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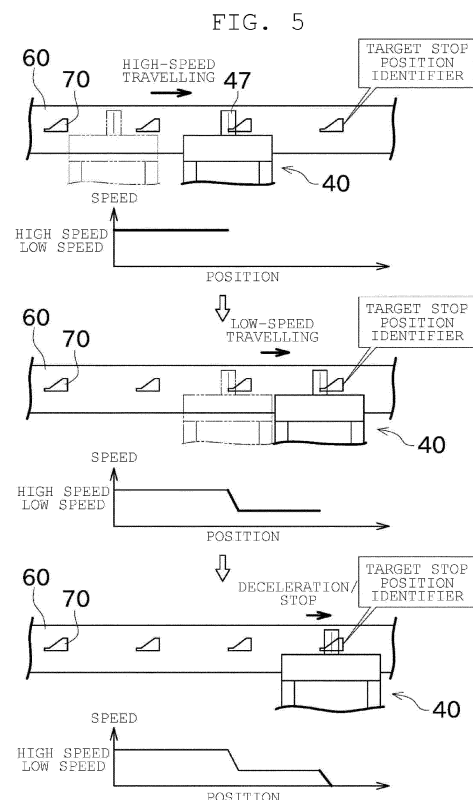
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(54) **YARN WINDING MACHINE AND TEACHING METHOD**

(57) A doffing cart 40 travels in a direction in which yarn processing units are arranged. A stop position identifier 70 is provided at a position corresponding to a stop position of the doffing cart 40. An optical sensor 47 detects the stop position identifier 70. On the basis of a magnitude of a detection value or a light receiving position detected by the optical sensor 47, the doffing cart 40 is stopped with respect to the stop position identifier 70.



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a yarn winding machine including a yarn processing unit and a work cart.

2. Description of the Related Art

[0002] An automatic winder (a yarn winding machine) of JP 2008-137539 A includes winding units (yarn processing units) and a doffing device (a work cart). The winding units are arranged side by side in one direction. The doffing device can travel in a direction in which the winding units are arranged, and performs doffing on the winding units.

[0003] The automatic winder of JP 2008-137539 A includes an index block for alignment of the doffing device and the winding unit. The index block is provided on a rail on which the doffing device travels.

[0004] The index block is provided at a position corresponding to each winding unit. The doffing device is provided with an index plate engageable with the index block. In a state where the index plate is engaged with the index block, the doffing device is located at an appropriate position for performing doffing on the winding unit.

[0005] In the configuration of JP 2008-137539 A, positioning accuracy may deteriorate due to wear of the index plate or the index block. Further, in order to change a stop position of the doffing device, it is necessary to change a position or a shape of the index plate or the index block. Note that, in the yarn winding machine, a work cart (for example, a yarn joining device) other than the doffing device may be provided. Further, the position at which the work cart is stopped is not limited to the yarn processing unit.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention has been made in view of the above circumstances. A main object is avoiding to deteriorate accuracy of a position at which a work cart is stopped. Furthermore, an object of the present invention is to provide a yarn winding machine capable of adjusting a position at which the work cart is stopped.

[0007] The problems to be solved by the present invention are as described above, and now, the means and effects for solving such problems will be described.

[0008] According to the present invention, a yarn winding machine having the following configuration is provided. The yarn winding machine includes a plurality of yarn processing units, a work cart, a stop position identifier, an optical sensor, and a control section. The yarn processing unit winds a yarn around a bobbin to form a

package. The work cart travels in a direction in which the yarn processing units are arranged as a travelling direction, and performs work on the yarn processing unit. The stop position identifier is provided at a position corresponding to a stop position of the work cart. The optical sensor is provided on the work cart and detects the stop position identifier. The control section calculates a position of the work cart with respect to the stop position identifier, and performs control to stop the work cart at a stop position of the work cart determined in advance, on the basis of magnitude of a detection value or on the basis of a light receiving position that is a position where the stop position identifier is detected in an area detectable by the optical sensor, the magnitude of the detection value or the light receiving position being detected by the optical sensor detecting a target stop position identifier to stop the work cart.

[0009] This enables calculation of a position of the work cart in a non-contact manner, and thus the accuracy of the position at which the work cart is stopped is unlikely to deteriorate. In addition, since the position of the work cart is calculated using the detection value or the light receiving position detected by the optical sensor, the position at which the work cart is stopped can be adjusted by changing the detection value or the light receiving position for stopping the work cart.

[0010] The stop position is set for each yarn processing unit, and the work cart may perform work on the yarn processing unit after stopping at the stop position.

[0011] This allows the work cart to perform the work with an appropriate positional relationship with respect to the yarn processing unit.

[0012] The optical sensor may be a line sensor.

[0013] This makes it possible to acquire more information than a spot-shaped optical sensor.

[0014] A direction of detection by the line sensor may be a direction orthogonal to a surface provided with the stop position identifier and orthogonal to the travelling direction.

[0015] As a result, by performing detection by the optical sensor while travelling, a detection range becomes a planar and wide range.

[0016] On the surface provided with the stop position identifier, in a direction orthogonal to the travelling direction, the stop position identifier may have a longer length on one side than another side in the travelling direction.

[0017] This allows calculation of a positional relationship between the optical sensor and the stop position identifier in the travelling direction.

[0018] On the surface provided with the stop position identifier, the stop position identifier may have a constant increasing ratio of the length in the direction orthogonal to the travelling direction.

[0019] As a result, a distance in the travelling direction between the optical sensor and the stop position identifier is proportional to a detection value of the optical sensor, which enables calculation of a specific distance between the optical sensor and the stop position identifier.

[0020] The control section may store a plurality of stop positions with respect to the stop position identifier, and store one of the plurality of stop positions in association with each work content of the work cart, and the control section may determine the stop position of the work cart with respect to the stop position identifier on the basis of the work content.

[0021] This enables to stop the work cart at an appropriate position according to the work content, by using one stop position identifier.

[0022] The stop position identifier may include a first stop position identifier as a target to stop the work cart and a second stop position identifier selected from the stop position identifiers between the work cart and the first stop position identifier in the travelling direction, and the control section may decelerate the work cart on the basis of detection of the second stop position identifier by the optical sensor.

[0023] As a result, the work cart travels at a high speed while being far from the stop position, and travels at a low speed while being close to the stop position, so that the work cart can reach the stop position in a short time.

[0024] There may be provided a yarn processing unit identifier that is for identifying the yarn processing unit and is provided at a position different from the stop position identifier in a direction orthogonal to the travelling direction, and a part of the stop position identifier may overlap with the yarn processing unit identifier in the travelling direction.

[0025] This enables to identify the yarn processing unit while aligning the stop position, by using the optical sensor for detection of the stop position. That is, it can be confirmed that the target yarn processing unit is reached.

[0026] The optical sensor may read the yarn processing unit identifier in a way different from the stop position identifier.

[0027] This enables clear distinction between the stop position identifier and the yarn processing unit identifier.

[0028] The yarn processing unit identifier may be provided in the yarn processing unit.

[0029] The work cart may travel along a rail, and the stop position identifier may be an opening formed in the rail.

[0030] This enables creation of the stop position identifier with simple work.

[0031] The stop position identifier may be provided in the yarn processing unit.

[0032] This can omit or simplify a process of registering the stop position for each yarn processing unit when performing work on the yarn processing unit.

[0033] There may be included an auxiliary identifier that is provided between the yarn processing units in the travelling direction and is for identifying a position of the work cart in the travelling direction.

[0034] This enables more detailed calculation of the position of the work cart.

[0035] According to a second aspect of the present invention, a following teaching method is provided. A yarn

winding machine that performs a teaching method includes: a plurality of yarn processing units adapted to wind a yarn around a bobbin to form a package; and a work cart adapted to travel in a direction in which the yarn processing units are arranged as a travelling direction, to perform work on the yarn processing units. The teaching method is adapted to teach a stop position of the work cart to the yarn winding machine. The teaching method includes an attaching step and a storing step. In the attaching step, a positioning member is attached to the yarn processing unit. In the storing step, magnitude of a detection value or a light receiving position that is a position where a stop position identifier is detected in an area detectable by the optical sensor is stored, the magnitude of the detection value or the light receiving position being detected by the optical sensor detecting a stop position identifier provided at a position corresponding to a stop position of the work cart in a state where the positioning member is in contact with the work cart.

[0036] This enables registration of the stop position for each yarn processing unit.

[0037] The teaching method may include a preparing step of attaching a positioning sensor to the work cart, and the yarn processing units may include a first yarn processing unit and a second yarn processing unit. The storing step may include: a first storing step of storing a detection value or a light receiving position for the first yarn processing unit; and a second storing step that is performed after the first storing step and is of storing a detection value or a light receiving position for the second yarn processing unit. In the first storing step, in a state where the positioning member attached to the first yarn processing unit is in contact with the work cart, the optical sensor may detect a detection value or a light receiving position, and the positioning sensor may detect the first yarn processing unit. In the second storing step, in a state where the second yarn processing unit and the work cart are aligned in a non-contact manner, a stop position of the work cart with respect to the second yarn processing unit may be calculated and stored on the basis of the detection value or the light receiving position detected by the optical sensor and on the basis of the position of the second yarn processing unit detected by the positioning sensor.

[0038] This enables registration of the stop position for the second and subsequent yarn processing units without arranging the positioning member in the second and subsequent yarn processing units.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039]

FIG. 1 is a front view of an automatic winder according to one embodiment of the present invention; FIG. 2 is a block diagram of the automatic winder; FIG. 3 is an enlarged front view illustrating a state where a stop position identifier is detected by an op-

tical sensor of a doffing cart;

FIG. 4 is a flowchart illustrating a process of causing a work cart to travel to a target yarn processing unit; FIG. 5 is a view illustrating a speed change when the work cart is caused to travel to a target yarn processing unit;

FIG. 6 is a view illustrating a process of registering a stop position for each yarn processing unit by using a positioning member;

FIG. 7 is a view illustrating a process of registering a stop position for each yarn processing unit by using an additional optical sensor;

FIG. 8 is a front view illustrating an alternative embodiment in which a stop position identifier is provided in the yarn processing unit;

FIG. 9 is an enlarged front view of a rail in a first alternative embodiment;

FIG. 10 is an enlarged front view of a rail according to a second alternative embodiment;

FIG. 11 is an enlarged plan view of a rail in a third alternative embodiment;

FIG. 12 is a view of a stop position identifier and a yarn processing unit identifier in a fourth alternative embodiment; and

FIG. 13 is a view illustrating another example of the stop position identifier and the yarn processing unit identifier.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0040] Next, an embodiment of the present invention will be described with reference to the drawings. With reference to FIG. 1, an overall configuration of an automatic winder (a yarn winding machine) will be described.

[0041] An automatic winder 1 includes a plurality of yarn processing units 10 arranged in parallel, a doffing cart (a work cart) 40, and a machine control device 50.

[0042] Each of the yarn processing units 10 includes a yarn supplying section 11, a yarn unwinding assisting device 12, a tension applying device 13, a yarn joining device 14, a yarn quality measuring instrument 15, a cradle 16, a winding drum 17, and a housing 18. The yarn supplying section 11 supports a yarn supplying bobbin 21. The yarn unwinding assisting device 12 comes into contact with a portion (a balloon) bulged outward in a yarn unwound from the yarn supplying bobbin 21 when being swung around by a centrifugal force. This enables to suppress the yarn from being excessively swung, and to unwind the yarn with a constant tension. The tension applying device 13 applies a predetermined tension on a travelling yarn. The yarn unwound from the yarn supplying bobbin 21 and a yarn of a package 22 are individually guided to the yarn joining device 14. The yarn joining device 14 joins the guided yarns with each other. The yarn quality measuring instrument 15 measures the quality of the travelling yarn (for example, a yarn thickness, a change amount, or the like) with an optical sensor or

the like. To the cradle 16, a winding bobbin is attached. The package 22 is formed by winding the yarn around the winding bobbin. The winding drum 17 comes into contact with the package 22 and rotates, to wind the yarn around the winding bobbin while traversing the yarn. Inside the housing 18, an electric component such as a unit control section 19 described later is provided.

[0043] The doffing cart 40 can travel along a parallel direction of the yarn processing units 10. Specifically, a rail 60 is formed along the parallel direction above the yarn processing unit 10, and the doffing cart 40 travels along the rail 60. When the package is fully wound in a certain yarn processing unit 10, the doffing cart 40 travels to the yarn processing unit 10 and stops. The doffing cart 40 removes the fully-wound package of the yarn processing unit 10. Then, a new winding bobbin around which a yarn is not wound is supplied to the yarn processing unit 10.

[0044] Specifically, the doffing cart 40 includes a yarn pull-out arm 41, a cradle opening arm 42, and a chucker 43. The yarn pull-out arm 41 is expanded and contracted by an actuator such as an air cylinder (not illustrated). To a distal end of the yarn pull-out arm 41, a suction-type yarn catching section is attached, and pulls out a yarn from the yarn supplying bobbin 21. The cradle opening arm 42 operates and opens the cradle 16 to remove the fully-wound package 22 from the cradle 16. The chucker 43 grips an empty winding bobbin held in a bobbin stocker (not illustrated) and supplies the empty winding bobbin to the cradle 16.

[0045] Next, a control system of the automatic winder 1 will be described with reference to FIG. 2.

[0046] As described above, the yarn processing unit 10 includes the unit control section 19. The unit control section 19 controls each section of the yarn processing unit 10.

[0047] The doffing cart 40 includes a cart control section (a control section) 45, a travelling motor 46, and an optical sensor 47. The cart control section 45 controls each section of the doffing cart 40. The travelling motor 46 is used to cause the doffing cart 40 to travel along the rail 60. The optical sensor 47 is used to stop the doffing cart 40 at a target position. The cart control section 45 calculates a position of the doffing cart 40 on the basis of a detection result of the optical sensor 47, and controls the travelling motor 46. Then, the doffing cart 40 is caused to travel to an appropriate position to perform doffing on the yarn processing unit 10.

[0048] The machine control device 50 includes a machine control section 51, an input section 52, and a display section 53. The machine control section 51 controls the plurality of yarn processing units 10 provided in the automatic winder 1. In addition, the machine control section 51 performs processing according to a command made by an operator operating the input section 52. For example, when the operator operates the input section 52 to set a condition relating to winding of a yarn, the setting is reflected in all the yarn processing units 10.

Further, when the operator operates the input section 52 to issue a command to display information relating to an operation status and/or yarn quality of each yarn processing unit 10, the machine control section 51 displays the information on the display section 53. Further, the machine control device 50 can communicate with each yarn processing unit 10 and the doffing cart 40.

[0049] Each of the unit control section 19, the cart control section 45, and the machine control section 51 includes an arithmetic device such as a CPU, and a storage device such as an HDD, an SSD, or a flash memory. Various programs are stored in the storage device, and the arithmetic device reads and executes the programs to perform the above-described control.

[0050] With reference to FIGS. 3 to 5, control of causing the doffing cart 40 to travel to the target stop position will be described. In the following description, an appropriate position of the doffing cart 40 to perform doffing on the yarn processing unit 10 is referred to as a stop position. A stop position with respect to the yarn processing unit 10 to perform doffing next is particularly referred to as a target stop position.

[0051] First, the optical sensor 47 and a stop position identifier 70 used to detect a position of the doffing cart 40 will be described. The optical sensor 47 is a reflective line sensor. The optical sensor 47 irradiates an irradiation surface with linear light, receives reflected light on a light receiving surface, and outputs a received light amount as a detection value. The optical sensor 47 of the present embodiment does not need to be able to detect a position of the reflected light incident on the light receiving surface.

[0052] The optical sensor 47 is provided on the doffing cart 40 and travels integrally with the doffing cart 40. The optical sensor 47 of the present embodiment is provided on an upper surface of the doffing cart 40, but may be provided at different positions. In addition, a longitudinal direction of linear light applied to the irradiation surface by the line sensor is hereinafter referred to as a "detection direction". Further, an area where the optical sensor 47 transmits and receives light and performs detection is referred to as a detection area 47a (see FIG. 3). In the present embodiment, the detection direction of the optical sensor 47 is parallel to a height direction (a vertical direction) of the automatic winder 1. In other words, the detection direction of the optical sensor 47 is a direction orthogonal to the travelling direction and orthogonal to a horizontal plane. The optical sensor 47 irradiates a side surface of the rail 60 with light and detects reflected light.

[0053] The rail 60 is provided with a plurality of stop position identifiers 70. As illustrated in FIG. 1, the stop position identifier 70 is provided corresponding to each yarn processing unit 10. The stop position identifier 70 has a light reflectance different from that of an installation surface (for example, a side surface of the rail 60) provided with the stop position identifier 70. The stop position identifier 70 may be, for example, a member (for example, a black member) having a light reflectance lower than

that of the installation surface or a member (a member that performs specular reflection) having a light reflectance higher than that of the installation surface. Alternatively, the stop position identifier 70 may be formed by cutting out the installation surface to form an opening. In this case, the stop position identifier 70 can be detected by detecting surroundings of the stop position identifier 70. Further, the detection direction of the optical sensor 47 can also be rephrased as a direction orthogonal to the travelling direction on the installation surface of the stop position identifier 70.

[0054] As illustrated in FIG. 3, the stop position identifier 70 includes a first parallel part 71, an inclined part 72, and a second parallel part 73. The first parallel part 71 and the second parallel part 73 are portions whose lengths (widths) in the detection direction are constant in the travelling direction. A length of the inclined part 72 in the detection direction changes depending on a position in the travelling direction. That is, the length in the detection direction increases from one side toward another side in the travelling direction. In particular, in the present embodiment, since the inclined part 72 is a straight line, an increasing ratio (a changing ratio) of the length in the detection direction is constant. In a situation where the detection area 47a overlaps with the inclined part 72, a received light amount (a detection value) changes as the doffing cart 40 moves in the travelling direction. By using this, a positional relationship between the stop position identifier 70 and the optical sensor 47 (that is, the doffing cart 40) can be detected. A received light amount (hereinafter, referred to as a reference received light amount) of the optical sensor 47 in a state where the doffing cart 40 is arranged at the stop position with respect to the yarn processing unit 10 is stored in advance. Then, during work of the automatic winder 1, the doffing cart 40 is caused to travel such that the received light amount detected by the optical sensor 47 coincides with the reference received light amount. This allows the doffing cart 40 to be accurately stopped at the target stop position. Note that the first parallel part 71 and/or the second parallel part 73 may be omitted.

[0055] Hereinafter, with reference to FIGS. 4 and 5, a flow of stopping the doffing cart 40 at the target stop position will be described. First, when doffing is required in the yarn processing unit 10, the unit control section 19 transmits the fact that the doffing is required, to the machine control section 51. The machine control section 51 transmits information specifying the yarn processing unit 10 that requires the doffing, to the cart control section 45.

[0056] When receiving information regarding the target yarn processing unit 10 from the machine control section 51 (S101), the cart control section 45 starts high-speed travelling toward the stop position identifier 70 (a first stop position identifier) corresponding to the target yarn processing unit 10 (S102, high-speed travelling in FIG. 5).

[0057] Next, the cart control section 45 determines whether or not the stop position identifier 70 immediately

before the target is detected (S103). Specifically, the process is performed as follows. Since the cart control section 45 stores information on a yarn processing unit 10 (specifically, identification information for identification of the yarn processing unit 10) that has performed doffing last time, the doffing cart 40 can specify the yarn processing unit 10 currently in proximity. Therefore, the number of the yarn processing units 10 to pass by to reach the target yarn processing unit 10 can be calculated. In addition, the cart control section 45 can detect the stop position identifier 70 by using the optical sensor 47 even during the high-speed travelling. As a result, when the number of the yarn processing units 10 to pass by before reaching the target yarn processing unit 10 is N, and the number of the yarn processing units 10 that have been passed by at the current time is M, the cart control section 45 can determine whether or not $N - M$ has become 1. When $N - M$ becomes 1, the doffing cart 40 reaches the stop position identifier 70 (a second stop position identifier) immediately before the target.

[0058] When it is determined that the stop position identifier 70 immediately before the target is detected, the cart control section 45 shifts to low-speed travelling (S104, low-speed travelling in FIG. 5). By shifting to the low-speed travelling at the stop position identifier 70 immediately before the target, it is possible to inhibit passing by the target stop position identifier 70. Furthermore, it is possible to shorten time to reach the target stop position identifier 70. In the present embodiment, the stop position identifier 70 immediately before the target is selected as the second stop position identifier, but the stop position identifier 70 that is two or more before the target may be selected as the second stop position identifier.

[0059] Next, the cart control section 45 determines whether or not the target stop position identifier 70 is detected (S105). Immediately after detecting the target stop position identifier 70 (in other words, immediately after detecting an end part of the stop position identifier 70 in the travelling direction), the cart control section 45 shifts to deceleration travelling and stops the doffing cart 40 (S106, deceleration/stop in FIG. 5). A deceleration of the deceleration travelling is calculated in advance. By decelerating with this deceleration and stopping, the doffing cart 40 stops at the target stop position. That is, a speed during the low-speed travelling, a position of the doffing cart 40 when the optical sensor 47 detects the end part of the stop position identifier 70 in the travelling direction, and a position of the doffing cart 40 for appropriately performing the doffing on the yarn processing unit 10 all are known, and thus the deceleration is calculated in advance on the basis of these values.

[0060] Note that, instead of the method of calculating the deceleration of the deceleration travelling, a deceleration timing may be calculated with the deceleration being made constant. That is, a distance (a minimum travel distance) traveled until the doffing cart 40 stops when decelerating at a constant deceleration from the low-speed travelling can be calculated on the basis of

the speed and the deceleration during the low-speed travelling. Therefore, when deceleration is started at a position (a deceleration start position) where a distance to the target stop position becomes equal to the minimum travel distance, the doffing cart 40 can be stopped at the target stop position. Specifically, a time from immediately after the target stop position identifier 70 is detected until reaching the deceleration start position is calculated in advance, and the cart control section 45 starts deceleration of the doffing cart 40 after the time from the detection of the stop position identifier 70 is elapsed.

[0061] However, even when the doffing cart 40 is decelerated at the calculated deceleration or deceleration timing, the doffing cart 40 may not stop at the target stop position due to control accuracy, inertia, or the like. Therefore, in the present embodiment, after the doffing cart 40 is stopped, the cart control section 45 determines whether or not a deviation from the target stop position is within a threshold value (S107). This determination is made on the basis of a received light amount detected by the optical sensor 47. That is, the received light amount detected by the optical sensor 47 after the doffing cart 40 is stopped is compared with the above-described reference received light amount. When a difference is within the threshold value, the cart control section 45 ends the cart control, and then performs control related to doffing. The inclined part 72 of the stop position identifier 70 according to the present embodiment has a constant changing ratio of the length in the detection direction. Therefore, a degree of the deviation from the target stop position can be determined by using the threshold value. In addition, the threshold value is preferably a value larger than a minimum distance in which the doffing cart 40 can move when being displaced with respect to the target stop position.

[0062] When the difference exceeds the threshold value, the cart control section 45 performs position adjustment control (S108). The position adjustment control is control to bring the doffing cart 40 close to the target stop position. The inclined part 72 of the stop position identifier 70 according to the present embodiment has a constant changing ratio of the length in the detection direction. Therefore, by calculating and storing in advance a change amount in the received light amount per unit length in the travelling direction, a length of positional shift of the doffing cart 40 can be calculated on the basis of the change amount. The cart control section 45 causes the doffing cart 40 to travel such that a length of the positional shift of the doffing cart 40 approaches 0. For example, when a length of the positional shift is L and a minimum speed of the doffing cart 40 is V, the travelling motor 46 is driven at the minimum speed for a time corresponding to L/V . Note that the cart control section 45 may calculate a driving amount of the travelling motor 46 (for example, the number of rotations of an output shaft or a value corresponding thereto) instead of calculating the driving time of the travelling motor 46.

[0063] After performing control of stopping the doffing

cart 40 at the target stop position, the cart control section 45 performs communication (for example, wireless communication such as infrared communication) with the yarn processing unit 10, and confirms that the doffing cart 40 has arrived in proximity to the target yarn processing unit 10. Thereafter, the cart control section 45 performs doffing on the target yarn processing unit 10. The cart control section 45 stores identification information of the yarn processing unit 10 confirmed here. The identification information of the yarn processing unit 10 is used for performing control of travelling to the next target yarn processing unit 10.

[0064] In the present embodiment, after position adjustment control, the cart control section 45 performs the next processing without redetermining the deviation from the target stop position. Alternatively, the cart control section 45 may perform the determination of step S107 again after the position adjustment control, to determine again whether the doffing cart 40 has approached the target stop position (whether the deviation from the target stop position is within the threshold value). As a result, the process of readjusting the position of the doffing cart 40 (specifically, the processes in steps S107 and S108, hereinafter, referred to as a readjustment process) is repeated until the deviation from the target stop position falls within the threshold value. However, in order to avoid repetition of the readjustment process for a long time, an upper limit may be set to the number of times or a processing time of the readjustment process. When the number of times of the readjustment process exceeds the upper limit (for example, two times) or the processing time exceeds the upper limit, the cart control section 45 may abnormally stop the doffing cart 40. Alternatively, the cart control section 45 may move the doffing cart 40 in a direction away from the target stop position when the number of times of the readjustment process or the processing exceeds the upper limit. In this case, the cart control section 45 obtains a travelling time to stop the doffing cart 40 at the target stop position, on the basis of a movement amount of the doffing cart 40 when separated from the target stop position and the initial deviation. Next, the cart control section 45 moves the doffing cart 40 according to the travelling time to move the doffing cart 40 to the target stop position.

[0065] A process of registering a stop position for each yarn processing unit 10 will be described.

[0066] In the present embodiment, the stop position identifier 70 is provided on the rail 60. Whereas, the doffing cart 40 performs work on the yarn processing unit 10. A position of the yarn processing unit 10 with respect to the rail 60 is not necessarily constant due to dimensional accuracy, rattling, deflection, or the like. Therefore, the stop position is preferably registered for each yarn processing unit 10.

[0067] FIG. 6 illustrates exemplification of a method of using a positioning member 81. The positioning member 81 is detachably attached to the yarn processing unit 10. When the doffing cart 40 and the positioning member 81

are brought into contact with each other in a state where the positioning member 81 is attached to the yarn processing unit 10 (an attaching step), the doffing cart 40 is located at a stop position with respect to the yarn processing unit 10. Then, the cart control section 45 stores a received light amount detected by the optical sensor 47 in this state as a reference received light amount (a storing step). By performing the above process on all the yarn processing units 10, the stop position can be registered for each yarn processing unit 10.

[0068] FIG. 7 illustrates a method of using a positioning sensor 82 in addition to the positioning member 81. The positioning sensor 82 is provided on the doffing cart 40 and moves integrally with the doffing cart 40. The positioning sensor 82 is a line sensor whose detection direction is parallel to the travelling direction. The positioning sensor 82 is arranged at a position where a characteristic portion (e.g., an edge portion) of the yarn processing unit 10 can be detected. Note that the positioning sensor 82 may be a sensor (for example, a laser sensor) other than the line sensor as long as the position of the characteristic portion of the yarn processing unit 10 can be detected.

[0069] First, the positioning sensor 82 is attached to the doffing cart 40 (a preparing step). Next, the positioning member 81 is attached to the yarn processing unit 10 similarly to the above, and the doffing cart 40 is aligned with the stop position. Then, the cart control section 45 stores a received light amount detected by the optical sensor 47 in this state as a reference received light amount. Furthermore, the cart control section 45 further stores a detection value (specifically, a position of the edge portion of the yarn processing unit 10) detected by the positioning sensor 82 in this state. The stored detection value by the positioning sensor 82 is a detection value detected when the doffing cart 40 is located at the stop position of the yarn processing unit 10. By using the stored detection value by the positioning sensor 82, the positioning member 81 does not need to be used for the second and subsequent yarn processing units 10. Specifically, the doffing cart 40 is moved to the second yarn processing unit 10, and the doffing cart 40 is moved such that the detection value of the positioning sensor 82 coincides with the detection value stored in advance. Thereafter, the received light amount detected by the optical sensor 47 in this state is stored as a reference received light amount. By performing the above process on all the yarn processing units 10, the stop position can be registered for each yarn processing unit 10.

[0070] In the example of FIG. 7, for the second and subsequent yarn processing units 10, the doffing cart 40 is moved such that the detection value of the positioning sensor 82 coincides with the detection value stored in advance. That is, the doffing cart 40 is moved with the detection value of the positioning sensor 82 as a reference. Alternatively, the doffing cart 40 may be moved with the received light amount of the optical sensor 47 as a reference. Specifically, when performing processing on the second and subsequent yarn processing units 10,

the doffing cart 40 is moved such that the received light amount detected by the optical sensor 47 coincides with the reference received light amount stored in the first yarn processing unit 10. In this state, a detection value of the positioning sensor 82 is acquired. Since a changing ratio of a length of the inclined part 72 of the stop position identifier 70 in the detection direction is constant, a difference between a detection value of a first positioning sensor 82 and a detection value of a second positioning sensor 82 corresponds to a difference in the stop position. Therefore, the cart control section 45 increases or decreases the reference received light amount by an amount corresponding to this difference. By performing the above process on all the yarn processing units 10, the stop position can be registered for each yarn processing unit 10.

[0071] In the present embodiment, since the stop position identifier 70 is provided on the rail 60, the stop position for each yarn processing unit 10 needs to be registered. Alternatively, as illustrated in FIG. 8, the stop position identifier 70 may be provided in the yarn processing unit 10. By directly providing on the yarn processing unit 10, the stop position can be determined using manufacturing accuracy of the yarn processing unit 10. Therefore, the stop position can be determined by a common detection value for all the yarn processing units 10. That is, the stop position does not need to be registered for all the yarn processing units 10, and the stop position may be registered for one yarn processing unit 10 alone, and information on the stop position may also be used for the remaining yarn processing units 10. In the example illustrated in FIG. 8, the stop position identifier 70 is provided in the housing 18, but the stop position identifier 70 may be provided at a different position in the yarn processing unit 10.

[0072] The doffing described above is work on the cradle 16. In addition to this, the doffing cart 40 can also perform work of yarn path reference. The work of yarn path reference is, for example, work on a yarn accumulating device when the yarn processing unit 10 includes the yarn accumulating device. Since the work on the cradle 16 and the work of yarn path reference have different work contents, preferable stop positions of the doffing cart 40 may be different. Therefore, by stopping the doffing cart 40 at a preferable position according to the work content, even when the doffing cart 40 performs work on the same yarn processing unit 10, work efficiency or a work success rate can be improved.

[0073] In the configuration of JP 2008-137539 A, alignment is performed using the index block provided on the rail, but it is difficult to arrange the index block aligned with two adjacent stop positions. Therefore, in the configuration of JP 2008-137539 A, it is difficult to stop the doffing cart at a preferable position according to the work content. The doffing cart 40 of the present embodiment can calculate a relative position of the doffing cart 40 with respect to the stop position identifier 70 on the basis of a received light amount of the optical sensor 47. There-

fore, two adjacent stop positions can be registered, and the doffing cart 40 can be stopped at the stop position corresponding to the work content.

[0074] For example, by individually performing the method described with reference to FIGS. 6 to 8 in accordance with the work content, a plurality of stop positions can be registered for one yarn processing unit 10 (one stop position identifier 70). Alternatively, after registering the stop position of reference work (for example, doffing), the plurality of stop positions may be registered for one yarn processing unit 10 by increasing or decreasing the stop position of the reference work by a predetermined value.

[0075] With reference to FIG. 9, a first alternative embodiment in which another identifier is provided in addition to the stop position identifier 70 will be described.

[0076] In the first alternative embodiment, a length of the optical sensor 47 in the detection direction is longer than a length of the stop position identifier 70 in the detection direction. Specifically, as illustrated in FIG. 9, a detection area of the optical sensor 47 is divided into an area A1, an area A2, and an area A3. The area A1, the area A2, and the area A3 are arranged in the detection direction. A length of the area A1 in the detection direction is longer than those of the areas A2 and A3, but may be the same or shorter. The area A1 is an area located at a center in the detection direction. In the area A1 of an installation surface of the rail 60, the stop position identifier 70 is provided. The area A2 is an area deviated upward from the area A1. In the area A2 of the installation surface of the rail 60, a yarn processing unit identifier 75 and an auxiliary identifier 76 are provided. The area A3 is an area deviated downward from the area A1. In the area A3 of the installation surface of the rail 60, a stop position identifier 77 indicating information different from that of the auxiliary identifier 76 is provided. The yarn processing unit identifier 75 may be provided on the yarn processing unit 10 (in particular, the housing 18) instead of the rail 60.

[0077] The yarn processing unit identifier 75, the auxiliary identifier 76, and the stop position identifier 77 are one-dimensional barcodes, and a direction of lines of the one-dimensional barcodes is parallel to the travelling direction. That is, the yarn processing unit identifier 75, the auxiliary identifier 76, and the stop position identifier 77 are read in a way of reading different from the stop position identifier 70. Therefore, the cart control section 45 can specify an identifier detected by the optical sensor 47, by merely performing simple processing on a received light amount of the optical sensor 47. The optical sensor 47 of the first alternative embodiment further has a function of reading a one-dimensional barcode. Further, since the yarn processing unit identifier 75, the auxiliary identifier 76, and the stop position identifier 77 are one-dimensional barcodes, the optical sensor 47 of the present embodiment can read the yarn processing unit identifier 75, the auxiliary identifier 76, and the stop position identifier 77 even while the doffing cart 40 is trav-

elling.

[0078] The yarn processing unit identifier 75 includes identification information of the yarn processing unit 10. The yarn processing unit identifier 75 is provided such that a position in the travelling direction is common to the stop position identifier 70. The cart control section 45 can specify the yarn processing unit 10 near the doffing cart 40 on the basis of the yarn processing unit identifier 75 read by the optical sensor 47. This enables confirmation that the target yarn processing unit 10 has been reached. Note that, in the above-described embodiment, communication is performed with the yarn processing unit 10 after the target yarn processing unit 10 is reached, to confirm the arrival in proximity to the target yarn processing unit 10. However, in the present alternative embodiment, since the arrival in proximity to the target yarn processing unit 10 can be confirmed using the yarn processing unit identifier 75, the communication with the yarn processing unit 10 for this confirmation can be omitted.

[0079] The auxiliary identifier 76 is used for the cart control section 45 to calculate a detailed position of the doffing cart 40. The auxiliary identifier 76 is provided at each position of sectioning a space between the yarn processing unit identifiers 75 into a plurality of (four in the example of FIG. 9) pieces. The cart control section 45 can calculate a more specific position of the doffing cart 40 on the basis of the number of auxiliary identifiers 76 that are further read after the yarn processing unit identifier 75 is read during travelling. By using the auxiliary identifier 76, it is possible to more appropriately control the acceleration/deceleration of the doffing cart 40. For example, in the above-described embodiment, the shift is made to the low-speed travelling at the stop position identifier 70 immediately before the target. However, by using the auxiliary identifier 76, for example, the shift can be made to the low-speed travelling from an intermediate point between the stop position identifier 70 immediately before the target and the target stop position identifier 70.

[0080] The stop position identifier 77 determines a stop position of the doffing cart 40 other than the yarn processing unit 10. For example, the stop position identifier 77 determines a position of the doffing cart 40 when performing maintenance, a position of the doffing cart 40 when discarding waste yarns stored in the doffing cart 40, and the like.

[0081] Instead of the configuration of the present alternative embodiment, a coordinate value (a value indicating a position in the travelling direction) may be associated with all the yarn processing unit identifiers 75 and the auxiliary identifiers 76. The coordinate values corresponding to the yarn processing unit identifier 75 and the auxiliary identifier 76 are determined in advance and stored in the cart control section 45. In this case, the cart control section 45 can specify the position of the doffing cart 40 by specifying the yarn processing unit identifier 75 or the auxiliary identifier 76 on the basis of a received

light amount of the optical sensor 47 and obtaining the coordinate value corresponding thereto. Furthermore, since the specific coordinate value and the yarn processing unit 10 are associated, the yarn processing unit 10 can be specified on the basis of the coordinate value specified by the cart control section 45. In this configuration, it is not necessary to count the auxiliary identifier 76.

[0082] With reference to FIG. 10, a second alternative embodiment in which the stop position identifier 70 has a different shape will be described.

[0083] An optical sensor 47 of the second alternative embodiment can detect not only a received light amount but also a light receiving position. Specifically, in the detection area 47a of the optical sensor 47, a plurality of light receiving elements are arranged side by side in the detection direction, and a received light amount of each light receiving element is individually detected. This enables to specify a light receiving position, which is a position where light is detected in the detection area 47a. When the optical sensor 47 of this type is used, a length of the stop position identifier 70 in the detection direction may be constant as illustrated in FIG. 10. A stop position identifier 70 of the second alternative embodiment is inclined from one side toward another side in the travelling direction. Therefore, a vertical position of the stop position identifier 70 in the detection area 47a in FIG. 10 differs according to a position of the optical sensor 47 in the travelling direction. Therefore, the position of the doffing cart 40 with respect to the stop position identifier 70 can be calculated on the basis of the light receiving position detected by the optical sensor 47.

[0084] With reference to FIG. 11, a third alternative embodiment in which the stop position identifier 70 has a different shape will be described.

[0085] An optical sensor 47 of the third alternative embodiment measures a distance to an object on the basis of a time taken to radiate and receive light. In a stop position identifier 70 of the third alternative embodiment, a thickness in plan view changes depending on a position in the travelling direction. In other words, when the optical sensor 47 moves with respect to the stop position identifier 70 in the travelling direction, a distance between the optical sensor 47 and the stop position identifier 70 in plan view changes. Therefore, the position of the doffing cart 40 with respect to the stop position identifier 70 can be calculated on the basis of the distance (a detection value) detected by the optical sensor 47.

[0086] Note that the stop position identifier 70 may be a member having a different light reflectance depending on a position. For example, when the light reflectance increases as the optical sensor 47 advances in the travelling direction, the position of the doffing cart 40 with respect to the stop position identifier 70 can be calculated on the basis of the received light amount detected by the optical sensor 47.

[0087] With reference to FIG. 12, a stop position identifier 70 and a yarn processing unit identifier 75 in a fourth

alternative embodiment will be described.

[0088] The stop position identifier 70 of the fourth alternative embodiment has the same shape as the stop position identifier 70 of the above-described embodiment. The yarn processing unit identifier 75 is a portion for identification of the yarn processing unit 10. A shape of the yarn processing unit identifier 75 is different at least between adjacent yarn processing units 10. That is, the yarn processing unit identifier 75 has at least three types of shapes. The doffing cart 40 can confirm that a correct yarn processing unit 10 has been reached, by simply analyzing a measurement result of the yarn processing unit identifier 75 (without performing the above-described wireless communication and the like).

[0089] Specifically, the yarn processing unit identifier 75 is an opening formed in the rail 60 similarly to the stop position identifier 70. Alternatively, the yarn processing unit identifier 75 may have a configuration in which a member having a light reflectance different from that of the rail 60 is attached. As illustrated in FIG. 12, the yarn processing unit identifier 75 has four areas consisting of a first area, a second area, a third area, and a fourth area in order from the bottom, in which an opening is selectively formed in the four areas. The first area is a portion for specifying presence, a position, and the like of the yarn processing unit identifier 75, and an opening is formed in all the yarn processing unit identifiers 75. The second to fourth areas are portions for identification of the yarn processing unit 10, and openings are formed to provide different combinations according to the yarn processing unit 10.

[0090] As described above, the automatic winder 1 of the above-described embodiment includes the plurality of yarn processing units 10, the doffing cart 40, the stop position identifier 70 (or the stop position identifier 77), the optical sensor 47, and the cart control section 45. The yarn processing unit 10 winds a yarn around a winding bobbin to form the package 22. The doffing cart 40 travels along the travelling direction in a direction in which the yarn processing units 10 are arranged as the travelling direction, and performs work on the yarn processing units 10. The stop position identifier 70 is provided at a position corresponding to a stop position of the doffing cart 40. The optical sensor 47 is provided on the doffing cart 40, and detects the stop position identifier 70. On the basis of magnitude of a detection value or on the basis of a light receiving position that is a position where light is detected in an area (the detection area 47a) where the optical sensor 47 can detect the stop position identifier 70, the magnitude of the detection value or the light receiving position being detected by the optical sensor 47 with respect to the target stop position identifier 70 to stop the doffing cart 40, the cart control section 45 calculates a position of the doffing cart 40 with respect to the stop position identifier 70, and performs control to stop the doffing cart 40 at a stop position of the doffing cart 40 determined in advance.

[0091] As a result, since the position of the doffing cart

40 can be calculated in a non-contact manner, accuracy of the position at which the doffing cart 40 is stopped is unlikely to deteriorate. Further, since the position of the doffing cart 40 is calculated using the detection value or the light receiving position detected by the optical sensor 47, the position for stopping the doffing cart 40 can be adjusted by changing the detection value or the light receiving position for stopping the doffing cart 40.

[0092] In the automatic winder 1 of the above-described embodiment, the stop position is set for each yarn processing unit 10. The doffing cart 40 performs work on the yarn processing unit 10 after stopping at the stop position.

[0093] This allows the doffing cart 40 to perform work with an appropriate positional relationship with respect to the yarn processing unit 10.

[0094] In the automatic winder 1 of the above-described embodiment, the optical sensor 47 is a line sensor.

[0095] This makes it possible to acquire more information than a spot-shaped optical sensor 47.

[0096] In the automatic winder 1 of the above-described embodiment, the detection direction of the line sensor is a direction orthogonal to the travelling direction on the surface provided with the stop position identifier 70.

[0097] As a result, by performing detection by the optical sensor 47 while travelling, a detection range becomes a planar and wide range.

[0098] In the automatic winder 1 of the above-described embodiment, a length of the stop position identifier 70 in a direction orthogonal to the travelling direction increases, as advancing from one side toward another side in the travelling direction.

[0099] This allows calculation of a positional relationship between the optical sensor 47 and the stop position identifier 70 in the travelling direction.

[0100] In the automatic winder 1 of the above-described embodiment, an increasing ratio of a length of the stop position identifier 70 in the direction orthogonal to the travelling direction is constant.

[0101] As a result, a distance in the travelling direction between the optical sensor 47 and the stop position identifier 70 is proportional to a detection value of the optical sensor 47, which enables calculation of a specific distance between the optical sensor 47 and the stop position identifier 70.

[0102] In the automatic winder 1 of the above-described embodiment, the cart control section 45 stores a plurality of stop positions with respect to the stop position identifier 70, and stores any of the plurality of stop positions in association with each work content of the doffing cart 40. The cart control section 45 determines the stop position of the doffing cart 40 with respect to the stop position identifier 70 on the basis of the work content.

[0103] This enables the doffing cart 40 to be stopped at an appropriate position according to the work content, by using one stop position identifier 70.

[0104] In the automatic winder 1 of the above-described embodiment, the stop position identifier 70 includes: the first stop position identifier as a target to stop the doffing cart 40; and the second stop position identifier selected from the stop position identifiers 70 between the doffing cart 40 and the first stop position identifier in the travelling direction. The cart control section 45 decelerates the doffing cart 40 on the basis of detection of the second stop position identifier by the optical sensor 47.

[0105] As a result, the doffing cart 40 travels at a high speed while being far from the stop position, and travels at a low speed while being close to the stop position, so that the doffing cart 40 can reach the stop position in a short time.

[0106] In the automatic winder 1 of the above-described embodiment, there is provided the yarn processing unit identifier 75 that is for identifying the yarn processing unit 10 and is provided at a position different from the stop position identifier 70 in the direction orthogonal to the travelling direction. A part of the stop position identifier 70 overlaps with the yarn processing unit identifier 75 in the travelling direction.

[0107] This enables to identify the yarn processing unit 10 while aligning the stop position by using the optical sensor 47 for detection of the stop position. That is, it is possible to confirm that the target yarn processing unit 10 has been reached.

[0108] In the automatic winder 1 of the above-described embodiment, the optical sensor 47 reads the yarn processing unit identifier 75 in a way different from the stop position identifier 70.

[0109] This enables clear distinction between the stop position identifier 70 and the yarn processing unit identifier 75.

[0110] In the automatic winder 1 of the above-described embodiment, the yarn processing unit identifier 75 is provided in the yarn processing unit 10.

[0111] In the automatic winder 1 of the above-described embodiment, the doffing cart 40 travels along the rail 60. The stop position identifier 70 is an opening formed in the rail 60.

[0112] This enables creation of the stop position identifier 70 with simple work.

[0113] In the automatic winder 1 of the above-described embodiment, the stop position identifier 70 is provided in the yarn processing unit 10.

[0114] This can omit or simplify a process of registering the stop position for each yarn processing unit 10 when performing work on the yarn processing unit 10.

[0115] In the automatic winder 1 of the above-described embodiment, there is provided the auxiliary identifier 76 that is for identifying the position of the doffing cart 40 in the travelling direction and is provided between the yarn processing units 10 in the travelling direction.

[0116] This enables more detailed calculation of the position of the doffing cart 40.

[0117] A teaching method of the above-described embodiment includes an attaching step and a storing step.

In the attaching step, the positioning member 81 is attached to the yarn processing unit 10. In the storing step, magnitude of a detection value is stored, or a light receiving position that is a position where light is detected in an area (the detection area 47a) where the optical sensor 47 can detect the stop position identifier 70 is stored, the magnitude of the detection value or the light receiving position being detected by the optical sensor 47 with respect to the stop position identifier 70 provided at a position corresponding to the stop position of the doffing cart 40 in a state where the positioning member 81 is in contact with the work cart.

[0118] This enables registration of the stop position for each yarn processing unit 10.

[0119] The teaching method of the above-described embodiment includes a preparing step of attaching the positioning sensor 82 to the doffing cart 40. The yarn processing units 10 include a first yarn processing unit and a second yarn processing unit. The storing step includes a first storing step and a second storing step. In the first storing step, a detection value or a light receiving position for the first yarn processing unit is stored. In the second storing step, the detection value or the light receiving position for the second yarn processing unit is stored. In the first storing step, in a state where the positioning member 81 attached to the first yarn processing unit is in contact with the doffing cart 40, the optical sensor 47 detects the detection value or the light receiving position, and the positioning sensor detects the first yarn processing unit. The second storing step is performed after the first storing step. In the second storing step, in a state where the position of the doffing cart 40 is aligned with the second yarn processing unit, the stop position of the doffing cart 40 with respect to the second yarn processing unit is calculated and stored on the basis of the detection value or the light receiving position detected by the optical sensor 47 and on the basis of the position of the second yarn processing unit detected by the positioning sensor 82.

[0120] This enables registration of the stop position for the second and subsequent yarn processing units 10 without arranging the positioning member in the second and subsequent yarn processing units 10.

[0121] Preferred embodiments and alternative embodiments of the present invention have been described above, but the above-described configurations may be modified as below.

[0122] In the above-described embodiment, the yarn processing unit identifier 75, the auxiliary identifier 76, and the stop position identifier 77 are all one-dimensional barcodes. However, at least any one may have the same configuration (a configuration in which a light reflectance is different from that of an installation surface, for example, a hole) as the stop position identifier 70. In particular, the yarn processing unit identifier 75 may have the same shape as the stop position identifier 70. Even if the yarn processing unit identifier 75 has the same configuration as the stop position identifier 70, by making a difference

in a detection value of the yarn processing unit identifier 75 for each yarn processing unit 10, the stop position identifier 70 and the yarn processing unit identifier 75 can be specified on the basis of a total value of a detection value of the stop position identifier 70 and a detection value of the yarn processing unit identifier 75. In other words, as illustrated in FIG. 13, when detection values of the stop position identifier 70 and the yarn processing unit identifier 75 are determined, it can be specified that the doffing cart 40 is reading an identifier of an A type when the detected value is 10 to 25, the doffing cart 40 is reading an identifier of a B type when the detected value is 30 to 45, and the doffing cart 40 is reading an identifier of a C type when the detected value is 50 to 65. In this way, the doffing cart 40 can distinguish three types of identifiers. On the basis of this way and the number of stop position identifiers 70 by which the doffing cart 40 has passed, the doffing cart 40 can specify the yarn processing unit 10 currently in proximity. Further, when the optical sensor 47 capable of detecting the light receiving position is similarly used, the stop position identifier 70 and the yarn processing unit identifier 75 can be specified by a combination of detection positions of the stop position identifier 70 and the yarn processing unit identifier 75.

[0123] In the above-described embodiment, the stop position identifier 70 is provided on a side surface of the rail 60. Alternatively, the stop position identifier 70 may be provided on another surface such as an upper surface of the rail 60.

[0124] In the above-described embodiment, the detection direction of the optical sensor 47 is a direction orthogonal to the travelling direction. Alternatively, when the optical sensor 47 capable of detecting a light receiving position is used, the detection direction of the optical sensor 47 may be parallel to the travelling direction. In this case, a position (in other words, a relative position of the doffing cart 40 with respect to the stop position identifier 70) of the stop position identifier 70 in the travelling direction can be specified on the basis of the light receiving position detected by the optical sensor 47. In this way, the doffing cart 40 can be stopped at the target stop position on the basis of the detection value of the optical sensor 47.

[0125] The flowchart illustrated in the above-described embodiment is an example, and some processes may be omitted, contents of some processes may be changed, or new processes may be added.

[0126] In the above-described embodiment, the doffing cart 40 has been described as an example of the work cart. Alternatively, the present invention can also be applied to a yarn joining cart.

[0127] In the above-described embodiment, the automatic winder 1 has been described as an example of the yarn winding machine. Alternatively, the present invention can also be applied to another yarn winding machine such as a spinning machine.

Claims

1. A yarn winding machine (1) comprising:

5 a plurality of yarn processing units (10) adapted to wind a yarn around a bobbin to form a package;
a work cart (40) adapted to travel in a direction in which the yarn processing units (10) are arranged as a travelling direction, and adapted to perform work on the yarn processing units (10);
10 a stop position identifier (70, 77) provided at a position corresponding to a stop position of the work cart (40);
an optical sensor (47) provided on the work cart (40) and adapted to detect the stop position identifier (70, 77); and
15 a control section (45) adapted to calculate a position of the work cart (40) with respect to the stop position identifier (70, 77), and perform control to stop the work cart (40) at a stop position of the work cart (40) determined in advance, based on magnitude of a detection value or based on a light receiving position that is a position where the stop position identifier (70, 71) is detected in an area detectable by the optical sensor (47), the magnitude of the detection value or the light receiving position being detected by the optical sensor (47) detecting the stop position identifier (70, 77) as a target to stop the work cart (40).
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2. The yarn winding machine (1) as claimed in claim 1, wherein

35 the stop position is set for each of the yarn processing units (10), and
the work cart (40) performs work on each of the yarn processing units (10) after stopping at the stop position.
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3. The yarn winding machine (1) as claimed in claim 1 or 2, wherein the optical sensor (47) is a line sensor.

45 4. The yarn winding machine (1) as claimed in claim 3, wherein a direction of detection by the line sensor is a direction orthogonal to a surface provided with the stop position identifier (70, 77) and orthogonal to the travelling direction.

50 5. The yarn winding machine (1) as claimed in claim 4, wherein on a surface provided with the stop position identifier (70, 77), in a direction orthogonal to the travelling direction, the stop position identifier (70, 77) has a longer length on one side than another side in the travelling direction.
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6. The yarn winding machine (1) as claimed in claim 5,

wherein on a surface provided with the stop position identifier (70, 77), the stop position identifier (70, 77) has a constant increasing ratio of a length in a direction orthogonal to the travelling direction.

7. The yarn winding machine (1) as claimed in any one of claims 1 to 6, wherein

the control section (45) stores a plurality of the stop positions with respect to the stop position identifier (70, 77), and stores one of the plurality of the stop positions in association with each work content of the work cart (40), and the control section (45) determines the stop position of the work cart (40) with respect to the stop position identifier (70, 77) based on the work content.

8. The yarn winding machine (1) as claimed in any one of claims 1 to 7, wherein the stop position identifier (70, 77) includes:

a first stop position identifier (70, 77) as a target to stop the work cart (40); and
a second stop position identifier (70, 77) selected from the stop position identifiers (70, 77) between the work cart (40) and the first stop position identifier (70, 77) in the travelling direction, and
the control section (45) decelerates the work cart (40) based on detection of the second stop position identifier (70, 77) by the optical sensor (47).

9. The yarn winding machine (1) as claimed in any one of claims 1 to 8, comprising a yarn processing unit identifier (75) adapted to identify each of the yarn processing units (10), the yarn processing unit identifier (75) being provided at a position different from the stop position identifier (70) in a direction orthogonal to the travelling direction, wherein a part of the stop position identifier (70) overlaps with the yarn processing unit identifier (75) in the travelling direction.

10. The yarn winding machine (1) as claimed in claim 9, wherein the optical sensor (47) reads the yarn processing unit identifier (75) in a way different from the stop position identifier (70).

11. The yarn winding machine (1) as claimed in claim 9 or 10, wherein the yarn processing unit identifier (75) is provided in each of the yarn processing units (10).

12. The yarn winding machine (1) as claimed in any one of claims 1 to 11, wherein

the work cart (40) travels along a rail (60), and

the stop position identifier (70, 77) is an opening formed in the rail (60).

13. The yarn winding machine (1) as claimed in any one of claims 1 to 11, wherein the stop position identifier (70) is provided in each of the yarn processing units (10).

14. The yarn winding machine (1) as claimed in any one of claims 1 to 13, comprising an auxiliary identifier (76) provided between the yarn processing units (10) in a travelling direction and adapted to identify a position of the work cart (40) in the travelling direction.

15. A teaching method for teaching a stop position of a work cart (40) to a yarn winding machine (1) including: a plurality of yarn processing units (10) adapted to wind a yarn around a bobbin to form a package; and the work cart (40) adapted to travel in a direction in which the yarn processing units (10) are arranged as a travelling direction, to perform work on the yarn processing units (10), the teaching method comprising:

an attaching step of attaching a positioning member (81) to at least one of the yarn processing units (10); and

a storing step of storing a magnitude of a detection value or storing a light receiving position that is a position where a stop position identifier (70, 77) is detected in an area detectable by an optical sensor (47), the magnitude of the detection value or the light receiving position being detected by the optical sensor (47) detecting the stop position identifier (70, 77) provided at a position corresponding to the stop position of the work cart (40) in a state where the positioning member (81) is in contact with the work cart (40).

16. The teaching method as claimed in claim 15, comprising a preparing step of attaching a positioning sensor (82) to the work cart (40),

wherein the yarn processing units (10) includes a first yarn processing unit and a second yarn processing unit, the storing step includes:

a first storing step of storing the detection value or the light receiving position for the first yarn processing unit; and

a second storing step of storing the detection value or the light receiving position for the second yarn processing unit, the second storing step being performed after the first storing step,

in the first storing step, in a state where the positioning member (81) attached to the first

yarn processing unit is in contact with the work cart (40), the optical sensor (47) detects the detection value or the light receiving position, and the positioning sensor (82) detects the first yarn processing unit, and 5
in the second storing step, in a state where the second yarn processing unit and the work cart (40) are aligned in a non-contact manner, a stop position of the work cart (40) with respect to the second yarn processing unit is calculated and stored based on the 10
detection value or the light receiving position detected by the optical sensor (47) and based on a position of the second yarn processing unit detected by the positioning 15
sensor (82).

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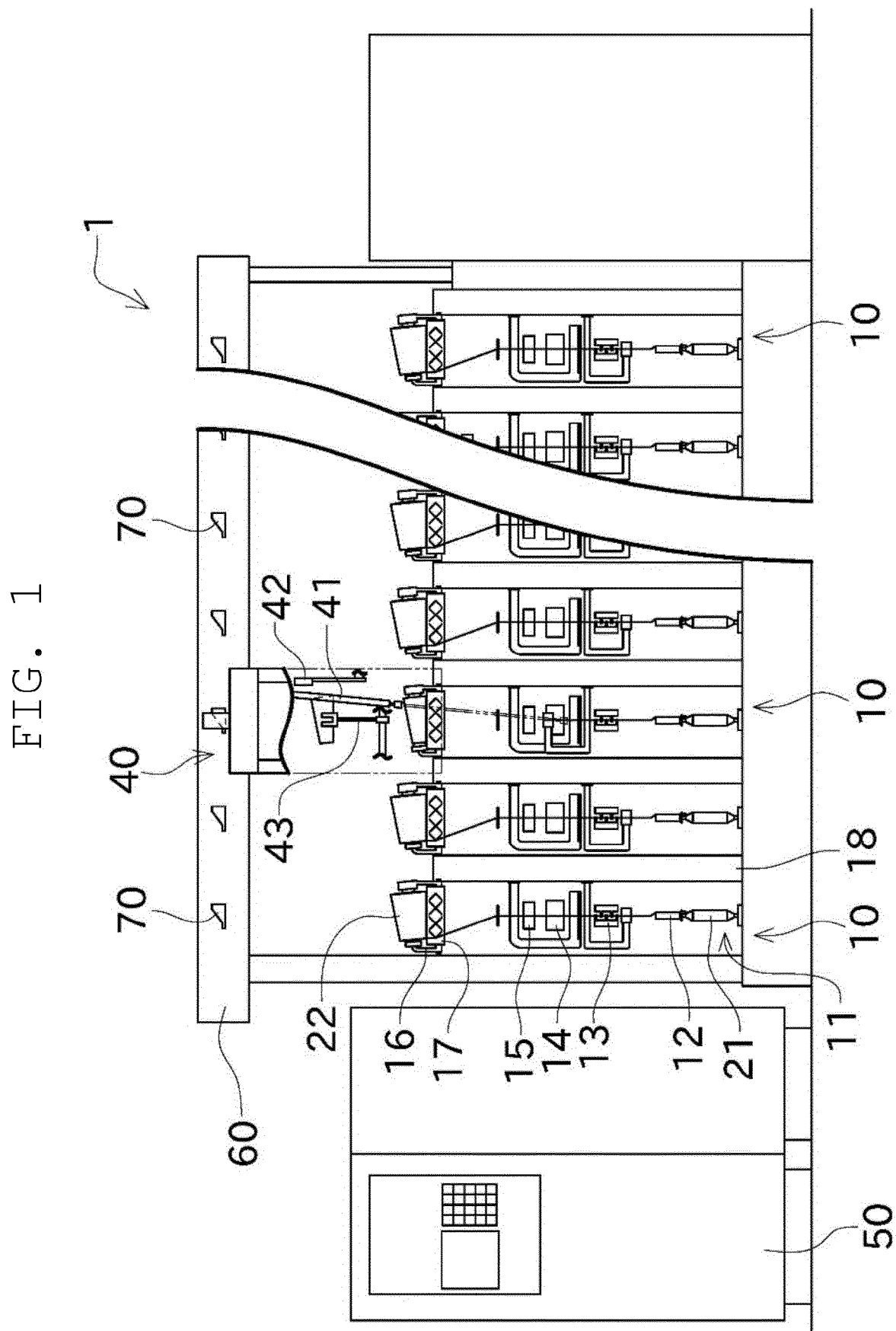


FIG. 2

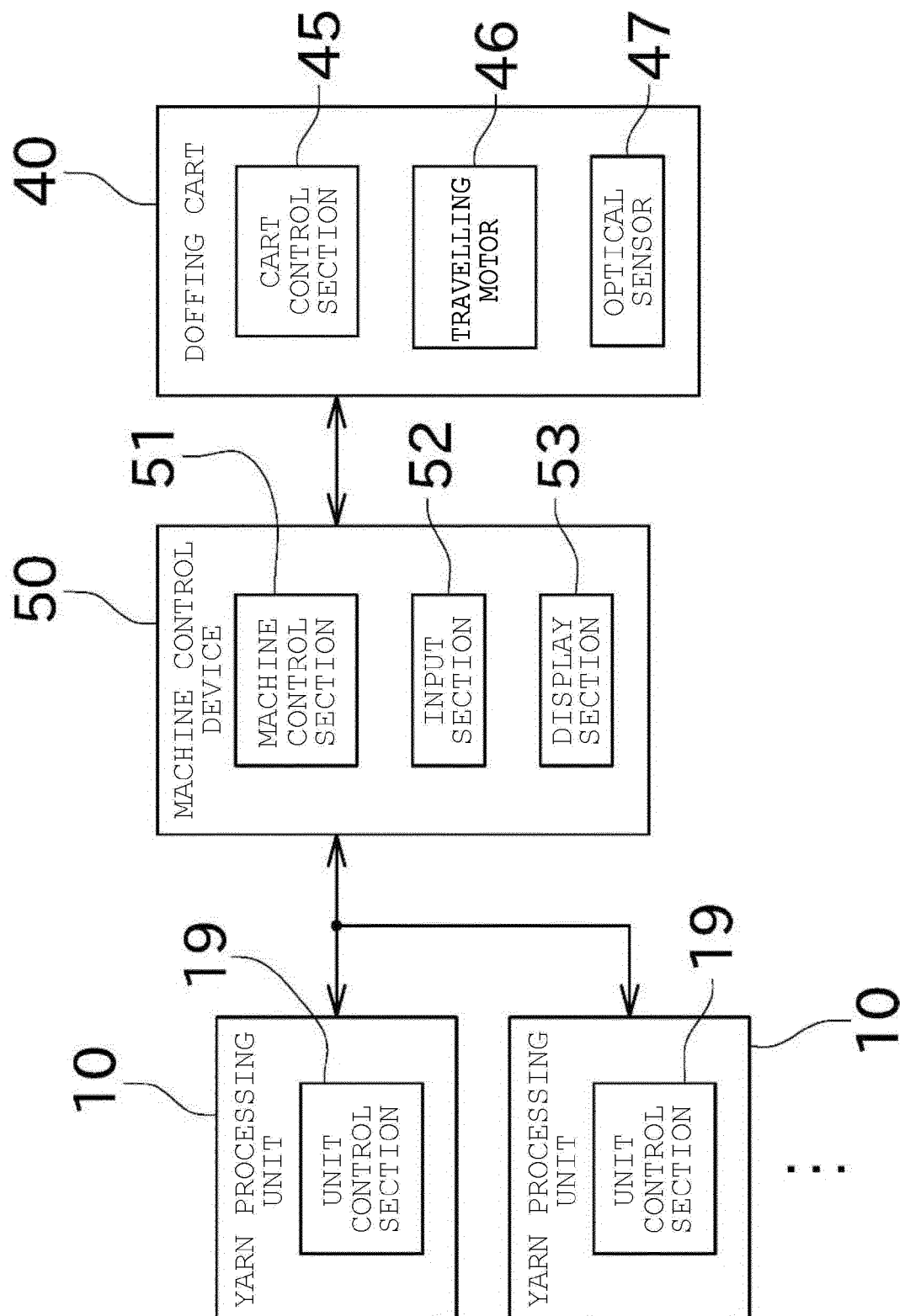


FIG. 3

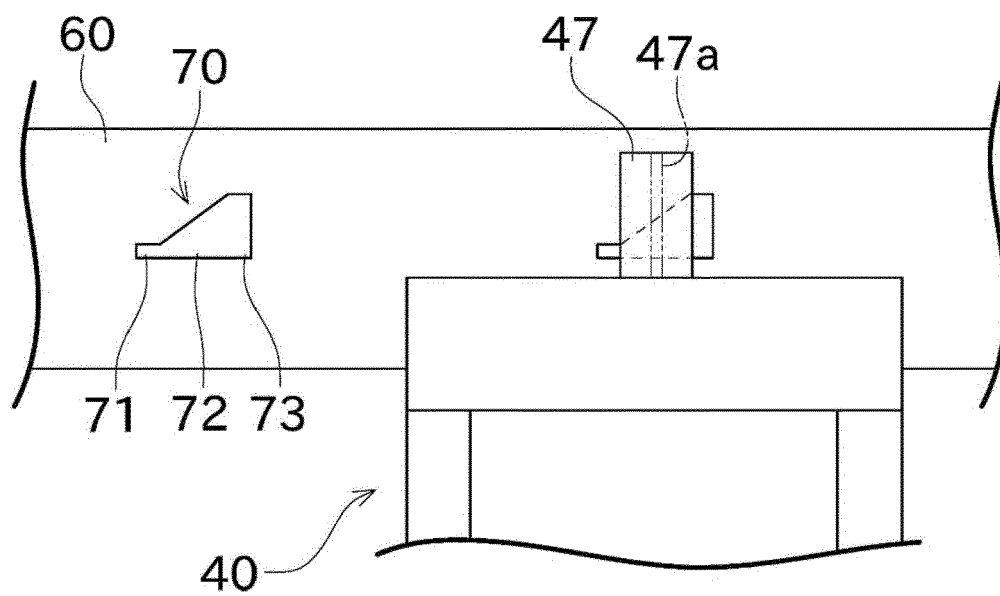


FIG. 4

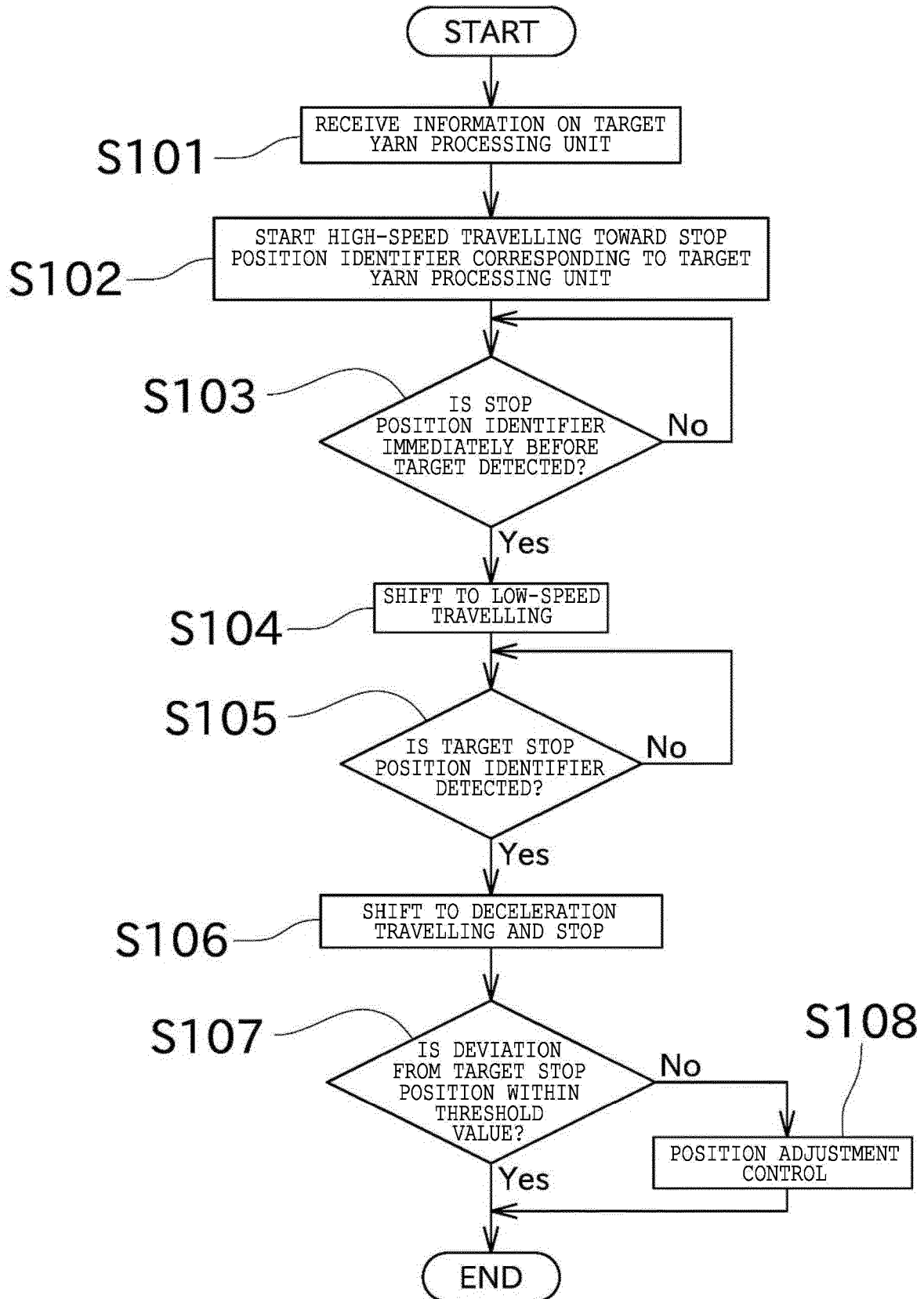


FIG. 5

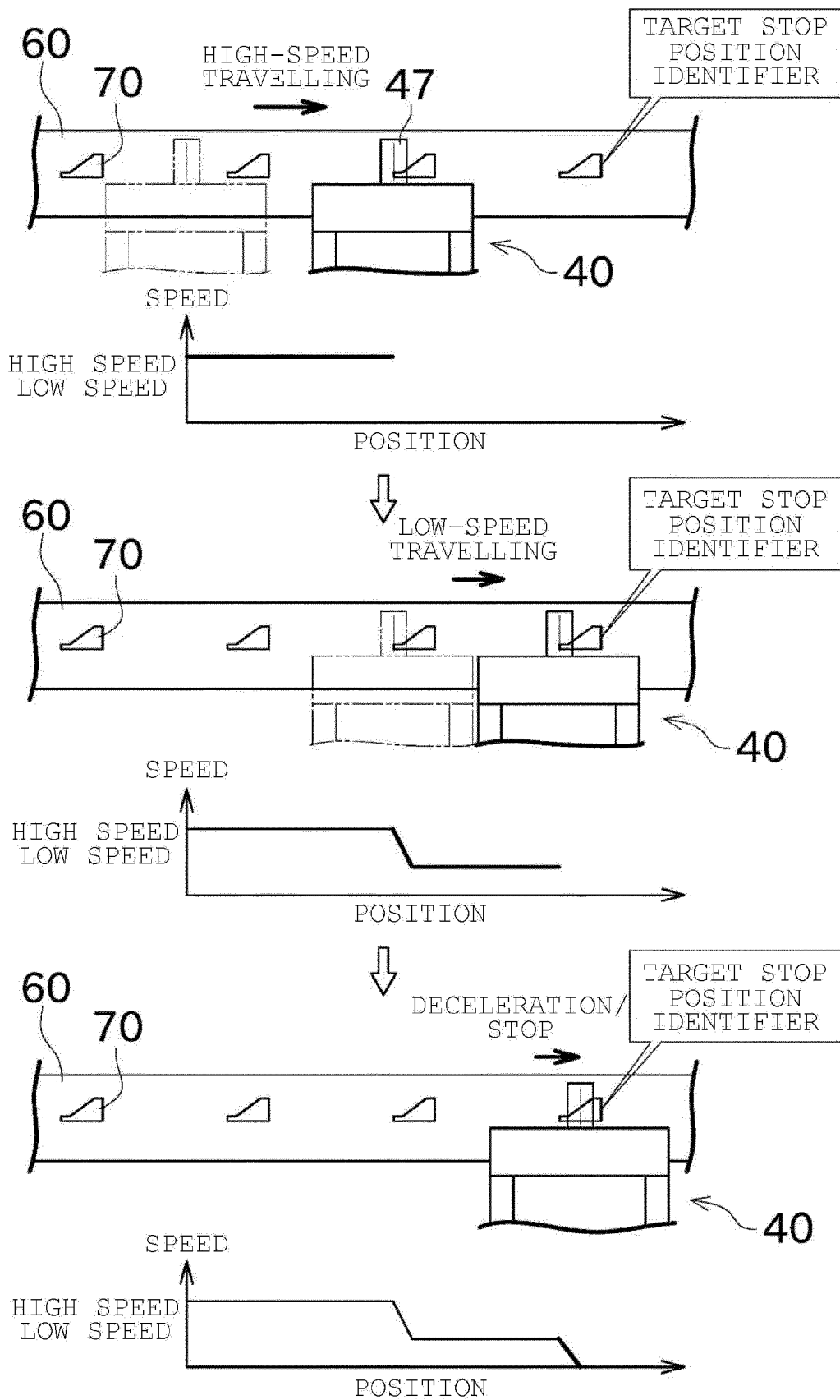


FIG. 6

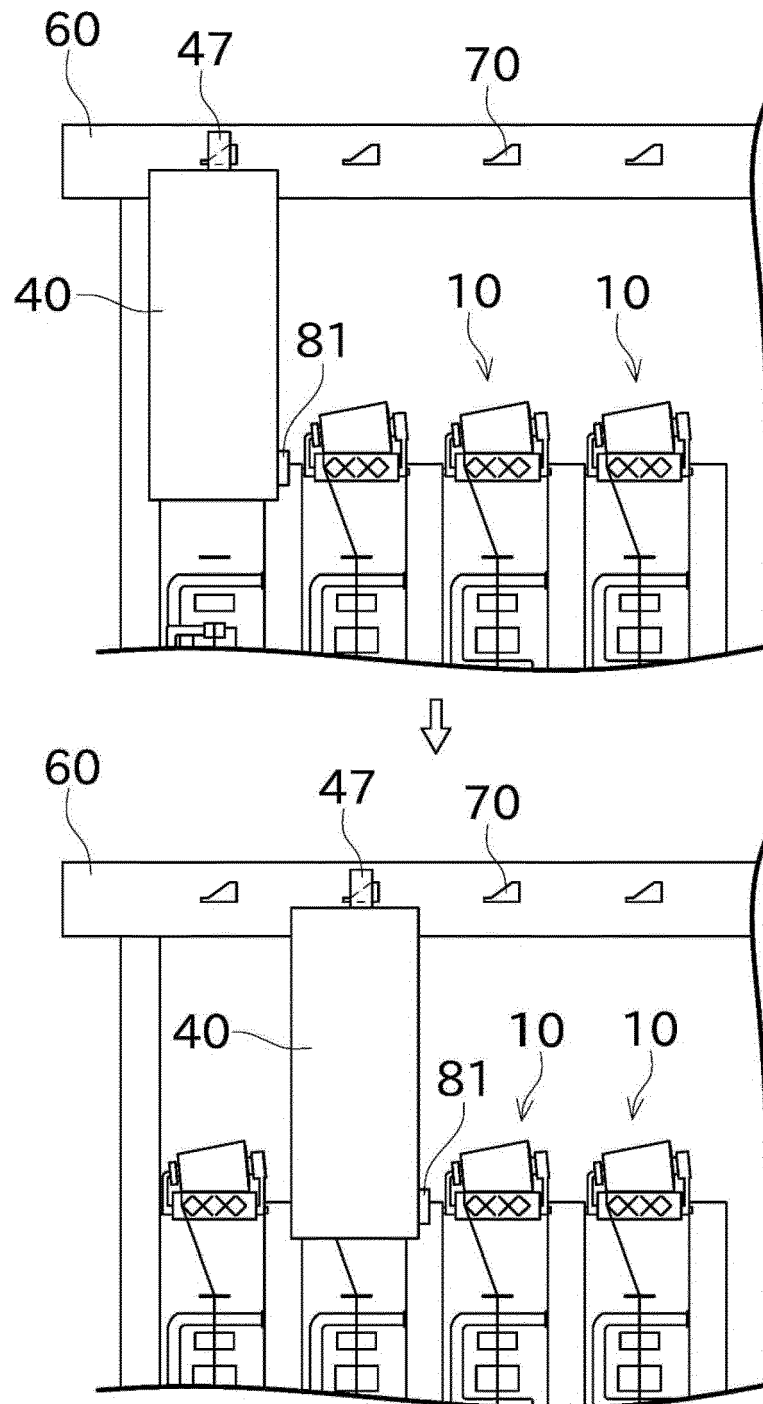


FIG. 7

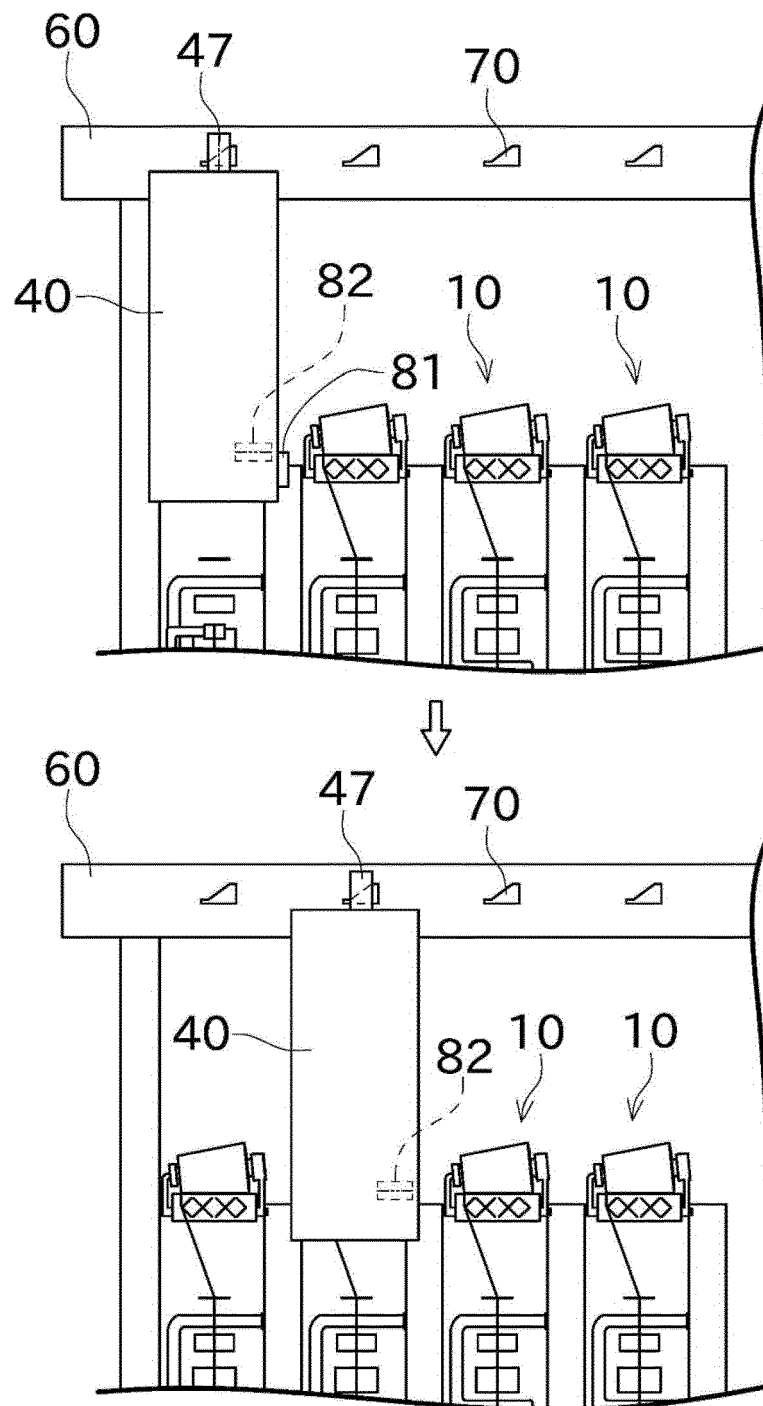


FIG. 8

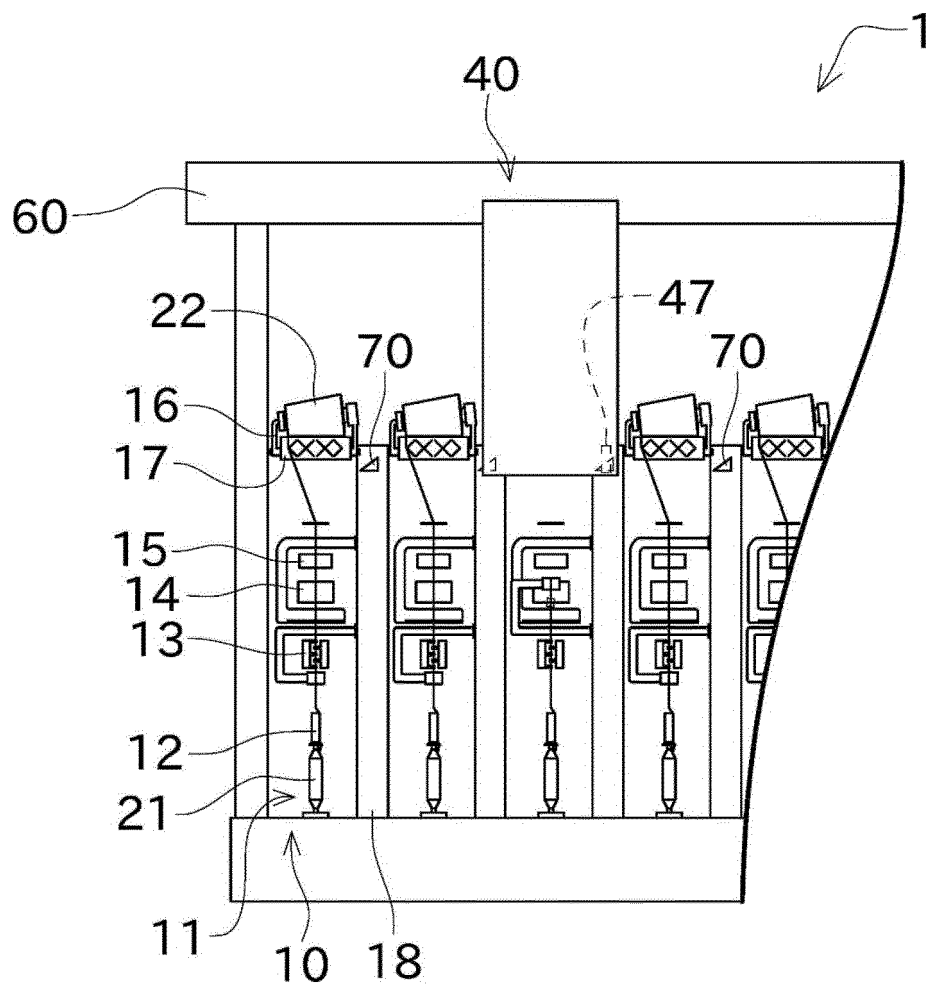


FIG. 9

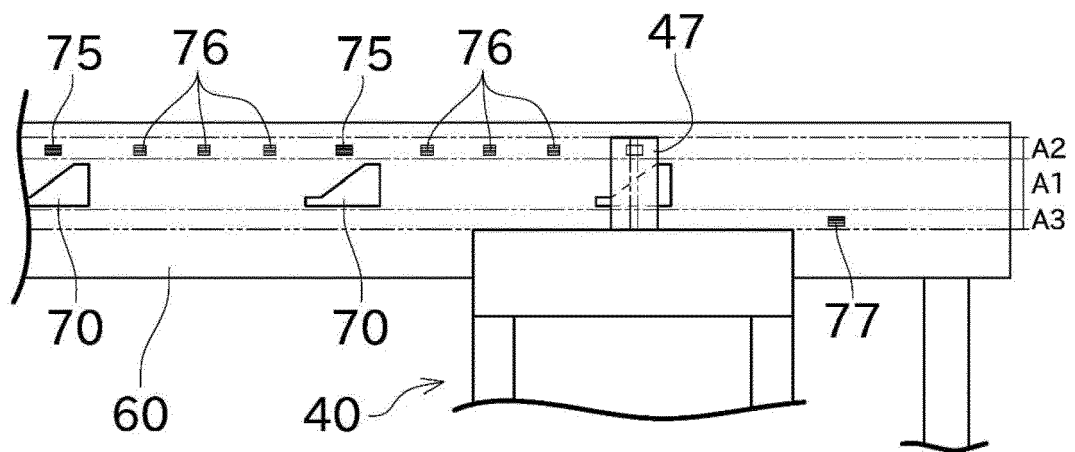


FIG. 10

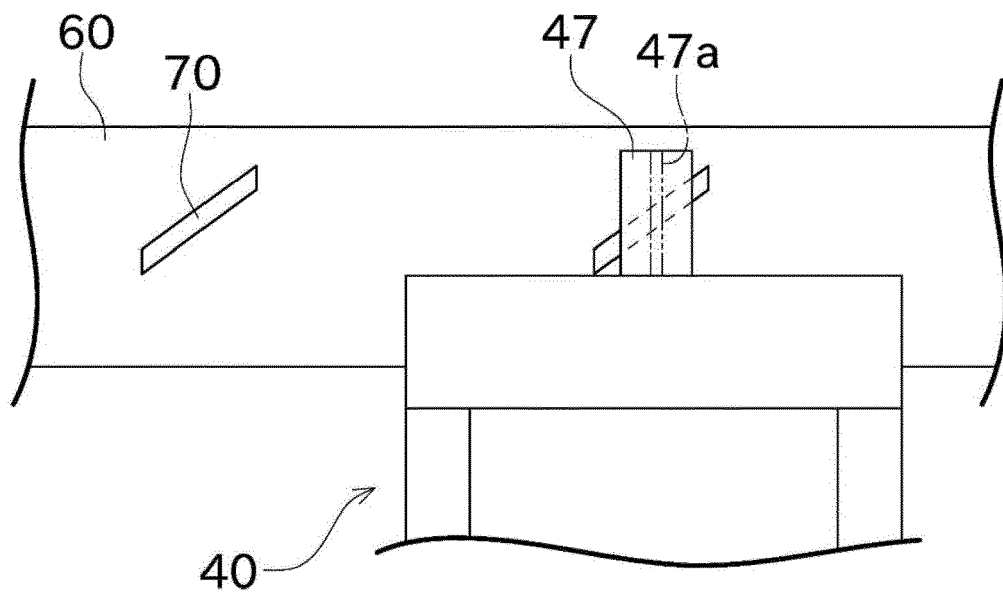


FIG. 11

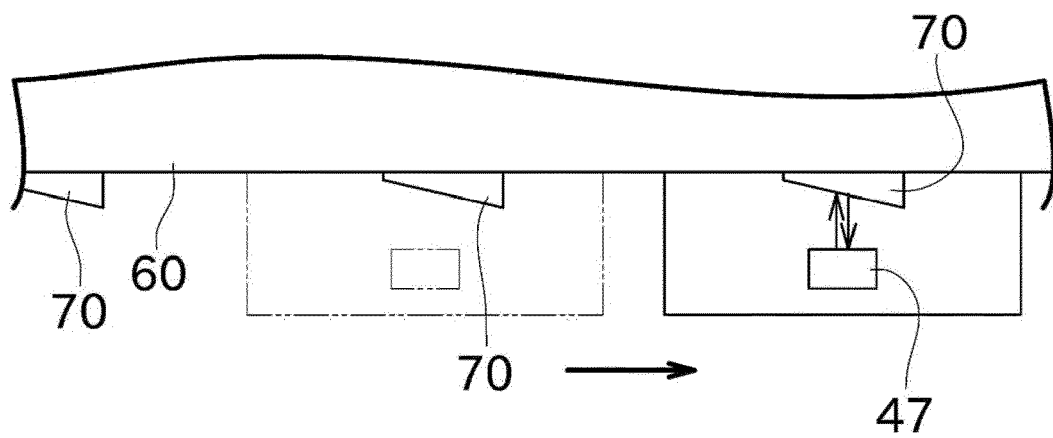


FIG. 12

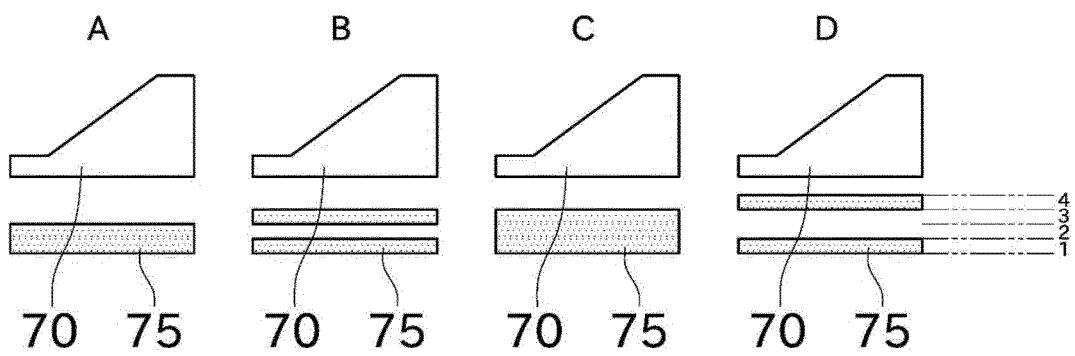
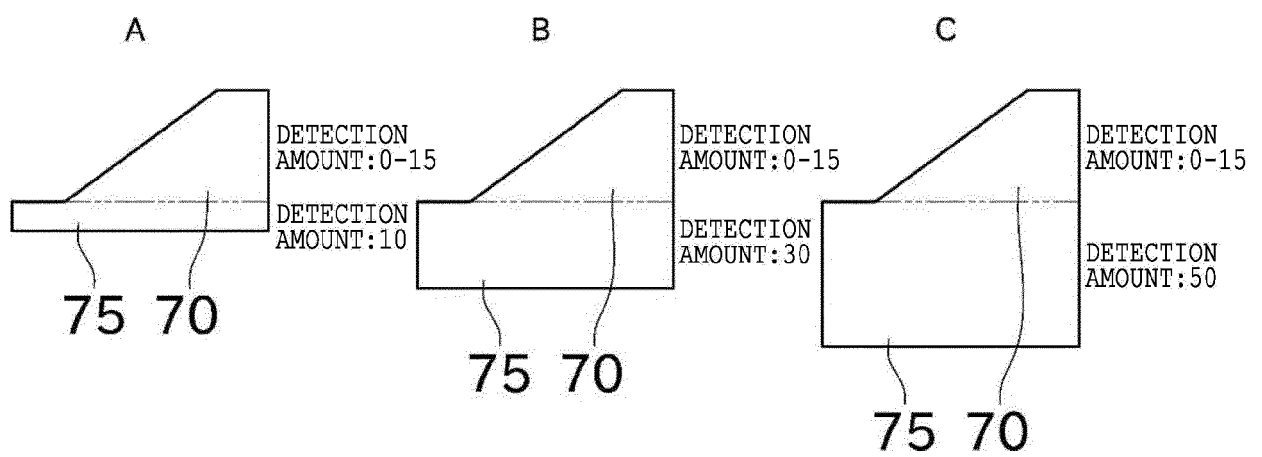


FIG. 13





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Place of search	Date of completion of the search	Examiner
The Hague	26 September 2022	Lemmen, René
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