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(54) **Yarn winding unit and yarn winding machine**

(57) A yarn winding unit (10) includes a winding section (18) that winds a yarn (20) around a winding tube (22) to form a package (30), and a control section (50) that controls the winding section (18). The winding section (18) includes a winding tube supporting section (23) that supports the winding tube (22), a contact roller (29) that rotates in contact with the winding tube (22) or the

package (30), and a traversing device (70) that is arranged independently of the contact roller (29) and that traverses the yarn (20) that is to be wound around the winding tube (22). The control section (50) controls the winding section (18) such that the traversing speed of the traversing device (70) is maintained equal to or below a predetermined speed when the winding of the yarn (20) is started.

FIG.7A

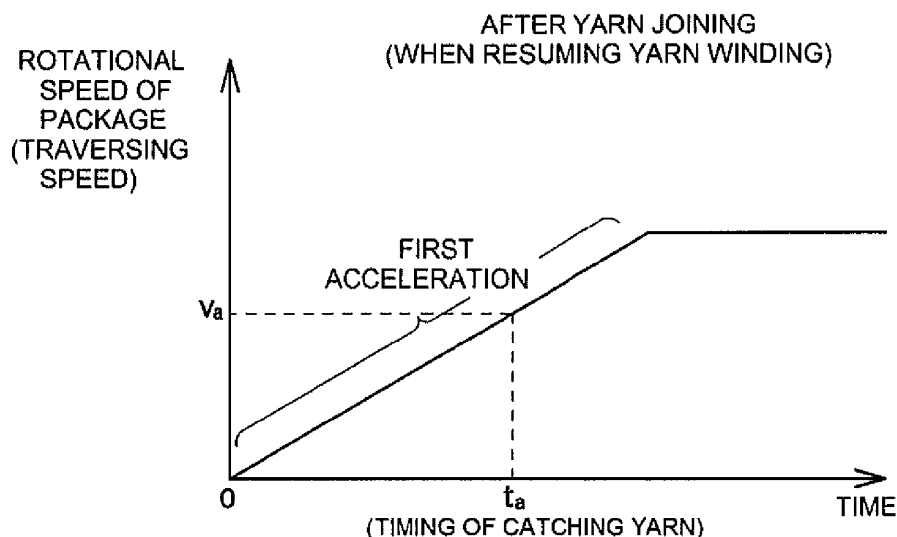
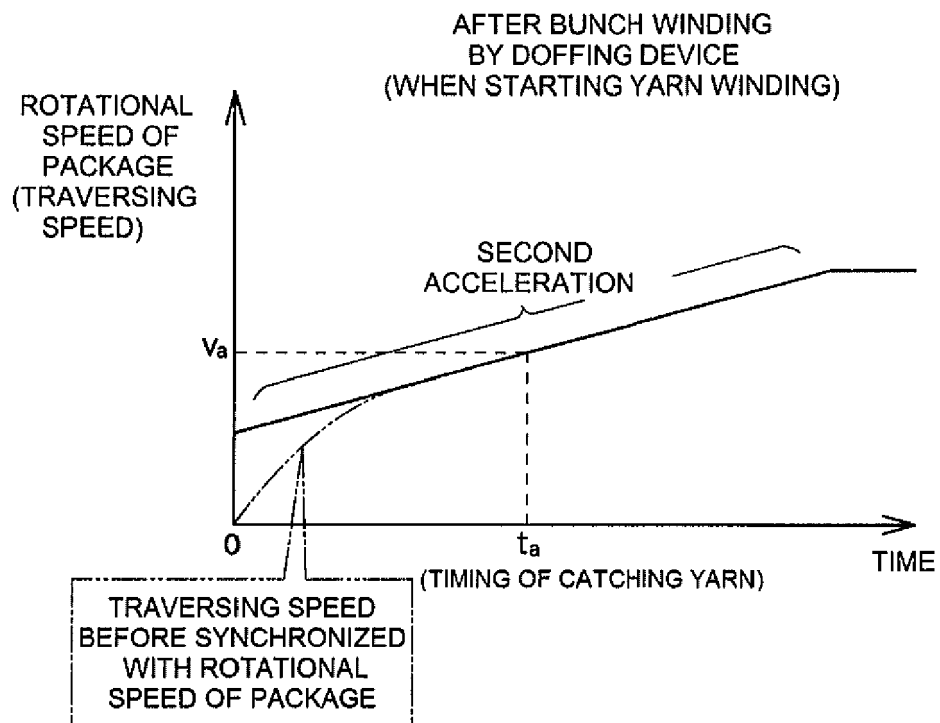


FIG.7B



Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to a yarn winding unit that winds a yarn, while traversing the yarn, into a package, and a yarn winding machine including such a yarn winding unit.

2. DESCRIPTION OF THE RELATED ART

[0002] Yarn winding machines in which a winding tube is rotatably supported with a cradle and a yarn is wound, while being traversed, around an outer peripheral surface of the winding tube into a package are known in the art. The yarn winding machines of this type include, for example, a traverse guide, which engages with and traverses the yarn, and a traverse driving section, which drives the traverse guide, as a yarn traversing structure.

[0003] Japanese Patent Application Laid-open No. 2009-227412 discloses a technique of controlling the traverse driving section to change a traversing width of a traversing device. More specifically, the yarn winding machine reduces the traversing width when a rotational speed (winding speed) of a package is rising, and increases the traversing width (to a normal traversing width) once the winding speed reaches a predetermined speed.

[0004] The above technique leads to prevention of occurrence of patterning and/or stitching. Two modes of controlling the traversing width are disclosed in this patent document, a mode in which a fixed traversing width is set, and a mode in which the traversing width is gradually increased in accordance with the winding speed.

SUMMARY OF THE INVENTION

[0005] In the event of yarn breakage or the like during winding of the yarn, the yarn is joined and then caught by the traversing device. Thereafter, the rotational speed of the package is gradually increased while the yarn is being traversed. When the package is removed after being fully wound, and a new winding tube is supplied to the cradle, bunch winding or the like is formed around this winding tube. Thereafter, the yarn is caught by the traversing device, and the rotational speed of the package is gradually increased. If the traversing device is made to catch the yarn while the traversing speed is high, yarn breakage can occur when the traversing device touches the yarn.

[0006] Such yarn breakage tends to occur especially in a yarn winding machine in which a doffing device or the like forms bunch winding. How this happens is explained with reference to FIGS. 10A and 10B. The traversing speed becomes zero at the end portions of the traversing width and reaches the highest at or about the

center of the traversing width (center portion). Such minute details are not indicated in FIGS. 10A and 10B, however. In general, the traversing speed is synchronized with the rotational speed of the package in the yarn winding machine, and therefore the two speeds are indicated basically by the same lines.

[0007] How the rotational speed of the package (i.e., the traversing speed) changes after yarn joining is shown in FIG. 10A. The package is not rotated during the yarn joining, and therefore the initial rotational speed of the package is zero. The traversing device catches the yarn at a predetermined timing (when time t_a has elapsed) after the start of rotation of the package. The traversing speed at this timing is represented as v_a .

[0008] How the rotational speed of the package (i.e., the traversing speed) that changes after a doffing device or the like forms bunch winding is shown in FIG. 10B. The bunch winding is formed by the doffing device or the like while the package is already being rotated, and therefore the initial rotational speed of the package is not zero. The acceleration of rotation of the package is the same, irrespective of whether it is after the bunch winding or after the yarn joining. Moreover, the timing at which the traversing device catches the yarn after the bunch winding with respect to the start of the yarn winding is also the same as the timing of catching the yarn after the yarn joining. This means that, when the yarn is caught, the traversing speed after the bunch winding is higher than the traversing speed after the yarn joining, by an amount corresponding to the initial rotational speed of the package ($v_b - v_a$, to be exact). As a consequence, the yarn breakage occurs more easily when the traversing device touches the yarn.

[0009] It is an object of the present invention to provide a yarn winding unit that controls a traversing speed at the start of yarn winding to prevent yarn breakage that tends to occur when the traversing device touches the yarn.

[0010] A yarn winding unit according to an aspect of the present invention includes a winding section and a control section. The winding section winds a yarn around a winding tube to form a package. The control section controls the winding section. The winding section includes a winding tube supporting section, a contact roller, and a traversing device. The winding tube supporting section supports the winding tube. The contact roller rotates in contact with the winding tube or the package. The traversing device is arranged independently of the contact roller and traverses the yarn that is to be wound around the winding tube. The control section controls the winding section such that a traversing speed of the traversing device is increased with a first acceleration when winding of the yarn is started while the winding tube or the package is at a stop and such that the traversing speed of the traversing device is increased with a second acceleration, which is lower than the first acceleration, when the winding of the yarn is started while the winding tube or the package is already being rotated.

[0011] A yarn winding machine according to another aspect of the present invention includes a plurality of the yarn winding units.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a front view of an automatic winder according to an embodiment of the present invention;
 FIG. 2 is a front view and a block diagram of a yarn winding unit;
 FIG. 3 is a side view of the yarn winding unit;
 FIG. 4 is a side view of the yarn winding unit that is in the processes of guiding an upper yarn and a lower yarn to a yarn joining device;
 FIG. 5 is a side view of the yarn winding unit that is in the processes of performing a first half of a doffing operation;
 FIG. 6 is a side view of the yarn winding unit that is in the processes of performing a second half of the doffing operation;
 FIG. 7A is a graph showing how the rotational speed of the package (traversing speed) changes after yarn joining;
 FIG. 7B is a graph showing how the rotational speed of the package (traversing speed) changes after bunch winding;
 FIGS. 8A and 8B are graphs showing other examples of adjustment of the rotational speed of the package (traversing speed) when catching the yarn;
 FIG. 9 is a perspective view for explaining how the bunch winding is manually performed;
 FIG. 10A is a graph showing how the rotational speed of the package (traversing speed) changes after yarn joining in a conventional yarn winding machine; and
 FIG. 10B is a graph showing how the rotational speed of the package (traversing speed) changes after bunch winding in the conventional yarn winding machine.

DETAILED DESCRIPTION

[0013] Exemplary embodiments according to the present invention are explained below with reference to the accompanying drawings. The terms 'upstream side' and 'downstream side' used throughout the specification refer to the upstream side and the downstream side, respectively, in a running direction of the yarn during the winding of the yarn.

[0014] As shown in FIG. 1, an automatic winder (yarn winding machine) 1 includes a plurality of yarn winding units 10 that are arranged side by side, a doffing device (a winding tube supplying device and a bunch winding device) 60, and a main controller 90.

[0015] Each of the yarn winding units 10 traverses a yarn 20 that has been unwound from a supply bobbin 21 and winds the yarn 20 around a winding tube 22 that is

supported by a cradle (winding tube supporting section) 23 to form a package 30.

[0016] When the package 30 is fully wound in a yarn winding unit 10, the doffing device 60 moves to a position of this yarn winding unit 10, removes the fully wound package 30, and supplies a winding tube 22 (empty bobbin) around which no yarn 20 is wound yet.

[0017] As shown in FIG. 1, the doffing device 60 includes a carriage section 61, a yarn drawing arm 62, a cradle releasing arm 63, and a gripping section 64. The carriage section 61 is movable along a not-shown rail arranged above the yarn winding units 10 in the arrangement direction of the yarn winding units 10.

[0018] The yarn drawing arm 62 includes an air cylinder (cylinder) that is arranged in a substantially vertical direction. A leading end (lower end) of a cylinder rod of this air cylinder is configured in a manner as to catch the yarn 20. The yarn drawing arm 62 catches the yarn 20 and draws it toward the cradle 23.

[0019] The cradle releasing arm 63 operates and releases the cradle 23 to remove the fully wound package 30 from the cradle 23.

[0020] The gripping section 64 grips one of the winding tubes 22 stored in a bobbin container 38 (FIG. 3), which will be described later, and pivots around a shaft 65 to mount the winding tube 22 onto the cradle 23.

[0021] The main controller 90 includes a machine setting section (setting section) 91 and a machine display section 92. When an operator inputs a predetermined setting value or selects a suitable control method, the machine setting section 91 performs settings onto each yarn winding unit 10. The machine display section 92 has a function of displaying a winding state of the yarn 20 in each yarn winding unit 10, details of occurrence of errors, and the like.

[0022] The structure of the yarn winding unit 10 is now explained more concretely with reference to FIGS. 2 and 3.

[0023] As shown in FIG. 2, each of the yarn winding units 10 includes a winding unit main body 16 and a control section 50.

[0024] The control section 50 includes a unit controller 51, a package driving controller 42, and a traverse driving controller 78. The unit controller 51 includes, for example, a CPU, a RAM, a ROM, an I/O port, and a communication port. A computer program for controlling each section of the winding unit main body 16 is recorded in the ROM. Certain sections of the winding unit main body 16 and the main controller 90 are connected to the I/O port and the communication port of the unit controller 51 so that control information and the like can be communicated between the unit controller 51 and those sections of the winding unit main body 16. The unit controller 51 thereby controls the operation of those sections of the winding unit main body 16. The package driving controller 42 controls driving of the package 30 (more specifically, a package driving motor 41). The traverse driving controller 78 controls driving of a traversing device 70 (more specifi-

cally, a traverse driving motor 76).

[0025] In the winding unit main body 16, a yarn unwinding assisting device 12, a tension applying device 13, a yarn joining device 14, a clearer 15, and a winding section 18 are arranged in this order from the side of the supply bobbin 21 along a yarn running path between the supply bobbin 21 and a contact roller 29.

[0026] While the yarn 20 is being unwound from the supply bobbin 21, the yarn unwinding assisting device 12 lowers a regulating member 40, which caps a core tube of the supply bobbin 21, so as to assist unwinding of the yarn 20 from the supply bobbin 21. The regulating member 40 makes contact with a balloon that is formed above the supply bobbin 21 by swinging and centrifugal force of the yarn 20 unwound from the supply bobbin 21, and controls the balloon under a suitable size, thereby assisting the unwinding of the yarn 20. A not-shown sensor that detects a chase portion of the supply bobbin 21 is arranged near the regulating member 40. When this sensor detects lowering of the chase portion, the yarn unwinding assisting device 12 lowers the regulating member 40 by operating, for example, an air cylinder (not shown).

[0027] The tension applying device 13 applies a predetermined tension to the running yarn 20. The tension applying device 13 can be, for example, of a gate type in which a fixed set of comb teeth and a movable set of comb teeth are arranged such that the two sets can engage with each other. The movable set of comb teeth can be swung by a rotary solenoid so that the two sets of comb teeth are brought into an engaged state or a released state. Alternatively, the tension applying device 13 can be, for example, of a disk type.

[0028] The yarn joining device 14 joins a lower yarn from the supply bobbin 21 and an upper yarn from the package 30 when the yarn 20 is cut due to a yarn defect detected by the clearer 15 or when the yarn 20 unwound from the supply bobbin 21 runs out. The yarn joining device 14 can be of a mechanical type or of a type that uses fluid such as compressed air.

[0029] The clearer 15 includes a clearer head 49 having a not-shown sensor that detects a thickness of the yarn 20 and an analyzer 52 that processes a yarn thickness signal received from this sensor. The clearer 15 monitors the yarn thickness signal received from the sensor to detect whether there is a yarn defect such as a slub. A cutter 39 is arranged near the clearer head 49 to cut the yarn 20 immediately if the clearer 15 detects a yarn defect.

[0030] A lower yarn catching member 25 is arranged below the yarn joining device 14. The lower yarn catching member 25 catches a yarn end from the supply bobbin 21 and guides it to the yarn joining device 14. An upper yarn catching member (guiding member) 26 is arranged above the yarn joining device 14. The upper yarn catching member 26 catches a yarn end from the package 30 and guides it to the yarn joining device 14. The lower yarn catching member 25 includes a lower yarn pipe arm 33

and a lower yarn suction mouth 32 at a leading end of the lower yarn pipe arm 33. The upper yarn catching member 26 includes an upper yarn pipe arm 36 and an upper yarn suction mouth 35 at a leading end of the upper yarn pipe arm 36.

[0031] The lower yarn pipe arm 33 and the upper yarn pipe arm 36 pivot around shafts 34 and 37, respectively. A suitable negative pressure source (not shown) is connected to each of the lower yarn pipe arm 33 and the upper yarn pipe arm 36. A suction flow is thereby produced at each of the lower yarn suction mouth 32 and the upper yarn suction mouth 35, allowing the lower yarn pipe arm 33 and the upper yarn pipe arm 36 to suck and catch the yarn ends of the upper yarn and the lower yarn, respectively.

[0032] The winding section 18 includes the cradle 23 that detachably supports the winding tube 22, the contact roller 29 that is rotatable in contact with the outer peripheral surface of the winding tube 22 or the outer peripheral surface of the package 30, and the traversing device 70.

[0033] The cradle 23 swings around a swing shaft 48. The diameter of the yarn layer on the winding tube 22 increases as winding of the yarn 20 proceeds. This increase can be absorbed by swinging of the cradle 23. As shown in FIG. 3, the bobbin container 38 is arranged above the cradle 23 so that the winding tubes 22 can be stored therein.

[0034] The package driving motor (second driving section) 41 is coupled to the cradle 23. The package driving motor 41 drives and rotates the winding tube 22 so that the yarn 20 is wound around the winding tube 22. A motor shaft of the package driving motor 41 is coupled to the winding tube 22, which is now supported by the cradle 23, in a manner not to rotate relative to the winding tube 22 (i.e., a direct drive system). The operation of the package driving motor 41 is controlled by the package driving controller 42. The package driving controller 42 adjusts, upon receiving an instruction from the unit controller 51, a rotational speed (or an acceleration) of the package driving motor 41.

[0035] The traversing device 70 includes a traverse guide 74 and the traverse driving motor (first driving section) 76. The traverse guide 74 engages with the yarn 20 to traverse the yarn 20. The traverse guide 74 is driven by the traverse driving motor 76. The traverse driving motor 76 is arranged separately from the package driving motor 41. The operation of the traverse driving motor 76 is controlled by the traverse driving controller 78. A yarn guiding section, which is shaped into, for example, a hook, is formed at a leading end of the traverse guide 74. The traversing device 70 performs reciprocal movements while the yarn guiding section is holding (guiding) the yarn 20, and the yarn 20 can thereby be traversed. A guide plate 28 is arranged slightly upstream of the traversing position to guide the upstream yarn 20 to the traversing position.

[0036] According to the present embodiment, the traversing speed of the traversing device 70 (reciprocating

speed of the traverse guide 74) is controlled so as to be synchronized with the rotational speed of the package 30 (i.e., to correspond to the rotational speed). In other words, the unit controller 51 instructs the package driving controller 42 to drive the package 30 at a determined rotational speed (or determined acceleration), and also instructs the traverse driving controller 78 to synchronize the traversing speed with the determined rotational speed. The unit controller 51 includes a storage section 54. Options for the acceleration of rotation of the package 30 (i.e., the acceleration of the traversing of the traversing device 70) when starting the winding of the yarn 20 are recorded in this storage section 54. Here, "when starting the winding of the yarn 20" indicates, not only when freshly starting the winding of the yarn 20 around the winding tube 22 but also when resuming the winding of the yarn 20 after the winding is suspended. The operator selects and instructs one of the acceleration options recorded in the storage section 54 by manipulating a setting section 55 arranged in the winding unit main body 16 or the machine setting section 91 (details will be provided later).

[0037] As described above, the yarn 20 that has been unwound from the supply bobbin 21 runs substantially upwardly in the automatic winder 1 and is wound into the package 30.

[0038] The procedure of a yarn joining process is now explained with reference to FIGS. 3 and 4.

[0039] When the yarn 20 is cut in response to detection of a yarn defect by the clearer 15, or when the yarn 20 unwound from the supply bobbin 21 runs out and becomes discontinuous between the supply bobbin 21 and the package 30, the package driving controller 42 stops rotation of the package 30, and the traverse driving controller 78 stops driving of the traverse guide 74.

[0040] Subsequently, the lower yarn catching member 25 sucks and catches the yarn end of the lower yarn above the yarn unwinding assisting device 12. Thereafter, as shown in FIG. 4, the lower yarn catching member 25 pivots upwardly around the shaft 34, and introduces the lower yarn to the yarn joining device 14. At substantially the same time, the upper yarn catching member 26 pivots upwardly around the shaft 37 from a position indicated in FIG. 3, and sucks and catches the yarn end of the upper yarn from the package 30. Thereafter, the upper yarn catching member 26 pivots downwardly around the shaft 37 and introduces the upper yarn to the yarn joining device 14, as shown in FIG. 4.

[0041] When the upper yarn and the lower yarn are introduced to the yarn joining device 14 as shown in FIG. 4, the yarn joining device 14 joins the upper yarn and the lower yarn, thereby making the yarn 20 continuous between the supply bobbin 21 and the package 30. Thereafter, the package driving controller 42 starts the rotation of the package 30, and the traverse driving controller 78 starts the driving of the traverse guide 74. When the traverse guide 74 catches the yarn 20 and starts the traversing of the yarn 20, the winding of the yarn 20 into the package 30 can be started (or resumed).

[0042] The procedure of a process of doffing a fully wound package 30 and starting the winding of the yarn 20 around a new winding tube 22 is now explained with reference to FIGS. 5 and 6.

[0043] When the yarn 20 is wound into a package 30 and its winding length reaches a predetermined value, which means full winding, the unit controller 51 sends a signal to the clearer 15 to operate the cutter 39 and cut the yarn 20. Consequently, the yarn 20 downstream of the cutting position is wound into the package 30.

[0044] At the same time, the unit controller 51 controls the lower yarn catching member 25 to pivot downwardly so that the yarn end of the lower yarn can be sucked into the lower yarn suction mouth 32. The yarn 20 caught by the lower yarn catching member 25 is shown in a solid line in Fig. 5. The unit controller 51 also instructs the package driving controller 42 to stop the rotation of the package 30 and instructs the traverse driving controller 78 to stop the driving of the traverse guide 74.

[0045] Next, the unit controller 51 sends a doffing request signal to the main controller 90. Upon receiving the doffing request signal, the main controller 90 sends a signal to the doffing device 60. Upon receiving this signal, the doffing device 60 moves to a position directly above the yarn winding unit 10 that has the fully wound package 30, and stops at this position. The doffing device 60 operates the cradle 23 with the cradle releasing arm 63 and removes the fully wound package 30 from the cradle 23. The removed package 30 is transferred to a not-shown conveyor belt arranged at the rear of the yarn winding unit 10. The conveyor belt carries the package 30 to the next process.

[0046] Subsequently, the unit controller 51 controls the lower yarn catching member 25 to pivot upwardly, as indicated by a thick arrow in FIG. 5, and to stay at a position indicated by a chained line in FIG. 5 (delivery position).

[0047] Thereafter, the doffing device 60 operates the air cylinder of the yarn drawing arm 62 to extend its length and lowers the leading end of the yarn drawing arm 62 toward the leading end of the lower yarn catching member 25 that is held at the delivery position (see FIG. 6). The yarn drawing arm 62 thereby catches the yarn 20 near the lower yarn catching member 25. When the yarn 20 is delivered from the lower yarn catching member 25 to the yarn drawing arm 62 in this manner, the doffing device 60 operates the air cylinder of the yarn drawing arm 62 to contract its length so that the yarn 20 is pulled further upwardly.

[0048] The gripping section 64 grips one of the winding tubes 22 stored in the bobbin container 38 and supplies the winding tube 22 to the cradle 23. The position of the yarn 20 caught by the yarn drawing arm 62 is adjusted so as to be set between the leading end of the winding tube 22 and the cradle 23. Subsequently, the doffing device 60 instructs the yarn winding unit 10 to rotate the package 30 at low speed and form bunch winding. Thereafter, the package driving controller 42 increases the ro-

tation speed of the package 30, and the traverse driving controller 78 starts the driving of the traverse guide 74. With the traverse guide 74 that catches and traverses the yarn 20, the winding of the yarn 20 into the package 30 can be started.

[0049] The control of the rotational speed of the package 30, which is performed after the yarn is joined or after the bunch winding is formed by the doffing device 60 as explained above, is now explained with reference to FIGS. 7A and 7B, respectively. The traversing speed is zero at the end of the traversing width, and reaches the maximum at or near the center of the traversing width (center portion). Graphs in FIGS. 7A and 7B or in later-discussed FIGS. 8A and 8B do not show such details, however.

[0050] As pointed out as problems in the prior art, the yarn 20 tends to easily break in the conventional technology because the yarn 20 is caught when the traversing speed is high. In contrast, according to the present embodiment, an acceleration is selected from two accelerations (first and second accelerations, the first acceleration being higher than the second acceleration) depending on the situation so that the traversing speed at the timing of catching the yarn 20 is lower than a predetermined speed (for example, a speed at which the yarn 20 breaks). More detailed explanation is presented below.

[0051] As explained above, the control section 50 (the package driving controller 42) does not allow the package 30 to rotate during the yarn joining. After the yarn joining, the control section 50 starts driving of both the package 30 and the traversing device 70 substantially at the same timing (in other words, the package 30 is at a stop when the winding of the yarn 20 is started).

[0052] In the above situation, the control section 50 performs control so that the rotational speed of the package 30 (i.e., the traversing speed of the traversing device 70) increases with the first acceleration. Although the first acceleration is relatively high, the traversing speed of the traversing device 70 is not too high at the timing of catching the yarn 20 (after elapse of time t_a) because the rotation of the package 30 is accelerated from the stop state. Subsequently, when the package 30 reaches the predetermined rotational speed, the control section 50 rotates the package 30 at a constant speed (prescribed winding speed).

[0053] The control section 50 (the package driving controller 42) rotates the package 30 at low speed during the bunch winding, and accelerates the rotation of the package 30 after the bunch winding is completed. In other words, in the situation of the bunch winding, the package 30 is already being rotated when the winding of the yarn 20 is started.

[0054] In the above situation, the control section 50 controls the rotational speed of the package 30 (i.e., the traversing speed of the traversing device 70) such that the rotation is accelerated at the second acceleration. Since the second acceleration is relatively low, the traversing speed of the traversing device 70 is not too high

at the timing of catching the yarn 20 (after elapse of the time t_a) as the package 30 is accelerated when the package 30 is already rotating. Subsequently, when the package 30 reaches the predetermined rotational speed, the control section 50 rotates the package 30 at a constant speed (prescribed winding speed). The acceleration of rotation of the package 30 can be increased steeply after the yarn 20 is caught in order to cause the package 30 to reach the predetermined rotational speed in a shorter time.

[0055] With the above control, the traversing speed is prevented from overly increasing when catching the yarn 20. Consequently, yarn breakage that tends to occur when the traversing device 70 (more specifically, the yarn guiding section of the traverse guide 74) touches the yarn 20 is reliably prevented.

[0056] Any method can be adopted for the unit controller 51 to determine whether the current state is after the yarn joining or after the bunch winding. For example, the unit controller 51 is aware of the yarn joining or the bunch winding (doffing) that has been performed, and therefore the determination can be made based on this information. Alternatively, the determination can be made based on the rotational speed of the package 30 at the start of the winding of the yarn 20 (or immediately before the driving of the traversing device 70).

[0057] As explained above, the operator can select and instruct one of the accelerations for the package 30 (i.e., the traversing device 70) by operating the setting section 55 or the machine setting section 91. The accelerations include one that is to be set after the yarn joining (when the winding of the yarn 20 is started with the package 30 being at a stop) and one that is to be set after the bunch winding (when the winding of the yarn 20 is started while the package 30 is already being rotated). For example, if the yarn 20 is thin, the operator can appropriately select relatively low accelerations so that yarn breakage can be reliably prevented.

[0058] Modifications of the above embodiment are now explained with reference to FIGS. 8A and 8B. FIGS. 8A and 8B show how the rotational speed of the package 30 and the traversing speed of the traversing device 70 change after the bunch winding is performed by the doffing device 60.

[0059] In the example shown in FIG. 8A, the control section 50 performs control so that, even after the bunch winding is performed by the doffing device 60, the package 30 (i.e., the traversing device 70) is rotated at a relatively high acceleration (the first acceleration); however, the control section 50 sets the timing of catching the yarn 20 ahead. Consequently, the traversing speed can be prevented from overly increasing when catching the yarn 20. This can prevent yarn breakage that tends to occur when the traversing device 70 touches the yarn 20. The timing of catching the yarn 20 and the acceleration for the traversing speed of the traversing device 70 can be adjusted at the same time.

[0060] In contrast, in the example shown in FIG. 8B, it

is at least not until the traversing device 70 catches the yarn 20 that the control section 50 synchronizes the rotational speed of the package 30 with the traversing speed. In other words, the acceleration of rotation of the package 30 is set (adjusted) such that the traversing speed of the traversing device 70 would not follow the rotational speed of the package 30. The traversing speed of the traversing device 70 is thereby prevented from rapidly increasing, and the traversing speed when catching the yarn 20 can be suppressed.

[0061] As explained above, the yarn winding unit 10 according to the present embodiment includes the winding section 18 and the control section 50. The winding section 18 winds the yarn 20 around the winding tube 22 to form the package 30. The control section 50 controls the winding section 18. The winding section 18 includes the cradle 23, the contact roller 29, and the traversing device 70. The cradle 23 supports the winding tube 22. The contact roller 29 rotates in contact with the winding tube 22 or the package 30. The traversing device 70 is arranged independently of the contact roller 29, and traverses the yarn 20 that is to be wound around the winding tube 22. The control section 50 controls the winding section 18 so that the traversing speed of the traversing device 70 is kept equal to or below a predetermined speed when starting the winding of the yarn 20.

[0062] The traversing speed of the traversing device 70 when catching the yarn 20 is equal to or below a predetermined speed. Consequently, the traversing device 70 (more specifically, the traverse guide 74) can be prevented from operating at high speed, and yarn breakage that tends to occur when the traversing device 70 touches the yarn 20 can be prevented.

[0063] The yarn winding unit 10 includes the storage section 54 in which at least the first acceleration and the second acceleration lower than the first acceleration are recorded. The control section 50 performs control such that the traversing speed of the traversing device 70 is increased with the first acceleration when the winding of the yarn 20 is started while the package 30 is at a stop, and that the traversing speed of the traversing device 70 is increased with the second acceleration when the winding of the yarn 20 is started while the package 30 is already being rotated.

[0064] By simply selecting one of the two accelerations, yarn breakage that tends to occur when the traversing device 70 (more specifically, the traverse guide 74) touches the yarn 20 is prevented.

[0065] The control section 50 controls the winding section 18 in a process of forming a single package 30 such that the traversing speed of the traversing device 70 is increased appropriately with the first acceleration or the second acceleration at a given time.

[0066] The automatic winder 1 includes the doffing device 60, the yarn joining device 14, and the upper yarn catching member 26. The doffing device 60 forms the bunch winding around the winding tube 22 supplied to the winding section 18. The yarn joining device 14 joins

the guided yarn 20. The upper yarn catching member 26 guides the yarn end from the package 30 to the yarn joining device 14. After the bunch winding is formed by the doffing device 60, the control section 50 drives the traversing device 70 with the second acceleration. After the yarn joining is performed by the yarn joining device 14, the control section 50 drives the traversing device 70 with the first acceleration.

[0067] The rotational speed of the package 30 is higher after the bunch winding than after the yarn joining. Therefore, the traversing speed of the traversing device 70 when catching the yarn 20 can be prevented from overly increasing, and the yarn 20 can be prevented from being broken.

[0068] The exemplary embodiments and modifications of the present invention have been explained above. The above structure can be modified as below.

[0069] According to the above embodiment, different accelerations are adopted for the traversing device 70 after the yarn joining and after the bunch winding performed by the doffing device 60. Any structure that can control the winding section 18 such that the traversing speed of the traversing device 70 when starting the winding of the yarn 20 is maintained equal to or below a predetermined speed falls into the scope of the present invention. For example, as shown in FIG. 9, when the bunch winding is formed manually, the winding is usually started after the package 30 is stopped. This means that, even if the rotational speed of the package 30 is increased with a relatively high acceleration (the first acceleration, for example), the yarn 20 can still be prevented from being broken.

[0070] The rotational speed of the package 30 (or the traversing speed of the traversing device 70) can be varied in various manners. For example, the speed can be varied in the form of a curved line, or can be changed in steps.

[0071] If the structure can substantially adjust the acceleration of the traversing device 70, the traversing speed of the traversing device 70 does not always need to be synchronized with the rotational speed of the package 30, i.e., the traversing speed of the traversing device 70 can be directly controlled.

[0072] A motor of any type can be used for the package driving motor 41. For example, a servomotor or a step motor can be used. An alternative structure can be such that the contact roller 29 is driven by a suitable driving device so that the package 30 can be rotated in accordance with the rotating contact roller 29. For the traverse driving motor 76 also, a motor of any type can be used. For example, the traverse driving motor 76 can be a servomotor, a step motor, or even a voice coil motor.

[0073] According to the present embodiment, the traversing device 70 is reciprocated on a substantially horizontal plane with respect to an installation surface of the yarn winding unit 10. Alternatively, for example, as disclosed in Japanese Patent Application Laid-open No. 2009-227412, the longitudinal direction of the traversing

device can be substantially perpendicular to the installation surface of the yarn winding unit.

[0074] Instead of the arm-type traversing device 70, a belt-type or rod-type traversing device can be adopted.

[0075] According to the present embodiment, the doffing device 60 performs operations of doffing, supplying the winding tubes 22, and forming bunch winding. These operations can be separately performed by separate devices.

[0076] According to the present embodiment, the package 30 has been assumed to be a cheese package. The present invention, however, is applicable to a package with tapered end surfaces or a cone package.

[0077] The present invention is applicable not only to the automatic winder, but also to other yarn winding machines including a rewinding machine and a spinning machine (such as an air-jet spinning machine and an open-end spinning machine).

[0078] A yarn winding unit according to an aspect of the present invention includes a winding section and a control section. The winding section winds a yarn around a winding tube to form a package. The control section controls the winding section. The winding section includes a winding tube supporting section, a contact roller, and a traversing device. The winding tube supporting section supports the winding tube. The contact roller rotates in contact with the winding tube or the package. The traversing device is arranged independently of the contact roller and traverses the yarn that is to be wound around the winding tube. The control section controls the winding section such that a traversing speed of the traversing device is increased with a first acceleration when winding of the yarn is started while the winding tube or the package is at a stop and such that the traversing speed of the traversing device is increased with a second acceleration, which is lower than the first acceleration, when the winding of the yarn is started while the winding tube or the package is already being rotated.

[0079] The traversing speed of the traversing device when catching the yarn can be maintained equal to or below a predetermined speed. Consequently, the yarn breakage that tends to occur when the traversing device touches the yarn at high speed can be prevented.

[0080] The yarn winding unit preferably includes a storage section that records therein the first acceleration and the second acceleration that is lower than the first acceleration. The control section controls the winding section such that the traversing speed of the traversing device is increased with the first acceleration when winding of the yarn is started while the winding tube or the package is at a stop and such that the traversing speed of the traversing device is increased with the second acceleration, which is lower than the first acceleration, when the winding of the yarn is started while the winding tube or the package is already being rotated.

[0081] With a simple operation of selecting one of the two accelerations, yarn breakage that tends to occur when the traversing device touches the yarn can be pre-

vented.

[0082] In the yarn winding unit, the control section preferably controls the traversing speed of the traversing device such that the traversing speed corresponds to a rotational speed of the winding tube or the package.

[0083] When bringing the traversing speed of the traversing device into correspondence with the rotational speed of the winding tube or the package, if the winding tube or the like has already been rotating before driving the traversing device (after the bunch winding or the like), the traversing speed of the traversing device significantly increases as the rotational speed of the winding tube or the package increases. As discussed above, however, by adjusting the acceleration of the traversing of the traversing device or the like (i.e., the acceleration of the rotation of the winding tube or the like) based on the rotational speed of the winding tube or the package, the traversing speed of the traversing device can be kept from overly increasing when catching the yarn, thereby preventing the yarn breakage.

[0084] In the yarn winding unit, the traversing device preferably includes a traverse guide that traverses the yarn in engagement with the yarn, and a first driving section that reciprocally drives the traverse guide. The yarn winding unit preferably further includes a second driving section that is arranged independently of the first driving section and that drives the winding tube or the package to rotate.

[0085] For example, even when the winding tube or the package is being rotated at high speed, control is performed such that, for example, the traversing device is driven at a low traversing speed. Consequently, the yarn breakage that tends to occur when the traversing device touches the yarn can be prevented.

[0086] A yarn winding machine according to another aspect of the present invention includes a plurality of yarn winding units.

[0087] Consequently, the yarn winding machine that can prevent the yarn breakage that tends to occur when the traversing device touches the yarn can be realized.

[0088] The yarn winding machine preferably includes a setting section that sets an acceleration of traversing of the traversing device that is to be used when starting the winding of the yarn.

[0089] For example, when the yarn is thin, the acceleration of the traversing can be reduced, or the timing at which the traversing device catches the yarn can be set ahead. The yarn breakage that tends to occur when the traversing device touches the yarn can thereby be reliably prevented.

[0090] The yarn winding machine preferably includes a winding tube supplying device that supplies the winding tube to the winding section of at least any one of the yarn winding units.

[0091] Consequently, after the winding tube supplying device supplies a winding tube, the yarn breakage that tends to occur when the traversing device touches the yarn can be prevented.

[0092] The yarn winding machine preferably further includes a bunch winding device, a yarn joining device, and a guiding member. The bunch winding device forms bunch winding around the winding tube supplied by the winding tube supplying device to the winding section. The yarn joining device joins the yarn that is guided. The guiding member guides at least an end of the yarn from the package to the yarn joining device. The control section controls the winding section such that the traversing device is driven to increase the traversing speed with the second acceleration after the bunch winding device forms the bunch winding and to increase the traversing speed with the first acceleration, which is higher than the second acceleration, after the yarn joining device joins the yarn.

[0093] The rotational speed of the package after the bunch winding is higher than the rotational speed after the yarn joining. With the above control, the traversing speed of the traversing device when catching the yarn can be prevented from overly increasing, and the yarn breakage can be prevented.

Claims

1. A yarn winding unit comprising:

a winding section (18) adapted to wind a yarn (20) around a winding tube (22) to form a package (30); and
 a control section (51) adapted to control the winding section (18),
 wherein the winding section (18) includes
 a winding tube supporting section (23) adapted to support the winding tube (22);
 a contact roller (29) adapted to rotate in contact with the winding tube (22) or the package (30); and
 a traversing device (70) arranged independently of the contact roller (29) and adapted to traverse the yarn (20) that is to be wound around the winding tube (22), **characterized in that**
 the control section (51) is adapted to control the winding section (18) such that a traversing speed of the traversing device (70) is increased with a first acceleration when winding of the yarn (20) is started while the winding tube (22) or the package (30) is at a stop and such that the traversing speed of the traversing device (70) is increased with a second acceleration, which is lower than the first acceleration, when the winding of the yarn (20) is started while the winding tube (22) or the package (30) is already being rotated.

2. The yarn winding unit according to Claim 1, **characterized in that** the control section (51) is adapted to control the traversing speed of the traversing device

(70) such that the traversing speed corresponds to a rotational speed of the winding tube (22) or the package (30).

3. The yarn winding unit according to Claim 1 or 2, **characterized in that**

the traversing device (70) includes
 a traverse guide (74) adapted to traverse the yarn (20) in engagement with the yarn (20); and
 a first driving section (76) adapted to reciprocally drive the traverse guide (74), and
 the yarn winding unit further comprises a second driving section (41) arranged independently of the first driving section (76) and adapted to drive the winding tube (22) or the package (30) to rotate.

4. The yarn winding unit according to any one of Claims 1 to 3, **characterized in that** the control section (51) is adapted to control the winding section (18) such that the traversing speed of the traversing device (70) is increased by using the first acceleration and the second acceleration during formation of a single package (30).

5. A yarn winding machine **characterized by** a plurality of the yarn winding units (10) according to any one of Claims 1 to 4.

6. The yarn winding machine according to Claim 5, **characterized by** a setting section (55; 91) adapted to set an acceleration of traversing of the traversing device (70) that is to be used when starting the winding of the yarn (20).

7. The yarn winding machine according to Claim 5 or 6, **characterized by** a winding tube supplying device (60) adapted to supply the winding tube (22) to the winding section (18) of at least any one of the yarn winding units (10).

8. The yarn winding machine according to Claim 7, **characterized by:**

a bunch winding device (60) adapted to form bunch winding around the winding tube (22) supplied by the winding tube supplying device (60) to the winding section (18);
 a yarn joining device (14) adapted to join the yarn (20) that is guided; and
 a guiding member (26) adapted to guide at least an end of the yarn (20) from the package (30) to the yarn joining device (14), and
 the control section (51) adapted to control the winding section (18) such that the traversing device (70) is driven
 to increase the traversing speed with the second acceleration after the bunch winding device (60) forms the bunch winding and,

to increase the traversing speed with the first acceleration, which is higher than the second acceleration, after the yarn joining device (14) joins the yarn (20).

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9. Method of operating a yarn winding unit comprising:

a winding section (18) winding a yarn (20) around a winding tube (22) to form a package (30); and

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a control section (51) controlling the winding section (18),

wherein the winding section (18) includes

a winding tube supporting section (23) supporting the winding tube (22);

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a contact roller (29) rotating in contact with the winding tube (22) or the package (30); and

a traversing device (70) arranged independently of the contact roller (29) and traversing the yarn (20) that is to be wound around the winding tube (22), **characterized by**

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controlling the winding section (18) such that a traversing speed of the traversing device (70) is increased with a first acceleration when winding of the yarn (20) is started while the winding tube (22) or the package (30) is at a stop and such that the traversing speed of the traversing device (70) is increased with a second acceleration, which is lower than the first acceleration, when the winding of the yarn (20) is started while the winding tube (22) or the package (30) is already being rotated.

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FIG.1

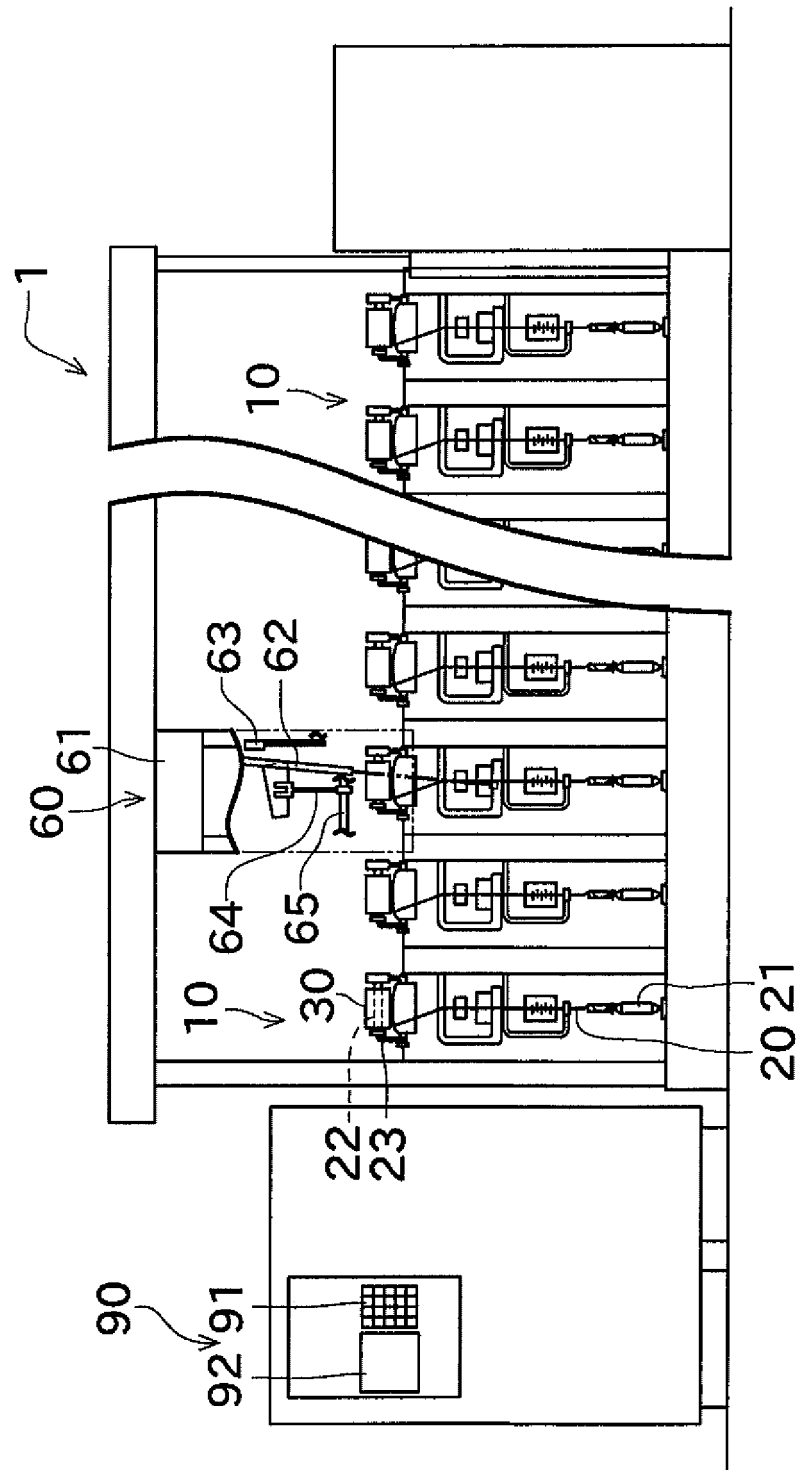


FIG.2

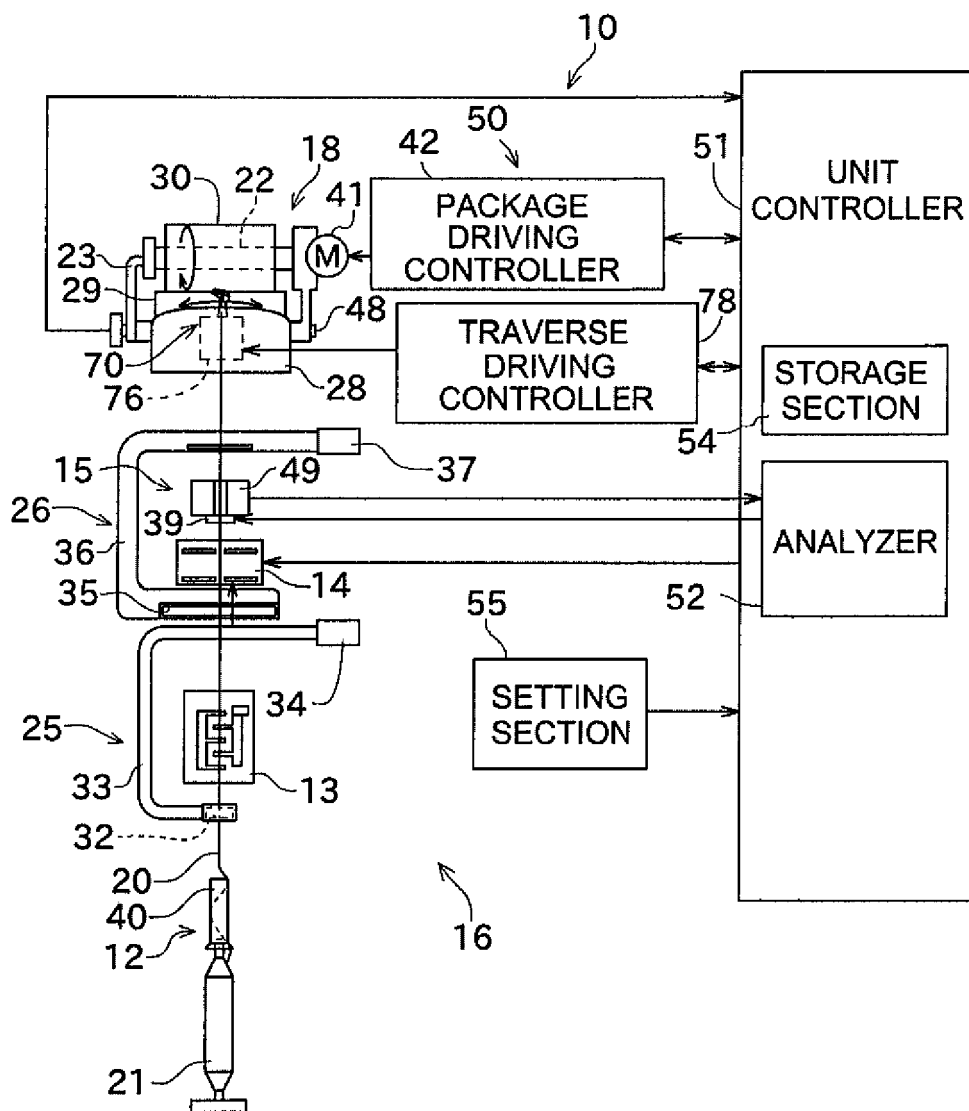


FIG.3

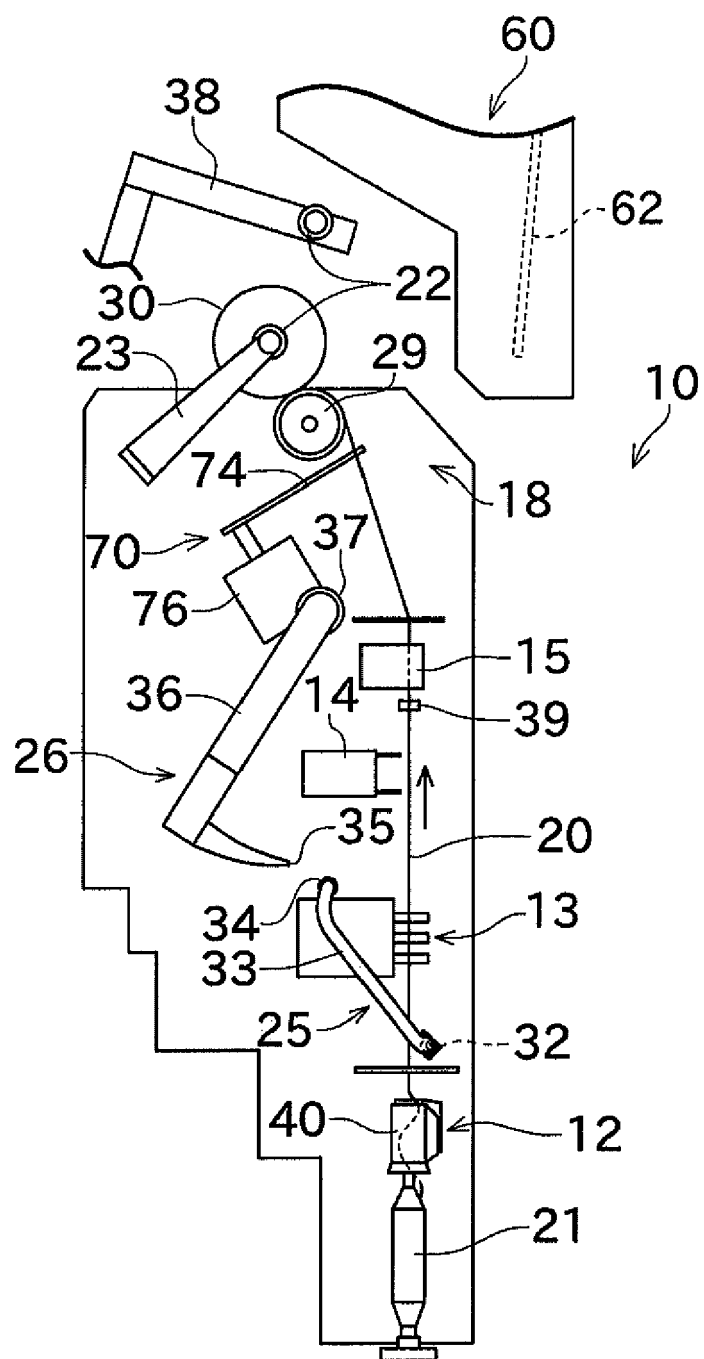


FIG.4

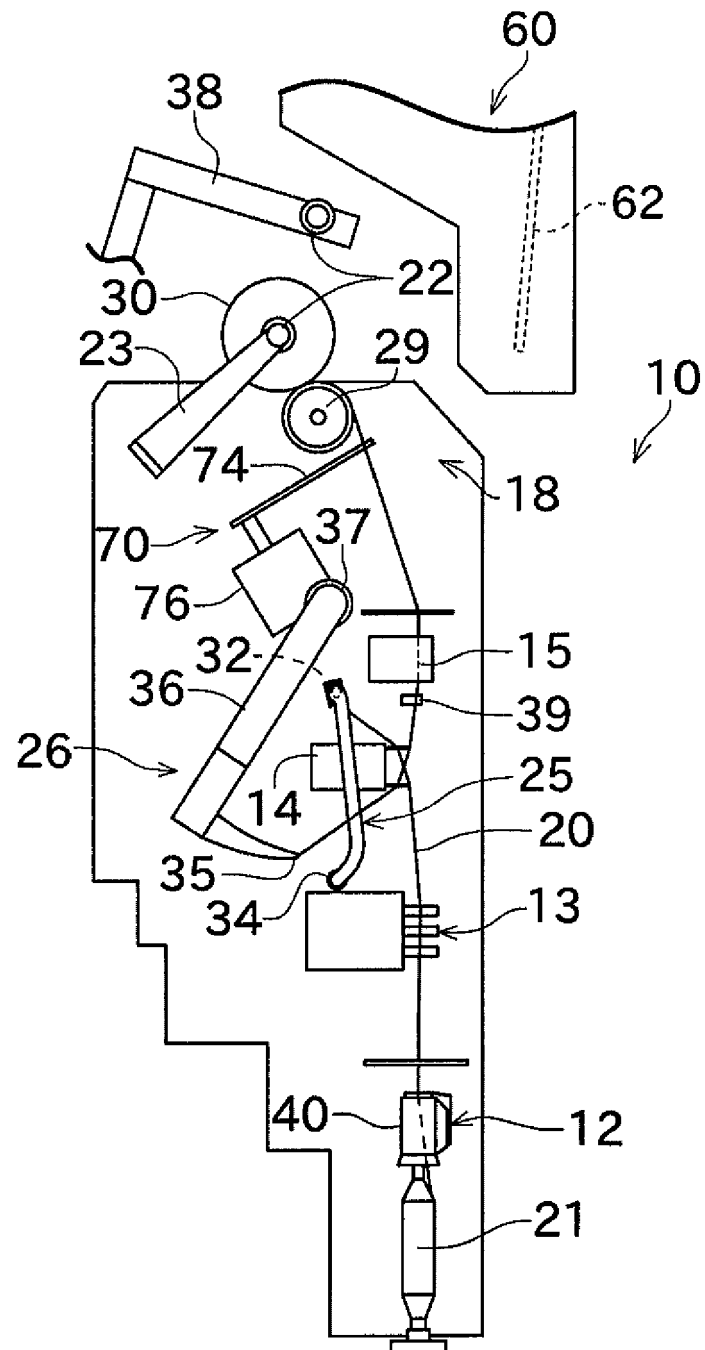


FIG.5

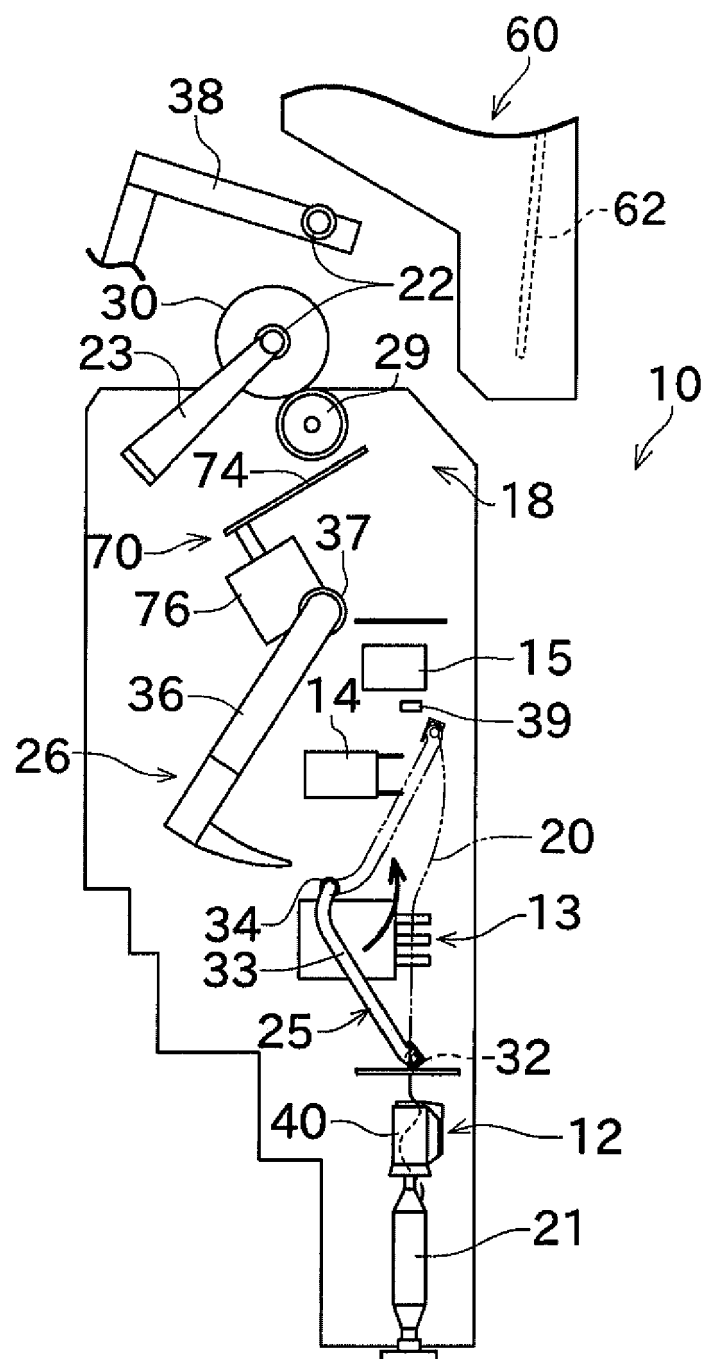


FIG.6

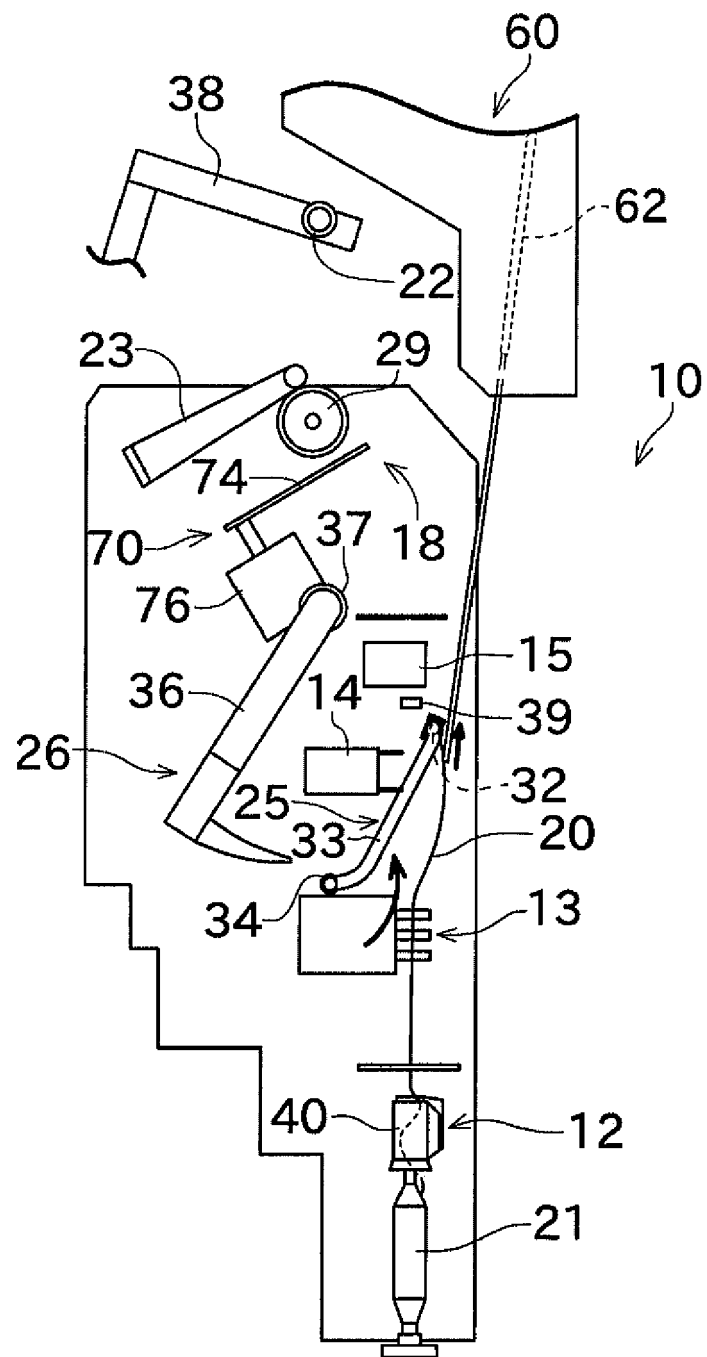


FIG.7A

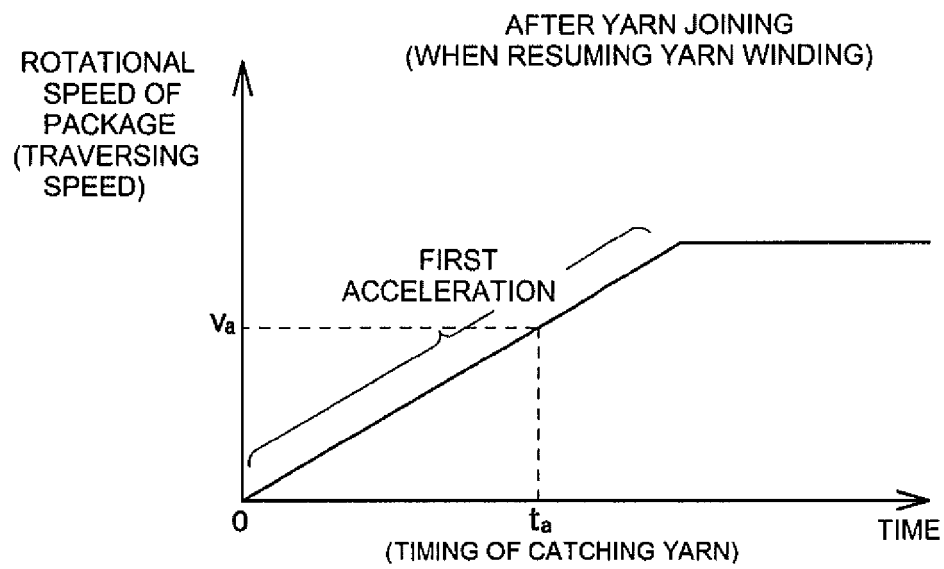


FIG.7B

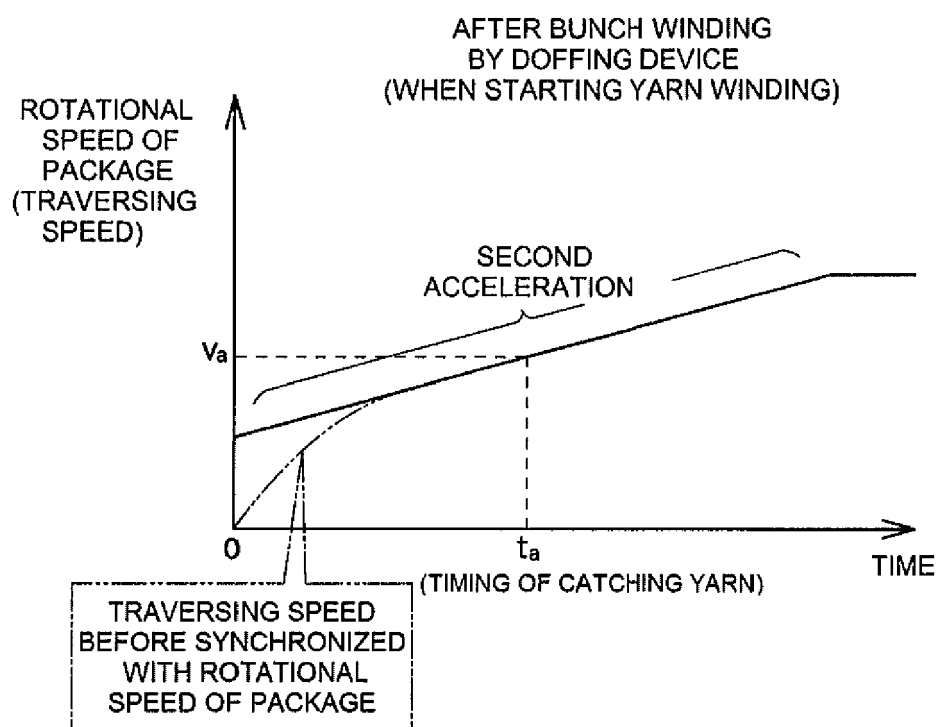


FIG.8A

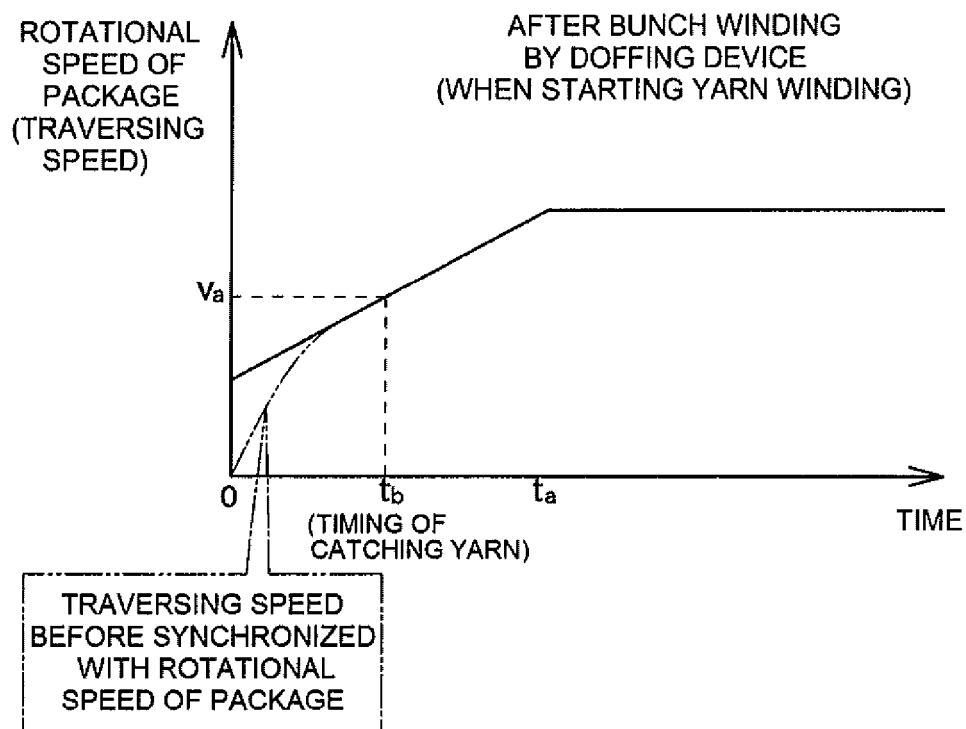


FIG.8B

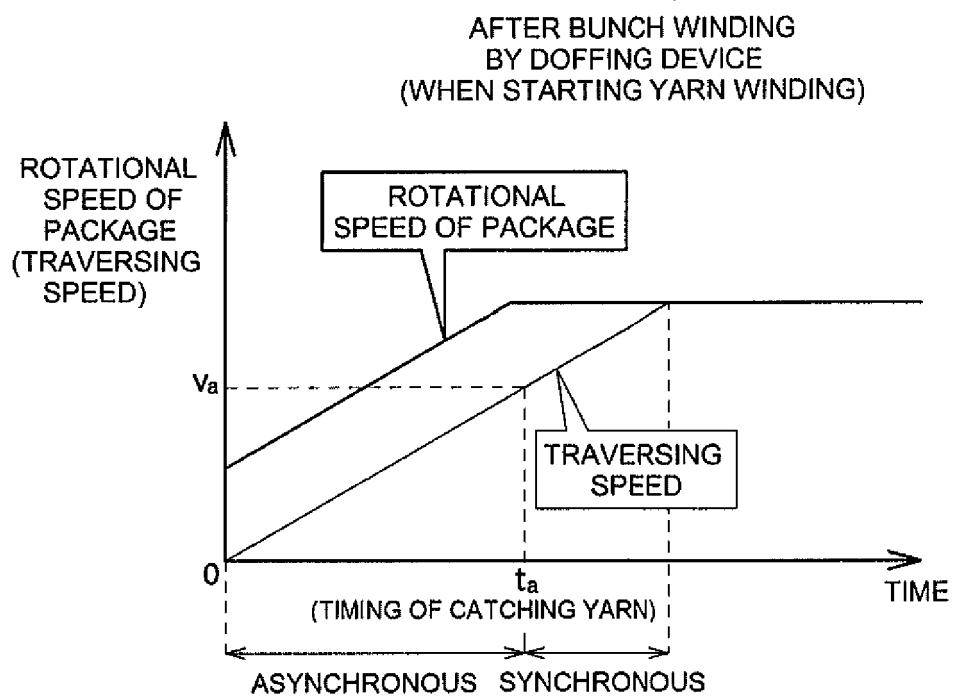


FIG.9

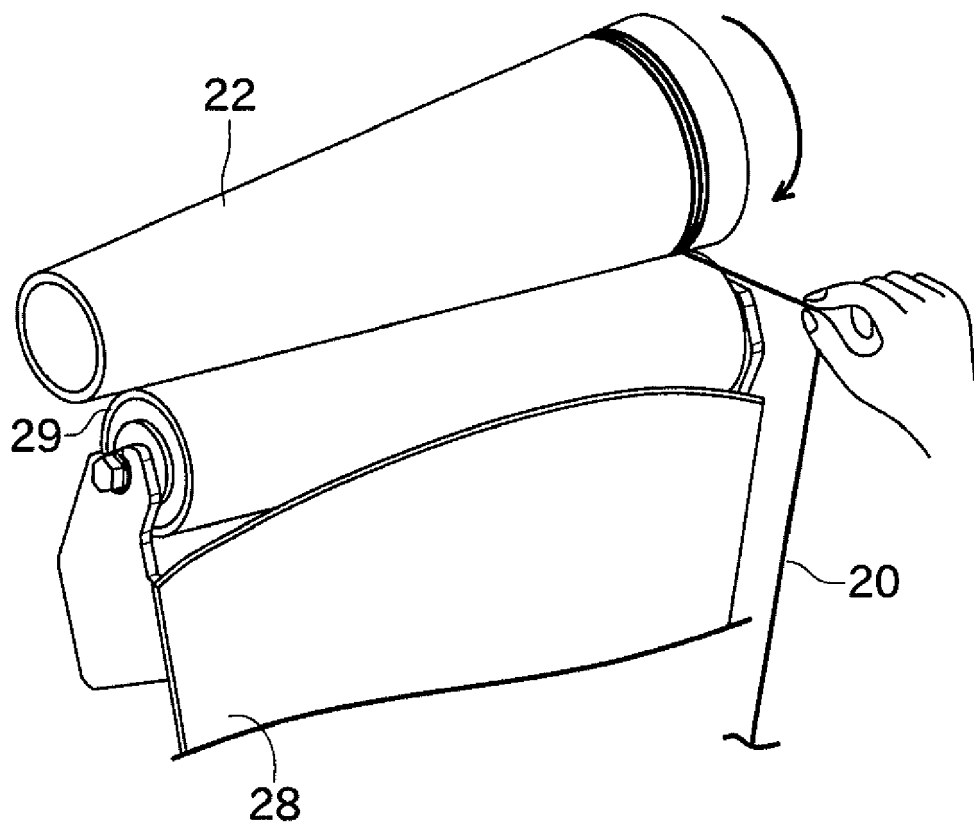


FIG.10A

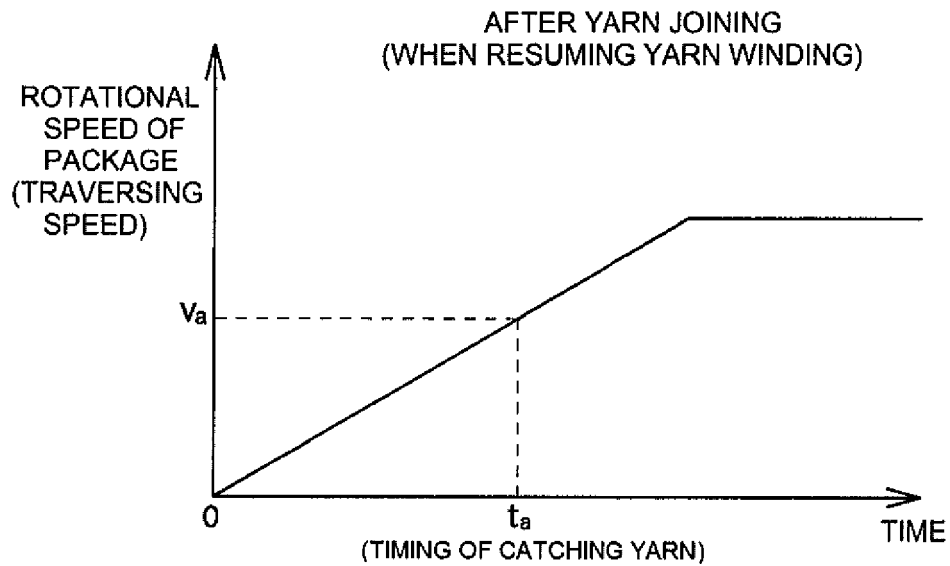
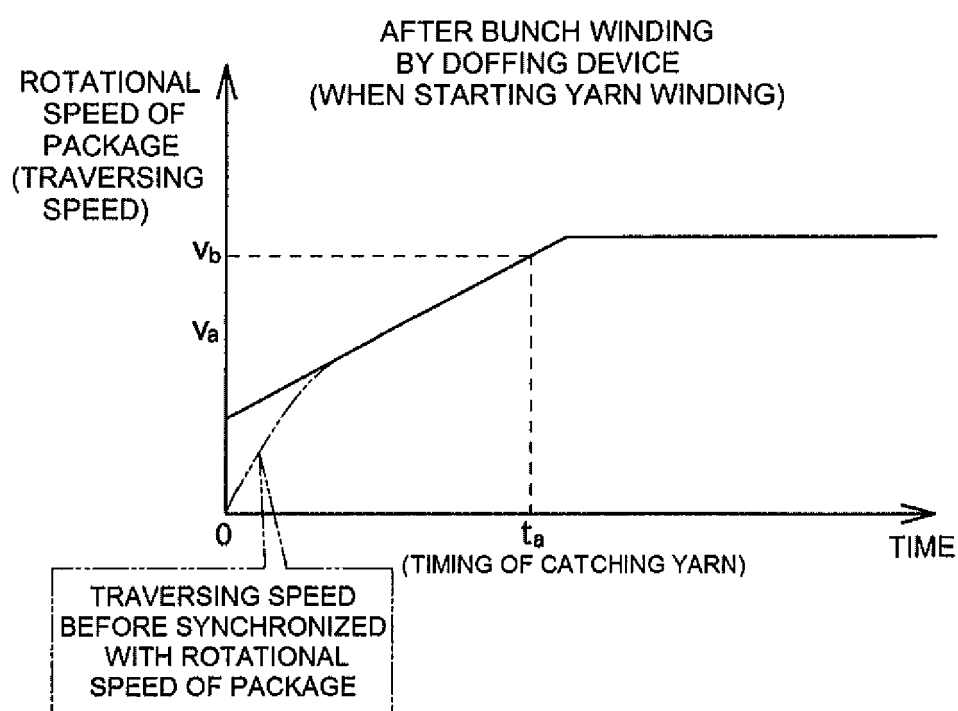


FIG.10B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009227412 A [0003] [0073]