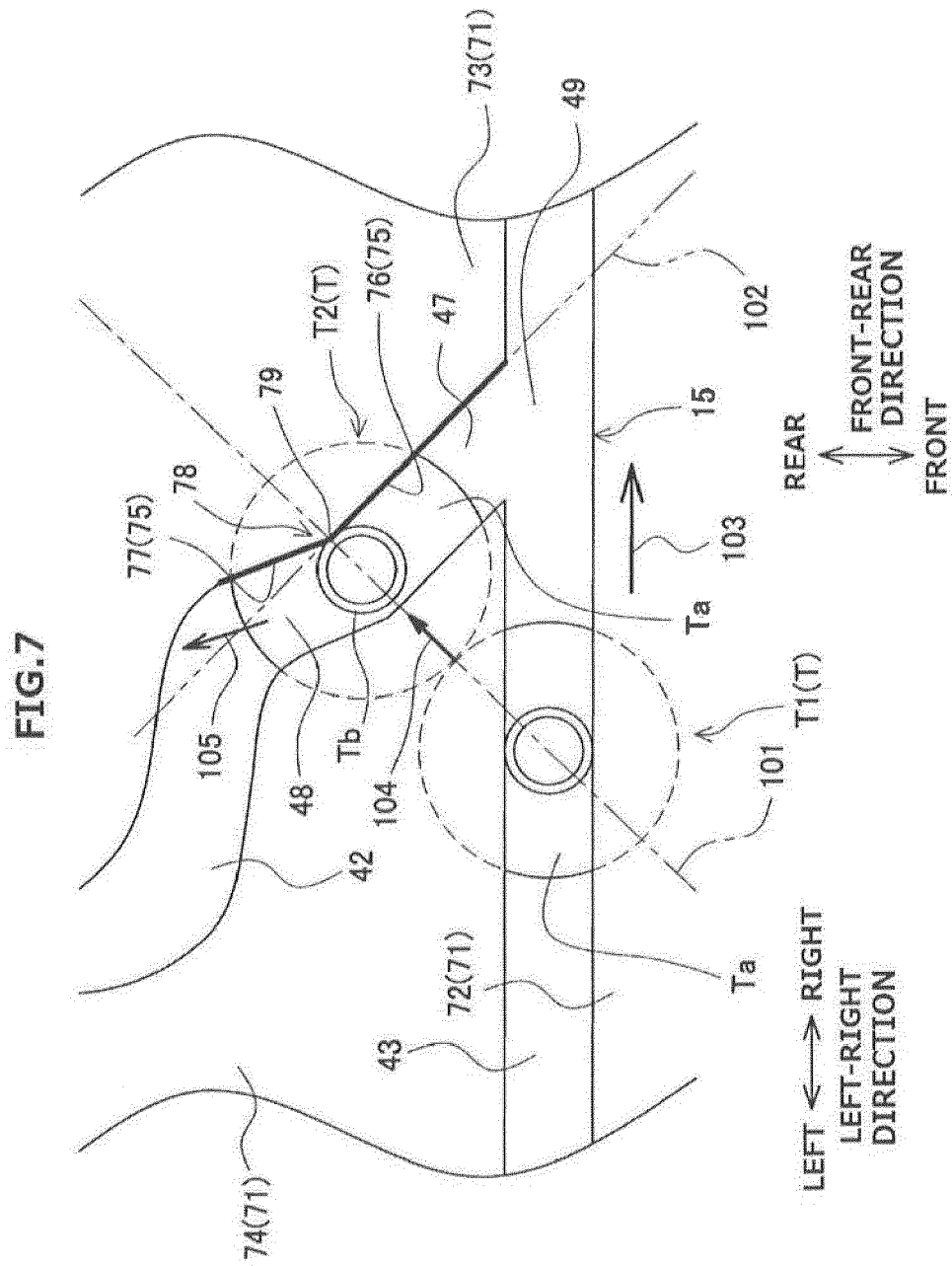
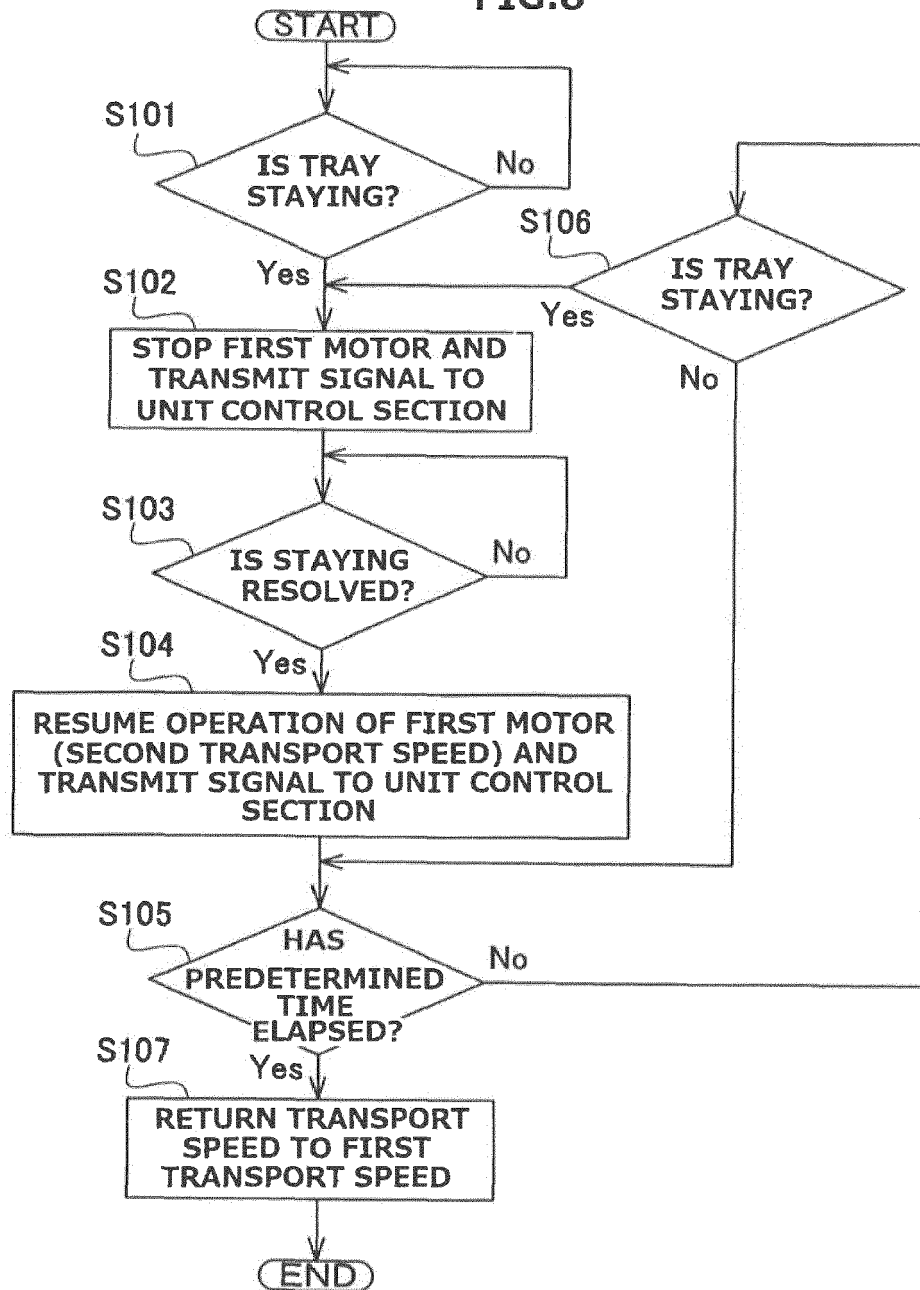


FIG. 8



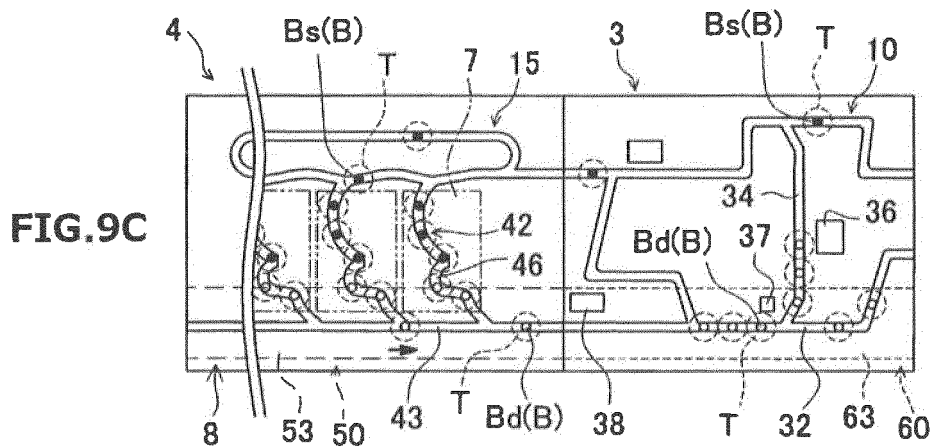
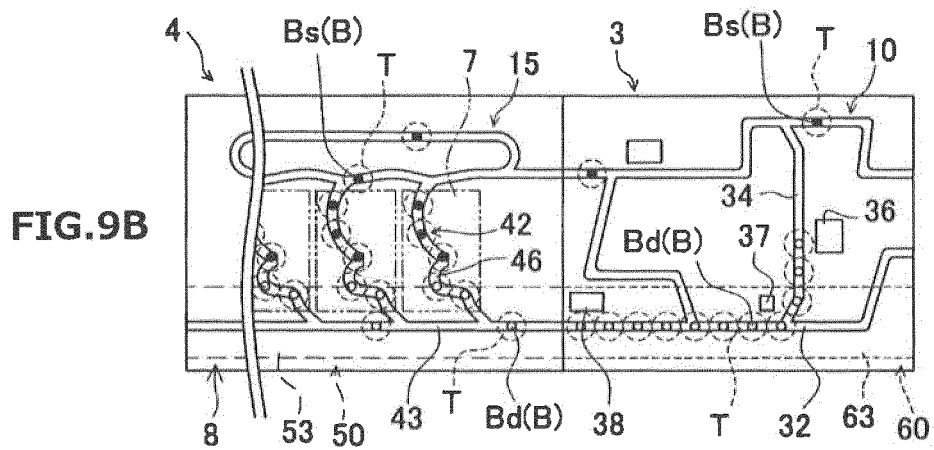
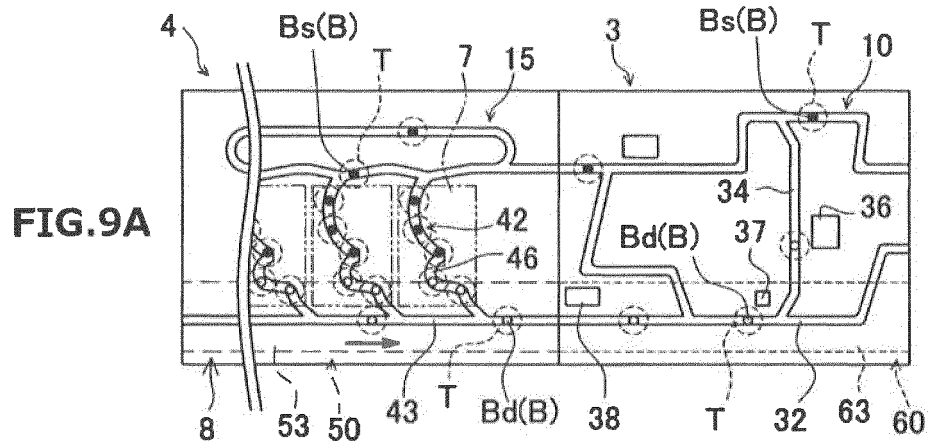


FIG. 10A

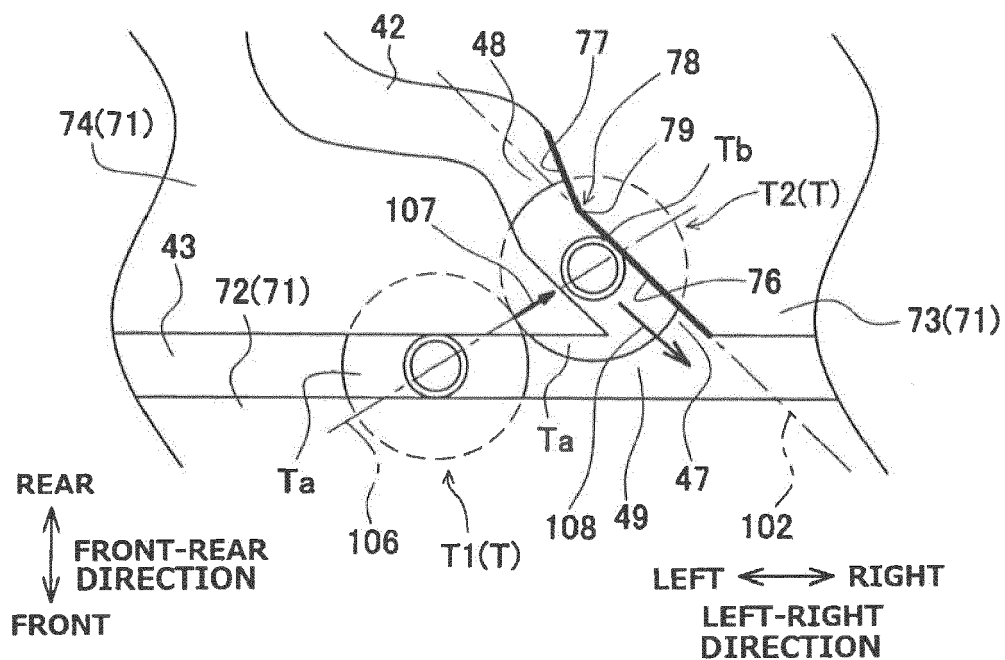


FIG. 10B

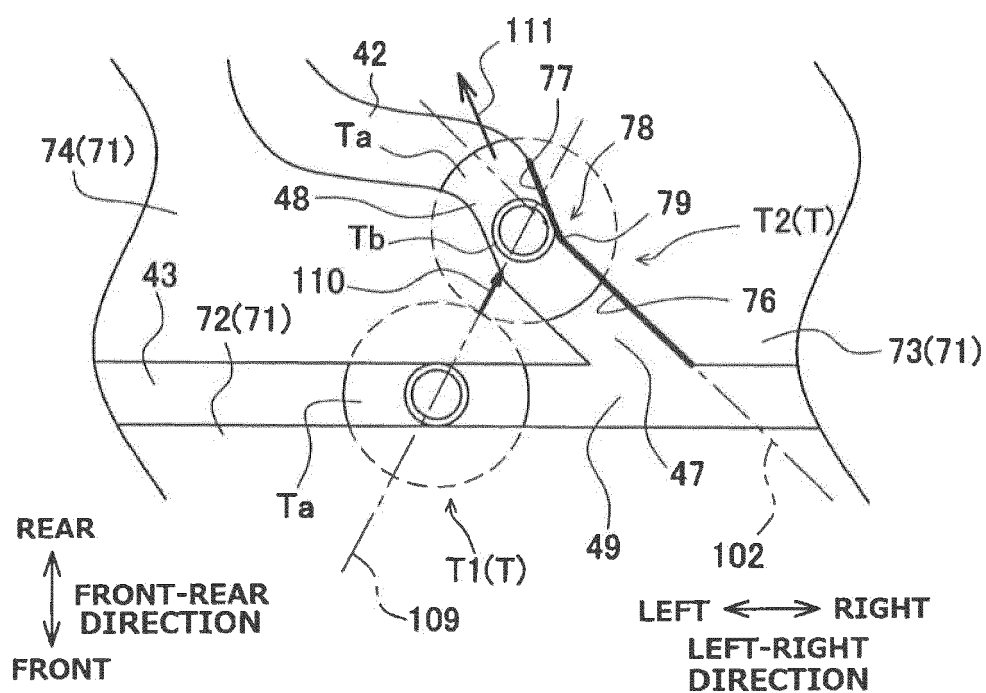


FIG. 11A

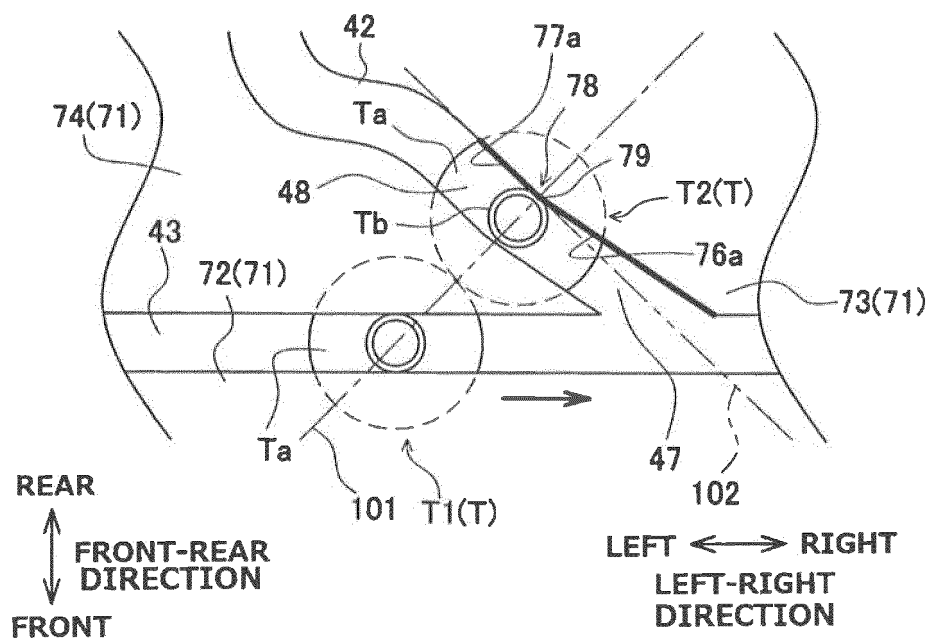
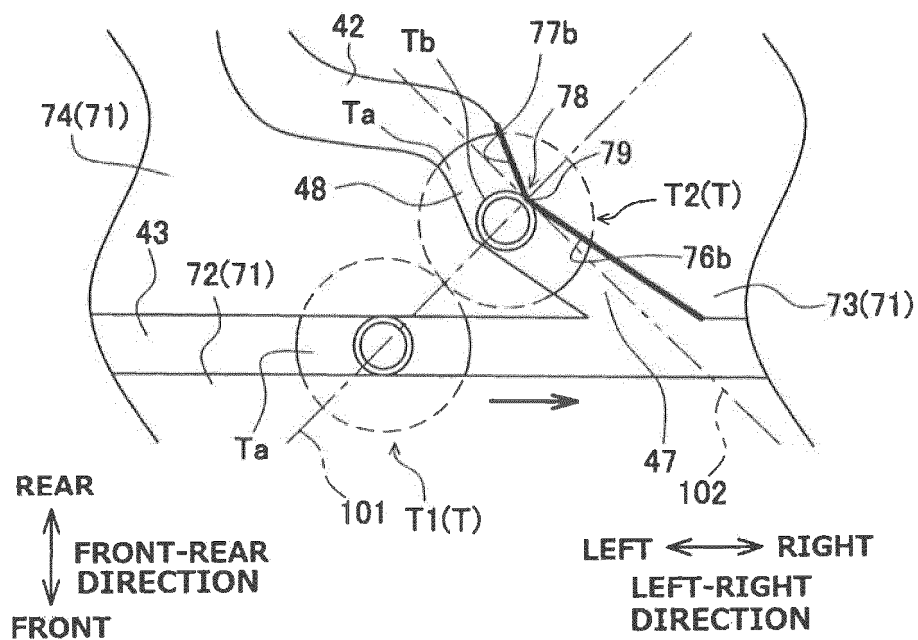


FIG. 11B





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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 6 February 2020	Examiner Pussemier, Bart
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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