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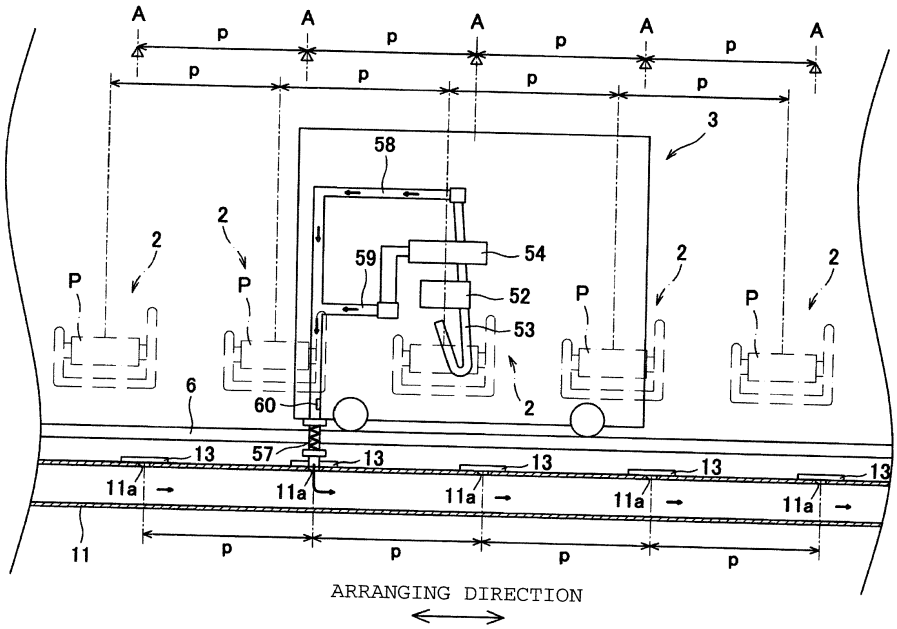
(54) YARN PROCESSING MACHINE

(57) A yarn processing machine includes a plurality of yarn processing units (2) arranged side by side in an arranging direction, an operation cart (3) that is movable in the arranging direction and to execute an operation on the yarn processing units (2), and a suction duct (11) arranged along the arranging direction, wherein the operation cart (3) includes an operation member (54) adapted to be connected to the suction duct (11) when the operation cart (3) is at an operation position (A) to carry out an operation on the yarn processing unit (2) and to carry out the operation using a negative pressure in the suction duct (11), and a detection means (60) adapted to detect the negative pressure supplied from the suction duct (11) .

FIG. 8



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn processing machine including a plurality of yarn processing units and an operation cart capable of executing an operation with respect to the plurality of yarn processing units.

2. Description of the Related Art

[0002] Japanese Unexamined Patent Publication No. 2014-9052, for example, discloses a spinning machine (yarn processing machine) in which a plurality of spinning units (yarn processing units) are arranged side by side in an arranging direction, and in which a yarn joining cart (operation cart) capable of moving in the arranging direction is arranged.

[0003] Such a spinning machine includes a suction duct, in which an interior is made to a negative pressure state by a suction device, along the arranging direction. The yarn joining cart, on the other hand, includes a suction mouth (operation member) that carries out operation using negative pressure (suction force), and is configured such that the negative pressure is supplied to the suction mouth by connecting the suction mouth to the suction duct.

[0004] When, for example, waste yarn clogs up the suction duct and the negative pressure in the suction duct lowers (suction force lowers), sufficient negative pressure cannot be supplied to the operation member, and for example, an operation mistake such as a yarn end cannot be satisfactorily sucked and caught may occur. The occurrence of such an operation mistake causes degradation of the operation efficiency.

[0005] The value of the negative pressure in the suction duct becomes smaller by pressure loss with increasing distance from the suction device, and thus at the time of recovery from a standby state described later and the like, the yarn joining cart has been required to be on standby for a long time until the negative pressure becomes greater than or equal to a prescribed value even in an area distant from the suction device. However, in such a case, the yarn joining cart has to be uselessly on standby until the negative pressure of the area distant from the suction device is raised even when carrying out the operation in an area close to the suction device where the negative pressure becomes greater than or equal to the prescribed value relatively quickly, thus degrading the operation efficiency.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention has been made in view of the above problems, and an object thereof is to improve the operation efficiency of the operation cart including the operation member using the negative pressure.

[0007] The present invention relates to a yarn processing machine including a plurality of yarn processing units arranged side by side in an arranging direction, an operation cart, a suction duct, and a suction device. The operation cart is movable in the arranging direction and is capable of executing an operation on the yarn processing units. The suction duct is arranged along the arranging direction. The suction device is connected to the suction duct. The operation cart includes an operation member and a detection means. The operation member is connected to the suction duct when the operation cart is at an operation position where an operation can be carried out on the yarn processing unit, and to carry out the operation using a negative pressure in the suction duct. The detection means detects the negative pressure supplied from the suction duct.

[0008] In the present invention, since the detection means that detects the negative pressure supplied from the suction duct is arranged on the operation cart, the operation by the operation member can be prevented from being carried out in a negative pressure lacking state, and the operation mistake by the operation member can be reduced. Furthermore, at the time of recovery from the standby state of the suction device, and the like, the operation can be immediately carried out when the negative pressure detected at the operation position where the operation cart carries out the operation is greater than or equal to the prescribed value without waiting for the negative pressure to rise in the entire suction duct. Therefore, according to the present invention, the operation efficiency of the operation cart can be improved.

[0009] Furthermore, in the present invention, the yarn processing machine further preferably includes a control section adapted to control the operation of the operation cart based on a negative pressure detected by the detection means.

[0010] The operation cart can be caused to execute an appropriate operation based on the negative pressure detected by the detection means by arranging such a control section.

[0011] Moreover, in the present invention, the control section preferably causes the operation cart to execute an operation on the yarn processing unit when the negative pressure detected by the detection means of the operation cart moved to the operation position is greater than or equal to a prescribed value.

[0012] The operation cart thus carries out the operation by the operation member while being supplied with the negative pressure of greater than or equal to the prescribed value, and thus the operation mistake can be reliably reduced.

[0013] Furthermore, in the present invention, when the negative pressure detected by the detection means becomes smaller than the prescribed value while the operation cart is carrying out the operation on the yarn processing unit, the control section preferably causes the

operation cart to stop the operation.

[0014] The occurrence of the operation mistake can be avoided by stopping the operation when the negative pressure becomes smaller than the prescribed value even while the operation cart is executing the operation.

[0015] Moreover, in the present invention, when the negative pressure detected by the detection means is smaller than a threshold value, the control section preferably causes the operation cart to execute a search mode for searching a negative pressure sudden change area where the negative pressure of the suction duct changes by an amount greater than or equal to a predetermined amount in the arranging direction.

[0016] Since waste yarn clogging is assumed to occur in the negative pressure sudden change area, the area of waste yarn clogging can be specified by executing the search mode.

[0017] Furthermore, in the present invention, the suction duct is preferably provided with a plurality of openings in the arranging direction, the operation member of the operation cart is preferably connectable to the suction duct through the opening, and the operation cart preferably searches for the negative pressure sudden change area by moving in the arranging direction while detecting the negative pressure when the operation member is connected to the suction duct through the opening in the search mode.

[0018] The negative pressure in the suction duct thus can be detected for each area provided with the opening, whereby the negative pressure sudden change area can be easily specified in more detail.

[0019] Furthermore, in the present invention, a plurality of shutter valves adapted to open and close the plurality of openings are preferably arranged, the operation cart preferably includes a contacting section adapted to make contact with the shutter valve, and the shutter valve is preferably switched to a state of opening the opening and a state of closing the opening when the contacting section is brought into contact during the movement of the operation cart.

[0020] According to such a configuration, an actuator and the like for electrically operating the shutter valve does not need to be arranged, and the opening can be opened by simply moving the operation cart to detect the negative pressure supplied from the suction duct.

[0021] Furthermore, in the present invention, the operation cart preferably carries out the detection of the negative pressure while moving at a low speed in the search mode. The low speed means a speed lower than the speed of when the operation cart moves to the operation position upon receiving the operation request from the yarn processing unit.

[0022] Thus, a time during which the operation member is connected to the suction duct through the opening can be ensured for a long time by moving the operation cart at a low speed in the search mode, whereby the negative pressure supplied from the suction duct can be easily detected. Moreover, although the speed is low, the search mode can be promptly completed by carrying out the detection of the negative pressure while moving.

[0023] Furthermore, in the present invention, the operation cart preferably carries out the detection of the negative pressure while stopping at each opening in the search mode.

[0024] Thus, the negative pressure in the suction duct can be more reliably detected by stopping the operation cart at each opening in the search mode.

[0025] Moreover, in the present invention, when a plurality of the operation carts are arranged, the control section preferably causes the operation cart, which has detected that the negative pressure is smaller than the threshold value, of the plurality of operation carts to execute the search mode.

[0026] The yarn joining cart, which has detected that a negative pressure is smaller than the threshold value, cannot carry out the operation in either case, and thus by causing such an operation cart to execute the search mode, the degradation of the operation efficiency can be suppressed.

[0027] Furthermore, in the present invention, when detected that the negative pressure is smaller than the threshold value in two or more of the plurality of operation carts, the control section preferably causes an operation cart at a position closest to the suction device of the two or more operation carts to execute the search mode.

[0028] When detected that the negative pressure is smaller than the threshold value in two or more operation carts, the area of waste yarn clogging, that is, the negative pressure sudden change area exists on a side closer to the suction device with respect to the two or more operation carts. Therefore, as described above, the negative pressure sudden change area can be promptly found by causing the operation cart at the position closest to the suction device of the two or more operation carts to execute the search mode.

[0029] Furthermore, in the present invention, when a plurality of the operation carts are arranged, the control section preferably causes the two or more operation carts to execute the search mode.

[0030] The negative pressure sudden change area can be more promptly found by causing the two or more operation carts to execute the search mode.

[0031] Moreover, in the present invention, the yarn processing machine further preferably includes a notifying means adapted to notify that the negative pressure detected by the detection means is smaller than the threshold value.

[0032] The operator is able to know the occurrence of waste yarn clogging by arranging such a notifying means, and preparation and the like for removing the waste yarn clogging can be promptly carried out.

[0033] Furthermore, in the present invention, the notifying means preferably notifies the negative pressure sudden change area detected by the search mode.

[0034] Accordingly, the operator can easily grasp the negative pressure sudden change area, that is, the area

of waste yarn clogging, and can promptly remove the waste yarn clogging.

[0035] Furthermore, in the present invention, the yarn processing unit preferably includes a winding section that winds a yarn to form a package, the operation member is preferably a suction mouth adapted to suck and catch a yarn end from the package, and the operation cart preferably executes a yarn joining operation using the suction mouth.

[0036] In this case, the waste yarn produced by the yarn joining operation sometimes gets clogged in the suction duct thus reducing the negative pressure, but the operation mistake due to lack of negative pressure can be prevented by arranging the detection means in the operation cart as described above.

[0037] Furthermore, in the present invention, the yarn processing unit further preferably includes a draft section adapted to draw a fiber bundle, and a spinning section adapted to produce a yarn from the fiber bundle drawn by the draft section, and the winding section preferably winds the yarn produced by the spinning section to form the package.

[0038] In such a case, when the yarn is disconnected between the spinning section and the winding section, the yarns can be joined using the suction mouth.

[0039] Furthermore, in the present invention, the spinning section preferably includes a spinning chamber, a spinning nozzle adapted to generate a whirling airflow at the spinning chamber, and a hollow guide shaft body having a distal end portion located in the spinning chamber.

[0040] According to such a spinning section, by acting the whirling airflow on the fiber bundle in the spinning chamber, twists can be applied to the fiber bundle to produce the yarn.

[0041] Furthermore, in the present invention, the operation cart further preferably includes a brake member. The brake member is adapted to make contact with or move away from the package and to stop rotation of the package by making contact with the package. The control section preferably adjusts a position of the brake member based on a value of a negative pressure detected by the detection means to change a distance between a suction port of the suction mouth and an outer peripheral surface of the package of when sucking a yarn end from the package.

[0042] When sucking the yarn end of the package with the suction mouth, the substantive suction force is changed by the negative pressure supplied to the suction mouth and the distance between the suction port of the suction mouth and the outer peripheral surface of the package. Therefore, the substantive suction force with respect to the package of the suction mouth can be maintained constant and the catching success rate of the yarn end can be improved by adjusting the position of the brake member based on the value of the detected negative pressure and changing the distance of when sucking the yarn end from the package.

[0043] Moreover, in the present invention, the yarn processing unit further preferably includes a cradle and a unit control section. The cradle is adapted to be swingable while rotatably supporting the package. The unit control section controls a position of the cradle. The unit control section adjusts a position of the cradle based on a value of a negative pressure detected by the detection means to change a distance between the suction port of the suction mouth and the outer peripheral surface of the package of when sucking the yarn end from the package.

[0044] Similar to the case where the brake member described above is used, the substantive suction force with respect to the package of the suction mouth can be maintained constant and the catching success rate of the yarn end can be improved by adjusting the position of the cradle based on the value of the detected negative pressure and changing the distance between the suction port of the suction mouth and the outer peripheral surface of the package of when sucking the yarn end from the package.

[0045] Furthermore, in the present invention, the suction mouth is preferably connected to a suction tube fixedly attached to the operation cart and is swingable with respect to the suction tube; and the detection means is preferably arranged on the suction tube.

[0046] With the detection means arranged on the fixed suction tube, the wiring of the detection means will not be pulled along at the time of the swinging of the suction mouth, and thus the arrangement of the detection means is facilitated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047]

FIG. 1 is a front view illustrating an overall configuration of a spinning machine according to the present embodiment;

FIG. 2 is a block diagram illustrating an electrical configuration of the spinning machine;

FIG. 3 is a side view of a spinning unit and a yarn joining cart;

FIG. 4 is a side view illustrating a state of stopping rotation of a package with a brake member of the yarn joining cart;

FIG. 5 is a side view illustrating a state of sucking and holding a yarn with a suction member of the yarn joining cart;

FIG. 6 is a side view illustrating a state of guiding the yarn to the yarn joining device with the suction member of the yarn joining cart;

FIG. 7 is a cross-sectional view of a spinning device;

FIG. 8 is a front view illustrating a state in which the yarn joining cart is at an operation position;

FIGS. 9A to 9C are top views of a shutter valve;

FIG. 10 is a flowchart illustrating an operation of the yarn joining cart that received a yarn joining request signal;

FIG. 11 is a flowchart illustrating a search mode;
FIGS. 12A to 12C are schematic views illustrating an operation of the yarn joining cart in the search mode;
FIGS. 13A to 13C are schematic views illustrating which yarn joining cart is to execute the search mode; and
FIGS. 14A and 14B are side views illustrating a state of adjusting a distance between the suction mouth and the package with the brake member.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[Present Embodiment]

(Overall configuration of spinning machine)

[0048] A spinning machine according to one embodiment of the present invention will be described with reference to the drawings. FIG. 1 is a front view illustrating an overall configuration of a spinning machine according to the present embodiment. A spinning machine 1 (yarn processing machine) illustrated in FIG. 1 includes a plurality of spinning units 2 (yarn processing units) arranged side by side in a predetermined arranging direction (left and right direction in FIG. 1), a yarn joining cart 3 (operation cart) that is movable in the arranging direction, a blower box 4 arranged on one end side of the arranging direction, and a motor box 5 arranged on the other end side of the arranging direction.

[0049] Each spinning unit 2 spins a fiber bundle T fed from a draft device 21 with a spinning device 22 to produce a yarn Y, and winds the yarn Y around a bobbin B with a winding device 24 to form a package P. The yarn joining cart 3 can travel on a rail 6 laid along the arranging direction of the spinning machine 1, and when yarn breakage or yarn cut occurs in one of the spinning units 2, the yarn joining cart 3 is moved to the relevant spinning unit 2 to carry out a yarn joining operation.

[0050] The blower box 4 accommodates a suction device 12 (blower) and the like for supplying a negative pressure to the spinning units 2 and the yarn joining cart 3. The motor box 5 accommodates a driving source and the like common to each spinning unit 2. Furthermore, the motor box 5 includes a machine control device 7, a display section 8 including a monitor and the like, and an input section 9 including a keyboard and the like. The display section 8 displays information and the like relating to each spinning unit 2 and the yarn joining cart 3. Furthermore, an operator can input settings of each condition and various types of commands to the machine control device 7 through the input section 9.

[0051] FIG. 2 is a block diagram illustrating an electrical configuration of the spinning machine 1. The machine control device 7 is configured to be able to communicate an electric signal between each spinning unit 2 and the yarn joining cart 3, and collectively manages and controls the spinning machine 1. Each spinning unit 2 includes a unit control section 20 that controls the operation of each section of the spinning unit 2 and carries out communication with the machine control device 7. Furthermore, the yarn joining cart 3 includes a cart control section 30 adapted to control the operation of each section of the yarn joining cart 3 and carry out communication with the machine control device 7. The cart control section 30 is configured to control the operation of the yarn joining cart 3 based on the negative pressure detected with a detection means 60, to be described later.

[0052] Each spinning unit 2 is assigned a unit number, so that the unit control section 20 of each spinning unit 2 can transmit a yarn joining request signal containing information relating to its unit number to the machine control device 7. The machine control device 7 can cause the yarn joining cart 3 to execute the yarn joining operation by further transmitting the yarn joining request signal to the cart control section 30 of the yarn joining cart 3. However, the yarn joining request signal maybe directly transmitted from the unit control section 20 to the cart control section 30.

(Spinning unit)

[0053] FIG. 3 is a side view of the spinning unit 2 and the yarn joining cart 3, FIG. 4 is a side view illustrating a state of stopping the rotation of the package P with a brake member 55 of the yarn joining cart 3, FIG. 5 is a side view illustrating a state of sucking and holding the yarn Y with a suction member (suction pipe 53 and suction mouth 54) of the yarn joining cart 3, and FIG. 6 is a side view illustrating a state of guiding the yarn Y to the yarn joining device 52 with the suction member (suction pipe 53 and suction mouth 54) of the yarn joining cart 3.

[0054] The spinning unit 2 includes, as main components, a draft device 21, a spinning device 22, a yarn accumulating device 23, and a winding device 24 arranged in this order from upstream to downstream of a travelling direction of the fiber bundle T or the yarn Y (hereinafter referred to as "yarn travelling direction").

[0055] The draft device 21 is arranged in proximity to an upper end portion of a frame 10 of the spinning machine 1. The draft device 21 includes four draft rollers 25 to 28, i.e., a back roller 25, a third roller 26, a middle roller 27, and a front roller 28 in this order from the upstream. A rubber apron belt 29 is provided on the middle roller 27. Each draft roller 25 to 28 is rotatably driven at a predetermined rotation speed. Furthermore, the draft device 21 includes opposing rollers 25a to 28a arranged to face the draft rollers 25 to 28. The draft device 21 draws (drafts) a sliver S, which is a material of the fiber bundle T, to a predetermined width to obtain the fiber bundle T by conveying the sliver S between the rotating draft rollers 25 to 28 and the opposing rollers 25a to 28a facing the draft rollers.

[0056] The spinning device 22 is arranged immediately downstream of the front roller 28. The spinning device

22 applies twists to the fiber bundle T supplied from the draft device 21 to spin the fiber bundle, and produces the spun yarn Y. In the present embodiment, a pneumatic type spinning device that applies twists to the fiber bundle T using a whirling airflow is adopted for the spinning device 22, but needless to say, other types can be adopted. Details of the spinning device 22 will be described later.

[0057] The yarn accumulating device 23 is arranged between the spinning device 22 and the winding device 24 in the yarn travelling direction. The yarn accumulating device 23 includes an accumulating roller 31, a yarn hooking member 32, and a motor 33. The accumulating roller 31 is configured to wind a certain amount of yarn Y around an outer peripheral surface thereof to temporarily accumulate the yarn, and is rotatably driven by the motor 33. The yarn hooking member 32 that can hook the yarn Y is attached to a downstream end portion of the accumulating roller 31, and the yarn Y is accumulated on the accumulating roller 31 when the yarn hooking member 32 integrally rotates with the accumulating roller 31 while hooking the yarn Y. The yarn accumulating device 23 has a function of applying a tension on the yarn Y to pull out the yarn Y from the spinning device 22, a function of accumulating the yarn Y fed from the spinning device 22 during the yarn joining operation by the yarn joining cart 3 to prevent slackening of the yarn Y, and a function of preventing the fluctuation of the tension of the yarn Y from the winding device 24 from being transmitted toward the spinning device 22.

[0058] A guide member 34 adapted to guide the yarn Y pulled out from the yarn accumulating device 23 toward the downstream is arranged on the downstream of the yarn accumulating device 23. The guide member 34 guides the yarn Y pulled out from the accumulating roller 31 so as to pass an extending line of a rotational axis of the accumulating roller 31.

[0059] A yarn monitoring device 36 that monitors the quality of the yarn Y is arranged between the spinning device 22 and the yarn accumulating device 23 in the yarn travelling direction. The yarn monitoring device 36 is configured to monitor the thickness of the travelling yarn Y with an optical sensor (not illustrated). The yarn monitoring device 36 detects a yarn defect (area of abnormality in the thickness of the yarn Y, etc.) of the yarn Y. The yarn monitoring device 36 is not limited to the optical sensor and may be, for example, a capacitance sensor. The yarn monitoring device 36 may also detect a foreign substance in the yarn Y as a yarn defect.

[0060] A cutter (not illustrated) adapted to immediately cut the yarn Y when the yarn defect of the yarn Y is detected with the yarn monitoring device 36 is arranged in proximity to the yarn monitoring device 36. In place of the cutter, the spinning unit 2 may stop the supply of air to the spinning device 22 and/or supply of the sliver S to the spinning device 22, and interrupt the production of the yarn Y to cut the yarn Y.

[0061] The winding device 24 is arranged downstream of the yarn accumulating device 23, and is adapted to wind the yarn Y around the bobbin B while traversing to form the package P. The winding device 24 includes a cradle 41, a winding drum 42, and a traverse device 43.

[0062] The cradle 41 rotatably supports the bobbin B (package P) for winding the yarn Y, and is swingable with a supporting shaft 44 as an axis. The cradle 41 can bring the outer peripheral surface of the bobbin B (package P) into contact with or move the outer peripheral surface of the bobbin B (package P) away from the winding drum 42 by being swung with the supporting shaft 44 as the axis. The winding rum 42 is rotatably driven at a constant rotation speed in a predetermined direction, and the outer peripheral surface of the bobbin B (package P) is brought into contact with the rotatably driven winding drum 42 so that the bobbin B (package P) is rotated in the winding direction accompanying the rotation of the winding drum 42, thus winding the yarn Y around the outer peripheral surface of the bobbin B (package P).

[0063] The traverse device 43 includes a traverse guide 45 that can be engaged with the yarn Y. The traverse guide 45 is configured to reciprocate in a direction parallel to an axis direction of the winding drum 42 by a driving source (not illustrated). The traverse guide 45 engaging the yarn Y is caused to reciprocate while the winding drum 42 is rotatably driven, so that the yarn Y can be wound into the package P while being traversed.

(Spinning device)

[0064] Details of the spinning device 22 will be described. FIG. 7 is a cross-sectional view of the spinning device 22. The spinning device 22 applies twists to the fiber bundle T supplied from the draft device 21 to produce the spun yarn Y. The spinning device 22 includes a nozzle block 70 and a hollow guide shaft body unit 80.

[0065] The nozzle block 70 is supported by a nozzle block supporting section 71 attached to the frame 10 of the spinning machine 1. The nozzle block 70 includes a fiber guide 72, a spinning chamber 73, and a first nozzle 74. The fiber guide 72 guides the fiber bundle T supplied from the draft device 21 to the spinning chamber 73. The fiber guide 72 is formed with a guiding path 72a, and is provided with a guide needle 72b. The fiber bundle T drawn by the draft device 21 is guided in from the guiding path 72a, and guided toward the downstream so as to be wound around the guide needle 72b.

[0066] The spinning chamber 73 is formed downstream of the fiber guide 72. A plurality of first nozzles 74 are formed at equal intervals around the spinning chamber 73. Compressed air supplied from a compressed air supplying source (not illustrated) is injected from the plurality of first nozzles 74 to the spinning chamber 73, thus generating a whirling airflow at the spinning chamber 73. The fiber bundle T is applied with twists by the whirling airflow in the spinning chamber 73, and then fed to the hollow guide shaft body unit 80.

[0067] The hollow guide shaft body unit 80 guides the fiber bundle T toward the downstream while further ap-

plying twists to the fiber bundle T applied with twists by the nozzle block 70. The hollow guide shaft body unit 80 includes a first hollow member 81, a second hollow member 82, a third hollow member 83, an accommodating member 84, a locking member 85, a fixing member 86, and an outer tube member 87.

[0068] The first hollow member 81 is configured by connecting a cone shaped distal end portion 81a, a circular truncated cone shaped intermediate portion 81b, and a cylindrical basal end portion 81c in this order from the upstream toward the downstream. The distal end portion 81a is provided with a first fiber passage 81d that passes therethrough along an axis line C. An upstream opening of the first fiber passage 81d is a fiber guide-in port 81e. The intermediate portion 81b and the cylindrical basal end portion 81c are provided with an accommodating space 81f for accommodating a portion on the upstream of the second hollow member 82.

[0069] The second hollow member 82 is a cylindrical member. The second hollow member 82 is provided with a second fiber passage 82a that passes therethrough along the axis line C. A plurality of second nozzles 82b are formed at equal intervals around the axis line C at an upstream end of the second hollow member 82. The upstream end of the second hollow member 82 is brought into contact with the downstream end of the distal end portion 81a of the first hollow member 81, whereby the first fiber passage 81d and the second fiber passage 82a are communicated.

[0070] The third hollow member 83 is a cylindrical member. The third hollow member 83 is provided with a third fiber passage 83a that passes therethrough along the axis line C. The upstream end of the third hollow member 83 is brought into contact with the downstream end of the second hollow member 82, whereby the second fiber passage 82a and the third fiber passage 83a are communicated.

[0071] The accommodating member 84 is a cylindrical member, and is provided with an accommodating space 84a that accommodates a portion on the downstream of the second hollow member 82, and an accommodating space 84b that accommodates a portion on the upstream of the third hollow member 83. Furthermore, a connecting portion 84c, to which an air supplying tube 100 is connected, is arranged at an outer peripheral portion of the accommodating member 84. An air introducing path 84d communicating to the accommodating space 84a is formed in the connecting portion 84c. The air supplying tube 100 is connected to the compressed air supplying source (not illustrated), and is adapted to supply the compressed air to the hollow guide shaft body unit 80. The air supplying tube 100 includes, for example, a flexible hose.

[0072] The locking member 85 is a cylindrical member, and has a shape that can engage with the downstream end of the accommodating member 84 and the downstream end of the third hollow member 83. The locking member 85 has a role of locking the third hollow member 83 with the third hollow member 83 accommodated in the accommodating space 84b of the accommodating member 84 inserted therein.

[0073] The fixing member 86 is a nut formed in a circular truncated cone shape, and can be screwed to the upstream end of the accommodating member 84. A flange 86a is formed at the downstream end of the fixing member 86.

[0074] The outer tube member 87 is attached to the outer peripheral surface of the accommodating member 84, and functions as a positioning member when attaching the hollow guide shaft body unit 80 to a holder (not illustrated) . That is, an outer diameter of the outer tube member 87 is substantially the same as an inner diameter of a cylindrical space formed in the holder, and can appropriately position the hollow guide shaft body unit 80 by engaging the outer tube member 87 with the cylindrical space.

[0075] In the hollow guide shaft body unit 80, the first hollow member 81, the second hollow member 82, and the third hollow member 83 are assembled while being brought into contact with each other in this order from the upstream. The first fiber passage 81d, the second fiber passage 82a, and the third fiber passage 83a are thereby communicated. The second hollow member 82 is assembled such that a gap is ensured between the outer peripheral surface of the second hollow member 82 and the inner wall surfaces of the accommodating space 81f, 84a. The air introducing path 84d, the accommodating space 84a, the accommodating space 81f, and the plurality of second nozzles 82b are thereby communicated, and the air can be injected from the plurality of second nozzles 82b to the second fiber passage 82a. Thus, with the hollow members 81 to 83, the accommodating member 84, and the locking member 85 in the assembled state, the fixing member 86 is screwed to the accommodating member 84 to configure the hollow guide shaft body unit 80.

[0076] During the spinning operation of the spinning device 22, the flange 86a of the fixing member 86 is brought into contact with the nozzle block supporting section 71, so that the hollow guide shaft body unit 80 is positioned with respect to the spinning chamber 73. In the hollow guide shaft body unit 80 positioned in such a manner, the distal end portion 81a of the first hollow member 81 is located in the spinning chamber 73, and a gap is ensured between the inner wall surface of the spinning chamber 73 and the outer peripheral surface of the first hollow member 81. The hollow guide shaft body unit 80 is moved by an actuator such as an air cylinder so that the flange 86a of the fixing member 86 moves away from the nozzle block supporting section 71 during, for example, the cleaning operation of the spinning device 22, the stopping of the spinning operation, and the like.

[0077] The spinning operation of the spinning device 22 configured as above will now be described. At the start of the spinning operation, the air is injected from the plurality of first nozzles 74 to the spinning chamber 73,

and the air is injected from the plurality of second nozzles 82b to the second fiber passage 82a. Thus, the fiber bundle T guided in from the draft device 21 to the spinning chamber 73 through the fiber guide 72 is guided out toward the downstream through the second fiber passage 82a and the third fiber passage 83a.

[0078] When the yarn Y starts to be spun from the spinning device 22, the injection of air from the plurality of second nozzles 82b to the second fiber passage 82a is stopped, and only the injection of air from the plurality of first nozzles 74 to the spinning chamber 73 is continued. The whirling airflow is thereby generated at the spinning chamber 73, the fiber end of the fiber bundle T is reversed and whirled at the periphery of the fiber guide-in port 81e of the first hollow member 81 by the whirling airflow, and twists are applied to the fiber bundle T in the spinning chamber 73. The yarn Y produced by applying twists to the fiber bundle T is guided out toward the downstream through the second fiber passage 82a and the third fiber passage 83a. During the spinning operation, the air injected from the plurality of first nozzles 74 to the spinning chamber 73 flows into a decompressing chamber 75 formed in the nozzle block 70 through the gap between the spinning chamber 73 and the first hollow member 81, and is discharged with the fibers that did not become part of the yarn Y.

(Yarn joining cart)

[0079] Next, a description will be made on the yarn joining cart 3. As illustrated in FIG. 1, the yarn joining cart 3 includes a plurality of wheels 51 for traveling on the rail 6. When the cart control section 30 controls a travelling motor 50 (see FIG. 2) to rotatably drive the wheel 51, the yarn joining cart 3 can freely travel in the arranging direction among the plurality of spinning units 2. When yarn breakage or yarn cut occurs in a spinning unit 2, the yarn joining cart 3 is moved to the relevant spinning unit 2 to carry out the yarn joining operation of the yarn Y disconnected between the spinning device 22 and the winding device 24.

[0080] As illustrated in FIGS. 3 to 6, the yarn joining cart 3 includes a yarn joining device 52, a suction pipe 53, a suction mouth 54, a brake member 55, a reverse rotation roller 56, and the like. When the yarn Y is disconnected between the spinning device 22 and the winding device 24, the yarn joining device 52 joins the yarn Y (upper yarn) from the spinning device 22 guided by the suction pipe 53 and the yarn Y (lower yarn) from the winding device 24 guided by the suction mouth 54, as illustrated in FIG. 6. In the present embodiment, a splicer that forms a joint by applying twists to the yarn ends of the upper yarn Y and the lower yarn Y by the whirling airflow is used as the yarn joining device 52. However, the yarn joining device 52 is not limited to the splicer, and for example, a knotter adapted to join the upper yarn Y and the lower yarn Y, and the like may be adopted. The operation of the yarn joining device 52 is controlled by the cart control section 30.

[0081] The suction pipe 53 is configured to be vertically swingable with a shaft 53a as a center. As illustrated in FIG. 5, when the suction pipe 53 is swung to the upper side, the distal end of the suction pipe 53 is located in proximity to the downstream of the spinning device 22, and thus can suck the upper yarn Y spun from the spinning device 22, and suck and hold the upper yarn Y. Furthermore, as illustrated in FIG. 6, the suction pipe 53 can guide the upper yarn Y to the yarn joining device 52 by being swung to the lower side while sucking and holding the upper yarn Y spun from the spinning device 22. The operation of the suction pipe 53 is controlled by the cart control section 30.

[0082] The suction mouth 54 is configured to be vertically swingable with a shaft 54a as a center. As illustrated in FIG. 5, when the suction mouth 54 is swung to the lower side, the distal end of the suction mouth 54 is located in proximity to the outer peripheral surface of the package P, and thus can suck the lower yarn Y pulled out from the package P, and suck and hold the lower yarn Y. Furthermore, as illustrated in FIG. 6, the suction mouth 54 can guide the lower yarn Y to the yarn joining device 52 by being swung to the upper side while sucking and holding the lower yarn Y pulled out from the package P. The operation of the suction mouth 54 is controlled by the cart control section 30.

[0083] The brake member 55 is configured to make contact with or move away from the package P, and can stop the rotation of the package P by making contact with the package P. The brake member 55 is swingable with a shaft 55a as a center, and has a plate 55b that can be brought into contact with the outer peripheral surface of the package P attached to the distal end portion. As illustrated in FIG. 4, when the brake member 55 is swung and the plate 55b is brought into contact with the outer peripheral surface of the package P, the rotation of the package P can be stopped. The operation of the brake member 55 is controlled by the cart control section 30.

[0084] The reverse rotation roller 56 is configured to make contact with or move away from the package P, and is rotatably driven in a reverse direction from the winding drum 42. As illustrated in FIG. 5, when the reverse rotation roller 56 is brought into contact with the package P, the package P is rotated in an unwinding direction, which is a reverse direction of the winding direction, so that the yarn Y can be unwound. When the suction mouth 54 is brought closer to the outer peripheral surface of the package P rotating in the unwinding direction, the yarn end of the lower yarn Y wound around the package P can be sucked and caught with the suction mouth 54, as illustrated in FIG. 5. The operation of the reverse rotation roller 56 is controlled by the cart control section 30.

[0085] Furthermore, a pipe-shaped connecting tube 57 projecting out to the lower side from a cart main body is arranged at a lower end portion of the yarn joining cart 3. As illustrated in FIG. 1, the spinning machine 1 includes

a suction duct 11 extending along the arranging direction, and one end of the suction duct 11 is connected to the suction device 12 accommodated in the blower box 4. The suction device 12 generates the negative pressure in the suction duct 11. The flow of air toward the suction device 12 is thereby generated inside the suction duct 11, thus obtaining a state in which the negative pressure is generated. As illustrated in FIGS. 3 to 6, the negative pressure is supplied to the suction pipe 53 and the suction mouth 54 when the connecting tube 57 is connected to the suction duct 11 through an opening 11a formed at an upper surface (one side surface) of the suction duct 11. The lower end of the connecting tube 57 is preferably in a state slightly lifted from the upper surface of the suction duct 11 to prevent wear, but may be in contact with the upper surface of the suction duct 11. In the embodiment described above, a plurality of openings 11a are formed at the upper surface of the suction duct 11, but the openings 11a may be formed at another surface of the suction duct 11. The position of the openings 11a on the suction duct 11 is not limited to the upper surface.

(Yarn joining operation)

[0086] FIG. 8 is a front view illustrating a state in which the yarn joining cart 3 is at an operation position A. The yarn joining cart 3 includes suction tubes 58, 59 fixedly attached to the cart main body. The connecting tube 57 of the yarn joining cart 3 is connected to the suction pipe 53 by way of the suction tube 58, and connected to the suction mouth 54 by way of the suction tube 59. A plurality of openings 11a are formed in the arranging direction at the pitch p equal to the arrangement pitch p of the spinning units 2 on the upper surface of the suction duct 11.

[0087] As illustrated in FIG. 8, the position of the yarn joining cart 3 when the connecting tube 57 of the yarn joining cart 3 is connected to the suction duct 11 through one of the openings 11a is referred to as an operation position A. A plurality of the operation positions A are set in the arranging direction at the pitch p equal to the arranging pitch p of the spinning units 2 in correspondence with each spinning unit 2. When the yarn joining cart 3 is at one of the operation positions A, the connecting tube 57 is connected to the suction duct 11 through the opening 11a, and a state is obtained in which the yarn joining operation can be carried out with respect to the corresponding spinning unit 2. Hereinafter, in each figure, the position of the yarn joining cart 3 is assumed to be indicated by a center position of the yarn joining cart 3 in the arranging direction (e.g., in FIG. 8, the yarn joining cart 3 is located at the operation position A corresponding to the middle spinning unit 2).

[0088] When the yarn joining cart 3 carries out the yarn joining operation, the yarn joining cart 3 is moved to the operation position A corresponding to the spinning unit 2 to be the target of the yarn joining operation, and stopped thereat. Then, the yarn joining device 52 overlaps the yarn path in the spinning unit 2 to be the target of the yarn joining operation when seen from the front, and the connecting tube 57 is connected to the corresponding opening 11a. When the connecting tube 57 is connected to the suction duct 11 through the opening 11a, the flow of air from the suction pipe 53 and the suction mouth 54 to the suction device 12 through the suction tubes 58, 59, the connecting tube 57, and the suction duct 11 is formed, as illustrated with an arrow in FIG. 8. The negative pressure (suction force) thus can be generated at the distal end of the suction mouth 54, and the lower yarn Y can be sucked and caught by the suction mouth 54.

[0089] In the present embodiment, a configuration of causing the suction pipe 53 to generate the suction force by supplying the compressed air to the suction pipe 53 from a different system is adopted. That is, the negative pressure supplied to the suction pipe 53 through the suction tube 58 is merely supplementary, and the operation of the suction pipe 53 will not be affected even if the negative pressure in the suction duct 11 is lowered (even if the suction force is lowered).

[0090] When carrying out the yarn joining operation, the cart control section 30 first swings the cradle 41 to move the package P away from the winding drum 42, and then swings the brake member 55 to bring the plate 55b into contact with the outer peripheral surface of the package P and stop the rotation of the package P, as illustrated in FIG. 4. Then, as illustrated in FIG. 5, the reverse rotation roller 56 is brought into contact with the package P to rotate the package P in the unwinding direction. The suction mouth 54 is then brought close to the outer peripheral surface of the package P rotating in the unwinding direction, so that the yarn end of the lower yarn Y wound into the package P is sucked and caught by the suction mouth 54. Furthermore, the upper yarn Y spun from the spinning device 22 is sucked and caught by the suction pipe 53 by swinging the suction pipe 53 to the upper side. Thereafter, the suction mouth 54 is swung to the upper side and the suction pipe 53 is swung to the lower side, so that the lower yarn Y and the upper yarn Y can be guided to the yarn joining device 52, as illustrated in FIG. 6. Lastly, the yarn joining device 52 is operated to carry out the yarn joining operation.

(Shutter valve)

[0091] A plurality of shutter valves 13 adapted to open and close each opening 11a are provided on the upper surface of the suction duct 11. FIGS. 9A to 9C are top views of the shutter valve 13. The shutter valve 13 of the present embodiment is a cross-shaped thin thickness member having a contour in which a plurality of arc shapes are combined. The shutter valve 13 is configured by a central portion 13a, and four valve portions 13b projecting toward a radially outer side from the central portion 13a. The four valve portions 13b are arranged at equal intervals of 90 degrees in the peripheral direction, and can close the opening 11a by having one of the valve

portion 13b cover the opening 11a. An opened portion 13c, which is a recess, is formed between two valve portions 13b adjacent in the peripheral direction, and the opening 11a is in an opened state when the opened portion 13c overlaps the opening 11a. The central portion 13a is attached to the upper surface of the suction duct 11 by way of a supporting shaft 14, so that the shutter valve 13 is rotatable with the supporting shaft 14 as the center.

[0092] As illustrated in FIG. 9A, when the valve portion 13b is covering the opening 11a, the valve portion 13b is closely attached to the upper surface of the suction duct 11 by the negative pressure in the suction duct 11, and hence the opening 11a is in a closed state by the shutter valve 13. On the other hand, when moving the yarn joining cart 3 to the operation position A (moving the connecting tube 57 to the same position as the opening 11a), the lower end portion of the connecting tube 57 is brought into contact with the edge of the valve portion 13b, and enters the opened portion 13c while rotating the shutter valve 13 in the course of the movement, as illustrated in FIG. 9B. When the yarn joining cart 3 reaches the operation position A, the connecting tube 57 overlaps the opening 11a while being located in the opened portion 13c, and the connecting tube 57 is connected to the suction duct 11 through the opening 11a, as illustrated in FIG. 9C.

[0093] Furthermore, when the yarn joining cart 3 is moved away from the operation position A, in the course of the movement, the lower end portion of the connecting tube 57 is brought into contact with the edge of the valve portion 13b and rotates the shutter valve 13. As a result, the opening 11a is again in the closed state by the shutter valve 13, as illustrated in FIG. 9A. That is, the shutter valve 13 of the present embodiment is configured to be switched to a position where the opening 11a is opened by the connecting tube 57 when the yarn joining cart 3 is moved to the operation position A, and switched to a position where the opening 11a is closed by the connecting tube 57 when the yarn joining cart 3 is moved away from the operation position A.

(Detection of negative pressure by yarn joining cart)

[0094] When waste yarn produced by the yarn joining operation gets clogged inside the suction duct 11 causing waste yarn clogging, the suction flow speed becomes slower and the negative pressure lowers in a region distant from the suction device 12 (upstream of suction flow) than the area where the waste yarn clogging occurred. Therefore, at the operation position A in such a region, sufficient negative pressure cannot be supplied to the suction mouth 54 even if the connecting tube 57 of the yarn joining cart 3 is connected to the opening 11a, and there is a problem in that the possibility of occurrence of the catching mistake of the lower yarn Y becomes high during the yarn joining operation.

[0095] Furthermore, when the yarn joining operation by the yarn joining cart 3 is not carried out for a certain time, a standby state in which the output of the suction device 12 is lowered or the suction device 12 is stopped may be realized to save energy. The value of the negative pressure in the suction duct 11 becomes smaller by the pressure loss with increasing distance from the suction device 12, and thus at the time of recovery from the standby state (or at the time of start-up of the suction device 12), the yarn joining cart 3 has been required to be on standby for a sufficiently long time until the negative pressure became greater than or equal to a prescribed value even in an area distant from the suction device 12. Even when the yarn joining operation is carried out in an area close to the suction device 12 where the negative pressure becomes greater than or equal to the prescribed value relatively quickly, the yarn joining cart 3 is uselessly on standby until the negative pressure of the area distant from the suction device 12 rises, which leads to degradation of the operation efficiency.

[0096] In order to solve such a problem, the yarn joining cart 3 of the present embodiment is provided with a detection means 60 including a negative pressure sensor for detecting the negative pressure supplied from the suction duct 11. As illustrated in FIG. 8, the detection means 60 is attached to the suction tube 59 fixed to the cart main body. Therefore, when the yarn joining cart 3 is moved to the operation position A and the suction mouth 54 is connected to the suction duct 11 by way of the suction tube 59 and the connecting tube 57, the negative pressure supplied to the suction mouth 54 can be detected by the detection means 60.

[0097] In the present specification, when the suction force is small, this is referred to as the negative pressure being small, and when the suction force is large, this is referred to as the negative pressure being large.

(Operation control of yarn joining cart based on detected negative pressure)

[0098] FIG. 10 is a flowchart illustrating the operation of the yarn joining cart 3 that received the yarn joining request signal. The yarn joining cart 3 that received the yarn joining request signal from a spinning unit 2 is moved to the operation position A for carrying out the yarn joining operation on the relevant spinning unit 2 (step S11). When the connecting tube 57 is connected to the opening 11a at the operation position A, and the negative pressure supplied from the suction duct 11 to the suction mouth 54 can be detected by the detection means 60, the cart control section 30 determines whether or not the value of the detected negative pressure is greater than or equal to the prescribed value (step S12). When the negative pressure is greater than or equal to the prescribed value (YES in step S12), the yarn joining operation is started (step S13). When the negative pressure is smaller than the prescribed value (NO in step S12), the yarn joining operation is not executed, and the process proceeds to step S17. The step S17 and the subsequent steps will

be described later.

[0099] Even after the yarn joining operation is started, the cart control section 30 determines whether or not the value of the negative pressure detected by the detection means 60 is greater than or equal to the prescribed value for, for example, every predetermined time (step S14). When the negative pressure becomes smaller than the prescribed value while the yarn joining operation is being carried out (NO in step S14), the yarn joining operation is stopped (step S16), and the process proceeds to step S17. When the negative pressure is maintained to be greater than or equal to the prescribed value (YES in step S14), the cart control section 30 determines whether or not the yarn joining operation is finished (step S15). When the yarn joining operation is finished (YES in step S15), the yarn joining cart 3 waits until the next yarn joining request signal is received. When the yarn joining operation is not finished (NO in step S15), steps S14 and S15 are repeated until the yarn joining operation is finished.

[0100] When the value of the negative pressure detected by the detection means 60 is smaller than the prescribed value in steps S12 and S14, an alarm indicating that the negative pressure is smaller than the prescribed value is displayed on the display section 8 (step S17). The alarm allows an operator to know that waste yarn clogging occurred somewhere in the suction duct 11. The yarn joining cart 3 then executes a search mode for searching a negative pressure sudden change area (area of waste yarn clogging) where the negative pressure of the suction duct 11 changes by greater than or equal to a predetermined amount in the arranging direction (step S18). After the search mode is finished, the cart control section 30 waits for a resume command of the yarn joining operation to be issued from the operator through the input section 9 (step S19), and after receiving the resume command, returns to step S11 to carry out the yarn joining operation. The process may return to step S11 after a lapse of a constant time after the search mode is finished without waiting for the resume command.

[0101] FIG. 11 is a flowchart illustrating a search mode, and FIGS. 12A to 12C are schematic views illustrating an operation of the yarn joining cart 3 in the search mode. In the search mode, the yarn joining cart 3 searches for the negative pressure sudden change area K, that is, the waste yarn clogging area K by checking the negative pressure at each operation position A while moving in the arranging direction.

[0102] In the search mode, first, the yarn joining cart 3 is moved from the current operation position A (position where the value of the negative pressure is detected to be smaller than the prescribed value) illustrated in FIG. 12A to an operation position A adjacent on the suction device 12 side, as illustrated in FIG. 12B, and is stopped thereat (step S21). The yarn joining cart 3 is moved toward the suction device 12 because the waste yarn clogging causing the lowering of the negative pressure is assumed to exist on the suction device 12 side than the area where the negative pressure smaller than the prescribed value is detected. The cart control section 30 stores the negative pressure at the operation position A one before as P1 and the negative pressure at the current operation position A as P2 (step S22), and determines whether or not a difference between P1 and P2 is greater than or equal to a predetermined amount P0 (step S23). The predetermined amount P0 is the negative pressure difference assumed to occur on both sides of the waste yarn clogging area K.

[0103] When the difference between P1 and P2 is smaller than the predetermined amount P0 (NO in step S23), waste yarn clogging is assumed to have not occurred between the current operation position A and the operation position A one before. Thus, the yarn joining cart is further moved from the current operation position A to the operation position A adjacent on the suction device 12 side, and steps S21 to S23 are repeated. When the steps S21 to S23 are repeated in such a manner, as illustrated in FIG. 12C, the difference between P1 and P2 becomes greater than or equal to P0 (YES in step S23) when the yarn joining cart 3 arrives at the operation position A adjacent on the suction device 12 side of the waste yarn clogging area K, and it can be found that the negative pressure sudden change area K (waste yarn clogging area K) exists between the current operation position A and the operation position A one before . When the negative pressure sudden change area K (waste yarn clogging area K) is detected, information relating to the negative pressure sudden change area K is sent from the cart control section 30 to the machine control device 7, and the machine control device 7 displays the negative pressure sudden change area K on the display section 8 (step S24). The operator thus can specify the waste yarn clogging area K, and the waste yarn clogging can be easily removed.

(Effect)

[0104] In the present embodiment, since the detection means 60 adapted to detect the negative pressure supplied from the suction duct 11 is arranged on the yarn joining cart 3 (operation cart), the operation by the suction mouth 54 (operation member) can be prevented from being carried out in a negative pressure lacking state, and the catching mistake (operation mistake) of the lower yarn Y by the suction mouth 54 can be reduced. Furthermore, at the time of recovery from the standby state or at the time of start-up of the suction device 12, the yarn joining operation (operation) can be immediately carried out when the negative pressure detected at the operation position A, where the yarn joining cart 3 carries out the operation, is greater than or equal to the prescribed value without waiting for the negative pressure to rise in the entire suction duct 11. Therefore, the operation efficiency of the yarn joining cart 3 can be improved.

[0105] In the present embodiment, the cart control section 30 (control section) controls the operation of the yarn joining cart 3 based on the negative pressure detected

by the detection means 60 is arranged, so that the yarn joining cart 3 can be caused to execute an appropriate operation according to the negative pressure detected by the detection means 60.

[0106] In the present embodiment, the cart control section 30 is configured to cause the yarn joining cart 3 to execute the yarn joining operation with respect to the spinning unit 2 (yarn processing unit) when the negative pressure detected by the detection means 60 of the yarn joining cart 3 that moved to the operation position A is greater than or equal to the prescribed value. According to such a configuration, the yarn joining cart 3 carries out the operation by the suction mouth 54 while being supplied with the negative pressure of greater than or equal to the prescribed value, and thus the catching mistake of the lower yarn Y can be reliably reduced.

[0107] Furthermore, in the present embodiment, when the negative pressure detected by the detection means 60 becomes smaller than the prescribed value while the yarn joining cart 3 is carrying out the yarn joining operation with respect to the spinning unit 2, the cart control section 30 causes the yarn joining cart 3 to stop the yarn joining operation. Thus, the occurrence of the catching mistake of the lower yarn Y can be avoided by stopping the yarn joining operation when the negative pressure becomes smaller than the prescribed value even while the yarn joining cart 3 is executing the yarn joining operation.

[0108] Furthermore, in the present embodiment, when the negative pressure detected by the detection means 60 is smaller than a threshold value (same as the prescribed value in the present embodiment), the cart control section 30 causes the yarn joining cart 3 to execute the search mode for searching the negative pressure sudden change area K where the negative pressure of the suction duct 11 changes by greater than or equal to the predetermined amount in the arranging direction. Since waste yarn clogging is assumed to have occurred in the negative pressure sudden change area K, the waste yarn clogging area K can be specified by executing the search mode.

[0109] Furthermore, in the present embodiment, the suction duct 11 is provided with the plurality of openings 11a in the arranging direction, and the suction mouth 54 of the yarn joining cart 3 is connectable to the suction duct 11 through the openings 11a, and the yarn joining cart 3 searches for the negative pressure sudden change area K by moving in the arranging direction while detecting the negative pressure when the suction mouth 54 is connected to the suction duct 11 through the openings 11a in the search mode. The negative pressure in the suction duct 11 thus can be detected for each area provided with the opening 11a, whereby the negative pressure sudden change area K can be easily specified in more detail.

[0110] Moreover, in the present embodiment, the plurality of shutter valves 13 adapted to open and close the plurality of openings 11a are arranged, the yarn joining cart 3 includes the connecting tube 57 (contacting section) that can be brought into contact with the shutter valve 13, and the shutter valve 13 is configured to be switched to the state of opening the opening 11a and the state of closing the opening 11a when the connecting tube 57 is brought into contact therewith at the time of the movement of the yarn joining cart 3. According to such a configuration, an actuator and the like for electrically operating the shutter valve 13 does not need to be arranged, and the opening 11a can be opened by simply moving the yarn joining cart 3 to detect the negative pressure in the suction duct 11.

[0111] Furthermore, in the present embodiment, the yarn joining cart 3 carries out the detection of the negative pressure while stopping at each opening 11a (each operation position A) in the search mode. Thus, the negative pressure in the suction duct 11 can be reliably detected by stopping the yarn joining cart 3 at each opening 11a in the search mode.

[0112] Furthermore, in the present embodiment, the display section 8 (notifying means) adapted to notify that the negative pressure detected by the detection means 60 is smaller than the threshold value (same as the prescribed value in the present embodiment) is arranged. The operator is able to know the occurrence of waste yarn clogging by arranging such a display section 8, and preparation and the like for removing the waste yarn clogging can be promptly carried out.

[0113] Furthermore, in the present embodiment, the display section 8 notifies of the negative pressure sudden change area K detected by the search mode. The operator thus can easily grasp the negative pressure sudden change area K, that is, the waste yarn clogging area K, and can promptly remove the waste yarn clogging.

[0114] In the present embodiment, the spinning unit 2 further includes the draft device 21 (draft section) adapted to draw the fiber bundle T and the spinning device 22 (spinning section) adapted to produce the yarn Y from the fiber bundle T drawn by the draft device 21, and the winding device 24 (winding section) winds the yarn Y produced by the spinning device 22 to form the package P. In such a case, when the yarn Y is disconnected between the spinning device 22 and the winding device 24, the yarns can be joined using the suction mouth 54.

[0115] Furthermore, in the present embodiment, the spinning device 22 includes the spinning chamber 73, the first nozzle 74 (spinning nozzle) capable of generating the whirling airflow at the spinning chamber 73, and the first hollow member 81 (hollow guide shaft body) having a distal end portion located in the spinning chamber 73. According to such a spinning device 22, by acting the whirling airflow on the fiber bundle T in the spinning chamber 73, twists can be applied to the fiber bundle T to produce the yarn Y.

[0116] Furthermore, in the present embodiment, the suction mouth 54 is connected to the suction tube 59 fixedly attached to the yarn joining cart 3 and is swingable with respect to the suction tube 59, and the detection

means 60 is preferably arranged on the suction tube 59. With the detection means 60 arranged on the fixed suction tube 59, the wiring of the detection means 60 will not be pulled along at the time of the swinging of the suction mouth 54, and thus the arrangement of the detection means 60 is facilitated.

[Other Embodiments]

[0117] The embodiment of the present invention has been described above, but the mode in which the present invention can be applied is not limited to the above-described embodiment, and modifications can be appropriately made within a scope not deviating from the gist of the present invention, as illustrated below.

[0118] For example, in the embodiment described above, one yarn joining cart 3 carries out the yarn joining operation with respect to the spinning units 2, but the yarn joining operation may be carried out by a plurality of yarn joining carts 3. Hereinafter, which yarn joining cart 3 is to execute the search mode when the yarn joining operation is carried out with respect to each spinning unit 2 by four yarn joining carts 3 (3A, 3B, 3C, 3D) will be described by way of example. Which yarn joining cart 3 is to execute the yarn joining operation and the search mode is determined by the machine control device 7 according to the position and the operation state of each yarn joining cart 3. That is, in such a case, the machine control device 7 functions as a control section in the present invention. However, the operator can also determine which yarn joining cart 3 is to execute the search mode.

[0119] FIGS. 13A to 13C are schematic views illustrating which yarn joining cart 3 is to execute the search mode. The yarn joining cart 3 denoted with a block arrow in each of FIGS. 13A to 13C is the cart that executes the search mode, and the direction of the arrow indicates a direction the relevant yarn joining cart 3 is moved when executing the search mode.

[0120] For example, as illustrated in FIG. 13A, when the yarn joining carts 3A, 3B, 3C, 3D are at each operation position A, the negative pressure is detected to be smaller than the prescribed value in the yarn joining carts 3A, 3B, which are farther from the suction device 12 than the waste yarn clogging area K. In this case, the yarn joining carts 3A, 3B cannot carry out the yarn joining operation in either case, and thus the yarn joining carts 3A, 3B are caused to execute the search mode, whereby the degradation of the operation efficiency can be suppressed. The yarn joining operation can be carried out in the yarn joining carts 3C, 3D at the operation position A where the negative pressure of greater than or equal to the prescribed value is supplied.

[0121] When the search mode is simultaneously executed in the yarn joining carts 3A, 3B, the yarn joining cart 3B closer to the suction device 12 (closer to the waste yarn clogging area K) can find the negative pressure sudden change area K first. Therefore, as illustrated in FIG. 13A, the negative pressure sudden change area K can be promptly found by causing only the yarn joining cart 3B at the position closest to the suction device 12 of the yarn joining carts 3A, 3B, which have detected that the negative pressure is smaller than the prescribed value, to execute the search mode without causing the yarn joining cart 3A to execute the search mode. In this case, the yarn joining cart 3B searches for the negative pressure sudden change area K while moving in the direction toward the suction device 12.

[0122] Alternatively, when detected that the negative pressure is smaller than the prescribed value in the yarn joining carts 3A, 3B, the yarn joining carts 3C, 3D detecting that the negative pressure is greater than or equal to the prescribed value may be caused to execute the search mode. When the search mode is simultaneously executed in the yarn joining carts 3C, 3D, the yarn joining cart 3C which is farther from the suction device 12 (closer to the waste yarn clogging area K) can find the negative pressure sudden change area K first. Therefore, as illustrated in FIG. 13B, the negative pressure sudden change area K can be promptly found by causing only the yarn joining cart 3C at the position farthest from the suction device 12 of the yarn joining carts 3C, 3D, which have detected that the negative pressure is greater than or equal to the prescribed value, to execute the search mode without causing the yarn joining cart 3D to execute the search mode. In this case, the yarn joining cart 3C searches for the negative pressure sudden change area K while moving in the direction away from the suction device 12.

[0123] Two or more yarn joining carts 3 may be caused to execute the search mode. In this case, as illustrated in FIG. 13C, the yarn joining cart 3B at the position closest to the suction device 12 of the yarn joining carts 3A, 3B which have detected that the negative pressure is smaller than the prescribed value, and the yarn joining cart 3C at the position farthest from the suction device 12 of the yarn joining carts 3C, 3D which have detected that the negative pressure is greater than or equal to the prescribed value are preferably caused to execute the search mode. The negative pressure sudden change area K thus can be more promptly found by the yarn joining cart (yarn joining cart 3C in this case), which is closer to the waste yarn clogging area K, of the yarn joining carts 3B, 3C.

[0124] Furthermore, in the embodiment described above, the yarn joining cart 3 carries out the detection of the negative pressure while stopping at each operation position A in the search mode. However, it is not essential for the yarn joining cart 3 to stop at each operation position A, and for example, the yarn joining cart 3 may be stopped at every predetermined number of operation position A.

[0125] Furthermore, it is not essential for the yarn joining cart 3 to stop at the operation position A in the search mode. For example, the yarn joining cart 3 may continue to move at a speed at which the negative pressure can

be detected without stopping at the operation position A in the search mode. In this case, the negative pressure sudden change area K can be promptly found compared to when the yarn joining cart 3 is stopped at the operation position A. However, when the moving speed is too fast, the time during which the connecting tube 57 and the opening 11a are connected becomes short, and the detection of the negative pressure becomes difficult, and hence the moving speed of the yarn joining cart 3 in the search mode is preferably lower than the speed of when the yarn joining cart 3 moves to the operation position A upon receiving the yarn joining request signal from the spinning unit 2.

[0126] The shutter valve 13 is in a state of closing the opening 11a when the valve portion 13b is closely attached to the upper surface of the suction duct 11 by the negative pressure in the suction duct 11. Therefore, when the moving speed of the yarn joining cart 3 is fast, the operation speed of the shutter valve 13 also becomes fast, and when the negative pressure in the suction duct 11 is small, it becomes difficult to hold the valve portion 13b at the close position with the negative pressure. Therefore, when the negative pressure is smaller than the threshold value, the moving speed of the yarn joining cart 3 is made slow so that the shutter valve 13 can be prevented from being constantly opened.

[0127] Furthermore, in the embodiment described above, description has been made on using the value of the negative pressure detected by the detection means 60 arranged in the yarn joining cart 3 to make a decision as to whether or not to execute the yarn joining operation or to execute the search mode. However, the method of using the value detected by the detection means 60 is not limited thereto. For example, when sucking the yarn end of the package P with the suction mouth 54 in the yarn joining operation, the substantive suction force changes by the negative pressure supplied to the suction mouth 54 and the distance between the suction port of the suction mouth 54 and the outer peripheral surface of the package P. Therefore, the catching success rate of the yarn end can be improved while maintaining the substantive suction force constant by adjusting such a distance based on the value of the negative pressure detected by the detection means 60.

[0128] A specific example will be described. FIGS. 14A and 14B are side views illustrating a state of adjusting a distance D of the suction mouth 54 and the package P by the brake member 55. When the suction force with which the suction mouth 54 sucks the yarn end of the package P is too weak, the yarn end cannot be sucked and the catching mistake of the yarn end tends to easily occur. When the suction force with which the suction mouth 54 sucks the yarn end of the package P is too strong, double leading of sucking the yarn Y at a plurality of areas may occur.

[0129] Thus, when the negative pressure (suction force) detected by the detection means 60 is small, as illustrated in FIG. 14A, the amount of pressing the plate 55b of the brake member 55 against the package P is reduced to reduce the distance D of the suction port 54b of the suction mouth 54 and the outer peripheral surface of the package P. The substantive suction force thus can be made strong. On the other hand, when the negative pressure (suction force) detected by the detection means 60 is large, as illustrated in FIG. 14B, the amount of pressing the plate 55b of the brake member 55 against the package P is increased to increase the distance D between the suction port 54b of the suction mouth 54 and the outer peripheral surface of the package P. The substantive suction force thus can be made weak. Therefore, the substantive suction force with respect to the yarn end of the suction mouth 54 can be maintained constant and the catching success rate of the yarn end can be improved by adjusting the position of the brake member 55 and changing the distance D of when sucking the yarn end from the package P based on the value of the detected negative pressure.

[0130] Instead of adjusting the distance D between the suction port 54b of the suction mouth 54 and the outer peripheral surface of the package P with the brake member 55, the distance D may be adjusted by a swing angle of the cradle 41. In this case, the cradle 41 is preferably configured so that the swing angle can be adjusted in a plurality of stages or adjusted continuously by a driving section including a stepping motor and the like, and the unit control section 20 preferably controls the position of the cradle 41 through the driving section.

[0131] Furthermore, in the embodiment described above, the "prescribed value" in the present invention that serves as determination criteria on whether or not to carry out the yarn joining operation, and the "threshold value" in the present invention that serves as determination criteria on whether or not to execute the search mode are set to the same numerical value. However, the prescribed value and the threshold value may be set to different values and a step-wise control may be carried out.

[0132] Moreover, in the embodiment described above, the detection means 60 is attached to the suction tube 59 fixedly attached to the cart main body. However, the area for attaching the detection means 60 is not limited thereto. For example, the detection means 60 may be attached to the connecting tube 57. Alternatively, as long as the wiring can be satisfactorily handled, the detection means 60 may be arranged on the suction mouth 54, which is the movable member.

[0133] Furthermore, in the embodiment described above, the alarm when the negative pressure becomes smaller than the threshold value or the negative pressure sudden change area K detected in the search mode is displayed on the display section 8 serving as the notifying means. However, the notifying means is not limited to the display section 8. For example, a speaker may be arranged as the notifying means, and notification may be made to the operator by voice with the speaker in place of or in addition to the display on the display section 8.

[0134] In the embodiment described above, the deter-

mination on whether or not to carry out the yarn joining operation based on the negative pressure detected by the detection means 60 and the operation control of the yarn joining cart 3 in the search mode are carried out by the cart control section 30. Furthermore, when a plurality of yarn joining carts 3 are arranged, which yarn joining cart 3 is to execute the yarn joining operation and the search mode is determined by the machine control device 7. However, the role allotment of the machine control device 7 and the cart control section 30 is not limited thereto, and changes can be appropriately made.

[0135] Furthermore, in the embodiment described above, the unit control section 20 is arranged on each spinning unit 2, but it is not essential to arrange the unit control section 20 on each spinning unit 2. For example, the unit control section 20 may be arranged for every two or more predetermined number of spinning units 2.

[0136] In the embodiment described above, description has been made on a case where the detection means 60 that detects the negative pressure supplied from the suction duct 11 is arranged on the yarn joining cart 3 of the spinning machine 1, but a device to which the present invention can be applied is not limited to the spinning machine 1. For example, when the suction mouth and the like of a doffing cart of an automatic winder is connected to the suction duct similar to the embodiment described above, a similar detection means may be arranged on the doffing cart.

Claims

1. A yarn processing machine (1) **characterized by** comprising:

   a plurality of yarn processing units (2) arranged side by side in an arranging direction;
   an operation cart (3) that is movable in the arranging direction and to execute an operation on the yarn processing units (2);
   a suction duct (11) arranged along the arranging direction; and
   a suction device (12) connected to the suction duct (11),
   wherein the operation cart (3) includes
   an operation member (54) adapted to be connected to the suction duct (11) when the operation cart (3) is at an operation position (A) to carry out an operation on the yarn processing unit (2), and to carry out the operation using a negative pressure in the suction duct (11), and
   a detection means (60) adapted to detect the negative pressure supplied from the suction duct (11).

2. The yarn processing machine according to claim 1, **characterized by** further comprising a control section (30) adapted to control an operation of the operation cart (3) based on the negative pressure detected by the detection means (60).

3. The yarn processing machine according to claim 2, **characterized in that** the control section (30) causes the operation cart (3) to execute an operation on the yarn processing unit (2) when the negative pressure detected by the detection means (60) of the operation cart (3) moved to the operation position (A) is greater than or equal to a prescribed value.

4. The yarn processing machine according to claim 3, **characterized in that** the control section (30) causes the operation cart (3) to stop the operation when the negative pressure detected by the detection means (60) becomes smaller than the prescribed value while the operation cart (3) is carrying out the operation on the yarn processing unit (2).

5. The yarn processing machine according to any one of claims 2 to 4, **characterized in that** when the negative pressure detected by the detection means (60) is smaller than a threshold value, the control section (30) causes the operation cart (3) to execute a search mode for searching a negative pressure sudden change area (K) where the negative pressure of the suction duct (11) changes by an amount greater than or equal to a predetermined amount in the arranging direction.

6. The yarn processing machine according to claim 5, **characterized in that**
   the suction duct (11) is provided with a plurality of openings (11a) in the arranging direction,
   the operation member (54) of the operation cart (3) is connectable to the suction duct (11) through the opening (11a), and
   the operation cart (3) searches for the negative pressure sudden change area (K) by moving in the arranging direction while detecting the negative pressure when the operation member (54) is connected to the suction duct (11) through the opening (11a) in the search mode.

7. The yarn processing machine according to claim 6, **characterized in that**
   a plurality of shutter valves (13) adapted to open and close the plurality of openings (11a) are arranged,
   the operation cart (3) includes a contacting section (57) adapted to make contact with the shutter valve (13), and
   the shutter valve (13) is switched to a state of opening the opening (11a) and a state of closing the opening (11a) when the contacting section (57) is brought into contact during the movement of the operation cart (3) .

8. The yarn processing machine according to claim 6

or 7, **characterized in that** in the search mode, the operation cart (3) carries out the detection of the negative pressure while moving at a speed lower than a speed of when the operation cart (3) moves to the operation position (A) upon receiving an operation request from the yarn processing unit (2) .

9. The yarn processing machine according to claim 6 or 7, **characterized in that** in the search mode, the operation cart (3) carries out the detection of the negative pressure while stopping at each of the openings (11a).

10. The yarn processing machine according to any one of claims 5 to 9, **characterized in that** when a plurality of the operation carts (3) are arranged, the control section (30) causes the operation cart (3), which has detected that the negative pressure is smaller than the threshold value, of the plurality of operation carts (3) to execute the search mode.

11. The yarn processing machine according to any one of claims 5 to 10, **characterized by** further comprising a notifying means (8) adapted to notify that the negative pressure detected by the detection means (60) is smaller than the threshold value.

12. The yarn processing machine according to claim 11, **characterized in that** the notifying means (8) notifies the negative pressure sudden change area (K) detected by the search mode.

13. The yarn processing machine according to any one of claims 2 to 12, **characterized in that**
the yarn processing unit (2) includes a winding section (24) adapted to wind a yarn (Y) to form a package (P),
the operation member (54) is a suction mouth (54) adapted to suck and catch a yarn end from the package (P), and
the operation cart (3) executes a yarn joining operation using the suction mouth (54).

14. The yarn processing machine according to claim 13, **characterized in that**
the yarn processing unit (2) further includes
a draft section (21) adapted to draw a fiber bundle (T), and
a spinning section (22) adapted to produce a yarn (Y) from the fiber bundle (T) drawn by the draft section (21), and
the winding section (24) winds the yarn (Y) produced by the spinning section (22) to form the package (P).

15. The yarn processing machine according to claim 14, **characterized in that**
the spinning section (22) includes
a spinning chamber (73),
a spinning nozzle (74) adapted to generate whirling airflow at the spinning chamber (73), and
a hollow guide shaft body (81) having a distal end portion located in the spinning chamber (73).

FIG. 1

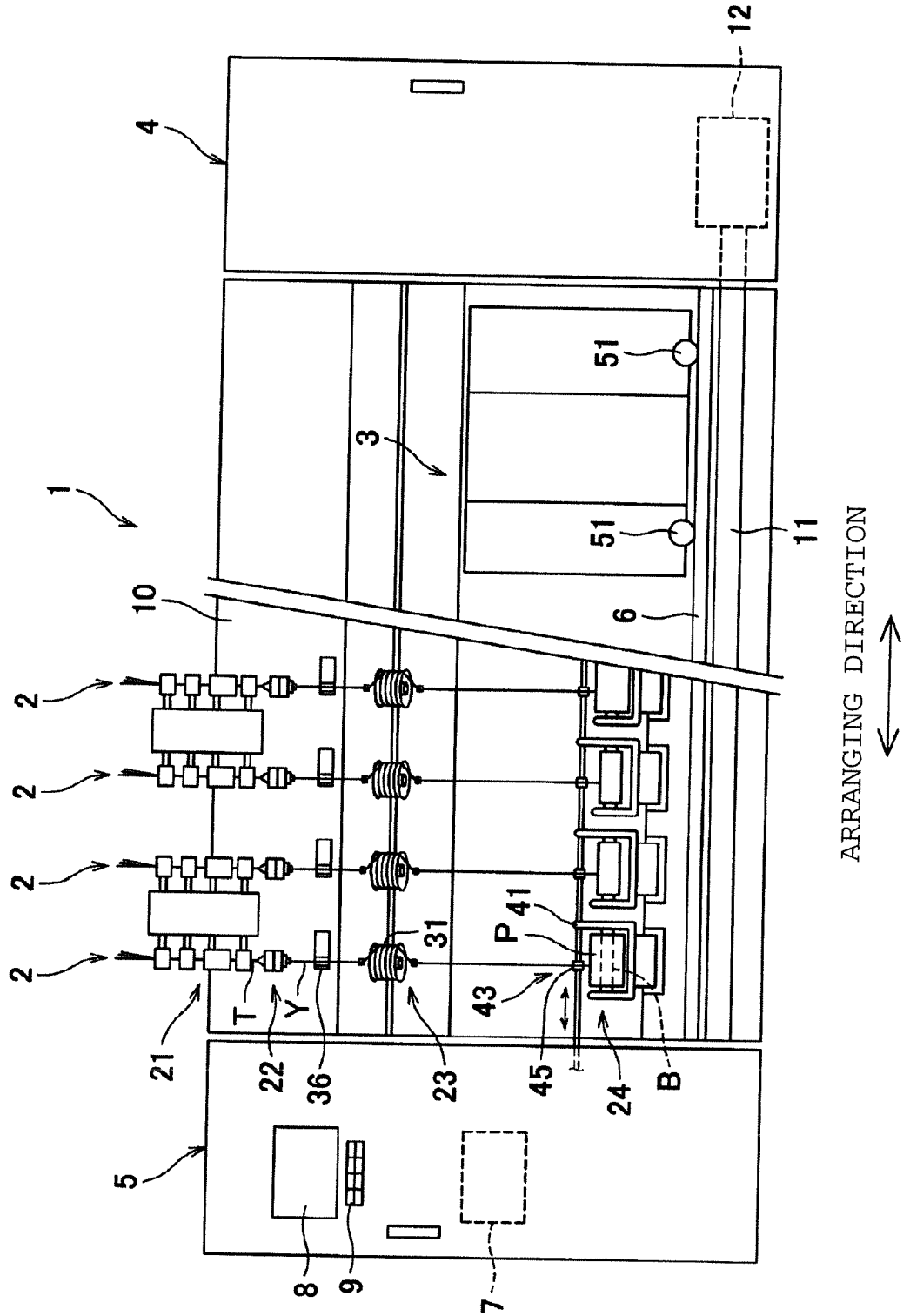

1
2
2
2
2
3
4
5
6
7
8
9
10
11
12
21
22
23
24
31
36
41
43
45
51
51
T
Y
P
B
ARRANGING DIRECTION

FIG. 2

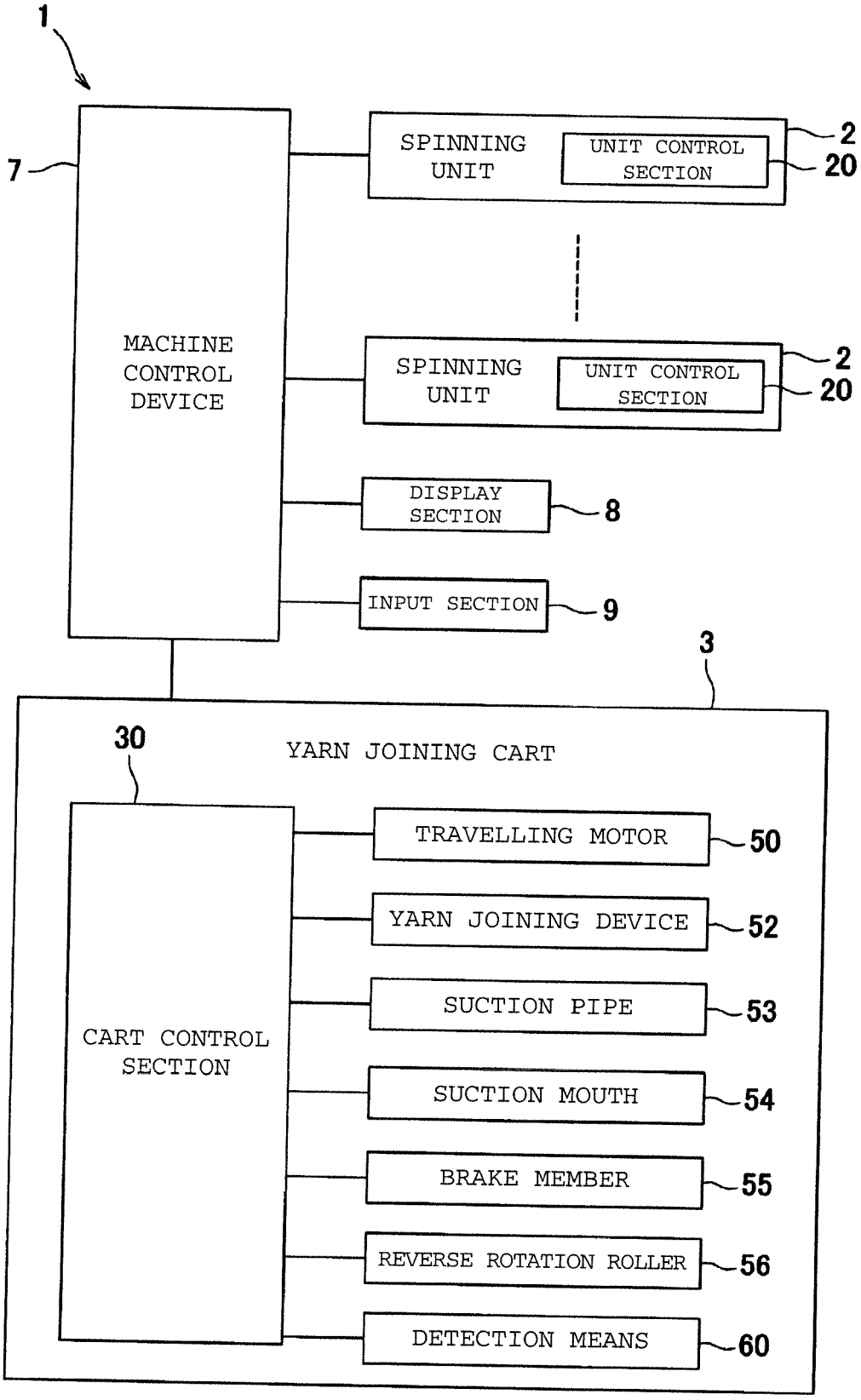

1
7
MACHINE CONTROL DEVICE
SPINNING UNIT
UNIT CONTROL SECTION
2
20
SPINNING UNIT
UNIT CONTROL SECTION
2
20
DISPLAY SECTION
8
INPUT SECTION
9
3
30
YARN JOINING CART
CART CONTROL SECTION
TRAVELLING MOTOR
50
YARN JOINING DEVICE
52
SUCTION PIPE
53
SUCTION MOUTH
54
BRAKE MEMBER
55
REVERSE ROTATION ROLLER
56
DETECTION MEANS
60

FIG. 3

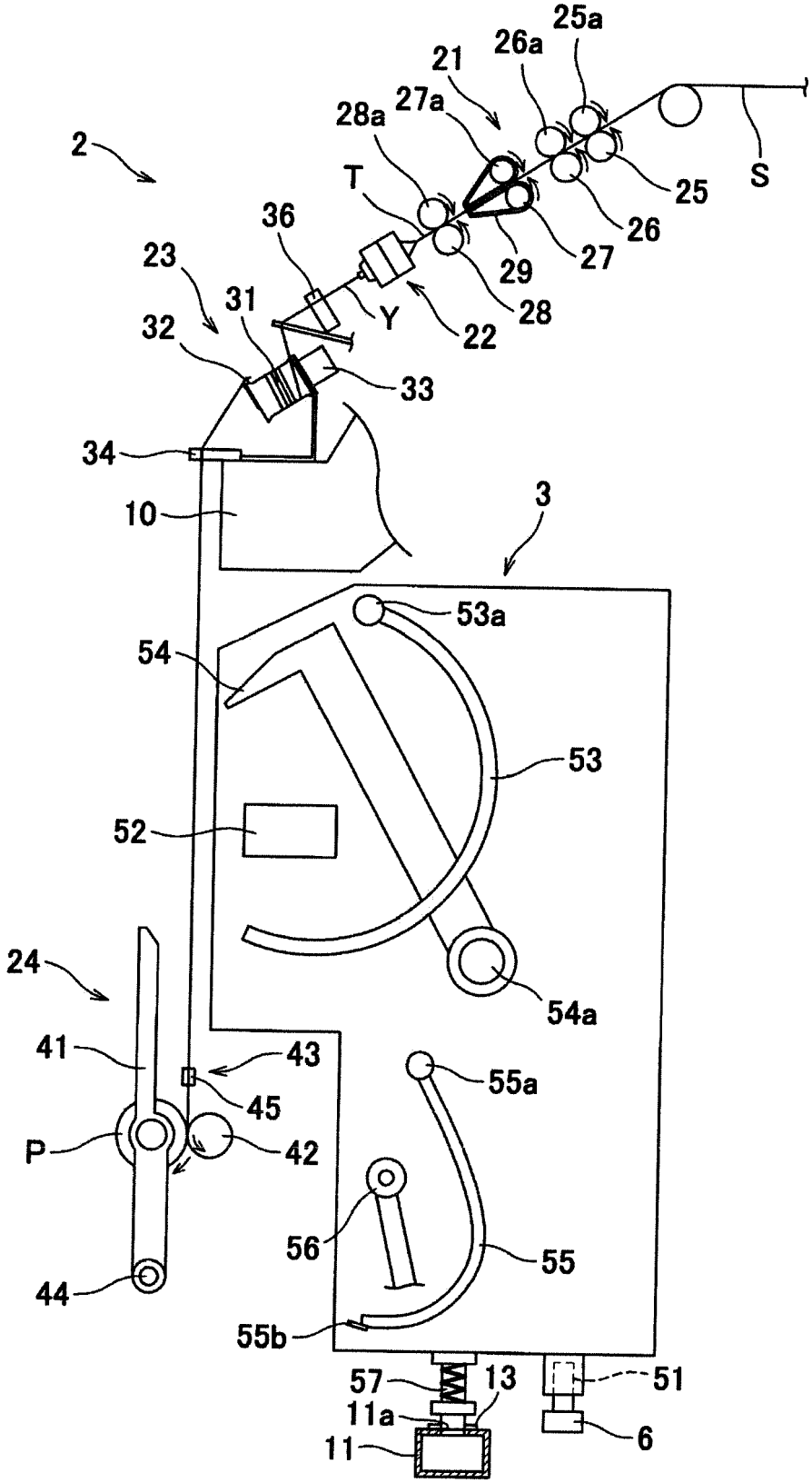

25a
26a
21
27a
28a
2
T
36
23
31
32
Y
22
29
28
27
26
25
S
33
34
10
3
53a
54
53
52
24
54a
41
43
55a
45
P
42
56
55
44
55b
57
13
51
11a
6
11

FIG. 4

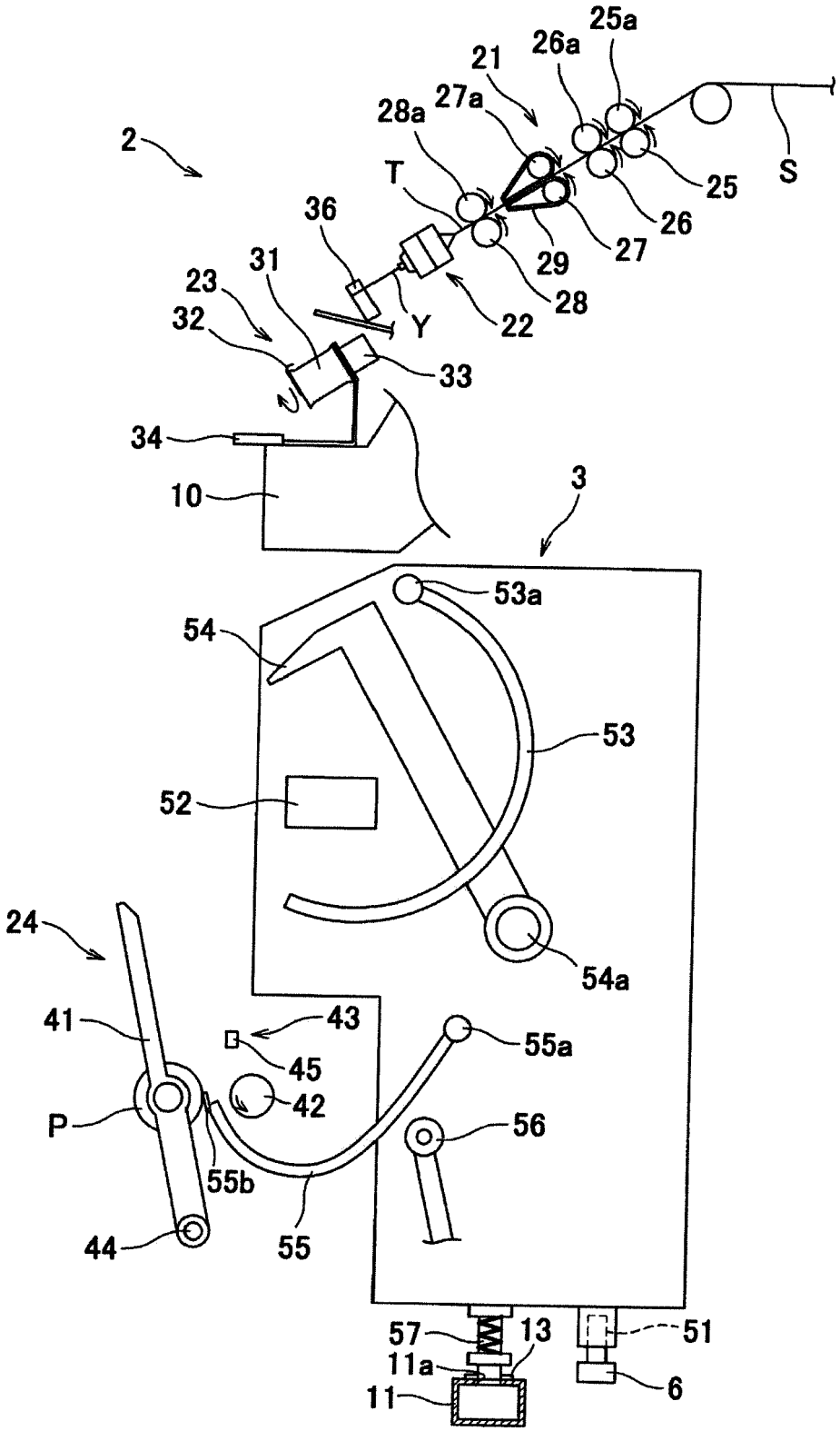

25a
26a
21
27a
28a
2
T
36
31
23
32
Y
33
34
10
3
53a
54
53
52
24
54a
41
43
45
55a
42
P
56
55b
44
55
57
13
51
11a
6
11

FIG. 5

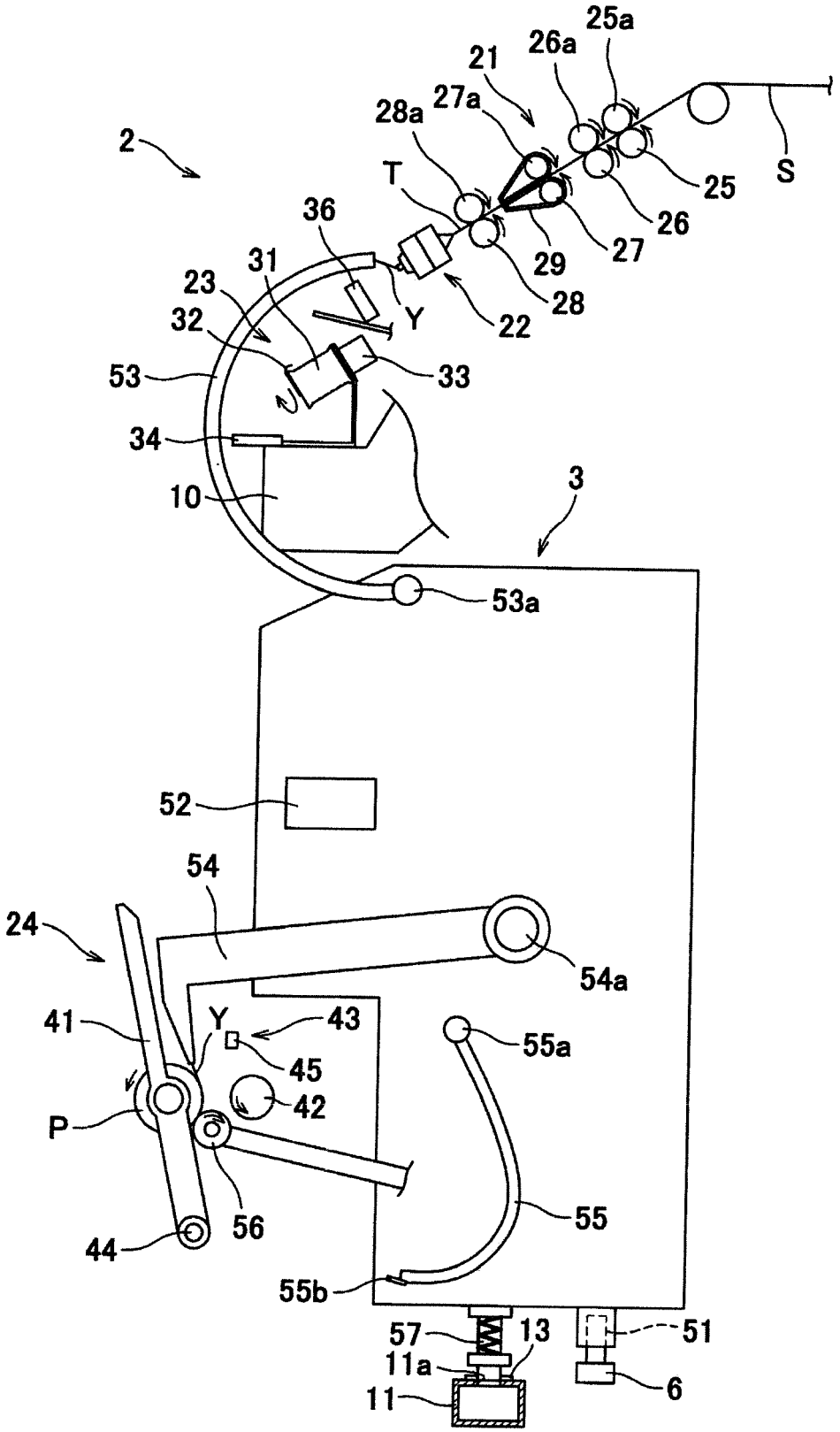

25a
26a
21
27a
28a
2
T
36
31
23
32
53
34
10
3
53a
52
54
24
54a
41
Y
43
45
42
P
56
44
55a
55
55b
57
13
51
11a
6
11
25
S
26
27
29
28
22
Y
33

FIG. 6

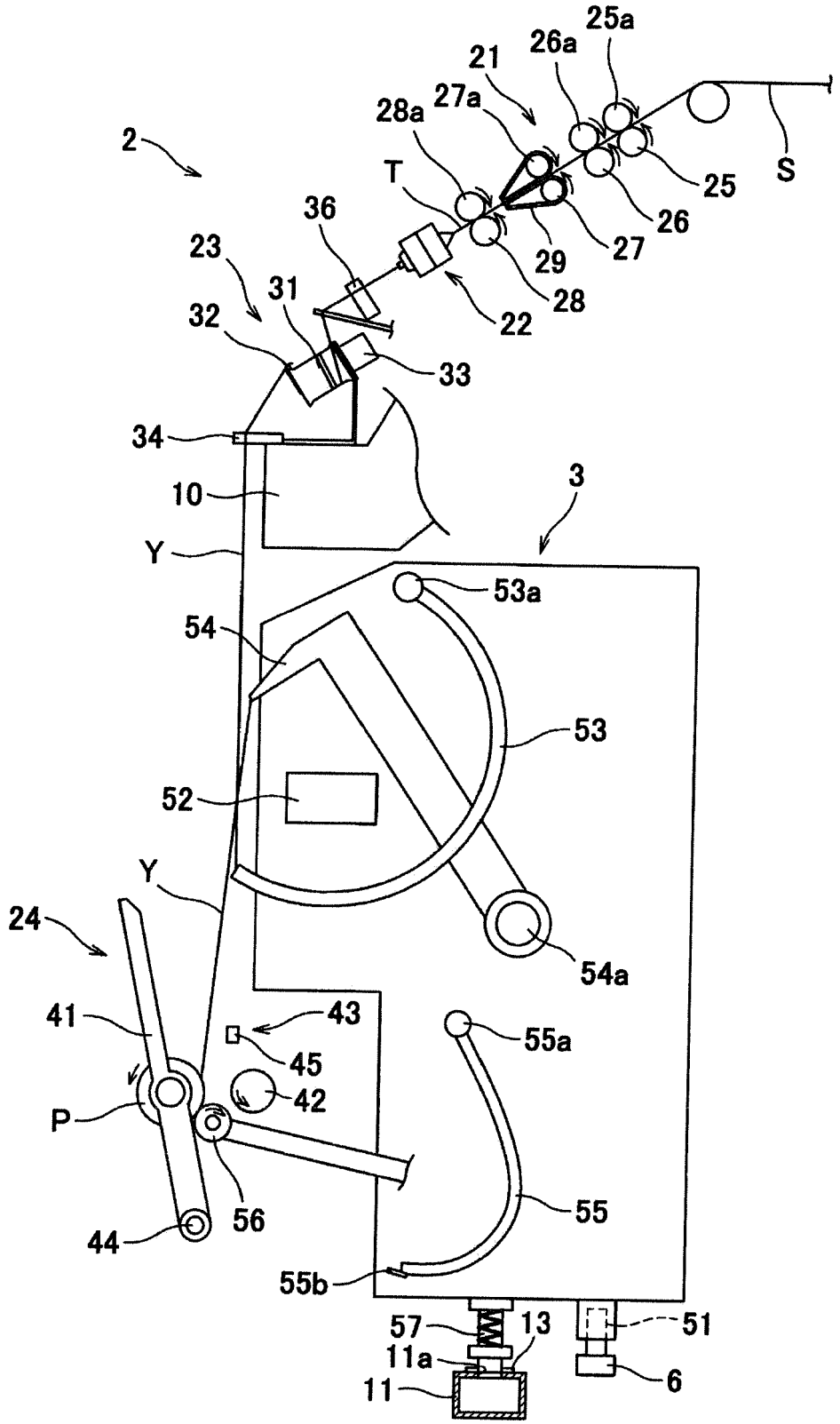

25a
26a
21
27a
28a
2
T
36
23
31
32
33
34
10
3
Y
53a
54
53
52
Y
24
54a
41
43
55a
45
42
P
56
55
44
55b
57
13
51
11a
6
11
S
25
26
27
29
28
22

FIG. 7

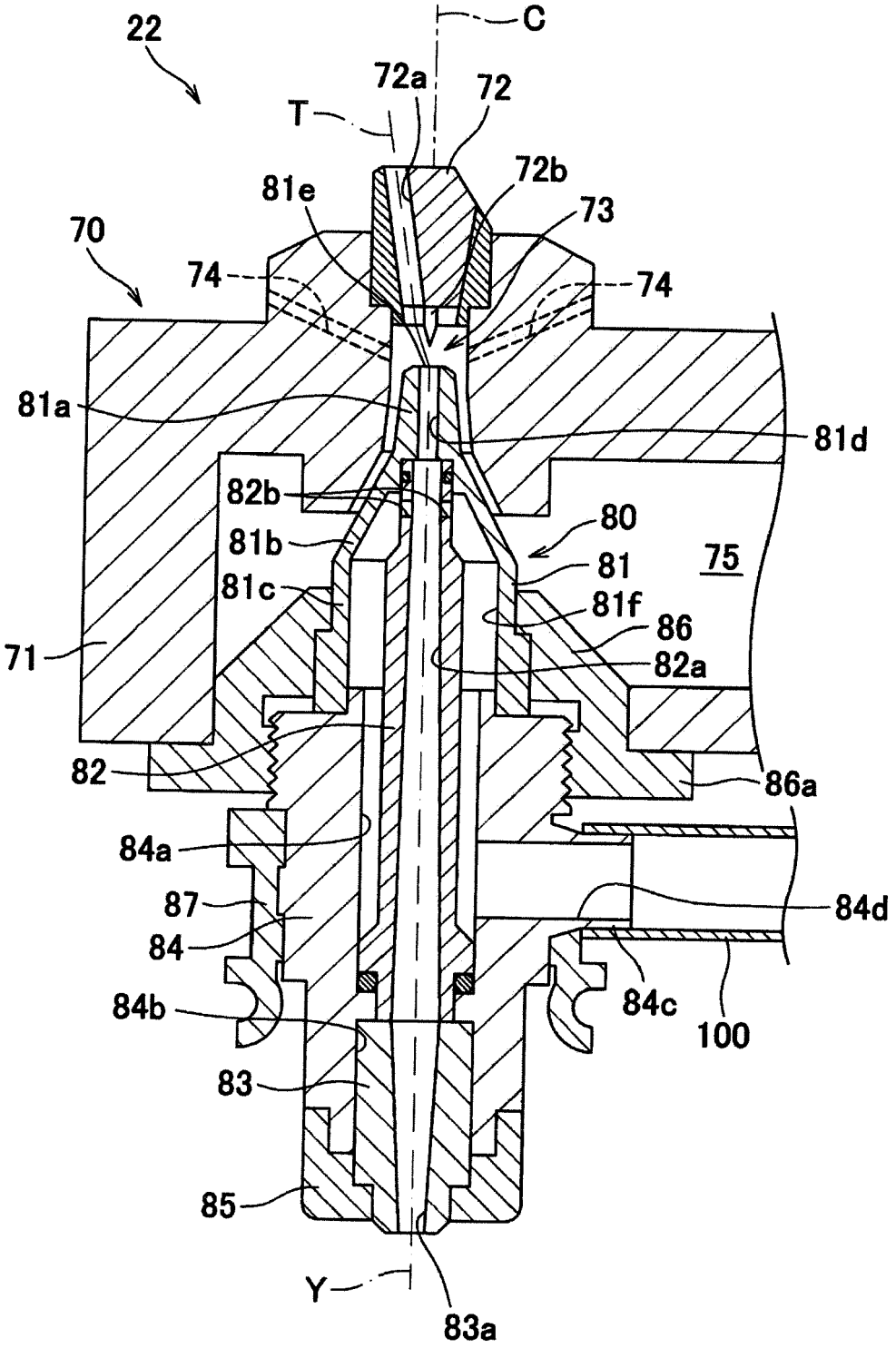

22
C
72a
72
T
72b
81e
73
70
74
74
81a
81d
82b
80
81b
81
75
81c
81f
86
71
82a
82
86a
84a
87
84d
84
84b
84c
100
83
85
Y
83a

FIG. 8

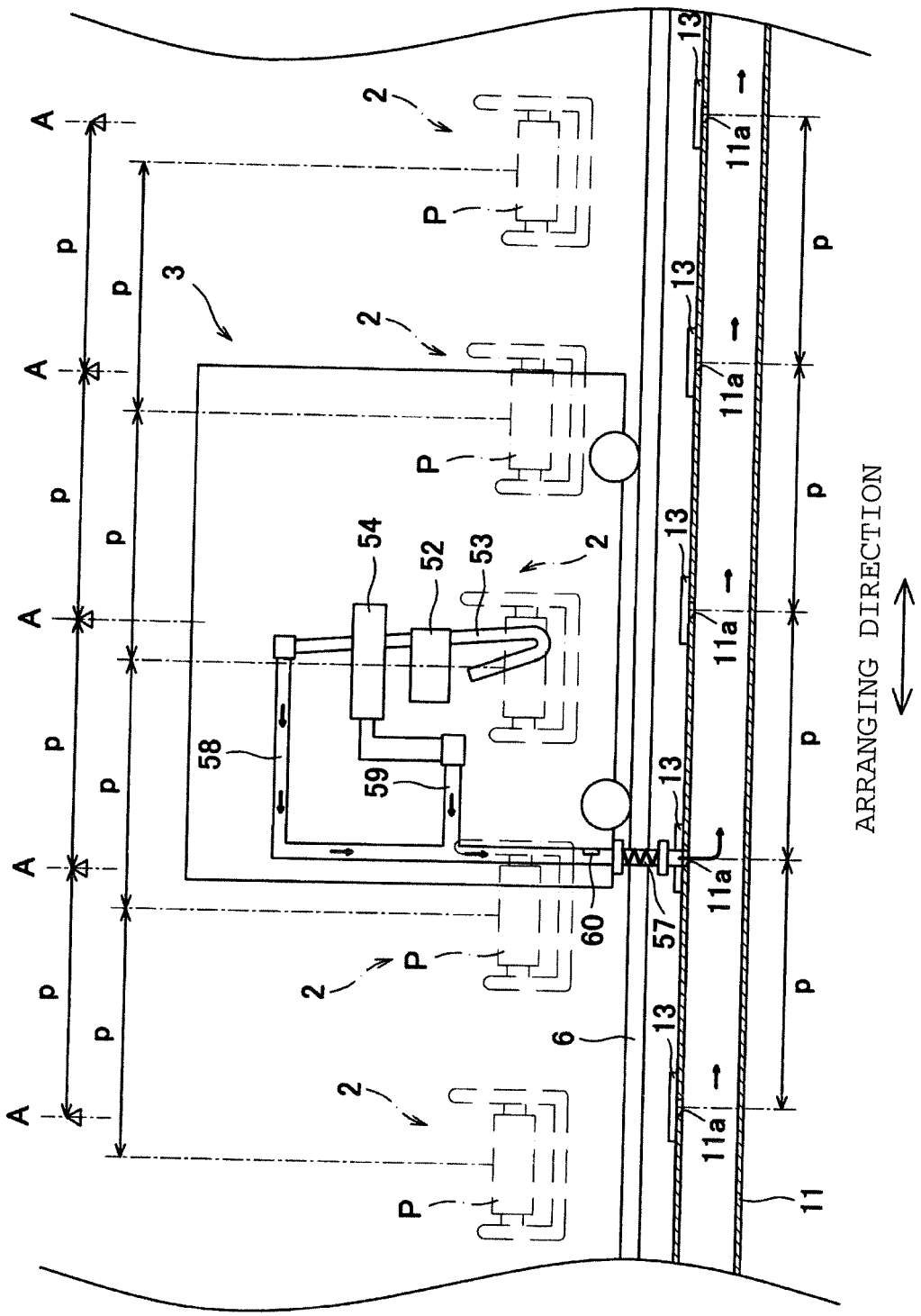


FIG. 9

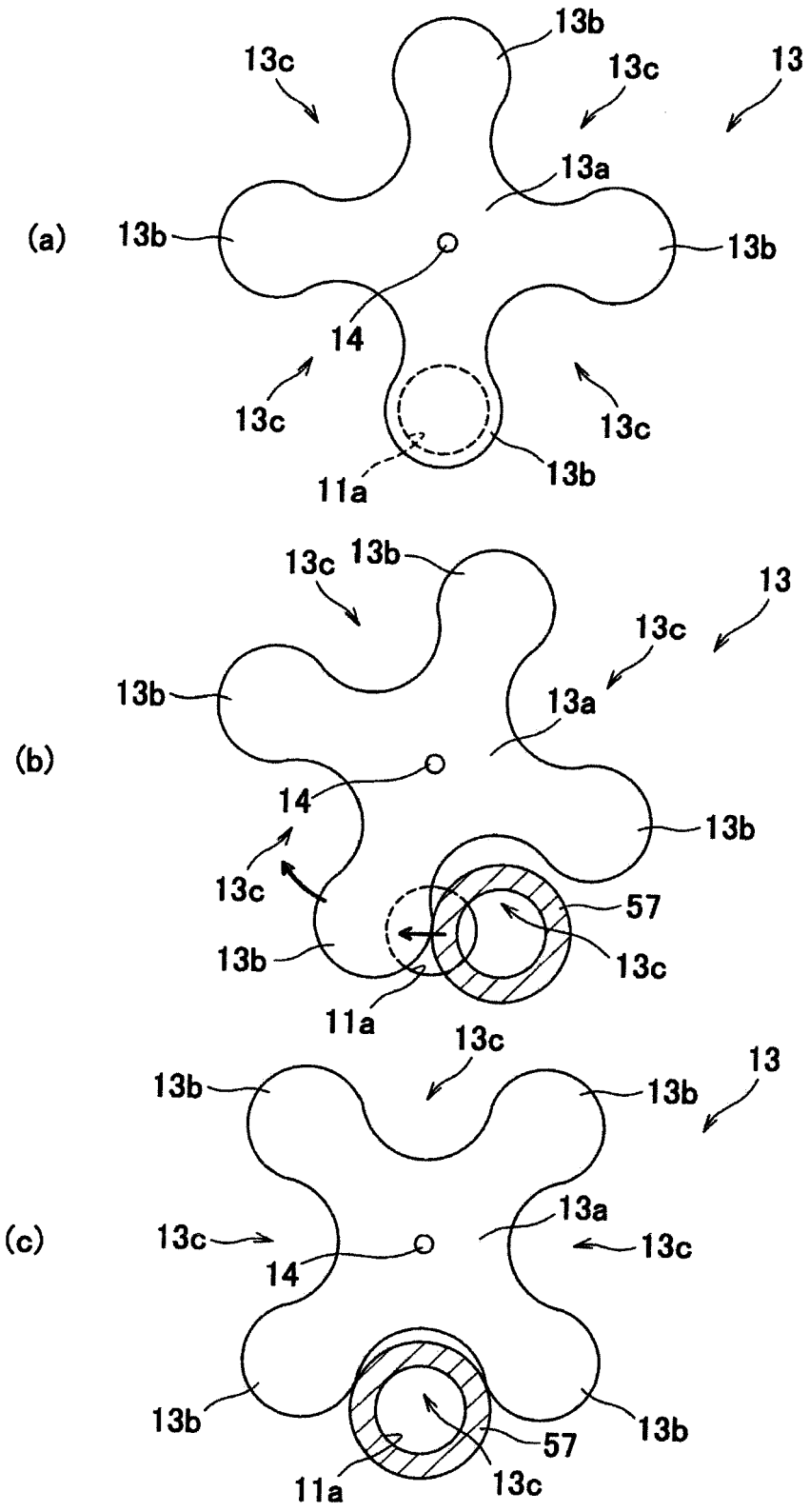

(a)
13b
13c
13c
13
13a
13b
13b
14
13c
13c
11a
13b
(b)
13c
13b
13
13c
13b
13a
14
13b
13c
57
13b
13c
11a
(c)
13c
13b
13b
13
13a
13c
13c
14
13b
13b
57
11a
13c

FIG. 10

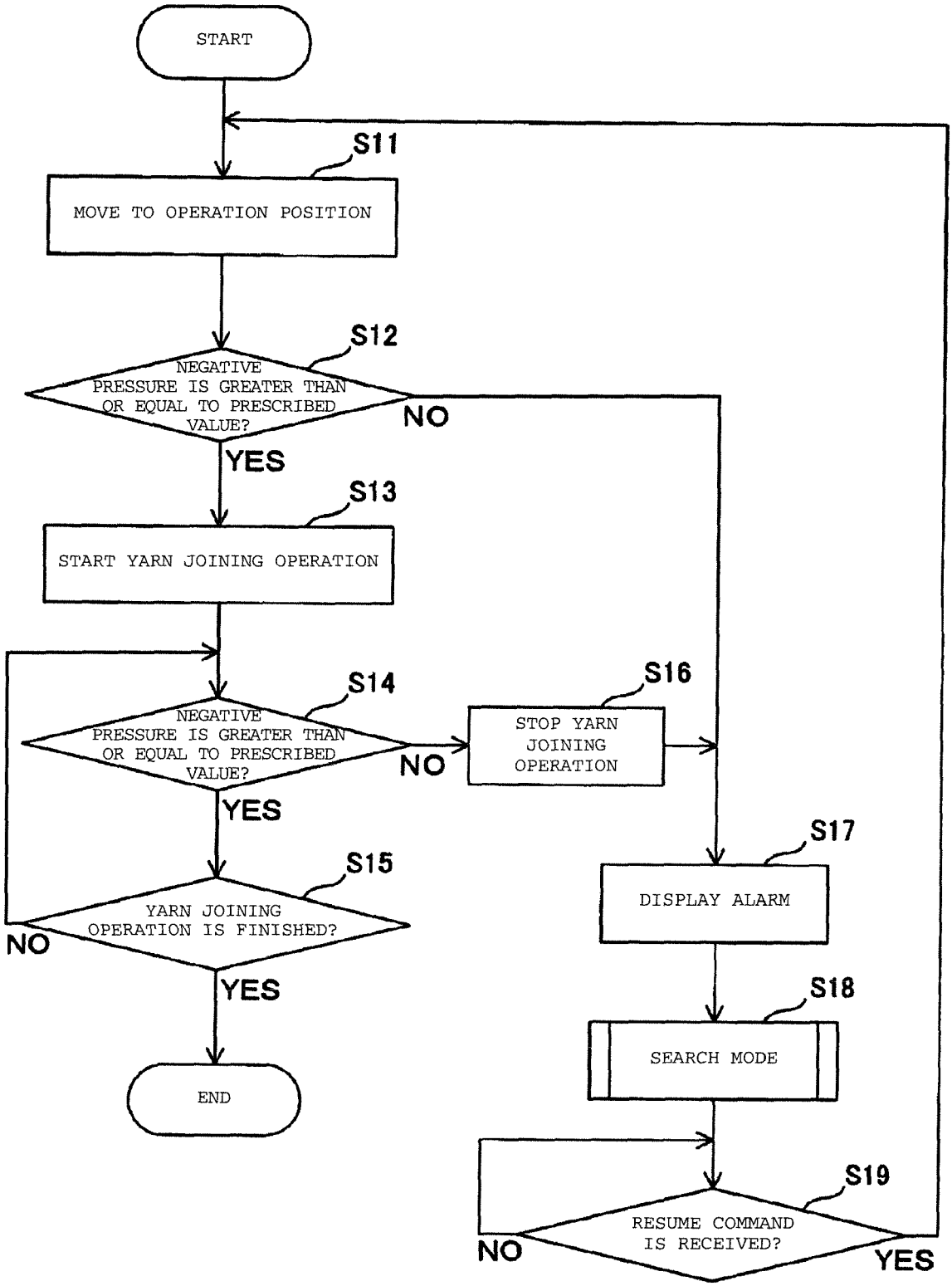

START
S11
MOVE TO OPERATION POSITION
S12
NEGATIVE PRESSURE IS GREATER THAN OR EQUAL TO PRESCRIBED VALUE?
NO
YES
S13
START YARN JOINING OPERATION
S14
NEGATIVE PRESSURE IS GREATER THAN OR EQUAL TO PRESCRIBED VALUE?
NO
YES
S16
STOP YARN JOINING OPERATION
S15
YARN JOINING OPERATION IS FINISHED?
NO
YES
END
S17
DISPLAY ALARM
S18
SEARCH MODE
S19
RESUME COMMAND IS RECEIVED?
NO
YES

FIG. 11

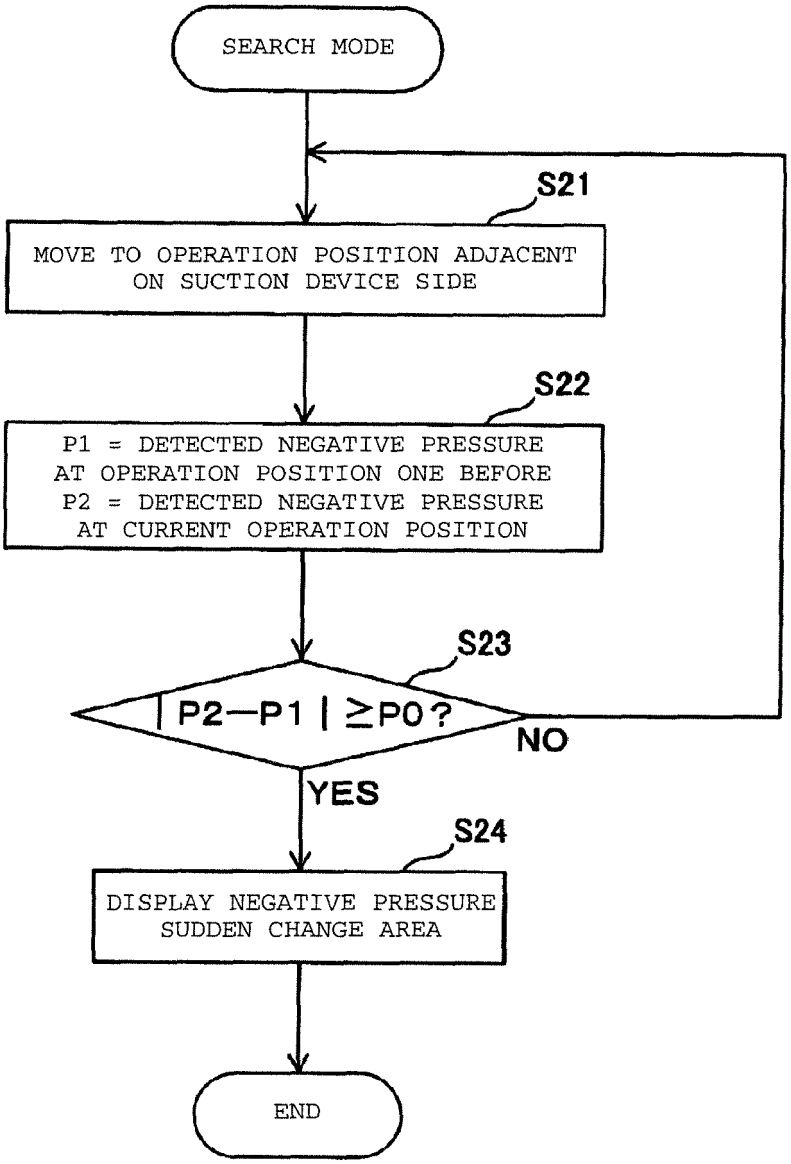

SEARCH MODE
S21
MOVE TO OPERATION POSITION ADJACENT ON SUCTION DEVICE SIDE
S22
P1 = DETECTED NEGATIVE PRESSURE AT OPERATION POSITION ONE BEFORE
P2 = DETECTED NEGATIVE PRESSURE AT CURRENT OPERATION POSITION
S23
| P2—P1 | ≥P0?
NO
YES
S24
DISPLAY NEGATIVE PRESSURE SUDDEN CHANGE AREA
END

FIG. 12

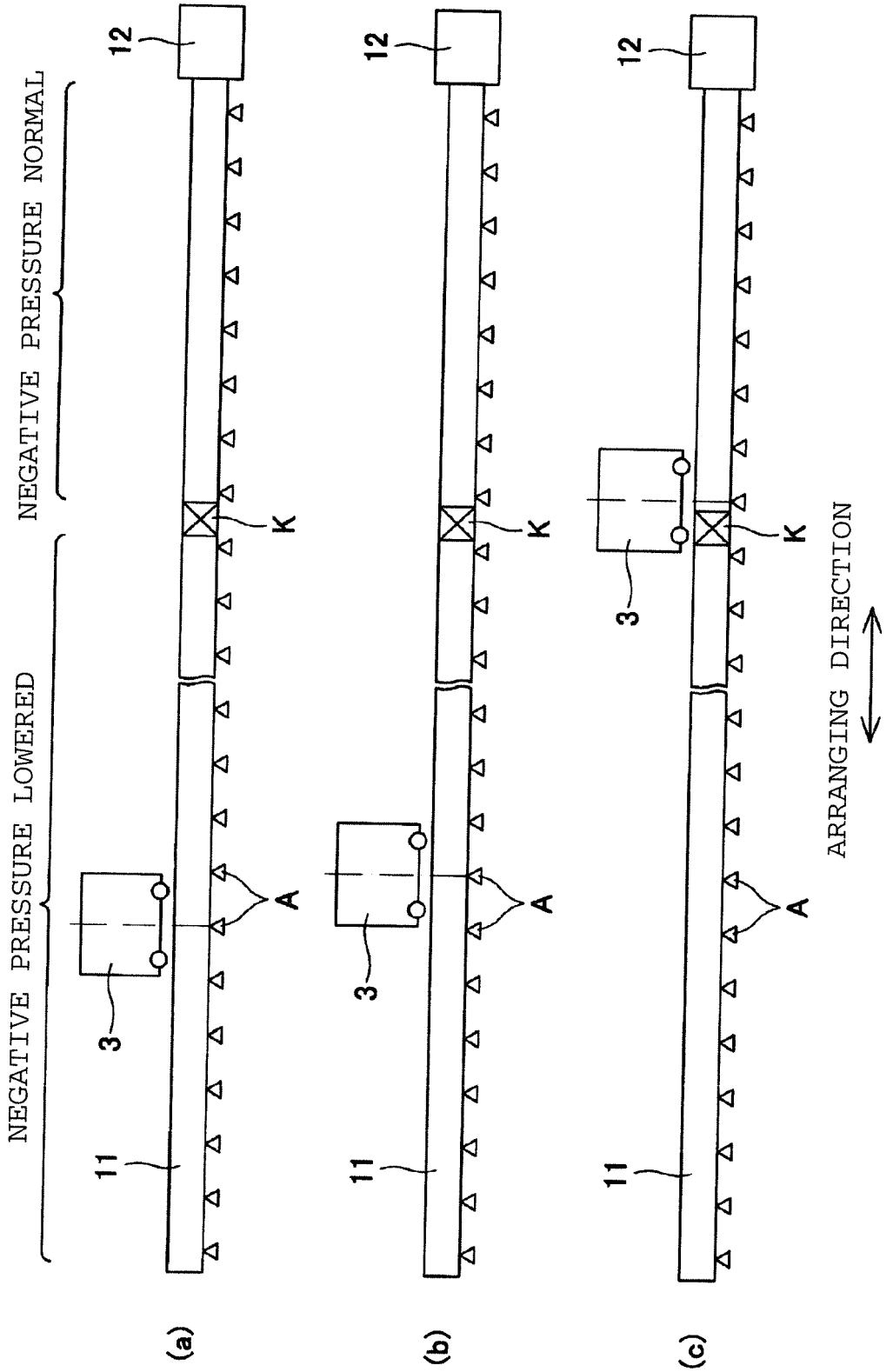

NEGATIVE PRESSURE LOWERED
NEGATIVE PRESSURE NORMAL
12
K
A
3
11
(a)
(b)
(c)
ARRANGING DIRECTION

FIG. 13

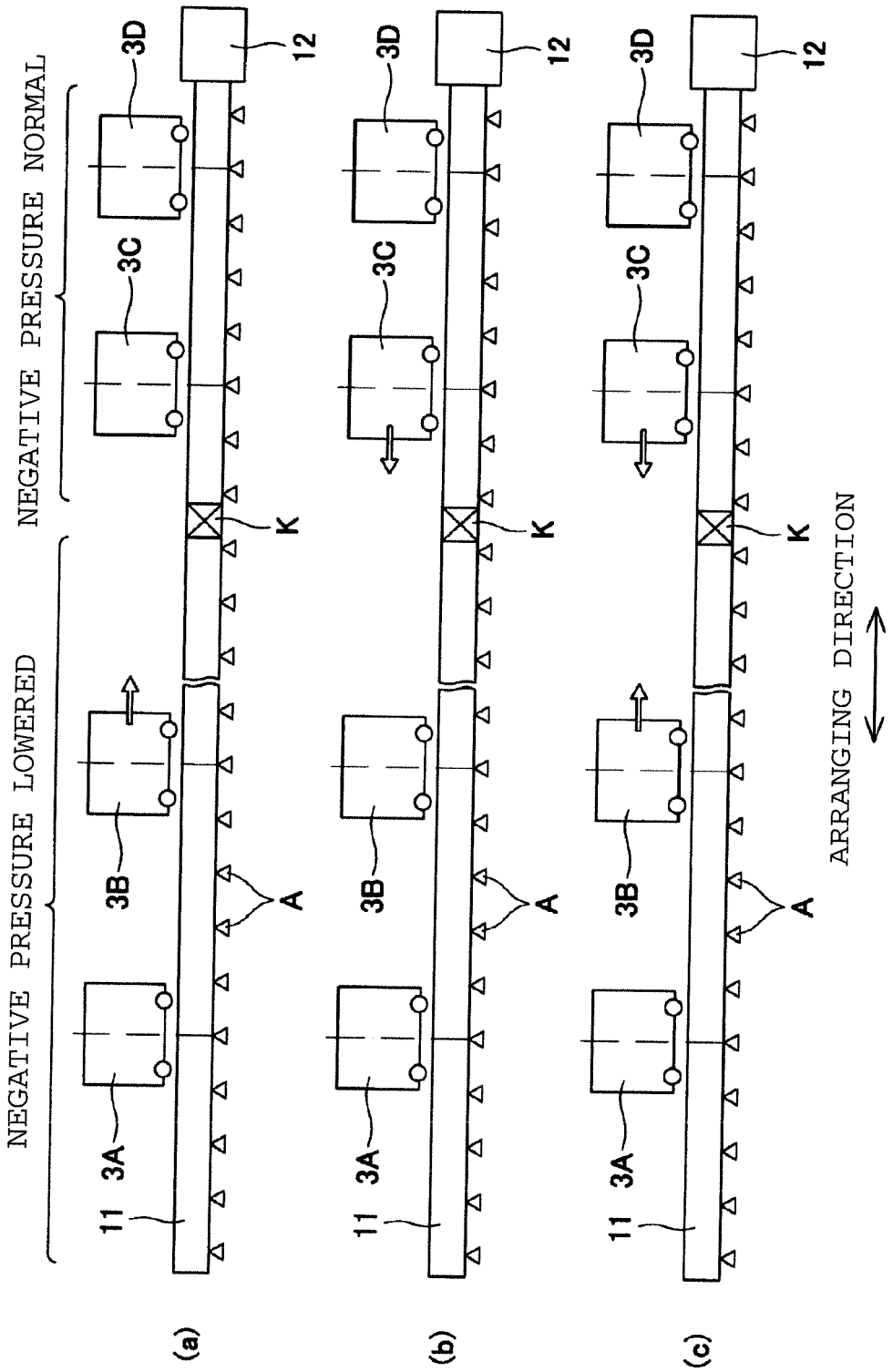
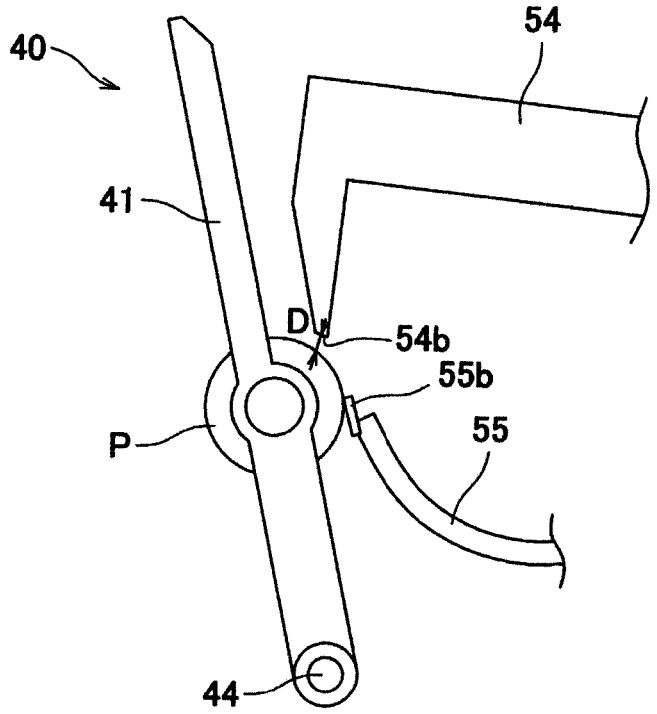
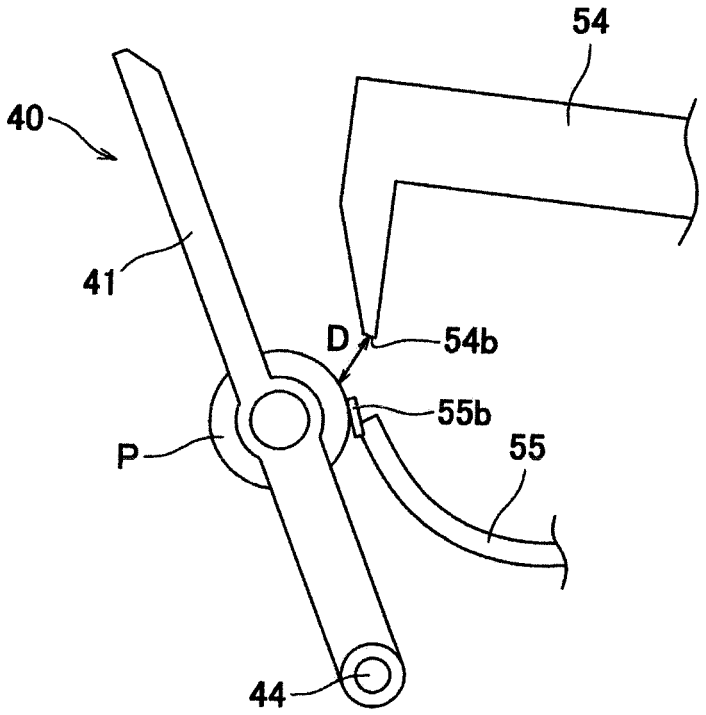

NEGATIVE PRESSURE NORMAL
NEGATIVE PRESSURE LOWERED
3D
3C
3B
3A
11
12
K
A
(a)
(b)
(c)
ARRANGING DIRECTION

FIG. 14

(a)



(b)



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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 3402

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D Y A	JP 2014 009052 A (MURATA MACHINERY LTD) 20 January 2014 (2014-01-20) * abstract; figures 1,3,5 * -----	1,2,13, 14 15 3-12	INV. B65H54/26 B65H54/70 B65H63/04
X Y	EP 1 659 082 A2 (MURATA MACHINERY LTD [JP]) 24 May 2006 (2006-05-24) * paragraphs [0033] - [0035]; figures 1-3 * -----	1,2,13, 14 15	
Y	EP 2 985 371 A2 (MURATA MACHINERY LTD [JP]) 17 February 2016 (2016-02-17) * figure 4 * -----	15	
A	EP 2 924 154 A1 (MURATA MACHINERY LTD [JP]) 30 September 2015 (2015-09-30) * paragraphs [0003] - [0013], [0026] - [0056]; figures 1-4 * -----	1-15	
A	JP 2001 200432 A (MURATA MACHINERY LTD) 27 July 2001 (2001-07-27) * abstract; figure 1 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B65H
D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 June 2018	Pussemier, Bart

CATEGORY OF CITED DOCUMENTS

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15-06-2018

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		EP 2924154 A1	30-09-2015
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JP 2001200432 A	27-07-2001	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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