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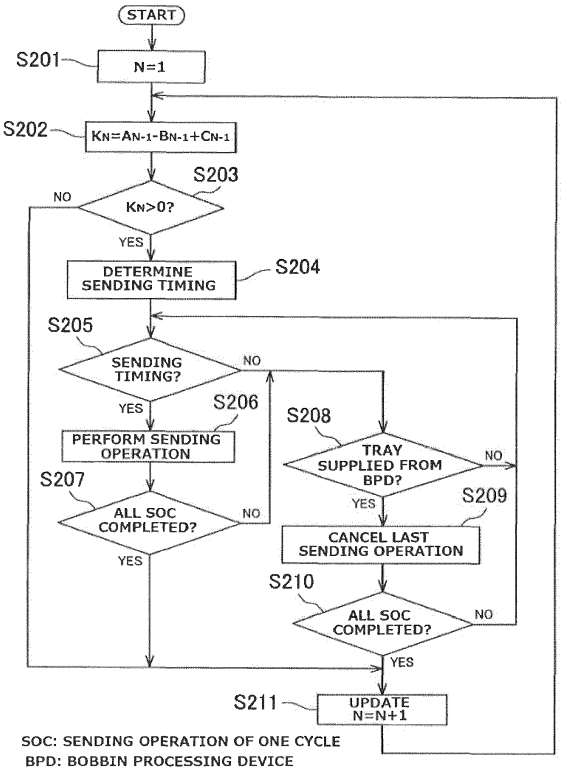
(54) YARN WINDING MACHINE

(57) The number K_N that is the number of times a tray stopper (35) is caused to perform a sending operation is set to $(A_{N-1}-B_{N-1}+C_{N-1})$ per cycle U (Step S202). A_{N-1} is the number of trays discharged from winding units (11) in [N-1]-th cycle U_{N-1}. B_{N-1} is the number of the trays supplied from a bobbin processing device (12) directly to a supply path (31) or to a portion in a return path (32) that is downstream than the tray stopper in the cycle U_{N-1}. C_{N-1} is the number of times the tray sending operation is canceled in the cycle U_{N-1}. When the tray is supplied from the bobbin processing device before all the sending operations to be performed in cycle U_N are completed (Step S208: YES), the last sending operation is canceled and not performed (Step S209).

FIG.5



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn winding machine including a plurality of winding units.

2. Description of the Related Art

[0002] In an automatic winder disclosed in Japanese Patent Application Laid-Open No. 2009-46269, a tray on which a yarn supplying bobbin has been mounted is supplied from a bobbin replacement unit to a mainline and then supplied from the mainline to winding units. A tray that is transported to a downstream end of the mainline without being supplied to any of the winding units is returned to an upstream end of the mainline via a bypass line.

[0003] In the case of the automatic winder disclosed in Japanese Patent Application Laid-Open No. 2009-46269, when a sufficient number of trays are being supplied to every winding unit, the tray that was not supplied to any winding unit is needlessly repeatedly transported from the mainline to the bypass line and vice versa. In such an automatic winder, usually, to enable in the winding unit finding of a yarn end of a yarn that has been wound on a yarn supplying bobbin, in the bobbin replacement unit the yarn end of the yarn is inserted into a hole formed in an upper end of a core tube of the yarn supplying bobbin. Therefore, the tray is supplied from the bobbin replacement unit to the winding unit in a state in which the yarn end has been inserted in the hole formed in the upper end of the core tube of the yarn supplying bobbin mounted thereon. When the tray is needlessly transported as explained above, the yarn end of the yarn wound on the yarn supplying bobbin drops (comes out of the hole formed in the upper end of the core tube) due to vibration and the like of the tray during transportation of the tray so that it may not be possible to find the end of the yarn when the tray is supplied to the winding unit. Moreover, if the tray is transported in a state in which the yarn end has dropped, it is possible that the dropped yarn end is disadvantageously caught in a member that constitutes a transportation path of the tray.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a yarn winding machine in which it is possible to supply necessary trays to each of the winding units and that can suppress transportation of unnecessary trays as much as possible.

[0005] This object is achieved by a yarn winding machine according to claim 1.

[0006] A yarn winding machine according to one aspect of the present invention includes a plurality of winding units; a bobbin processing device; a tray transporting device; and a control device. Each of the winding units unwinds a yarn from a yarn supplying bobbin and winds the unwound yarn into a package. The bobbin processing device performs pre-processing on the yarn supplying bobbin that is mounted on a tray and collects the tray on which an empty bobbin from which the yarn has been unwound in the winding unit is mounted. The tray transporting device transports the tray between the winding units and the bobbin processing device. The tray transporting device includes a supply path; a collection path; a return path; a conveyor device; and a tray controlling device. The supply path is a path on which the tray on which the yarn supplying bobbin has been mounted is transported to the winding units. The collection path is a path on which the tray that has been discharged from the winding units is transported to the bobbin processing device. The return path is a path on which the tray that has been transported to a downstream end of the supply path is transported so as to be returned to an upstream end of the supply path. The conveyor device transports the tray along the supply path, the collection path, and the return path. The tray controlling device is arranged on the return path and sends the tray present on the return path to the upstream end of the supply path. The bobbin processing device supplies the tray to any one of the supply path and the return path. The control device causes the tray controlling device to perform a sending operation of sending the tray at a first sending pace that corresponds to a difference between a pace at which the trays are discharged from the winding units to the collection path and a pace at which the trays are supplied from the bobbin processing device directly to the supply path or to a portion in the return path that is downstream than the tray controlling device.

[0007] 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

[0008]

FIG. 1 is a schematic configurational diagram of a yarn winding machine according to a first embodiment.

FIG. 2A is a plan view of a tray stopper in a state in which the tray stopper has stopped sending of trays and FIG. 2B is a plan view of the tray stopper in a state in which the tray stopper permits sending of trays.

FIG. 3 is a block diagram of an electrical configuration of the yarn winding machine.

FIG. 4 is a flowchart indicating a process procedure of a control that causes the tray stopper to send the

trays.

FIG. 5 is a flowchart indicating a process procedure of a normal sending control.

FIG. 6 is a view for explaining specific examples of the normal sending control.

FIG. 7 is a schematic configurational diagram of a yarn winding machine according to a second embodiment.

FIG. 8 is a flowchart of a process procedure that causes to perform an additional sending operation in the second embodiment.

FIG. 9 is a schematic configurational diagram of a yarn winding machine according to a third embodiment.

FIG. 10 is a schematic configurational diagram of a yarn winding machine according to a fourth embodiment.

FIG. 11 is a schematic configurational diagram of a yarn winding machine according to a fifth embodiment.

FIG. 12 is a schematic configurational diagram of a yarn winding machine according to a sixth embodiment.

DETAILED DESCRIPTION

First Embodiment

[0009] A preferred first embodiment of the present invention is explained below. Note that, the explanation will be given while appropriately referring to the directions shown in the drawings.

Overall Configuration of Yarn Winding Machine

[0010] As shown in FIG. 1, a yarn winding machine 1 includes a plurality of winding units 11 arranged in a left-right direction, a bobbin processing device 12 arranged at a right end, a control box 13 arranged at a left end, and a tray transporting device 14 arranged in an area (area between the bobbin processing device 12 and the control box 13) in which the winding units 11 are arranged.

Winding Unit

[0011] The winding unit 11 unwinds a yarn from a yarn supplying bobbin S (shown with a solid circle) mounted on a tray T supplied via a later-explained supply path 31 and winds the unwound yarn into a not-shown package. Moreover, the winding unit 11 discharges to a later-explained collection path 34 a tray T on which has been mounted an empty bobbin E (shown with a hollow circle) which is a yarn supplying bobbin S from which all the yarn has been unwound.

Bobbin Processing Device

[0012] The bobbin processing device 12 transports (supplies) to the tray transporting device 14 the tray T on which the yarn supplying bobbin S has been mounted and collects the tray T on which the empty bobbin E returned from the tray transporting device 14 has been mounted. The bobbin processing device 12 performs pre-processing (for example, yarn end finding) on the yarn supplying bobbin S that is going to be supplied to the winding unit 11 to enable a wind processing in the winding unit 11. Moreover, the bobbin processing device 12 performs post-processing (e.g., residual yarn removal) on the empty bobbin E collected from the winding unit 11. The contents of the pre-processing and the post-processing conducted in the bobbin processing device 12 is not limited to the yarn end finding and the residual yarn removal. In the present embodiment, it is assumed that the yarn supplying bobbin S is supplied to the bobbin processing device 12 from a not-shown spinning frame; however, an operator may supply to the bobbin processing device 12 the yarn supplying bobbin S spun in the spinning frame.

Control Box

[0013] The control box 13 includes an operation panel 16. The operation panel 16 is provided on a front side of the control box 13. The operator can input a winding parameter and the like by using the operation panel 16. Moreover, on the operation panel 16 are displayed an operating state, an abnormal state, and the like of the winding units 11.

Tray Transporting Device

[0014] The tray transporting device 14 transports the tray T between the bobbin processing device 12 and the winding units 11. As shown in FIG. 1, the tray transporting device 14 includes the supply path 31, a return path 32, individual paths 33, and the collection path 34. A conveyor device 39 (see FIG. 3) constituted by a belt conveyor and the like is provided in each path and the transportation of the tray T in each path is performed by the corresponding conveyor device 39. Arrows shown in FIG. 1 indicate a transportation direction of the tray T (same hold true for other drawings).

[0015] The supply path 31 is located in the back side of the winding units 11 and extends in the left-right direction from the winding unit 11 on the left to the winding unit 11 on the right. A right end (upstream end) of the supply path 31 is connected to the bobbin processing device 12. As a result, the tray T is supplied directly from the bobbin processing device 12 to the supply path 31. The tray T, which is supplied to the supply path 31, is transported on the supply path 31 from the right side to the left side. Moreover, the tray transporting device 14 includes a tray sensor 29 that can detect a surplus tray

T. The surplus tray T is a tray that has been transported to a downstream end (left end) of the supply path 31.

[0016] The return path 32 extends along the left-right direction in the back side of the supply path 31. That is, the supply path 31 is located between the winding units 11 and the return path 32. Each ends of the return path 32 is connected to a corresponding end of the supply path 31. The tray T is transported from the left side to the right side on the return path 32. As a result, the surplus tray T that is transported to the downstream end (left end) of the supply path 31 is transported via a connecting member to an upstream end (left end) of the return path 32. That is, the surplus tray T that is transported to the downstream end of the supply path 31 is returned to the upstream end (right end) of the supply path 31 by being transported on the return path 32.

[0017] A tray stopper 35 ("tray controlling device" according to the present invention) is arranged in the middle of the return path 32. The tray controlling device is a device that can send the tray T at a desired necessary pace (frequency). By deactivating the control of the tray stopper 35 in a state in which the conveyor device 39 is being driven, the tray T can be sent. It is preferable that the tray stopper 35 is arranged in a downstream end part (right end part) of the return path 32. As shown in FIGS. 2A and 2B, the tray stopper 35 includes an arm 41 and two rollers 42 and 43. The arm 41 is connected to a not-shown motor and the like. The arm 41 is pivotable around an axis 41a that extends vertically. Moreover, the arm 41 is divided into two parts 41b and 41c that extend in mutually different directions. The part 41b is located in the downstream side (right side) of the return path 32 than the part 41c.

[0018] The roller 42 is attached to a tip end of the part 41b of the arm 41. The roller 42 is supported by the part 41b of the arm 41 so as to be rotatable around an axis 42a that extends vertically. The roller 43 is attached to a tip end of the part 41c of the arm 41. The roller 43 is supported by the part 41c of the arm 41 so as to be rotatable around an axis 43a that extends vertically.

[0019] When no tray T is to be sent, the tray stopper 35 is in a state shown in FIG. 2A. In this state, the roller 42 can contact the tray T present in the return path 32, and the roller 43 does not contact the tray T present in the return path 32. Because the tray T that is being transported on the return path 32 contacts the roller 42, further transportation of the tray T is stopped. While the tray stopper 35 is maintained in the state shown in FIG. 2A, the transportation of the tray T that is transported on the return path 32 is stopped by the tray stopper 35. That is, the trays T accumulate on the return path 32.

[0020] When sending the tray T, a sending operation is performed. The sending operation includes pivoting the arm 41 around the axis 41a in the clockwise direction when seen from above so that the tray stopper 35 attains a state shown in FIG. 2B, and then pivoting the arm 41 in the opposite direction so that the tray stopper 35 is returned to the state shown in FIG. 2A. When the tray stopper 35 is in the state shown in FIG. 2B, the roller 42 does not contact the tray T present in the return path 32 but the roller 43 contacts the tray T present in the return path 32. As a result, the tray T that was stopped from being transported by the roller 42 is sent to the supply path 31. Moreover, the transportation of the next tray T is stopped by the roller 43. Then, when the arm 41 is returned to the state shown in FIG. 2A by pivoting the arm 41 in the opposite direction, the transportation of the tray T whose transportation was previously stopped by the roller 43 is now stopped by the roller 42.

[0021] A bridge breaker 36 is arranged at a connecting part of the supply path 31 and the downstream end of the return path 32. The bridge breaker 36 functions to prevent occurrence of a so-called bridge. The bridge is a phenomenon that the tray T sent by the tray stopper 35 and the tray T supplied from the bobbin processing device 12 to the supply path 31 clog up the connecting part of the return path 32 and the supply path 31.

[0022] The plurality of the individual paths 33 is located toward a front side than the supply path 31 and the individual paths 33 are arranged in the left-right direction. Each of the individual paths 33 is provided corresponding to each of the winding units 11. Each of the individual paths 33 extends in a front-back direction while curving on the way. A rear end of each of the individual paths 33 is connected to the supply path 31 and a front end thereof is connected to the collection path 34. The connecting part with the supply path 31 of the individual path 33 is inclined with respect to the front-back direction so as to go toward left side more the same goes toward the front side. Moreover, three trays T can be accommodated in each of the individual paths 33. That is, two trays T can be accommodated between the supply path 31 and the tray T positioned at a winding position of the individual path 33. As a result, when the tray T transported on the supply path 31 from the right side to the left side reaches the connecting part of the individual path 33 with the supply path 31, and if the number of the trays T that have been accommodated in a given individual path 33 is two or less, then this tray T is transported from the supply path 31 to the individual path 33. On the other hand, if three trays T have already been accommodated in a given individual path 33, then this tray T is transported on the supply path 31 toward the left side. That is, the trays T are supplied to the individual paths 33 sequentially from the individual path 33 located on the right side.

[0023] One winding unit 11 is arranged per individual path 33. The winding unit 11 unwinds the yarn from the yarn supplying bobbin S mounted on the tray T located at the winding position (in the present embodiment, position of the tray T present on the most front side among the three trays T that have been accommodated in the individual path 33) of the individual path 33 and performs winding of the yarn. When the unwinding of the yarn from the yarn supplying bobbin S is finished, a not-shown tray discharging section of the winding unit 11 discharges the tray T, on which the empty bobbin E from which the yarn

is unwound is mounted, from the winding position to the collection path 34. Then, the new tray T is moved to the winding position so that the winding unit 11 can unwind the yarn from the new yarn supplying bobbin S mounted on this new tray T.

[0024] The collection path 34 extends in the left-right direction and is located toward the front side than the individual paths 33. A right end (downstream end) of the collection path 34 is connected to the bobbin processing device 12. The tray T discharged by the winding unit 11 is transported from the individual path 33 to the collection path 34. In the collection path 34, the tray T is transported from the left side toward the right side and the tray T is finally returned to the bobbin processing device 12. In this manner, the tray T is collected in the bobbin processing device 12.

Electrical Configuration of Yarn Winding Machine

[0025] An electrical configuration of the yarn winding machine 1 is explained next. As shown in FIG. 3, the yarn winding machine 1 includes an MCU (Multi Control Unit) 51, a plurality of winding control sections 52, a bobbin processing control section 53, a transportation control section 54, a sending control section 55, and a communication board 56.

[0026] The MCU 51 is arranged in the control box 13. When a signal indicative of a setting of the yarn winding machine 1 is received from the operation panel 16, the MCU 51 transmits a signal to each of the winding control sections 52, the bobbin processing control section 53, the transportation control section 54, and the sending control section 55 for performing various settings therein based on the received signal. Moreover, the MCU 51 transmits a signal to the operation panel 16 to cause the operation panel 16 to display the operating state, the abnormal state, and the like of the winding units 11.

[0027] One winding control section 52 is arranged in each of the winding units 11 and the winding control section 52 controls an operation of this winding unit 11. The bobbin processing control section 53 is arranged in the bobbin processing device 12 and the bobbin processing control section 53 controls an operation of the bobbin processing device 12. The transportation control section 54 is arranged in the conveyor device 39 and the transportation control section 54 controls an operation of the conveyor device 39 (motor and the like that drives conveyors) . The sending control section 55 is arranged in the tray stopper 35 and the sending control section 55 controls an operation of the tray stopper 35.

[0028] The MCU 51, the winding control sections 52, the bobbin processing control section 53, the transportation control section 54, the sending control section 55, the communication board 56, and the tray sensor 29 are connected to each other and can perform communication with each other. The communication board 56 is a device that controls this communication. Note that, in the first embodiment, a combination of the MCU 51, the winding control sections 52, the bobbin processing control section 53, the transportation control section 54, the sending control section 55, the communication board 56 corresponds to a "control device" according to the present invention.

Sending Control by Tray Stopper

[0029] A control of sending the tray T performed by the tray stopper 35 is explained next. The sending control section 55 performs a process procedure in accordance with a flowchart shown in FIG. 4 when the tray T is to be sent by the tray stopper 35. The process procedure shown in FIG. 4 is started when the operation of the yarn winding machine 1 is started (that is, when the winding is started in the winding units 11) .

[0030] The process procedure shown in FIG. 4 is explained below in detail. When the operation of the yarn winding machine 1 is started, the sending control section 55 starts a maximum sending control (Step S101) . The maximum sending control is a control to cause the tray stopper 35 to perform the sending operation at a maximum pace ("second sending pace" according to the present invention). At the maximum speed, for example, the sending operation is performed once per second. The sending control section 55 continues the maximum sending control while no tray T is detected by the tray sensor 29 (Step S102: NO). Whether the bobbin processing device 12 has stopped is determined based on a signal received from the bobbin processing control section 53.

[0031] When a tray T is detected by the tray sensor 29 (Step S102: YES), the sending control section 55 switches the control from the maximum sending control to a normal sending control (S103). The normal sending control will be explained in detail later. The sending control section 55 continues the normal sending control while the bobbin processing device 12 (abbreviated to "BPD" in FIG. 4 for sake of convenience) does not stop abnormally and the like (Step S104: NO).

[0032] If the bobbin processing device 12 had stopped abnormally and the like (Step S104: YES), the sending control section 55 waits until the bobbin processing device 12 returns to normal from the stopped state (Step S105: NO). Note that, the determination at Step S105 as to whether the bobbin processing device 12 has returned to normal from the stopped state is performed based on a signal received from the bobbin processing control section 53.

[0033] Note that, the normal sending control is continued while the bobbin processing device 12 is in the stopped state. When the bobbin processing device 12 is in the stopped state, each of the winding units 11 continues the winding until the winding of a predetermined number of packages is completed. Then, when the winding of the predetermined number of packages is completed in the winding units 11 and a certain time has elapsed since a signal that indicates that the winding has been completed has been lastly outputted from any of the winding units 11, by the method explained below,

number K_N that is the number of times of performing the sending operation per cycle U calculated in the normal sending control becomes equal to or less that 0 (zero), and the sending operation is not performed.

[0034] When the bobbin processing device 12 returns to normal from the stopped state (Step S105: YES), counting of the number of the trays T discharged thereafter from the winding units 11 is started (Step S106). The counting of the trays T at Step S106 is performed based on the signal sent from each of the winding units 11 and that indicates the winding in the winding unit 11 has been completed.

[0035] When the count of the trays T exceeds a threshold value "a" (C>Ca) (Step S107: YES), the sending control section 55 switches the control from the normal sending control to the maximum sending control (Step S108). The sending control section 55 continues the maximum sending control until a tray T is detected by the tray sensor 29 (Step S109: NO). When a tray T is detected by the tray sensor 29 (Step S109: YES), the process procedure is returned to Step S103.

[0036] If the count of the trays T has not exceeded the threshold value (Step S107: NO), and if no tray T is detected by the tray sensor 29 (Step S110: NO), the process procedure is returned to Step S107. When a tray T is detected by the tray sensor 29 (Step S110: YES), the process procedure is returned to Step S104.

Normal Sending Processing

[0037] A normal sending processing is explained next. The normal sending processing is a processing of setting the number of times the tray stopper 35 is to be caused to perform the sending operation per predetermined cycle U and causing the tray stopper 35 to perform the sending operation based on the set number. Note that, the pace at which the tray stopper 35 is to be caused to perform the sending operation in the normal sending processing corresponds to a "first sending pace" according to the present invention. The term "pace" in the present specification means "frequency" and/or "number of times per predetermined time".

[0038] The normal sending processing is a processing performed in accordance with a flowchart shown in FIG. 5. More specifically, in the normal sending processing, first of all, the sending control section 55 resets a variable N (N being a natural number) to 1 (Step S201) .

[0039] Then, the sending control section 55 sets the number K_N that is the number of times the sending operation is to be performed in the N-th cycle U_N to $(A_{N-1}-B_{N-1}+C_{N-1})$ (Step S202). That is, the number K_N is set higher by C_{N-1} than number $(A_{N-1}-B_{N-1})$. A_{N-1} is the number of the trays T discharged from the winding units 11 in [N-1]-th cycle U_{N-1}. B_{N-1} is the number of the trays T supplied from the bobbin processing device 12 to the supply path 31 in the cycle U_{N-1}. C_{N-1} is the number of times the sending operation is canceled in the cycle U_{N-1}. Cancellation of the sending operation will be explained later. Note that, when N=1, each of A0, B0, C0, which correspond to A_{N-1}, B_{N-1}, C_{N-1}, will be 0 (zero). Note that, C_{N-1} is not essential; it is possible to calculate K_N from A_{N-1} and B_{N-1} without considering C_{N-1}.

[0040] If the number K_N is greater than 0 (Step S203: YES), a timing of performing the sending operation in the cycle U_N is determined such that the sending operation is performed K_N times in the cycle U_N (Step S204) . When doing so, it is preferable to determine the timing of performing the sending operation such that the sending operation is performed at regular intervals as much as possible within the cycle U_N. When the sending timing comes (Step S205: YES), the sending control section 55 causes the tray stopper 35 to perform the sending operation (Step S206). When all the sending operations to be performed in one cycle (abbreviated to "SOC" in FIG. 5 for sake of convenience) are completed by performing the sending operation at Step S206 (Step S207: YES), the process procedure advances to Step S211. On the other hand, if all the sending operations to be performed in one cycle are not completed (Step S207: NO), the process procedure advances to Step S208. Moreover, if the sending timing has not come yet (Step S205: NO), the process procedure advances to Step S208.

[0041] At Step S208, it is determined whether the tray T is supplied from the bobbin processing device 12 to the supply path 31. If the tray T has not been supplied from the bobbin processing device 12 to the supply path 31 (Step S208: NO), the process procedure returns to Step S205. If the tray T has been supplied from the bobbin processing device 12 to the supply path 31, among the sending operations that are planned to be performed next within the N-th cycle U_N, the last sending operation is canceled and not performed (Step S209). After canceling the sending operation at Step S209, if the sending operation planned in the cycle U_N is remaining (Step S210: NO), the process procedure returns to Step S205.

[0042] On the other hand, if all the sending operations planned in one cycle U_N are completed because of canceling the sending operation at Step S209 (Step S210: YES), the process procedure advances to Step S211. Also, if K_N is 0 or less (Step S203: NO), the process procedure advances to Step S211. At Step S211, the variable N is increased by 1 (that is, updated to [N+1]). After the sending control section 55 updates the variable N at Step S211, the process procedure returns to Step S202.

[0043] A concrete example of sending the tray T from the tray stopper 35 in each cycle U when the normal sending control mentioned above is executed is explained below. FIG. 6 shows three Examples 1 to 3 of the timings of, when one cycle is of 10 seconds, discharging the tray T from the winding units 11, supplying the tray T from the bobbin processing device 12, and performing the sending operation by the tray stopper 35. In FIG. 6, "tray discharging" means discharging the tray T from the winding units 11. Moreover, "tray supplying" means supplying the tray T from the bobbin processing

device 12. Moreover, "sending operation" means the sending operation performed by the tray stopper 35.

[0044] In FIG. 6, each of 1, 2, ..., 9, 10 in each of the cycles represents a period of 0 to 1 second, 1 to 2 seconds, 2 to 3 seconds, 3 to 4 seconds, 4 to 5 seconds, 5 to 6 seconds, 6 to 7 seconds, 7 to 8 seconds, 8 to 9 seconds, and 9 to 10 seconds from a starting point of a given cycle. Note that, the period of 0 to 1 second, for example, may be called a period "1" in the following explanation. Moreover, in FIG. 6, the timing at which the tray T is discharged from the winding unit 11, the timing at which the tray T is supplied from the bobbin processing device 12, and the timing at which the sending operation is performed are shown with a hatching pattern. Moreover, when cross (X) is marked in the hatching pattern of the timing at which the sending operation is performed, it means that this sending operation is canceled.

[0045] In the case of Example 1, three trays T are discharged from the winding units 11 in the cycle U_{N-1} (A_{N-1}=3). Moreover, in the cycle U_{N-1}, one tray T is supplied from the bobbin processing device 12 (B_{N-1}=1). Moreover, in Example 1, because sending of the tray T from the tray stopper 35 in the cycle U_{N-1} is not performed, canceling of the sending of the tray T from the tray stopper 35 is also not performed (C_{N-1}=0).

[0046] As a result, in the case of Example 1, the number K_N that is the number of times of performing the sending operation in the cycle U_N is set to 2 (=3-1+0). Moreover, in the cycle U_N, to cause these two sending operations to be performed at substantially regular intervals, the periods "5" and "10" are determined as the timing of performing the sending operation. Moreover, in the cycle U_N, the tray T is not supplied from the bobbin processing device 12 (B_N=0). Therefore, canceling of the sending of the tray T from the tray stopper 35 is also not performed (C_N=0). Moreover, in the cycle U_N, two trays T are discharged from the winding unit 11 (A_N=2). Therefore, number K_{N+1} that is the number of times of performing the sending operation in [N+1]-th cycle U_{N+1} is set to 2 (=2-0+0). Moreover, in the cycle U_{N+1} also, the periods "5" and "10" are determined as the timing of performing the sending operation.

[0047] In Example 2 also, A_{N-1}, B_{N-1}, C_{N-1} are similar to those in Example 1, and the number K_N that is the number of times of performing the sending operation in the cycle U_N is set to 2, and the periods "5" and "10" are determined as the timing of performing the sending operation. In Example 2, in the cycle U_N, the trays T are supplied from the bobbin processing device 12 during the periods "3" and "8" (B_N=2). At the time point at which the tray T is supplied from the bobbin processing device 12 during the period "3", thereafter, because the sending operations are planned to be performed during the periods "5" and "10," among these sending operations, the sending operation to be performed during the period "10", which is the last sending operation, is canceled. Then, in the case of Example 2, when the sending operation is performed during the period "5", all the sending operations in the cycle U_N are completed (that is, Step S207: YES is satisfied). Note that, in this case, at the time point at which the tray T is supplied from the bobbin processing device 12 during the period "8", because all the sending operations in the cycle U_N have been completed (that is, the sending operation during the period "10" has been already canceled), the sending operation is not canceled because of this.

[0048] In this manner, in Example 2, the sending operation is canceled one time in the cycle U_N (C_N=1). Moreover, in the cycle U_N, two trays T are discharged from the winding units 11 (A_N=2). Therefore, the number K_{N+1} that is the number of times of performing the sending operation in the cycle U_{N+1} is set to 1 (=2-2+1).

[0049] In Example 3 also, A_{N-1}, B_{N-1}, C_{N-1} are similar to those in Examples 1 and 2, and the number K_N that is the number of times of performing the sending operation in the cycle U_N is set to 2, and the periods "5" and "10" are determined as the timing of performing the sending operation. In Example 3, in the cycle U_N, the trays T are supplied from the bobbin processing device 12 to the supply path 31 during the periods "1" and "3" (B_N=2). At the time point at which the tray T is supplied from the bobbin processing device 12 to the supply path 31 during the period "1", thereafter, because the sending operations are planned during the periods "5" and "10", among these sending operations, the sending operation to be performed during the period "10", which is the last sending operation, is canceled. Moreover, at the time point at which the tray T is supplied from the bobbin processing device 12 to the supply path 31 during the period "3", thereafter, because the sending operation is planned during the period "5", the sending operation during the period "5" is canceled. Then, in the case of Example 3, at the time point at which the tray T is supplied from the bobbin processing device 12 to the supply path 31 during the period "3", all the sending operations in the cycle U_N are completed (that is, Step S210: YES is satisfied).

[0050] In this manner, in Example 3, the sending operation is canceled twice in the cycle U_N (C_N=2). Moreover, in the cycle U_N, two trays T are discharged from the winding units 11 (A_N=2). Therefore, the number K_{N+1} that is the number of times of performing the sending operation in the cycle U_{N+1} is set to 2 (=2-2+2).

Advantageous Effects

[0051] When the sufficient number of the trays T are supplied to every winding unit 11, if the trays T are sent to the supply path 31 by causing the tray stopper 35 to perform the sending operation more than required times, the trays T are repeatedly and needlessly transported to the supply path 31 and the return path 32 without any tray T being supplied to any of the winding units 11. As explained above, to enable the yarn end finding of the yarn in the winding unit 11, the yarn supplying bobbins S are transported in the trays T in the state in which the yarn end has been inserted in the hole formed in the

upper end of the core tube of the yarn supplying bobbin S. Therefore, when the trays T on which the yarn supplying bobbins S have been mounted are needlessly transported as mentioned above, the yarn end of the yarn wound on the yarn supplying bobbin S drops due to vibration and the like of the tray T during transportation of the tray T, so that it may not be possible to find the end of the yarn in the winding unit 11. Moreover, the dropped yarn end may be disadvantageously caught in a member that constitutes the supply path 31 and the return path 32.

[0052] To address this issue, in the first embodiment, the tray stopper 35 is caused to perform the sending operation at the first sending pace that corresponds to a difference between the pace at which the trays T are discharged from the winding units 11 to the collection path 34 and the pace at which the trays T are supplied directly from the bobbin processing device 12 to the supply path 31. Specifically, the number of times of performing the sending operation is set for each predetermined cycle U, in the cycle U_{N-1}, when the number of the trays T discharged from the winding units 11 is A_{N-1}, the number of the trays T supplied directly from the bobbin processing device 12 to the supply path 31 is B_{N-1}, and the number of times of cancellation of the sending operation is C_{N-1}, the number of times of performing the sending operation in the cycle U_N is set to $(A_{N-1}-B_{N-1}+C_{N-1})$. Accordingly, while supplying the trays T (yarn supplying bobbins S) of the number necessary for the winding units 11, because the trays T that are in excess are left in the return path 32, the trays T can be prevented from repeatedly and needlessly being transported on the supply path 31 and the return path 32.

[0053] Moreover, in the cycle U_N, when the tray T has been supplied from the bobbin processing device 12 to the supply path 31, if the sending operations are planned after the tray T was supplied, the last sending operation among the planned sending operations is canceled. As a result, in comparison to the case where the sending operation is not canceled, the number of the trays T supplied to the supply path 31 in the cycle U_N can be set to an appropriate number. Moreover, in contrast, when C_{N-1} number of the sending operations are canceled among the sending operations planned in the cycle U_{N-1}, the number of times the sending operation should be performed in the cycle U_N is set to $(A_{N-1}-B_{N-1}+C_{N-1})$, that is, C_{N-1} times higher than $(A_{N-1}-B_{N-1})$. As a result, even when the sending operation is canceled, shortage of the trays does not occur in the cycle U_N.

[0054] Immediately after the start of the operation of the yarn winding machine 1 (that is, start of winding by the winding units 11), because sufficient number of the trays T are not being supplied to each of the winding units 11, the number of the trays T present in the return path 32 is small. Therefore, even if the sending operation is performed, the trays T may not be actually sent. Moreover, when the sufficient number of the trays T is supplied to all the winding units 11, the tray T that is transported to the downstream end of the supply path 31 without being supplied to any of the winding units 11 is detected by the tray sensor 29.

[0055] Therefore, after the start of the operation of the yarn winding machine 1 and until a tray T is detected by the tray sensor 29, the tray stopper 35 is caused to perform the sending operation at the second sending pace that is faster than the first sending pace set as explained above (by executing the maximum sending control). As a result, immediately after the start of the operation of the yarn winding machine 1, the time required to supply the sufficient number of the trays T to each of the winding units 11 can be shortened as much as possible. Then, after a tray T is detected by the tray sensor 29, the tray stopper 35 is caused to perform the sending operation at the first sending pace (by switching to the normal sending control). Accordingly, while supplying the trays T of the number necessary for the winding units 11, the trays T can be prevented from repeatedly and needlessly being transported on the supply path 31 and the return path 32.

[0056] During the time from stopping the operation of the bobbin processing device 12 until the bobbin processing device 12 returns to normal, the winding of the yarn is performed in the winding units 11, and the trays T present in the supply path 31 are supplied to each of the winding units 11. Therefore, immediately after the bobbin processing device 12 returns to normal from the stopped state, because the sufficient number of the trays T is not supplied to each of the winding units 11, it may happen that the number of the trays T in the return path 32 is small. Therefore, the trays T may not be actually sent even if the sending operation is performed. Moreover, when the sufficient number of the trays T is supplied to all the winding units 11, the tray T that is transported to the downstream end of the supply path 31 without being supplied to any of the winding units 11 is detected by the tray sensor 29.

[0057] However, if the duration from stopping the operation of the bobbin processing device 12 until the bobbin processing device 12 returns to normal is short, because the number of the trays T to be supplied from the supply path 31 to the winding units 11 during this duration is small, a situation that the sufficient number of the trays T is not supplied to each of the winding units 11 does not occur.

[0058] Therefore, when the bobbin processing device 12 returns to normal from the stopped state, the tray stopper 35 is caused to perform the sending operation at the first sending pace (by executing the normal sending control). Thereafter, the number of the trays T discharged from the winding units 11 is counted. When the count of the trays T exceeds a threshold value "a", from this time point, in a period while no tray T is detected by the tray sensor 29 (or before a tray is detected), the tray stopper 35 is caused to perform the sending operation at the second sending pace that is faster than the first sending pace (by executing the maximum sending control). As a result, after the bobbin processing device 12 returns to normal, the time required to supply the sufficient number of the

trays T to each of the winding units 11 can be shortened as much as possible. Then, after a tray T is detected by the tray sensor 29 (or once a tray is detected), the tray stopper 35 is caused to perform the sending operation at the first sending pace (by switching to the normal sending control). Accordingly, while supplying the trays T of the number necessary for the winding units 11, the trays T can be prevented from repeatedly and needlessly being transported on the supply path 31 and the return path 32.

[0059] On the other hand, after the bobbin processing device 12 returns to normal from the stopped state, in a period while no tray T is detected by the tray sensor 29, if the count of the trays T does not exceed the threshold value "a", the tray stopper 35 is caused to perform the sending operation at the first sending pace (by executing the normal sending control). Accordingly, while supplying the trays T of the number necessary for the winding units 11, the trays T can be prevented from repeatedly and needlessly being transported on the supply path 31 and the return path 32.

[0060] Because the second sending pace is the maximum pace of the tray stopper 35, after the start of the operation of the yarn winding machine 1 and/or after the bobbin processing device 12 returns to normal, the time required to supply the sufficient number of the trays T to each of the winding units 11 can be shortened.

[0061] To execute the normal sending control mentioned above, it is necessary for the sending control section 55 to grasp the number of the trays T discharged from the winding units 11 and the number of the trays T supplied from the bobbin processing device 12. In the first embodiment, because the sending control section 55 can communicate with the bobbin processing control section 53 and the winding control section 52 of each of the winding units 11, the sending control section 55 is able to grasp this information.

Second Embodiment

[0062] A preferred second embodiment of the present invention is explained below. As shown in FIG. 7, in a yarn winding machine 101 according to the second embodiment, opposite to the yarn winding machine 1 according to the first embodiment, a bobbin processing device 102 is arranged on the left side of a tray transporting device 104, and a control box 103 is arranged on the right side of the tray transporting device 104. To cope with this, in the tray transporting device 104, a left end of the return path 32 is connected to the bobbin processing device 102. Also, in the second embodiment, the tray T is supplied from the bobbin processing device 102 to an upstream end (portion that is upstream than the tray stopper 35) of the return path 32.

[0063] Even in the second embodiment, the sending control section 55 causes the tray stopper 35 to perform the sending operation based on the control according to the flowchart shown in FIG. 4. However, in the second embodiment, the process procedure in the normal sending control is different from that in the first embodiment. The normal sending control according to the second embodiment is performed based on a flowchart shown in FIG. 8. More specifically, in the second embodiment, in the normal sending control, first of all, the sending control section 55 resets a variable M to 0 (Step S301) and waits until the tray T is discharged from either of the winding units 11 (Step S302: NO). When the tray T is discharged from either of the winding units 11 (Step S302: YES), the tray stopper 35 is caused to perform the sending operation (Step S303), and the variable M is increased by 1 (that is, updated to [M+1]) (Step S304). Note that, the determination at Step S302 is performed based on a signal received from the winding unit 11. If the value of the variable M is smaller than a threshold value Ma (Step S305: NO), the process procedure returns to Step S302. If the value of the variable M is Ma or more (Step S305: YES), the tray stopper 35 is caused to perform the sending operation (Step S306) one time, and the process procedure returns to Step S301. As a result, in the second embodiment, each time Ma number of the sending operations are performed, the sending operation is performed one more time.

[0064] In the first embodiment, the tray T supplied from the bobbin processing device 12 and the tray T sent by the tray stopper 35 are supplied directly to the supply path 31. In contrast, in the second embodiment, the tray T is supplied from the bobbin processing device 12 to the portion that is upstream than the tray stopper 35 in the return path 32, and the tray T sent by the tray stopper 35 is only supplied to the supply path 31. Therefore, in this case, when the tray T is discharged from either of the winding units 11, an interval between the trays T becomes larger if only the tray stopper 35 is caused to perform the sending operation. Accordingly, there is a possibility that the supply of the trays T to the winding units 11 is delayed.

[0065] To address this issue, in the second embodiment, each time Ma number of the sending operations are performed, the sending operation is performed one more time. As a result, the delay in the supply of the trays T to the winding units 11 can be prevented.

[0066] Note that, in the second embodiment, the sending operation is performed only one time at Step S306 but the sending operation can be performed two or more times at Step S306.

Third Embodiment

[0067] A preferred third embodiment of the present invention is explained below. As shown in FIG. 9, in a yarn winding machine 201 according to the third embodiment, a bobbin processing device 202 is arranged on the right side of a tray transporting device 204, and a control box 203 is arranged on the left side of the tray transporting device 204. Moreover, in the yarn winding machine 201, the bobbin processing device 202 can supply the trays T from two tray supplying sections 202a and 202b. That

is, the trays T can be supplied from the bobbin processing device 202 to the winding units 11 from two tray supply outlets. The tray T supplied from the tray supplying section 202a and the tray T supplied from the tray supplying section 202b are the one that the yarn supplying bobbin S mounted in each of them have been subjected to the pre-processing by separate mechanism (pre-processing device) of the bobbin processing device 202. Moreover, the bobbin processing device 202 supplies from the tray supplying sections 202a and 202b the trays T on which are mounted the yarn supplying bobbins S on which the yarns of the same type have been wound.

[0068] The tray supplying section 202a is connected to a right end (upstream end) of the supply path 31. As a result, the tray T supplied from the tray supplying section 202a is supplied directly to the upstream end of the supply path 31. Moreover, in the third embodiment, the tray transporting device 204 includes a connection path 215 that connects the tray supplying section 202b to a portion in the return path 32 between the tray stopper 35 and the bridge breaker 36. As a result, the tray T supplied from the tray supplying section 202b is supplied via the connection path 215 to a portion in the return path 32 that is downstream than the tray stopper 35.

[0069] Even in the third embodiment, like in the first embodiment, the tray stopper 35 is caused to perform the sending operation based on the control according to the flowcharts shown in FIGS. 4 and 5. However, in the case of the third embodiment, in the control shown in FIG. 5, the total of the number of the trays T supplied from the two tray supplying sections 202a and 202b of the bobbin processing device 202 in the cycle U_N is taken as B_N.

Fourth Embodiment

[0070] A preferred fourth embodiment of the present invention is explained below. As shown in FIG. 10, in a yarn winding machine 301 according to the fourth embodiment, a bobbin processing device 302 is arranged on the left side of a tray transporting device 304, and a control box 303 is arranged on the right side of the tray transporting device 304. Moreover, the bobbin processing device 302 can supply the trays T from two tray supplying sections 302a and 302b. That is, the trays T can be supplied from the bobbin processing device 302 to the winding units 11 from two tray supply outlets. The tray T supplied from the tray supplying section 302a and the tray T supplied from the tray supplying section 302b are the one that the yarn supplying bobbin S mounted in each of them have been subjected to the pre-processing by separate mechanism (pre-processing device) of the bobbin processing device 302. Moreover, the bobbin processing device 302 supplies from the tray supplying sections 302a and 302b the trays T on which are mounted the yarn supplying bobbins S on which the yarns of the same type have been wound.

[0071] The tray supplying section 302a is connected to an upstream end (left end) of the return path 32. Moreover, the tray transporting device 304 includes a connection path 315 that connects the tray supplying section 302b to a portion in the return path 32 that is downstream than the tray stopper 35. In the fourth embodiment, the bridge breaker 36 is arranged in a downstream end part of the supply path 31.

[0072] Even in the fourth embodiment, like in the second embodiment, the tray stopper 35 is caused to perform the sending operation based on the control according to the flowcharts shown in FIGS. 4 and 8.

Fifth Embodiment

[0073] A preferred fifth embodiment of the present invention is explained below. As shown in FIG. 11, in a yarn winding machine 401 according to the fifth embodiment, a bobbin processing device 402 is arranged on the right side of a tray transporting device 404, and a control box 403 is arranged on the left side of the tray transporting device 404. Moreover, the bobbin processing device 402 can supply the trays T from two tray supplying sections 402a and 402b. That is, the trays T can be supplied from the bobbin processing device 402 to the winding units 11 from two tray supply outlets. The tray T supplied from the tray supplying section 402a and the tray T supplied from the tray supplying section 402b are the one that the yarn supplying bobbin S mounted in each of them have been subjected to the pre-processing by separate mechanism (pre-processing device) of the bobbin processing device 402. In the fifth embodiment, different types of the yarns are wound on each of the yarn supplying bobbins S mounted on the tray T in the tray supplying sections 402a and 402b.

[0074] The tray transporting device 404 includes two supply paths 411a and 411b, two return paths 412a and 412b, and two collection paths 414a and 414b.

[0075] The supply path 411a extends in the left-right direction along a plurality of the winding units 11 arranged on the right side among the winding units 11, and the supply path 411a is connected to each of the individual paths 33 corresponding to these winding units 11 arranged on the right side. An upstream end of the supply path 411a is connected to the tray supplying section 402a of the bobbin processing device 402.

[0076] The supply path 411b is arranged on the left side of the supply path 411a. The supply path 411b extends in the left-right direction along a plurality of the winding units 11 among the winding units 11 arranged on the left side of the winding units 11 that correspond to the supply path 411a, and the supply path 411b is connected to each of the individual paths 33 corresponding to these winding units 11 arranged on the left side.

[0077] The tray T is transported from the right side to the left side on the supply paths 411a and 411b. Moreover, the tray transporting device 404 includes tray sensors 421a and 421b that respectively detect the tray T that has been transported to a downstream end of the

respective supply paths 411a and 411b.

[0078] The return path 412a extends along the left-right direction in the back side of the supply path 411a. Each ends of the return path 412a is connected to a corresponding end of the supply path 411a. The tray T is transported from the left side to the right side on the return path 412a. Moreover, a tray stopper 422a is arranged in a downstream end part of the return path 412a. The tray stopper 422a is similar in configuration and function to the tray stopper 35 (see FIG. 1). Moreover, a bridge breaker 423 is arranged in a portion that is further downstream than the tray stopper 422a of the return path 412a. The bridge breaker 423 is similar in configuration and function to the bridge breaker 36 (see FIG. 1).

[0079] The return path 412b extends in the left-right direction and is positioned on the back side of the supply path 411b but on the left side of the return path 412a. Each ends of the return path 412b is connected to a corresponding end of the supply path 411b. The tray T is transported from the left side to the right side on the return path 412b. Moreover, a tray stopper 422b is arranged at a central portion of the return path 412b. The tray stopper 422b is similar in configuration and function to the tray stopper 35 (see FIG. 1) . Moreover, the tray transporting device 404 includes a connection path 415 that connects the tray supplying section 402b of the bobbin processing device 402 to a portion in the return path 412b that is downstream than the tray stopper 422b.

[0080] The collection path 414a extends in the left-right direction and is positioned on the front side of the individual paths 33 to which the supply path 411a is connected, and the collection path 414a is connected to these individual paths 33. A right end of the collection path 414a is connected to the bobbin processing device 402. In the collection path 414a, the tray T is transported from the left side to the right side.

[0081] The collection path 414b extends in the left-right direction and is positioned on the front side of the individual paths 33 to which the supply path 411b is connected, and the collection path 414b is connected to these individual paths 33. In the collection path 414b, the tray T is transported from the left side to the right side. A position in the front-back direction of a substantially half portion of the collection path 414b on the upstream side that includes the connecting part with the individual paths 33, is almost the same as the collection path 414a. On the other hand, a substantially half portion of the collection path 414b on the downstream side is positioned on the front side than the collection path 414a, and this part runs parallel to the collection path 414a in the front-back direction. A downstream end of the collection path 414b is connected to the bobbin processing device 402.

[0082] In the fifth embodiment, like in the first embodiment, the tray stoppers 422a and 422b are caused to perform the sending operations based on the control according to the flowcharts shown in FIGS. 4 and 5.

[0083] However, in the fifth embodiment, in the control shown in FIG. 5, the number of the trays T discharged to the collection path 414a in the cycle U_N is taken as A_N. Moreover, the number of the trays T supplied from the tray supplying section 402a in the cycle U_N is taken as B_N. Moreover, the number of times the sending operation is canceled among the sending operations that the tray stopper 422a is caused to perform in the cycle U_N is taken as C_N.

[0084] Moreover, in the control to cause the tray stopper 422b to perform the sending operation, the number of the trays T that are discharged to the collection path 414b in the cycle U_N is taken as A_N. Moreover, the number of the trays T supplied from the tray supplying section 402b in the cycle U_N is taken as B_N. Moreover, the number of times the sending operation is canceled among the sending operations that the tray stopper 422b is caused to perform in the cycle U_N is taken as C_N.

Sixth Embodiment

[0085] A preferred sixth embodiment of the present invention is explained below. As shown in FIG. 12, in a yarn winding machine 501 according to the sixth embodiment, a bobbin processing device 502 is arranged on the left side of a tray transporting device 504, and a control box 503 is arranged on the right side of the tray transporting device 504. Moreover, the bobbin processing device 502 can supply the trays T from two tray supplying sections 502a and 502b. That is, the trays T can be supplied from the bobbin processing device 502 to the winding units 11 from two tray supply outlets. The tray T supplied from the tray supplying section 502a and the tray T supplied from the tray supplying section 502b are the one that the yarn supplying bobbin S mounted in each of them have been subjected to the pre-processing by separate mechanism (pre-processing device) of the bobbin processing device 502. In the sixth embodiment, different types of the yarns are wound on each of the yarn supplying bobbins S mounted on the tray T in the tray supplying sections 502a and 502b.

[0086] The tray transporting device 504 includes two supply paths 511a and 511b, two return paths 512a and 512b, and two collection paths 514a and 514b.

[0087] The supply path 511a extends in the left-right direction along a plurality of the winding units 11 arranged on the right side among the winding units 11, and the supply path 511a is connected to each of the individual paths 33 corresponding to these winding units 11 arranged on the right side. The supply path 511b is arranged on the left side of the supply path 511a. The supply path 511b extends in the left-right direction along a plurality of the winding units 11 among the winding units 11 arranged on the left side of the winding units 11 that correspond to the supply path 511a, and the supply path 511b is connected to each of the individual paths 33 corresponding to these winding units 11 arranged on the left side. The tray T is transported from the right side to the left side on the supply paths 511a and 511b. Moreover, the tray transporting device 504 includes tray sensors

521a and 521b that respectively detect the tray T that has been transported to a downstream end of the respective supply paths 511a and 511b.

[0088] The return path 512a extends along the left-right direction in the back side of the supply path 511a. Each ends of the return path 512a is connected to a corresponding end of the supply path 511a. The tray T is transported from the left side to the right side on the return path 512a. Moreover, a tray stopper 522a is arranged at a central portion of the return path 512a. The tray stopper 522a is similar in configuration and function to the tray stopper 35 (see FIG. 1). Moreover, a bridge breaker 523 is arranged in a portion that is further downstream than the tray stopper 522a of the return path 512a. The bridge breaker 523 is similar in configuration and function to the bridge breaker 36 (see FIG. 1). Moreover, the tray transporting device 504 includes a connection path 515 that connects the tray supplying section 502a to a portion in the return path 512a between the tray stopper 522a and the bridge breaker 523.

[0089] The return path 512b extends in the left-right direction and is positioned on the back side of the supply path 511b but on the left side of the return path 512a. Each ends of the return path 512b is connected to a corresponding end of the supply path 511b. The tray T is transported from the left side to the right side on the return path 512b. Moreover, an upstream end of the return path 512b is connected to the tray supplying section 502b.

[0090] A substantially half portion of the collection path 514a on the upstream side (right side) extends in the left-right direction and is positioned on the front side of the individual paths 33 to which the supply path 511a is connected, and the collection path 514a is connected to these individual paths 33. In the collection path 514a, the tray T is transported from the right side to the left side. A substantially half portion of the collection path 514a on the downstream side (left side) is positioned on the front side than the substantially half portion of the collection path 514a on the upstream side. A downstream end of the collection path 514a is connected to the bobbin processing device 502.

[0091] The collection path 514b extends in the left-right direction and is positioned on the front side of the individual paths 33 to which the supply path 511b is connected, and the collection path 514b is connected to these individual paths 33. In the collection path 514b, the tray T is transported from the right side to the left side. A downstream end of the collection path 514b is connected to the bobbin processing device 502.

[0092] In the sixth embodiment, like in the first embodiment, the tray stopper 522a is caused to perform the sending operation based on the control according to the flowcharts shown in FIGS. 4 and 5. Moreover, like in the second embodiment, a tray stopper 522b is caused to perform the sending operation based on the control according to the flowcharts shown in FIGS. 4 and 8.

[0093] However, in the sixth embodiment, in the control shown in FIG. 5, the number of the trays T discharged to the collection path 514a in the cycle U_N is taken as A_N. Moreover, the number of the trays T supplied from the tray supplying section 502b in the cycle U_N is taken as B_N. Moreover, the number of times the sending operation is canceled among the sending operations that the tray stopper 522a is caused to perform in the cycle U_N is taken as C_N.

[0094] The first to sixth embodiments according to the present invention are explained above; however, the present invention is not limited to the above first to sixth embodiments and various modifications thereof can be made within the scope defined in the claims.

[0095] Moreover, in the first embodiment, in a given cycle U, when the tray T is supplied from the bobbin processing device, if the sending operation is planned after the tray T is supplied, the last sending operation among the planned sending operations is canceled; however, the configuration is not limited to this. Some sending operation other than the last sending operation among the planned sending operations may be canceled. Same holds true with respect to the sending operation performed by the tray stopper according to the third, fifth, and sixth embodiments.

[0096] Moreover, in a given cycle U, when the tray T is supplied from the bobbin processing device, the sending operation needs not be canceled even if the sending operation is planned after the tray T is supplied. Note that, in this case, the number K_N that is the number of times the tray stopper is caused to perform the sending operation in the cycle U_N is set to $(A_{N-1}\text{-}B_{N-1})$.

[0097] Moreover, in the first embodiment, the number of times the tray stopper 35 is caused to perform the sending operation in each cycle U is set; however, the configuration is not limited to this. By using a different method than causing to perform the sending operation by setting the number of times of performing the sending operation in each cycle U, the tray stopper 35 can be caused to perform the sending operation at a pace that corresponds to a difference between the number of the trays T discharged from the winding units 11 and the number of the trays T supplied directly from the bobbin processing device 12 to the supply path or to a portion in the return path 32 that is downstream than the tray stopper 35. Same holds true for the sending operation performed by the tray stopper 35 according to the third embodiment, the tray stopper 422a according to the fifth embodiment, and the tray stopper 522a according to the sixth embodiment.

[0098] In the second embodiment, the tray stopper 35 is caused to perform the sending operation when the tray T is discharged from either of the winding units 11; however, the configuration is not limited to this. By using a different method, when the tray T has been discharged, than causing the tray stopper 35 to perform the sending operation, the tray stopper 35 can be caused to perform the sending operation at a pace that corresponds to a difference between the number of the trays T discharged from the winding units 11 and the number of the trays T

supplied directly from the bobbin processing device to the supply path or to a portion in the return path that is upstream than the tray stopper. Same holds true for the sending operation performed by the tray stopper 35 according to the fourth embodiment and the tray stopper 522b according to the sixth embodiment.

[0099] Moreover, in the first to sixth embodiments, after the yarn winding machine starts operating, in a period while no tray T is detected by the tray sensor arranged at the downstream end part of the supply path, the tray stopper is caused to perform the sending operation at a maximum pace by executing a maximum sending control; however, the configuration is not limited to this. For example, instead of executing the maximum sending processing, the tray stopper can be caused to perform the sending operation at a fast pace ("second sending pace" according to the present invention) that is slower than the maximum pace but faster than the pace at which the normal sending processing is performed. Alternatively, after the yarn winding machine starts operating, even in a period while no tray T is detected by the tray sensor arranged at the downstream end part of the supply path, the tray stopper can be caused to perform the sending operation by executing the normal sending processing. That is, in this case, the Steps S101 and S102 are absent from the flowchart of FIG. 4, and the process procedure can be advanced to Step S103 when the operation of the yarn winding machine is started.

[0100] In the first embodiment, when the bobbin processing device 12 returns to normal from the stopped state, the tray stopper is caused to perform the sending operation by executing the normal sending control, and thereafter, the number of the trays T discharged from the winding units 11 is counted. Then, if the count of the trays T exceeds a threshold value, from this time point, in a period while no tray T is detected by the tray sensor 29, the tray stopper is caused to perform the sending operation by executing the maximum sending control. However, the configuration is not limited to this.

[0101] For example, irrespective of the number of the trays T discharged from the winding unit 11 after the bobbin processing device 12 returns to normal from the stopped state, the tray stopper 35 can be caused to perform the sending operation by executing the maximum sending control in a period from when the bobbin processing device 12 returns to normal from the stopped state and while no tray T is detected by the tray sensor 29.

[0102] Instead of executing the maximum sending processing, the tray stopper can be caused to perform the sending operation at a fast pace ("second sending pace" according to the present invention) that is slower than the maximum pace but faster than the pace at which the normal sending processing is performed. Alternatively, irrespective of the number of the tray T discharged from the winding unit 11 after the bobbin processing device returns to normal from the stopped state, the tray stopper can be caused to perform the sending operation by executing the normal sending processing in a period from when the bobbin processing device returns to normal from the stopped state and while no tray T is detected by the tray sensor.

[0103] The tray stopper 35 according to the second embodiment, the tray stopper 35 according to the fourth embodiment, and the tray stopper 522b according to the sixth embodiment are caused to further perform the sending operation each time the sending operation is performed Ma times; however, the configuration is not limited to this. The tray stopper can be caused to perform the sending operation simply when the tray T is discharged from either of the winding units.

[0104] Moreover, in the first to sixth embodiments, the MCU 51, the winding control sections 52, the bobbin processing control section 53, the transportation control section 54, the sending control section 55, the communication board 56, and the tray sensor are connected to each other and can perform communication with each other; however, the configuration is not limited to this. Among these components, it is sufficient that at least the sending control section 55, the winding control sections 52, the bobbin processing control section 53, and the tray sensor can perform communication with each other. Alternatively, for example, the MCU 51 can perform communication with the winding control sections 52, the bobbin processing control section 53, the transportation control section 54, the sending control section 55, and the tray sensor. In this case, the MCU 51 can receive a signal from each of the winding control sections 52, the bobbin processing control section 53, and the tray sensor, and send a signal to the sending control section 55 based on the received signal. With this configuration, the sending control section 55 is able to perform the above control.

[0105] The configuration of the tray controlling device is not limited to that of the tray stopper 35. The tray controlling device can be a device that can send the tray T by driving the conveyor device 39, which is in a stopped state, at a necessary timing. Alternatively, the tray controlling device can be a device that pushes the tray T present on the conveyor device 39, which is in a stopped state, at a necessary timing.

[0106] A yarn winding machine according to one aspect of the present invention includes a plurality of winding units; a bobbin processing device; a tray transporting device; and a control device. Each of the winding units unwinds a yarn from a yarn supplying bobbin and winds the unwound yarn into a package. The bobbin processing device performs pre-processing on the yarn supplying bobbin that is mounted on a tray and collects the tray on which an empty bobbin from which the yarn has been unwound in the winding unit is mounted. The tray transporting device transports the tray between the winding units and the bobbin processing device. The tray transporting device includes a supply path; a collection path; a return path; a conveyor device; and a tray controlling device. The supply path is a path on which the tray on which the yarn supplying bobbin has been mounted is transported to the winding units. The collection path is a

path on which the tray that has been discharged from the winding units is transported to the bobbin processing device. The return path is a path on which the tray that has been transported to a downstream end of the supply path is transported so as to be returned to an upstream end of the supply path. The conveyor device transports the tray along the supply path, the collection path, and the return path. The tray controlling device is arranged on the return path and sends the tray present on the return path to the upstream end of the supply path. The bobbin processing device supplies the tray to any one of the supply path and the return path. The control device causes the tray controlling device to perform a sending operation of sending the tray at a first sending pace that corresponds to a difference between a pace at which the trays are discharged from the winding units to the collection path and a pace at which the trays are supplied from the bobbin processing device directly to the supply path or to a portion in the return path that is downstream than the tray controlling device.

[0107] In the above yarn winding machine, the tray controlling device is arranged on the return path, and the tray controlling device is caused to send the tray at the first sending pace that corresponds to the difference between the pace at which the trays are discharged from the winding units to the collection path (e.g., number of the trays discharged per predetermined time) and the pace at which the trays are supplied from the bobbin processing device directly to the supply path or to the portion in the return path that is downstream than the tray controlling device (e.g., number of the trays supplied per predetermined time. Accordingly, while supplying the trays (yarn supplying bobbins) of the number necessary for the winding units, because the trays that are in excess are left in the return path, the trays can be prevented from repeatedly and needlessly being transported on the supply path and the return path.

[0108] In the above yarn winding machine, the tray transporting device includes a tray sensor arranged at a downstream end part of the supply path and that detects the tray. The control device causes the tray controlling device to perform the sending operation at a second sending pace that is faster than the first sending pace in a period from when winding starts in the winding units and while no tray is detected by the tray sensor, and causes the tray controlling device to perform the sending operation at the first sending pace after a tray is detected by the tray sensor.

[0109] Immediately after the start of the winding of the winding units, because sufficient number of the trays are not being supplied to each of the winding units, the number of the trays present in the return path is small. Therefore, even if the sending operation is performed, the trays may not be actually sent. Moreover, when the sufficient number of the trays is supplied to all the winding units, the tray that is transported to the downstream end of the supply path without being supplied to any of the winding units is detected by the tray sensor.

[0110] Therefore, in the above yarn winding machine, after the start of the winding of the winding units and until a tray is detected by the tray sensor, the tray controlling device is caused to perform the sending operation at the second sending pace that is faster than the first sending pace. As a result, after the start of the winding of the winding units, the time required to supply the sufficient number of the trays to each of the winding units can be shortened as much as possible. Then, after a tray is detected by the tray sensor, the tray controlling device is caused to perform the sending operation at the first sending pace. Accordingly, while supplying the trays of the number necessary for the winding units, the trays can be prevented from repeatedly and needlessly being transported on the supply path and the return path.

[0111] In the above yarn winding machine, the tray transporting device includes a tray sensor arranged at a downstream end part of the supply path and that detects the tray. The control device causes the tray controlling device to perform the sending operation at a second sending pace that is faster than the first sending pace in at least a part of a period from when the bobbin processing device returns to normal from a stopped state and while no tray is detected by the tray sensor, and causes the tray controlling device to perform the sending operation at the first sending pace after a tray is detected by the tray sensor.

[0112] During the time from stopping the operation of the bobbin processing device until the bobbin processing device returns to normal, the winding of the yarn is performed in the winding units, and the trays present in the supply path are supplied to each of the winding units. Therefore, immediately after the bobbin processing device returns to normal from the stopped state, it may happen that the number of the trays in the return path is small. Moreover, in this case, the trays may not be actually sent even if the sending operation is performed. Moreover, after the bobbin processing device returns to normal, when the sufficient number of the trays is supplied to all the winding units, the tray that is transported to the downstream end of the supply path without being supplied to any of the winding units is detected by the tray sensor.

[0113] Therefore, in the above yarn winding machine, the tray controlling device is caused to perform the sending operation at the second sending pace that is faster than the first sending pace in at least a part of the period from when the bobbin processing device returns to normal from the stopped state and while no tray is detected by the tray sensor. As a result, after the bobbin processing device returns to normal, the time required to supply the sufficient number of the trays to each of the winding units can be shortened as much as possible. Then, after a tray is detected by the tray sensor, the tray controlling device is caused to perform the sending operation at the first sending pace. Accordingly, while supplying the trays of the number necessary for the winding units, the trays can be prevented from repeatedly and needlessly being

transported on the supply path and the return path.

[0114] In the above yarn winding machine, the control device causes the tray controlling device to perform the sending operation at the first sending pace when the bobbin processing device returns to normal from the stopped state, and counts number of the trays discharged from the winding units after the bobbin processing device returns to normal from the stopped state. When the count of the trays exceeds a threshold value, from this time point, the control device causes the tray controlling device to perform the sending operation at the second sending pace in a period while no tray is detected by the tray sensor.

[0115] If the duration from stopping the operation of the bobbin processing device until the bobbin processing device returns to normal is short, because the number of the trays on each of which the yarn supplying bobbin from which the yarn had been unwound in the winding unit is mounted to be discharged to the collection path (number of the trays to be supplied to the winding units) during this duration is small, a situation that the sufficient number of the trays is not supplied to each of the winding units does not occur.

[0116] Therefore, in the above yarn winding machine, when the bobbin processing device returns to normal from the stopped state, the tray controlling device is caused to perform the sending operation at the first sending pace, and the number of the trays discharged from the winding units is counted. When the count of the trays exceeds the threshold value, from this time point, in the period while no tray is detected by the tray sensor, the tray controlling device is caused to perform the sending operation at the second sending pace. As a result, after the bobbin processing device returns to normal, if the sufficient number of the trays is not supplied to each of the winding units, the time required to supply the sufficient number of the trays to each of the winding units can be shortened as much as possible.

[0117] On the other hand, if the count of the trays does not exceed the threshold value, the tray controlling device continues to perform the sending operation at the first sending pace. Accordingly, it is possible to prevent more than required number of the trays from being sent by the tray controlling device.

[0118] In the above yarn winding machine, the second sending pace is a maximum pace at which the tray controlling device can perform the sending operation.

[0119] In the above yarn winding machine, in a situation where no tray is likely to be sent even if the tray controlling device performs the sending operation, the tray controlling device is caused to perform the sending operation at the maximum pace. As a result, the time required to supply the sufficient number of the trays to each of the winding units can be shortened as much as possible.

[0120] In the above yarn winding machine, the bobbin processing device supplies the tray to a portion in the return path that is upstream than the tray controlling device. The control device causes the tray controlling device to perform the sending operation at least one more time each time the sending operation is performed a predetermined number of times.

[0121] In the case where the tray is supplied from the bobbin processing device to the portion in the return path that is upstream than the tray controlling device, only the tray sent by the tray controlling device is supplied to the supply path. As a result, in comparison to the case where the tray is supplied from the bobbin processing device to the supply path or to the portion in the return path that is downstream than the tray controlling device, an interval between the trays becomes larger. Accordingly, there is a possibility that the supply of the trays to the winding units is delayed even if the tray controlling device is caused to perform the sending operation.

[0122] Therefore, in the above yarn winding machine, when only the tray sent by the tray controlling device is supplied to the supply path, in addition to performing the sending operation at the first sending pace, the tray controlling device is caused to perform the sending operation at least one more time each time the sending operation is performed a predetermined number of times. Accordingly, the delay in the supply of the trays to the winding units can be suppressed.

[0123] In the above yarn winding machine, the control device sets per predetermined cycle number of times to cause the tray controlling device to perform the sending operation. Assuming that N is a natural number, when number of the trays discharged from the winding units in [N-1]-th cycle is A_{N-1} and number of the trays supplied in [N-1]-th cycle from the bobbin processing device directly to the supply path or to the portion in the return path that is upstream than the tray controlling device is B_{N-1}, the control device sets the number of times to cause the tray controlling device to perform the sending operation in N-th cycle to $(A_{N-1}-B_{N-1})$.

[0124] In the above yarn winding machine, because the number of times to cause the tray controlling device to perform the sending operation in N-th cycle is set to $(A_{N-1}-B_{N-1})$, the tray controlling device can send the tray at the first sending pace.

[0125] In the above yarn winding machine, the control device cancels, in each cycle, when the tray is supplied from the bobbin processing device directly to the supply path or to the portion in the return path that is downstream than the tray controlling device, if the sending operation is planned after the tray is supplied, any of the planned sending operations. The control device sets, when C_{N-1} number of the sending operations among the sending operations planned in [N-1]-th cycle are canceled, the number of times to cause the tray controlling device to perform the sending operation in N-th cycle higher by C_{N-1}.

[0126] In the above yarn winding machine, in each cycle, when the tray is supplied from the bobbin processing device directly to the supply path or to the portion in the return path that is downstream than the tray controlling

device, if the sending operation is planned after the tray is supplied, any of the planned sending operations is canceled. As a result, the number of the trays supplied to the supply path in each cycle can be set to an appropriate number. Moreover, when C_{N-1} number of the sending operations among the sending operations planned in [N-1]-th cycle are canceled, the number of times to cause the tray controlling device to perform the sending operation in N-th cycle is set higher by C_{N-1}. As a result, even when the sending operation is canceled to cope with the supply of the trays from the bobbin processing device, shortage of the trays does not occur.

[0127] In the above yarn winding machine, the control device includes a plurality of winding control sections; a bobbin processing control section; and a sending control section. Each of the winding control sections is arranged in a corresponding one of the winding units and controls the corresponding winding unit. The bobbin processing control section controls the bobbin processing device. The sending control section controls the tray controlling device. The sending control section is communicably connected to the winding control sections and communicably connected to the bobbin processing control section.

[0128] To cause the tray controlling device to send the tray at a pace explained above, it is necessary for the sending control section to grasp information about the number of the trays supplied from the bobbin processing device and information about the number of the trays discharged from the winding units. In the above yarn winding machine, because the sending control section is communicably connected to the winding control sections and communicably connected to the bobbin processing control section, the sending control section can perform control while grasping the above information.

[0129] According to the present invention, while supplying necessary trays to the winding units, because the trays that are in excess are left in the return path, the trays can be prevented from repeatedly and needlessly being transported on the supply path and the return path.

[0130] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

[0131] 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 machine comprising:

a plurality of winding units (11), each of the winding units (11) configured to unwind a yarn from a yarn supplying bobbin (S) and to wind the unwound yarn into a package;

a bobbin processing device (12) configured to perform a pre-processing on the yarn supplying bobbin (S) that is mounted on a tray (T), and to collect the tray (T) on which an empty bobbin (E) from which the yarn has been unwound in the winding unit (11) is mounted;

a tray transporting device (14) configured to transport the tray (T) between the winding units (11) and the bobbin processing device (12); and

a control device (51 to 56), wherein

the tray transporting device (14) includes

a supply path (31) configured to transport a tray (T) on which the yarn supplying bobbin (S) has been mounted to the winding units (11);

a collection path (34) configured to transport a tray (T) that has been discharged from the winding units (11) to the bobbin processing device (12);

a return path (32) configured to transport a tray (T) that has been transported to a downstream end of the supply path (31) so as to be returned to an upstream end of the supply path (31);

a conveyor device (39) configured to transport a tray (T) along the supply path (31), the collection path (34), and the return path (32); and

a tray controlling device (35) arranged on the return path (32) and configured to send a tray (T) present on the return path (32) to the upstream end of the supply path (31),

the bobbin processing device (12) configured to supply the tray (T) to any one of the supply path (31) and the return path (32), and

the control device (51 to 56) configured to cause the tray controlling device (35) to perform a sending operation of sending the tray (T) at a first sending pace that corresponds to a difference between a pace at which the trays (T) are discharged from the winding units (11) to the collection path (34) and a pace at which the trays (T) are supplied from the bobbin processing device (12) directly to the supply path (31) or to a portion in the return path (32) that is downstream than the tray controlling device (35).

2. The yarn winding machine as claimed in Claim 1, wherein

the tray transporting device (14) includes a tray sensor (29) arranged at a downstream end part of the supply path (31) and configured to detect a tray (T), wherein

the control device (51 to 56) is configured to cause

the tray controlling device (35) to perform the sending operation at a second sending pace that is faster than the first sending pace in a period from when winding starts in the winding units (11) and while no tray (T) is detected by the tray sensor (29), and to cause the tray controlling device (35) to perform the sending operation at the first sending pace after a tray (T) is detected by the tray sensor (29).

3. The yarn winding machine as claimed in Claim 2, wherein
the control device (51 to 56) is configured to cause the tray controlling device (35) to perform the sending operation at the second sending pace that is faster than the first sending pace in at least a part of a period from when the bobbin processing device (12) returns to normal from a stopped state and while no tray (T) is detected by the tray sensor (29), and to cause the tray controlling device (35) to perform the sending operation at the first sending pace after a tray (T) is detected by the tray sensor (29).

4. The yarn winding machine as claimed in Claim 1, wherein
the tray transporting device (14) includes a tray sensor (29) arranged at a downstream end part of the supply path (31) and configured to detect a tray (T), wherein
the control device (51 to 56) is configured to cause the tray controlling device (35) to perform the sending operation at a second sending pace that is faster than the first sending pace in at least a part of a period from when the bobbin processing device (12) returns to normal from a stopped state and while no tray (T) is detected by the tray sensor (29), and to cause the tray controlling device (35) to perform the sending operation at the first sending pace after a tray (T) is detected by the tray sensor (29).

5. The yarn winding machine as claimed in Claim 3 or 4, wherein
the control device (51 to 56) is configured to cause the tray controlling device (35) to perform the sending operation at the first sending pace when the bobbin processing device (12) returns to normal from the stopped state, and to count the number of the trays (T) discharged from the winding units (11) after the bobbin processing device (12) returns to normal from the stopped state, wherein
when the count of the trays (T) exceeds a threshold value, from this time point, the control device (51 to 56) is configured to cause the tray controlling device (35) to perform the sending operation at the second sending pace in a period while no tray (T) is detected by the tray sensor (29).

6. The yarn winding machine as claimed in any one of Claims 2 to 5, wherein the second sending pace is a maximum pace at which the tray controlling device (35) can perform the sending operation.

7. The yarn winding machine as claimed in any one of Claims 1 to 6, wherein
the bobbin processing device (102) is configured to supply the tray (T) to a portion in the return path (32) that is further upstream than the tray controlling device (35), and
the control device (51 to 56) is configured to cause the tray controlling device (35) to perform the sending operation at least one more time each time the sending operation is performed a predetermined number of times.

8. The yarn winding machine as claimed in any one of Claims 1 to 7, wherein
the control device (51 to 56) is configured to set per predetermined cycle the number of times to cause the tray controlling device (35) to perform the sending operation, wherein
assuming that N is a natural number,
when the number of the trays (T) discharged from the winding units (11) in the [N-1]-th cycle is A_{N-1} and the number of the trays (T) supplied in the [N-1]-th cycle from the bobbin processing device (102) directly to the supply path (31) or to the portion in the return path (32) that is more upstream than the tray controlling device (35) is B_{N-1}, the control device (51 to 56) is configured to set the number of times to cause the tray controlling device (35) to perform the sending operation in N-th cycle to $(A_{N-1}-B_{N-1})$.

9. The yarn winding machine as claimed in Claim 8, wherein
the control device (51 to 56) is configured to cancel, in each cycle, when the tray (T) is supplied from the bobbin processing device (102) directly to the supply path (31) or to the portion in the return path (32) that is more downstream than the tray controlling device (35), if the sending operation is planned after a tray (T) is supplied, any of the planned sending operations, and
the control device (51 to 56) is configured to set, when C_{N-1} is the number of the sending operations among the sending operations planned in [N-1]-th cycle are canceled, the number of times to cause the tray controlling device (35) to increase the sending operation in N-th cycle by C_{N-1}.

10. The yarn winding machine as claimed in any one of Claims 1 to 9, wherein
the control device (51 to 56) includes:

a plurality of winding control sections (52) each arranged in a corresponding one of the winding units (11) and each configured to control the corresponding winding unit (11);

a bobbin processing control section (53) configured to control the bobbin processing device (12); and
a sending control section (55) configured to control the tray controlling device (35), wherein

the sending control section (55) is communicably connected to the winding control sections (52) and communicably connected to the bobbin processing control section (53).

FIG.1

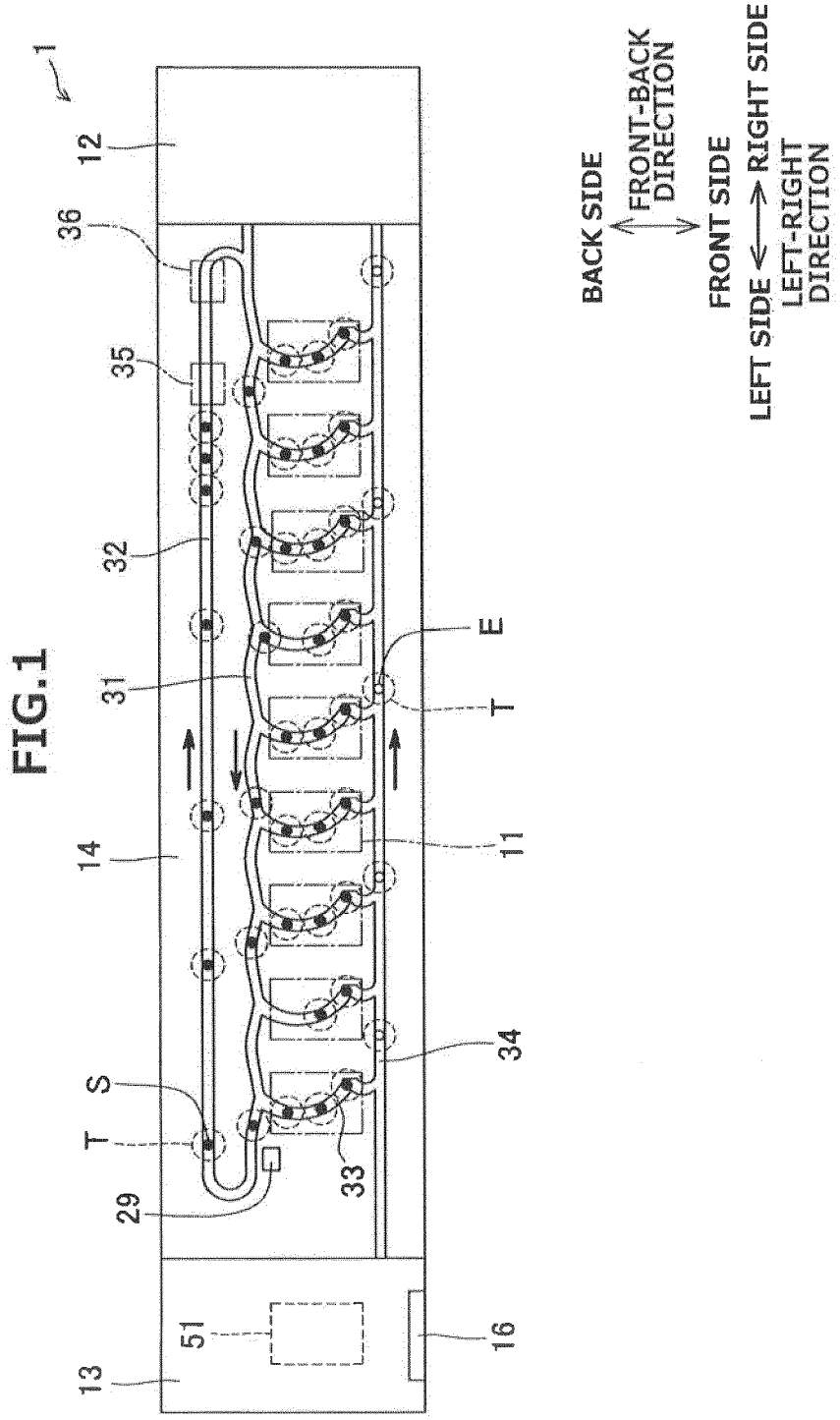

1
12
36
35
32
31
14
T
S
29
33
34
11
T
E
51
13
16
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.2A

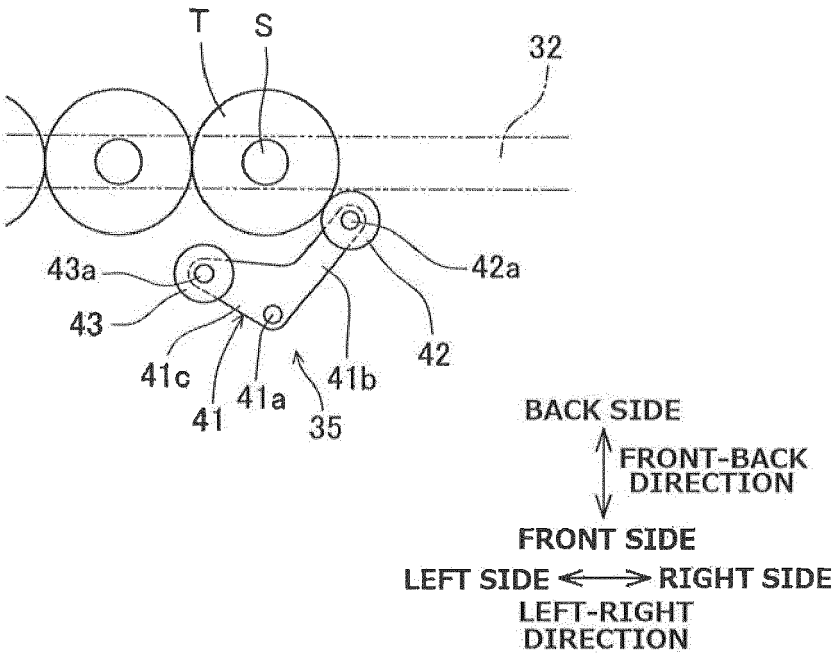

T
S
32
43a
42a
43
42
41c
41a
41b
41
35
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.2B

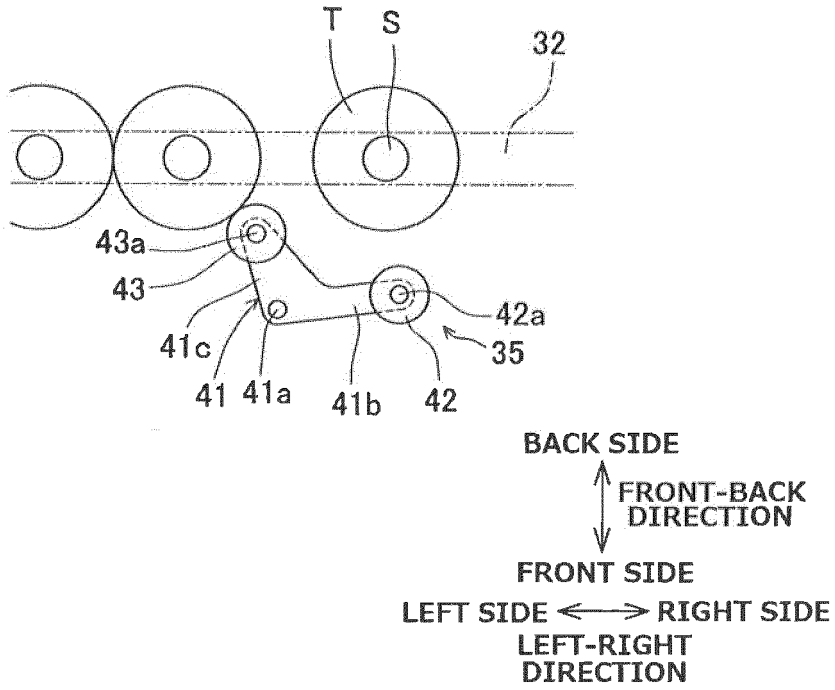

T
S
32
43a
43
42a
35
41c
41
41a
41b
42
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.3

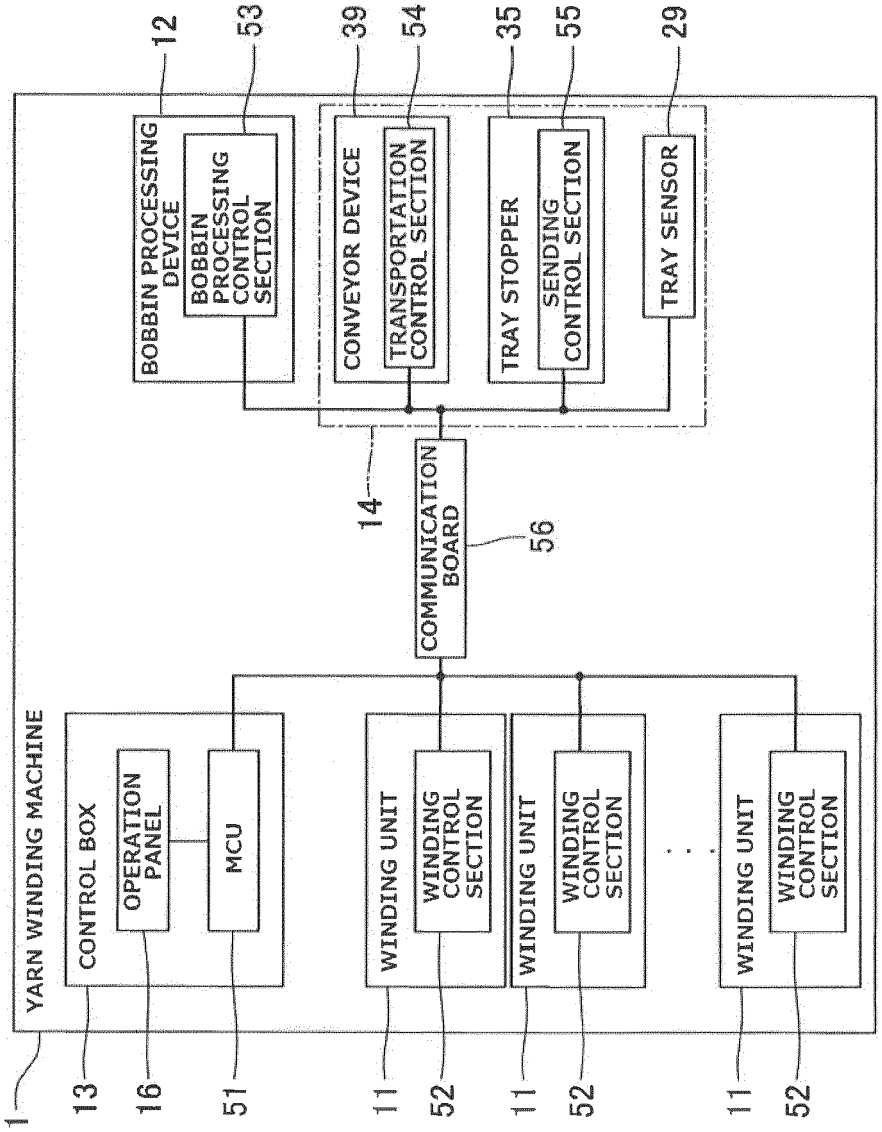
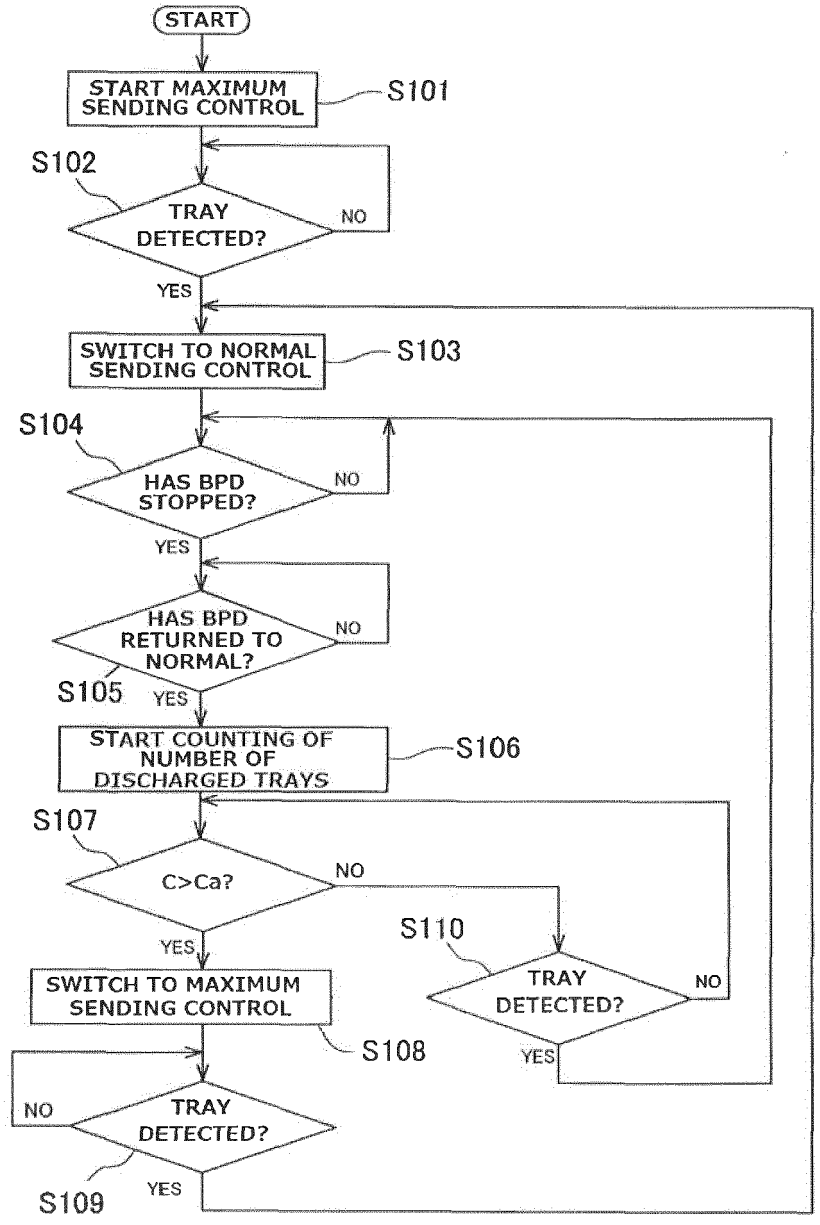
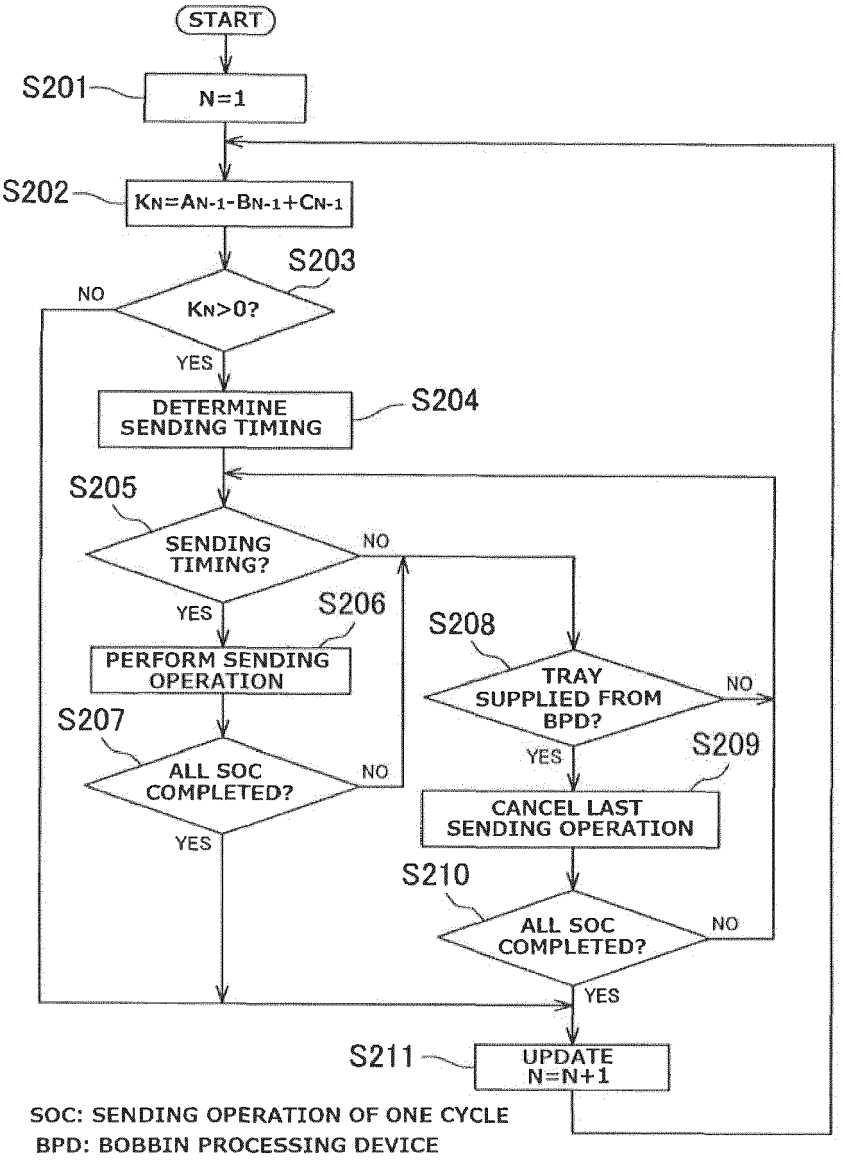

YARN WINDING MACHINE
CONTROL BOX
OPERATION PANEL
MCU
WINDING UNIT
WINDING CONTROL SECTION
WINDING UNIT
WINDING CONTROL SECTION
WINDING UNIT
WINDING CONTROL SECTION
COMMUNICATION BOARD
BOBBIN PROCESSING DEVICE
BOBBIN PROCESSING CONTROL SECTION
CONVEYOR DEVICE
TRANSPORTATION CONTROL SECTION
TRAY STOPPER
SENDING CONTROL SECTION
TRAY SENSOR
1
13
16
51
11
52
11
52
11
52
14
56
12
53
39
54
35
55
29

FIG.4



BPD: BOBBIN PROCESSING DEVICE

FIG.5



SOC: SENDING OPERATION OF ONE CYCLE
BPD: BOBBIN PROCESSING DEVICE

FIG.6

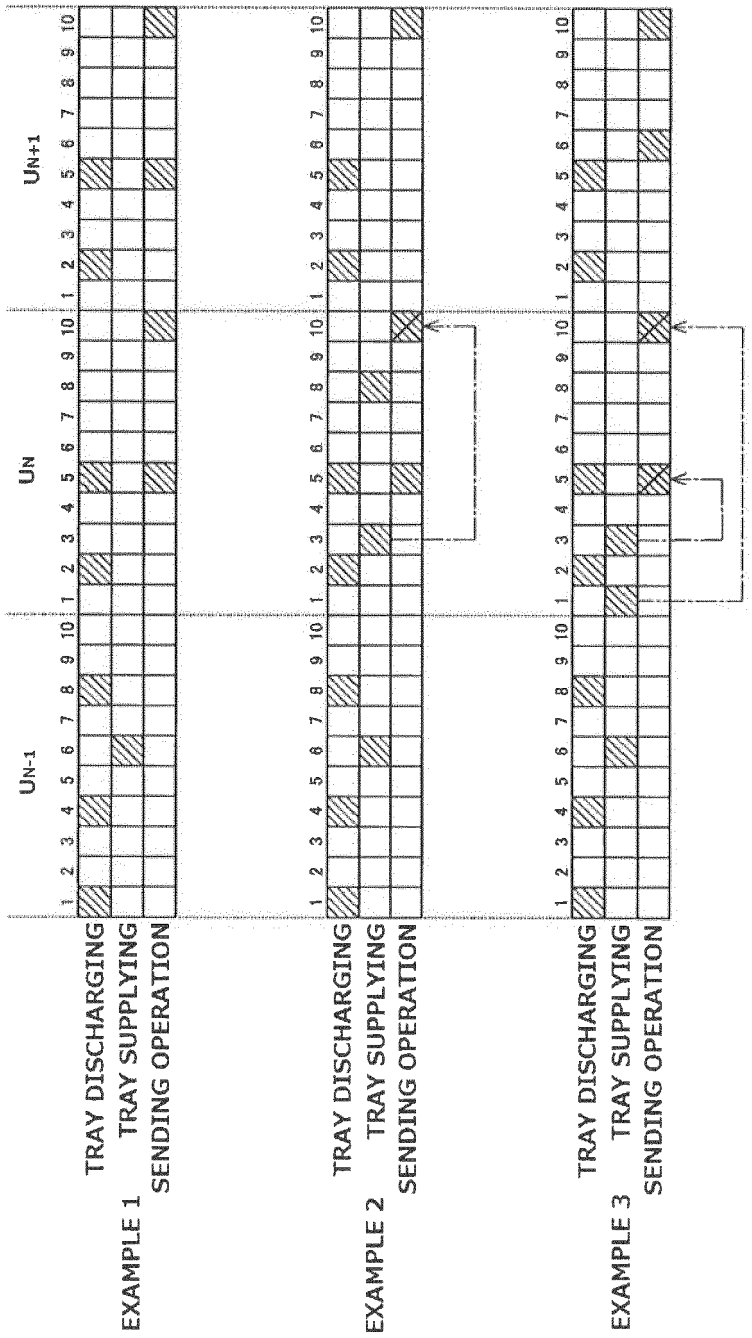

UN-1
UN
UN+1
1 2 3 4 5 6 7 8 9 10
EXAMPLE 1
TRAY DISCHARGING
TRAY SUPPLYING
SENDING OPERATION
EXAMPLE 2
TRAY DISCHARGING
TRAY SUPPLYING
SENDING OPERATION
EXAMPLE 3
TRAY DISCHARGING
TRAY SUPPLYING
SENDING OPERATION

FIG.7

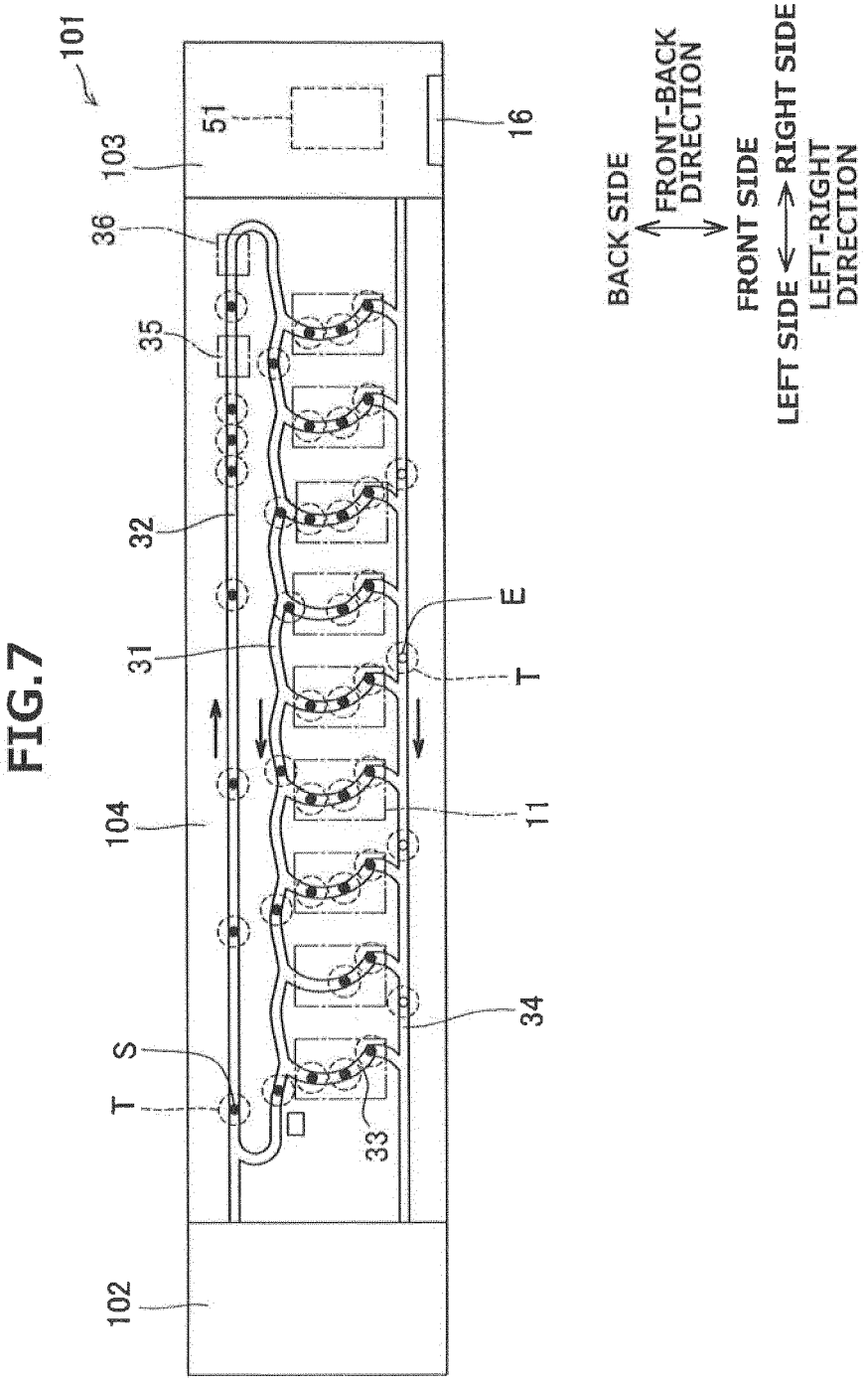

101
103
51
16
36
35
32
31
E
T
104
11
34
T
S
33
102
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.8

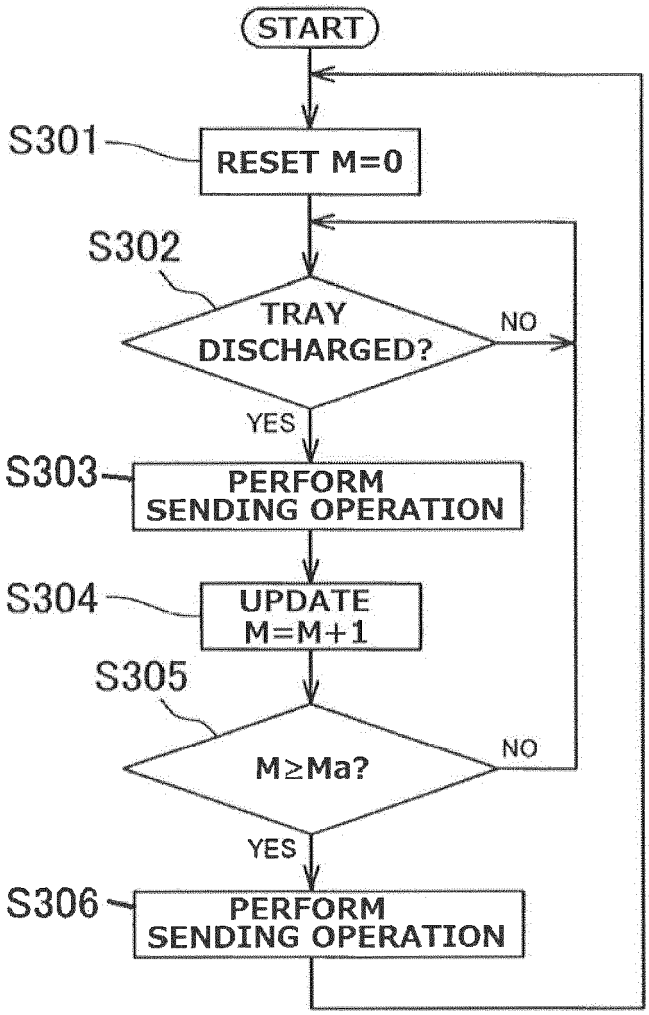

START
S301
RESET M=0
S302
TRAY DISCHARGED?
NO
YES
S303
PERFORM SENDING OPERATION
S304
UPDATE M=M+1
S305
M≥Ma?
NO
YES
S306
PERFORM SENDING OPERATION

FIG.9

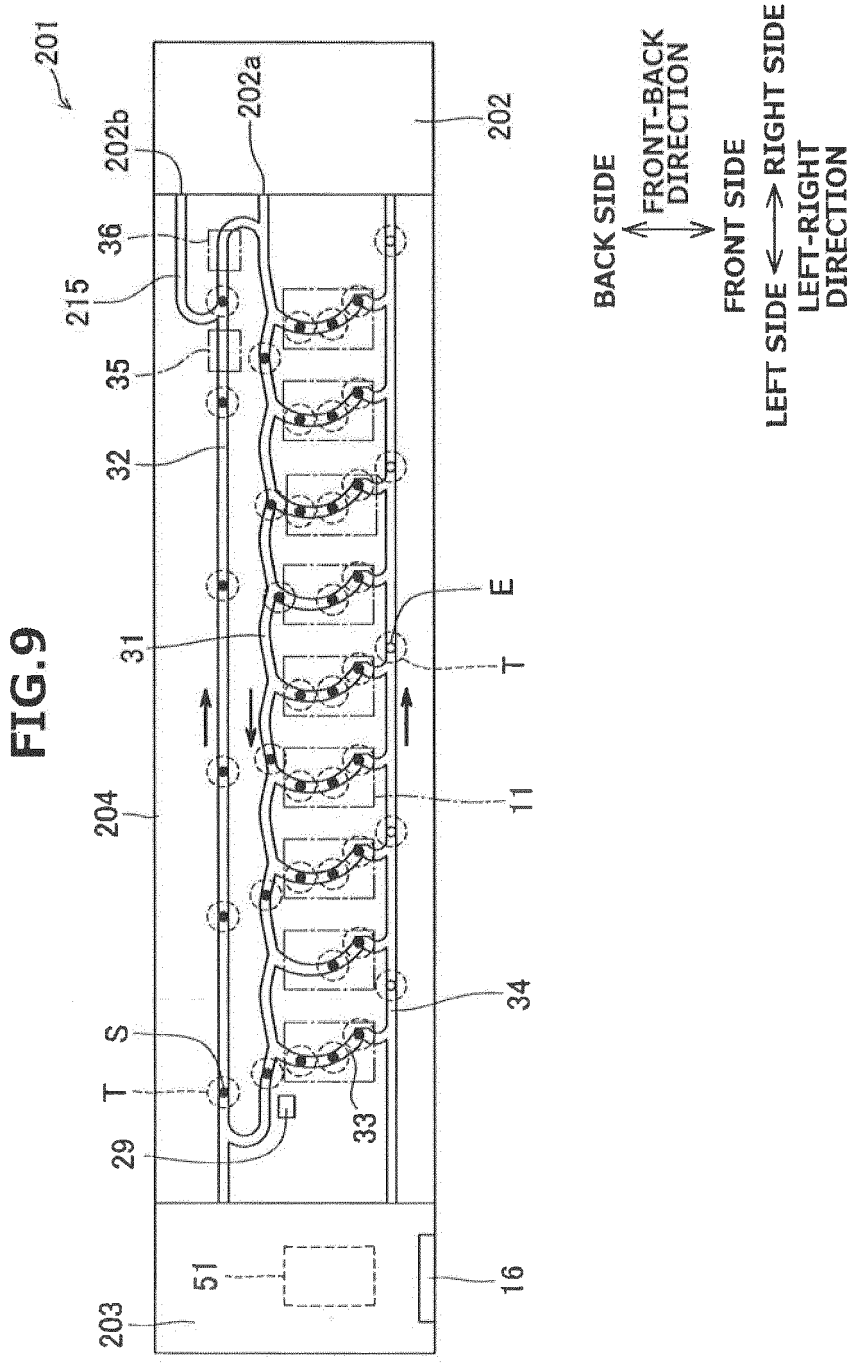
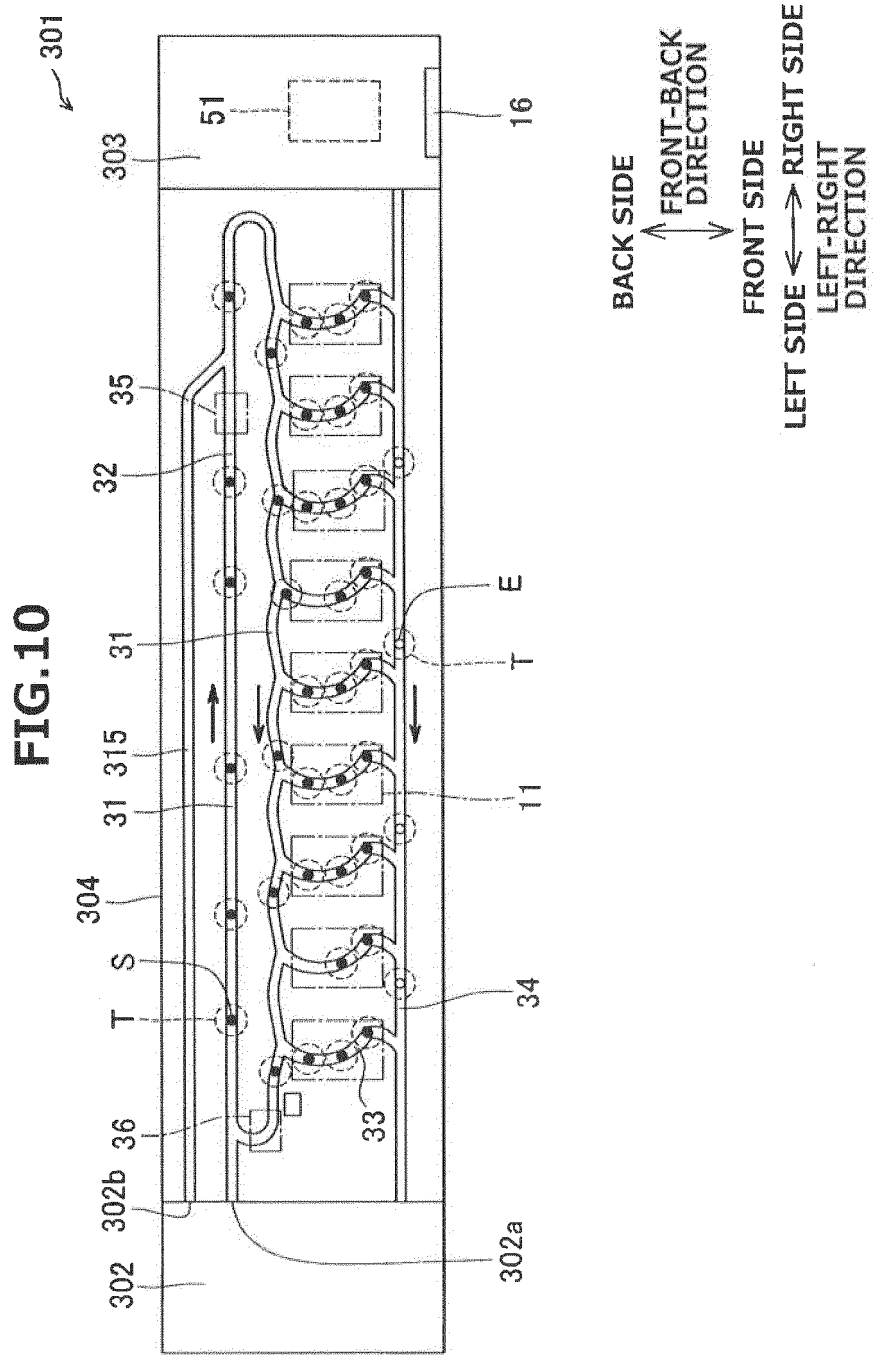

201
202a
202b
202
36
215
35
32
31
E
T
11
204
34
S
T
29
33
51
16
203
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.10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35
32
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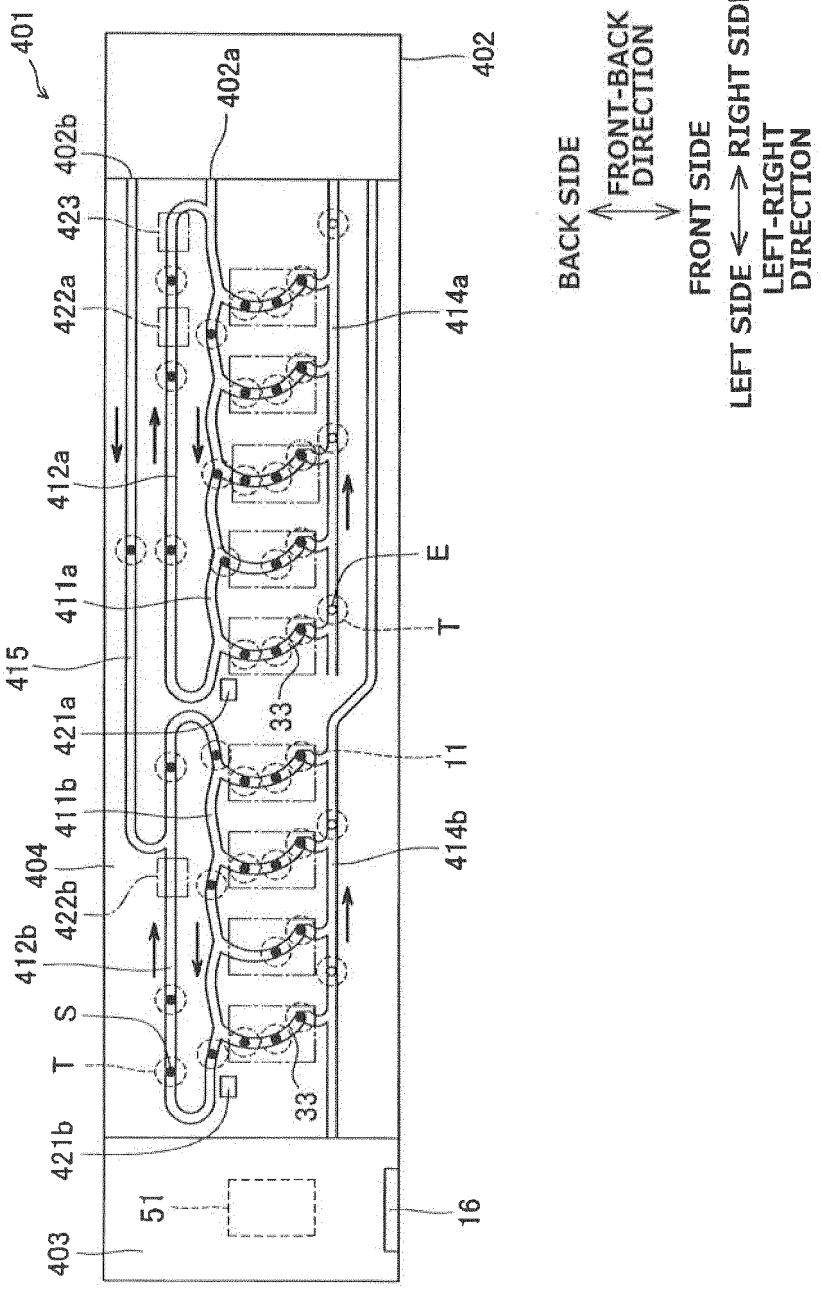
315
31
304
S
T
36
33
34
11
E
T
302b
302
302a
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.11


401
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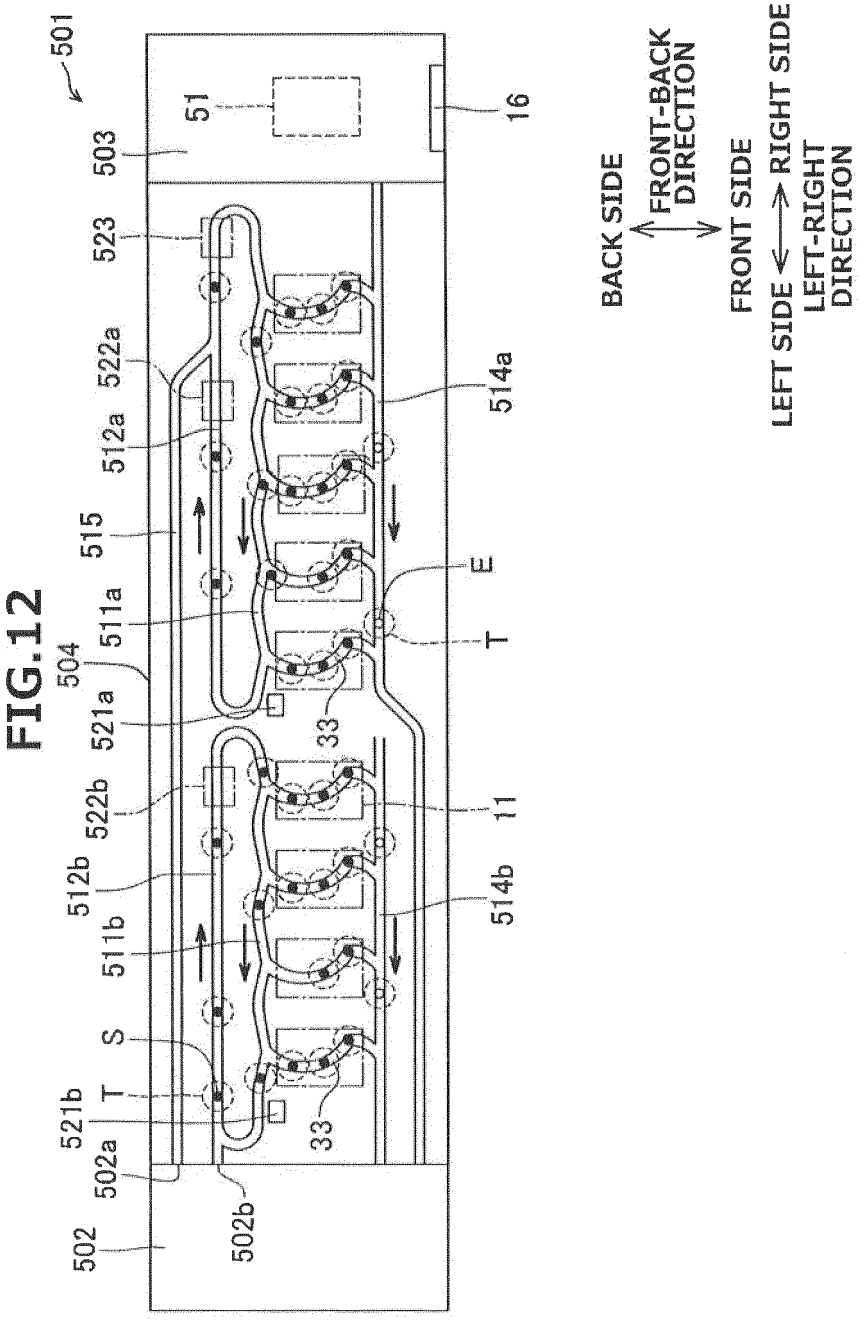
402a
402b
423
422a
414a
412a
411a
E
T
415
33
421a
11
411b
414b
404
422b
412b
S
T
33
421b
51
16
403
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

FIG.12


501
51
16
503
523
522a
512a
515
511a
504
521a
522b
512b
511b
S
T
521b
502a
502
502b
514a
E
T
33
11
514b
33
BACK SIDE
FRONT-BACK DIRECTION
FRONT SIDE
LEFT SIDE
RIGHT SIDE
LEFT-RIGHT DIRECTION

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EUROPEAN SEARCH REPORT

Application Number
EP 18 21 1718

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 5 509 614 A (NISHIKAWA KAZUO [JP] ET AL) 23 April 1996 (1996-04-23) * column 1, line 45 - column 2, line 2; claims 1-4; figures 1,2 *	1-10	
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TECHNICAL FIELDS SEARCHED (IPC)

B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	24 May 2019	Pussemier, Bart

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24-05-2019

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