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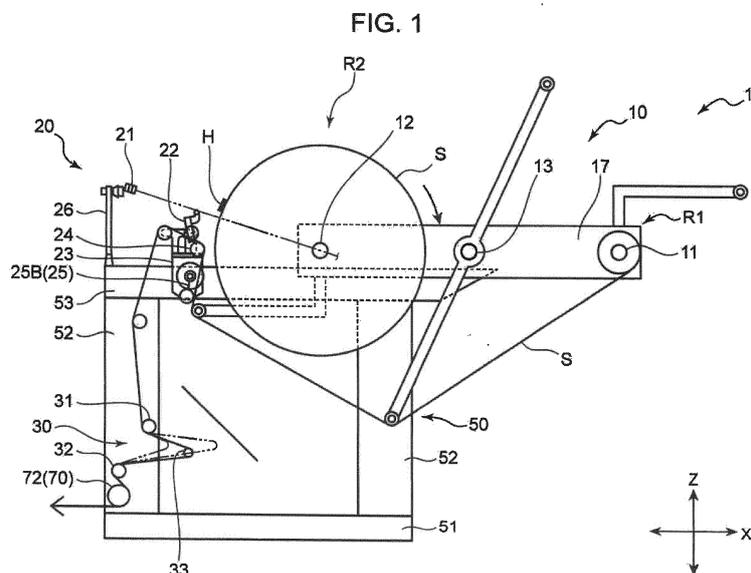
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(54) **SHEET SUPPLY METHOD AND SHEET SUPPLY DEVICE**

(57) A sheet supply method includes an unwinding step of supplying a sheet to a downstream location at a predetermined conveyance speed and a joining step of joining the sheet from a first roll to the sheet of a second roll by pressing the sheet run from the first roll onto an outer peripheral surface of the second roll, and cutting the sheet from the first roll at an upstream position of a joining section where the sheets have been joined to each other. In the joining step, the running speed of the

sheet run from the first roll is made lower than the predetermined conveyance speed in the unwinding step, and different from a supply speed of the sheet from a supply part in the joining step. An accumulating mechanism decelerates or accelerates the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed and the supply speed.



Description

Technical Field

[0001] The present invention relates to a sheet supply method and a sheet supply apparatus.

Background Art

[0002] As disclosed in Patent Literatures 1 and 2, there have been conventionally known sheet supply apparatus for sequentially unwinding a sheet from a pair of sheet rolls for sheet supply to a line in a downstream location, the sheet supply apparatus including a joining mechanism which joins the sheet from one roll in supply to the sheet of the other roll in standby. The apparatus can continuously supply the sheet to the line in the downstream location by joining the sheet run from the one roll in supply to the sheet of the other roll in standby at a time when the sheet of the one roll in supply decreases and reaches a specific residual length.

[0003] The sheet supply apparatus disclosed in Patent Literatures 1 and 2 includes support shafts for respectively supporting a pair of rolls, a joining mechanism having a pressing roll which presses a sheet run from one of the rolls in supply onto an outer peripheral surface of the other roll in standby, and a supply part which supplies the sheet to the line in the downstream location. When the sheet of the one roll in supply decreases and reaches a specific residual length, the apparatus can perform sheet joining by pressing the sheet in supply onto the outer peripheral surface of the other roll in standby to thereby adhere the sheets to each other via an adhesive provided on the outer peripheral surface.

[0004] The sheet supply apparatus disclosed in Patent Literatures 1 and 2 performs the joining while supplying the sheet to the line in the downstream location by rotating both the support shafts for the rolls in such a manner as to unwind the sheet at the same speed as a supply speed of the sheet to the line in the downstream location. Furthermore, in the joining, a moving speed of the outer peripheral surface of the standby roll is set at the same value as a running speed of the sheet being supplied.

[0005] Normally, a conveyance speed of a sheet is set to be high enough to ensure a line manufacturing efficiency. Therefore, in a joining operation of a conventional sheet supply apparatus, a sheet running at a high speed must be pressed onto an outer peripheral surface of a fast rotating standby roll at a location where an adhesive is provided, which requires a hard timing adjustment and thus an increased accuracy for the joining operation.

[0006] Also, there is an occasion that the line in the downstream location is stopped and the sheet supply is suspended for changing to a roll or sheet having a different specification or the like. In the conventional sheet supply apparatus, however, the sheet adhesion using adhesive is established by allowing the adhesive provided on the outer peripheral surface of the standby roll to

move to a position where the sheet being supplied is to be pressed. Consequently, in the state where the sheet supply is suspended, the adhesive cannot be moved to the pressing position, which fails to establish the joining.

This causes a problem of the burdensome operation that an operator must guide a leading end of the sheet of a new roll or a standby roll set in the sheet supply apparatus to the line in the downstream location through a predetermined pass line.

Citation List

Patent Literature

[0007]

Patent Literature 1: Japanese Patent Publication No. 2003-118895

Patent Literature 2: International Unexamined Patent Publication No. 2017/149610

Summary of Invention

[0008] An object of the present invention is to provide a sheet supply method and a sheet supply apparatus which can establish sheet joining even in a state where a sheet supply to a line in a downstream location is suspended, and can easily perform sheet joining at an accurate timing even at a high speed of the sheet supply to the line.

[0009] A sheet supply method according to one aspect of the present invention is a sheet supply method for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply by using a sheet supply apparatus including: a first support shaft which rotatably supports the first roll of sheet at a center position thereof; a second support shaft which rotatably supports the second roll of sheet at a center position thereof; a joining mechanism which joins the sheet of the second roll and the sheet of the first roll to each other; a supply part which supplies the sheet run from the first roll or the second roll to a downstream location; and an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet. The sheet supply method includes: an unwinding step of controlling the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location; and a joining step of controlling the first support shaft, the second support shaft, and the joining mechanism to join the sheet from the first roll to the sheet of the second roll by pressing an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll, and to cut the sheet

from the first roll at an upstream position of a joining section where the sheet from the first roll has been joined to the sheet of the second roll. In the joining step, the first support shaft is controlled to make the running speed of the sheet run from the first roll lower than the predetermined conveyance speed in the unwinding step, and different from a supply speed of the sheet from the supply part in the joining step, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part.

[0010] A sheet supply apparatus according to another aspect of the present invention is a sheet supply apparatus for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply. The sheet supply apparatus includes: a first support shaft which rotatably supports the first roll at a center position thereof; a second support shaft which rotatably supports the second roll at a center position thereof; a joining mechanism which joins the sheet of the second roll and the sheet of the first roll to each other, and includes a cutter for cutting the sheet run from the first roll at an upstream position of a joining section where the sheets have been joined to each other after the sheet joining; a supply part which supplies the sheet run from the first roll or the second roll to a downstream location of the sheet supply apparatus; a controller which controls the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location in an ordinary operation where the sheet is supplied from the sheet supply apparatus to the downstream location, and controls the first support shaft, the second support shaft, and the joining mechanism to press an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll for the sheet joining; and an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet. The controller controls the first support shaft to make the running speed of the sheet from the first roll lower than the predetermined conveyance speed for the sheet joining, and different from a supply speed of the sheet from the supply part for the sheet joining, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part.

[0011] The present invention makes it is possible to provide a sheet supply method and a sheet supply apparatus which can easily perform sheet joining at an ac-

curate timing, and perform the sheet joining even in a state where sheet supply from a supply part to a downstream location is suspended.

5 Brief Description of Drawings

[0012]

10 Fig. 1 is a partial cross-sectional front view schematically showing a configuration of a sheet supply apparatus according to a first embodiment of the present invention.

15 Fig. 2 is a block diagram showing an electrical configuration of a controller which controls operations of the sheet supply apparatus.

20 Fig. 3 is a flowchart showing a sequence of a sheet supply method according to the first embodiment of the present invention.

25 Fig. 4 is a flowchart showing another sequence of the sheet supply method according to the first embodiment of the present invention.

30 Fig. 5 is a schematic view showing a state where an intermediate portion of a sheet of a first roll is pressed onto an outer peripheral surface of a second roll in the sheet supply method.

35 Fig. 6 is a schematic view showing a state where the sheet of the first roll is cut in the sheet supply method.

40 Fig. 7 is a schematic view showing a state where the sheet from the first roll is wound up thereto.

45 Fig. 8 is a partial cross-sectional front view schematically showing a configuration of a sheet supply apparatus according to a second embodiment of the present invention.

35 Description of Embodiments

[0013] Hereinafter, a sheet supply apparatus and a sheet supply method according to embodiments of the present invention will be described in detail with reference to the accompanying drawings.

(First Embodiment)

45 **[0014]** First, a configuration of a sheet supply apparatus 1 according to a first embodiment of the present invention will be described with reference to Figs. 1 and 2. Fig. 1 is a partial cross-sectional front view of the sheet supply apparatus 1. Fig. 2 is a block diagram showing an electric configuration of a controller 80 which controls operations of the sheet supply apparatus 1. Hereinafter, a lateral direction in Fig. 1 is defined as an "X direction", a vertical direction in Fig. 1 is defined as a "Z direction", and a direction (i.e., a depth direction of the paper sheet in Fig. 1) perpendicularly intersecting the X and Z directions is defined as a "Y direction".

55 **[0015]** The sheet supply apparatus 1 is an apparatus for sequentially unwinding a sheet S from a first roll R1 of sheet S and a second roll R2 of sheet S. As shown in

Fig. 1, the sheet supply apparatus 1 includes a base 50, a support mechanism 10 mounted on the base 50 for supporting the first and second rolls R1, R2, a joining mechanism 20 attached to the base 50 for joining the sheet S of the second roll R2 and the sheet S run from the first roll R1 to each other, a drive part or supply part 70 which supplies the sheet S run from the first roll R1 or the second roll R2 to a downstream location of the sheet supply apparatus 1, an accumulating mechanism 30 which accumulates a predetermined length of the sheet S at an upstream position of the drive part 70, and a controller 80 which controls the support mechanism 10, the joining mechanism 20, and the drive part 70.

[0016] In Fig. 1, the first roll R1 is in a supply state of supplying the sheet S, and the second roll R2 is in a standby state of suspending supply of the sheet S. The sheet supply apparatus 1 can continuously supply the sheet S to a line in a downstream location of the sheet supply apparatus 1 by permitting the joining mechanism 20 to join the sheet S of the second roll R2 (the standby roll) and the sheet S of the first roll R1 (the supply roll) to each other, and to cut the sheet S run from the first roll R1 at an upstream position of a joining section where the sheets S have been joined to each other.

[0017] As shown in Fig. 1, the second roll R2 has an outer peripheral surface provided with an adhesive H (e.g., a double-sided tape) to adhere the sheet S of the second roll R2 and the sheet S of the first roll R1 to each other. Structural elements of the sheet supply apparatus 1 will be described below.

[0018] The base 50 includes a mount plate 51 placed on a predetermined setting surface, a plurality of pillars 52 extending in the Z direction, and a beam 53 extending in the X direction. As shown in Fig. 1, the pillars 52 stand on the mount plate 51 to face each other in the X direction. The beam 53 has the opposite ends which are fixedly attached to corresponding upper ends of the pillars 52.

[0019] The support mechanism 10 is attached to the base 50 rotatably about a rotary shaft 13 extending in the Y direction. Specifically, the support mechanism 10 includes the rotary shaft 13, a rotary member 17 which is rotatable about the rotary shaft 13, and a first support shaft 11 and a second support shaft 12 provided to the rotary member 17 for rotatably supporting the first and second rolls R1, R2 at their respective center positions.

[0020] The rotary member 17 extends in a direction orthogonal to the rotary shaft 13. The first support shaft 11 is provided at one end portion of the rotary member 17 that is one side with respect to the rotary shaft 13, and the second support shaft 12 is provided at the other end portion of the rotary member 17 that is on the other side with respect to the rotary shaft 13. The first and second support shafts 11, 12 are supported on the rotary member 17 by one end thereof and extend in the Y direction (forward of the paper sheet). In this configuration, the first and second rolls R1, R2 can be mounted onto the support mechanism 10 by inserting the first and second support shafts 11, 12 through the centers of the first and second

rolls R1, R2 from their respective free ends.

[0021] The support mechanism 10 further includes a rotary member driving source 18 (Fig. 2) which generates a drive force to rotate the rotary member 17, and a shaft driving source 19 (Fig. 2) which generates a drive force to rotate the first and second support shafts 11, 12 around respective axes. Each of the rotary member driving source 18 and the shaft driving source 19 is constituted by, for example, a motor. The rotary drive force of the motor is transmitted to the rotary shaft 13, and the first and second support shafts 11, 12 via a power transmission mechanism including a belt and a pulley. Consequently, the rotary shaft 13, and the first and the second support shafts 11, 12 can rotate around respective axes at a predetermined speed.

[0022] Meanwhile, although unillustrated, the rotary member 17 can be held in any posture in an ordinary operation where the sheet S is supplied to the line in the downstream location. For instance, the rotary member 17 may be held in a posture such that the supply roll (the first roll R1) is at a higher position in the Z direction and closer to the joining mechanism 20 than the standby roll (second roll R2). Further, when joining the sheets S of the two rolls to each other, the rotary member 17 is caused to rotate about the rotary shaft 13 to move the second or standby roll R2 closer to the joining mechanism 20 as shown in Fig. 1 (to reach a splice position).

[0023] The joining mechanism 20 includes a joining unit 23 movable in the X direction along the beam 53, a unit driving source 27 (Fig. 2) which generates a drive force to move the joining unit 23, a pressing roller 24 for pressing an intermediate portion of the sheet S run from the first roll R1 onto the outer peripheral surface of the second roll R2, a cutter 25 for cutting the sheet S run from the first roll R1, a radius detector 21 for detecting a distance (radius) from the center of the second roll R2 to the outer peripheral surface thereof, and an adhesive detector 22 for detecting a circumferential position of an adhesive H provided on the outer peripheral surface of the second roll R2.

[0024] The unit driving source 27 includes, for example, a servomotor, and the drive force thereof is transmitted to the joining unit 23 via a power transmission mechanism including a belt and a pulley. Owing to the transmitted drive force, it is possible to move the joining unit 23 forward to be closer to the second roll R2 at the splice position and backward to be away from the second roll R2.

[0025] The pressing roller 24 has an axis extending in the Y direction, and is attached to the joining unit 23. Hence, the pressing roller 24 shifts forward and backward together with the joining unit 23 while kept in parallel to the axis of the second roll R2. This configuration achieves a joining operation of joining the sheets S by causing the pressing roller 24 to press the intermediate portion of the sheet S run from the first roll R1 onto the outer peripheral surface of the second roll R2 to thereby adhere the sheets S to each other via the adhesive H.

[0026] The cutter 25 has a cutter blade 25B rotatable about an axis extending in the Y direction, and a cutter driving source 25A (Fig. 2) which generates a drive force to rotate the cutter blade 25B. The cutter 25 is also attached to the joining unit 23, and thus can shift forward and backward together with the joining unit 23. The cutter 25 can cut the sheet S run from the first roll R1 at an upstream position of the joining section where the sheets S have been jointed to each other after the joining operation.

[0027] The radius detector 21 includes, for example, a laser sensor. As shown in Fig. 1, the radius detector 21 is fixedly held at a higher position than the joining unit 23 via a bracket 26 standing on the beam 53.

[0028] The adhesive detector 22 includes, for example, a color sensor (a line sensor or an area sensor). The adhesive detector 22 is further attached to the joining unit 23, and thus can shift forward and backward together with the joining unit 23.

[0029] The drive part 70 is arranged at a most downstream position in a sheet conveyance direction in the sheet supply apparatus 1. The drive part 70 includes a driving roller 72 having an axis extending in the Y direction so as to support the sheet S, and a roller driving source 71 (Fig. 2) which generates a drive force to rotate the driving roller 72 around the axis at a predetermined speed. The roller driving source 71 includes, for example, a motor. A conveyance speed is regulated to supply the sheet S to the line in the downstream location at a predetermined conveyance speed by adjusting the rotational speed of the driving roller 72 via the output from the roller driving source 71.

[0030] The accumulating mechanism 30 is provided between the first support shaft 11 and the drive part 70 (the driving roller 72), and accumulates a predetermined length of the sheet S by receiving an upstream portion of the sheet S. The accumulating mechanism 30 serves as a control mechanism which executes feedback control via the controller 80 so that the running speed of the sheet S run from the first roll R1 coincides with the predetermined conveyance speed. As shown in Fig. 1, the accumulating mechanism 30 has a pair of fixed rollers 31, 32, and a movable roller 33 which is disposed between the pair of fixed rollers 31, 32 and moved depending on a tension of the sheet S. The sheet S being supplied can be supported on the fixed rollers 31, 32, and the movable roller 33.

[0031] When the tension of the sheet S is lower than a predetermined set value, the movable roller 33 is moved to increase a path length of the sheet S, thereby increasing an accumulated length of the sheet S. Conversely, when the tension of the sheet S is higher than the set value, the movable roller 33 is moved to decrease the path length of the sheet S, thereby decreasing the accumulated length of the sheet S.

[0032] The accumulating mechanism 30 further includes a position detection sensor 34 (Fig. 2) for detecting a position of the movable roller 33. A result of the detec-

tion obtained by the position detection sensor 34 is sent to the controller 80. The controller 80 controls the rotational speed of the first support shaft 11 based on the detection result. In other words, positional information of the movable roller 33 is fed back for the control of the first support shaft 11. Accordingly, it is possible to regulate the running speed of the sheet S run from the first roll R1 to coincide with the predetermined conveyance speed by placing the movable roller 33 at a predetermined position.

[0033] The controller 80 includes a CPU (Central Processing Unit), a RAM (Random Access Memory), a ROM (Read Only Memory) and the like in combination. As shown in Fig. 2, the controller 80 has a control portion 81 for controlling the respective operation parts of the sheet supply apparatus 1. The control portion 81 includes a rotary member control section 81A which controls rotation and stop of the motor constituting the rotary member driving source 18, a shaft control section 81B which controls rotation and stop of the motor constituting the shaft driving source 19, a unit control section 81C which controls drive and stop of the servomotor constituting the unit driving source 27, a cutter control section 81D which controls drive of the cutter driving source 25A, a roller control section 81E which controls rotation and stop of the motor constituting the roller driving source 71, a radius determination section 81F, and an adhesive position determination section 81G. The radius determination section 81F determines a radius at a specific position of the second roll R2 or a mean radius thereof based on the detection result from the radius detector 21. The adhesive position determination section 81G determines a circumferential position of the adhesive H on the outer peripheral surface of the second roll R2 based on the detection result from the adhesive detector 22.

[0034] The controller 80 executes controls described below in the ordinary operation where the sheet is supplied to the downstream location, and in the sheet joining. First, for the sheet supplying in the ordinary operation, the controller 80 (the shaft control section 81B and the roller control section 81E) controls the first support shaft 11 and the drive part 70 to supply the sheet S from the drive part 70 to the downstream location at the predetermined conveyance speed set for the line in the downstream location. At this time, the controller 80 controls the first support shaft 11 by using the feedback from the accumulating mechanism 30 so that the running speed of the sheet S from the first roll R1 coincides with the supply speed of the sheet S from the drive part 70.

[0035] Further, in the sheet joining, the controller 80 (the shaft control section 81B and the unit control section 81C) controls the first support shaft 11, the second support shaft 12, and the joining mechanism 20 to press the intermediate portion of the sheet S run from the first roll R1 onto the outer peripheral surface of the second roll R2 in the condition where the running speed of the sheet S run from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll

R2.

[0036] For example, when changing the type or size of a product to be manufactured in the line in the downstream location, it is necessary to use a roll or sheet having a changed specification as a material. Thus, the second roll R2 is replaced with another second roll R2 as a new material. The joining operation described above is then performed in a condition where the line in the downstream location is stopped and supply of the sheet S to the line is suspended.

[0037] Hereinafter, a sheet supply method according to the embodiment will be described in accordance with operations executed by the controller 80. Each of Figs. 3 and 4 is a flowchart showing a sequence of the sheet supply method. The description below is proceeded with reference to the flowchart.

[0038] In the ordinary operation where the sheet S is supplied to the line in the downstream location, first, an unwinding step S10 is executed. In this step, the first support shaft 11 and the drive part 70 are controlled by the controller 80 (the shaft control section 81B, the roller control section 81E) so that the sheet S run from the first roll R1 is supplied from the drive part 70 to the downstream location at the predetermined conveyance speed set for the line in the downstream location. At this time, the rotational speed of the first support shaft 11 is regulated depending on the position of the movable roller 33 in the accumulating mechanism 30 as described above. The second support shaft 12 is kept from rotating in this step.

[0039] Next, the drive of the first support shaft 11 and the drive part 70 is stopped by the controller 80 (the shaft control section 81B, the roller control section 81E) if the line in the downstream location is stopped and the operation of suspending the supply of the sheet S is performed by the operation part 90 (Fig. 2) ("YES" in step S20). Consequently, the supply of the sheet S from the sheet supply apparatus 1 to the line in the downstream location is suspended (step S30). Besides, the rotation of the rotary member 17 is controlled by the controller 80 (the rotary member control section 81A) to move the replaced standby second roll R2 serving as a new material to the splice position (Fig. 1) (Step S40).

[0040] Subsequently, a joining preparation step S50 is executed. In this step S50, first, a radius of the second roll R2 in standby is detected by the radius detector 21(step S51). Information about a result of the detection is transmitted to the controller 80 (the radius determination section 81F). In the case where the radius of the second roll R2 is known, this step may be omitted.

[0041] Thereafter, the unit driving source 27 is controlled by the controller 80 (the unit control section 81C) so that the joining unit 23 is moved closer to the second roll R2 at the splice position (step S52). At this time, the movement of the joining unit 23 is controlled on the basis of the information of the radius of the second roll R2 detected in step S51 to keep the sheet S run from the first roll R1 from coming into contact with the outer peripheral

surface of the second roll R2.

[0042] Subsequently, the second roll R2 is rotated, during the time where a circumferential position of the adhesive H on the outer peripheral surface of the rotating second roll R2 is detected by the adhesive detector 22 (step S53). Information of a result of the detection is transmitted to the controller 80 (the adhesive position determination section 81G).

[0043] Thereafter, the second roll R2 is rotated until the adhesive H arrives at a predetermined position based on the detection result, and the rotation is then stopped (step S54). Specifically, as shown in Fig. 5, the second roll R2 is rotated until the adhesive H moves to a position on upstream of a pressing position P1 (e.g., 50 mm before the pressing position P1) where the sheet S of the first roll R1 is pressed in the rotational direction (indicated by the arrow in the drawing) of the second roll R2.

[0044] After that, a joining step S60 is executed. In this step, the following controls are executed in the sequence described later. Specifically, the first support shaft 11, the second support shaft 12, and the joining mechanism 20 are controlled so that the sheet S run from the first roll R1 and the sheet S of the second roll R2 are joined to each other by pressing the intermediate portion of the sheet S run from the first roll R1 onto the outer peripheral surface of the second roll R2 in the condition where the running speed of the sheet S from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll R2. The cutter 25 is controlled to cut the sheet S from the first roll R1 at an upstream position of a joining section where the sheets have been joined to each other. It should be noted here that the supply of the sheet S from the drive part 70 to the downstream location is suspended in this step.

[0045] First, the feedback control to the first support shaft 11 based on the detection result from the position detection sensor 34 in the accumulating mechanism 30 is suspended (step S61). Next, prior to the joining operation, the rotation of the first support shaft 11 is controlled by the controller 80 (the shaft control section 81B) to wind back the sheet S to the first roll R1 until an accumulated length of the sheet S in the accumulating mechanism 30 comes to a minimum in advance (step S62). In other words, the sheet S is wound back to the first roll R1 until the path length of the sheet S in the accumulating mechanism 30 comes to a minimum.

[0046] Subsequently, the unit driving source 27 is controlled by the controller 80 (the unit control section 81C) so that the joining unit 23 is moved further closer to the second roll R2. Consequently, as shown in Fig. 5, the intermediate portion of the sheet S of the first roll R1 is pressed by the pressing roller 24 onto the outer peripheral surface of the second roll R2 (at a position on the outer peripheral surface of the second roll R2 other than the location where the adhesive H is provided) with a predetermined torque in the condition where the unwinding of the sheet S from the first roll R1 is suspended and the second roll R2 is kept from rotating (step S63).

[0047] The first support shaft 11 and the second support shaft 12 are then controlled by the controller 80 (the shaft control section 81B) so that the first roll R1 and the second roll R2 start the rotating while keeping the pressing state (step S64). At this time, the first support shaft 11 and the second support shaft 12 are controlled to rotate the second roll R2 until the adhesive H passes the pressing position PI in the condition where the running speed of the sheet S from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll R2. In this way, a leading end of the sheet S of the second roll R2 is adhered to the intermediate portion of the sheet S of the first roll R1 via the adhesive H. Consequently, the sheet S of the second roll R2 and the sheet S of the first roll R1 are joined to each other.

[0048] The first support shaft 11 is controlled by the controller 80 (the shaft control section 81B) to make the running speed of the sheet S from the first roll R1 in the joining step S60 lower than the predetermined conveyance speed in the unwinding step S10, and different from the supply speed (0 m/min) of the sheet S from the drive part 70 from which the supply of the sheet S to the downstream location is suspended, e.g., 5 m/min.

[0049] The sheet S run from the first roll R1 in the joining step S60 is received by and accumulated in the accumulating mechanism 30. The accumulating mechanism 30 operates (moves the movable roller 33) to increase the path length of the sheet S in accordance with a length of the sheet S run from the first roll R1 in the joining step S60. The accumulating mechanism 30 can be made to reliably accumulate the sheet S run from the first roll R1 in the joining step S60 by setting the accumulated length of the sheet S in the accumulating mechanism 30 at the minimum in advance in step S62. As a result, the accumulating mechanism 30 can receive and accumulate an excess of the sheet S caused by a speed difference between the running speed (5 m/min) of the sheet S from the first roll R1 and the supply speed (0 m/min) of the sheet S from the drive part 70.

[0050] As shown in Fig. 6, the sheet S of the first roll R1 is cut by the cutter 25 at an upstream position of the joining section where the sheet S of the first roll R1 is joined to the sheet S of the second roll R2, and the rotation of the first roll R1 and the second roll R2 are stopped (step S65). The controller 80 shifts from the supply control to the standby control for the first roll R1, and from the standby control to the supply control for the second roll R2 (step S66).

[0051] Here, the statement "the running speed of the sheet S from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll R2" means that the two speeds coincide with each other at the pressing position PI. Hence, the running speed of the sheet S run from the first roll R1 may be slightly reduced as far as causing no influence on the running speed of the sheet S at the pressing position P1. This makes it possible to increase the tension of the sheet S between the first roll R1 and the pressing position PI, and

hence enables the cutter 25 to more easily cut the sheet S comparing to a loosen state.

[0052] Next, the accumulated length of the sheet S in the accumulating mechanism 30 is adjusted to an appropriate value by performing the feedback control to the second support shaft 12 based on the detection result from the position detection sensor 34 in the accumulating mechanism 30 to rotate the second roll R2 (step S67). After that, the joining unit 23 is moved backward and the rotary member 17 is rotated to move the second roll R2 to a higher position than the first roll R1 in the Z direction (step S68). As shown in Fig. 7, the first roll R1 is reversely rotated to wind up the portion of the sheet S that is upstream of the cutting position, and the rotation of the first roll R1 is stopped after the winding-up of the sheet S is completed (step S69). Step 69 is executed in parallel with steps S67, S68.

[0053] Subsequently, the second support shaft 12 and the drive part 70 are controlled by the controller 80 (the shaft control section 12, the roller control section 81E) to guide the leading end of the fresh sheet S run from the second roll R2 to the line in the downstream location through the predetermined route. Thereafter, the supply of the sheet S is restarted at the predetermined conveyance speed upon restarting the operation of the line in the downstream location. The sheet supply method according to the embodiment is conducted in the above-described sequence.

(Second Embodiment)

[0054] A sheet supply apparatus and a sheet supply method according to a second embodiment of the present invention will be described with reference to Fig. 8. An operation of joining sheets S in the second embodiment is performed concurrently with an ordinary operation where the sheet S is supplied to a line in a downstream location, whereas the operation of joining the sheets S in the first embodiment is performed in the condition where the line is stopped. Hereinafter, only the differences from the first embodiment will be described.

[0055] First, a configuration of a sheet supply apparatus 1A according to the second embodiment will be described. The sheet supply apparatus 1A includes an accumulating mechanism 30 which is configured to counterbalance an excess or a deficiency of the sheet S which is caused by a speed difference between a running speed of the sheet S from a first roll R1 and a supply speed of the sheet S from a drive part 70 in the sheet joining. Specifically, as shown in Fig. 8, the accumulating mechanism 30 further includes a gathering mechanism 35 which gathers a predetermined length of the sheet S in addition to a feedback control mechanism (fixed rollers 31, 32, a movable roller 33) described in the first embodiment. The gathering mechanism 35 is provided between the joining mechanism 20 and the feedback control mechanism.

[0056] The gathering mechanism 35 has a plurality of fixed guide rollers 37 and a plurality of movable guide

rollers 36. Each of the fixed guide rollers 37 is fixedly held at a specific position. The movable guide rollers 36 are movable closer to or away from the fixed guide rollers 37. Specifically, a movable guide roller(s) 36 is moved away from the fixed guide rollers 37 to increase the path length of the sheet S or closer to the fixed guide rollers 37 to decrease the path length of the sheet S.

[0057] Next, a sheet supply method according to the second embodiment conducted by using the sheet supply apparatus 1A will be described. In the sheet supply method, the operation of joining the sheets S is performed concurrently with the ordinary operation where the sheet S is supplied to the line in the downstream location. Therefore, step S30 in Fig. 3 is omitted. Further, in place of step S20, it is determined whether a predetermined joining criterion (e.g., whether a residual length of the first roll R1 is smaller than a predetermined length) is satisfied. When the criterion is satisfied, the second roll R2 is moved to a splice position (Fig. 8) (step S40) while the ordinary operation is maintained.

[0058] Subsequently, a radius of the second roll R2 is measured (step S51), a joining unit 23 is moved closer to the second roll R2 (step S52), and a position of the adhesive H is detected (step S53) and adjusted (step S54) in the joining preparation step S50 while the ordinary operation is maintained.

[0059] The step 61 of suspending the control to a first support shaft 11 depending on a sheet tension is omitted from the joining step S60. The feedback control mechanism performs the feedback control to the running speed of the sheet S from the first roll R1 and a gathered length of the sheet S in the gathering mechanism 35 via a controller 80 depending on the tension of the sheet S. The controller 80 then controls the gathering mechanism 35 to move a movable guide roller(s) 36, and accumulate the sheet S in the gathering mechanism 35 by receiving an upstream portion of the sheet S.

[0060] The first support shaft 11 is controlled with a feedback from the feedback control mechanism to accelerate the sheet S from the first roll R1 so that the running speed of the sheet S from the first roll R1 is higher than a predetermined conveyance speed. An excess of the sheet S which is caused by a speed difference between the running speed of the accelerated sheet S and the predetermined conveyance speed is gathered in the gathering mechanism 35. The sequence of operations is performed in place of step S62 (i.e., winding-up of the sheet onto the first roll R1) in Fig. 4.

[0061] Subsequently, the first support shaft 11 is controlled by the controller 80 (a shaft control section 81B) to make the running speed of the sheet S from the first roll R1 lower than the predetermined conveyance speed (that is equal to a supply speed of the sheet S from a drive part 70). At the same time, the feedback control mechanism places the gathering mechanism 35 under the feedback control via the controller 80 for supply of the sheet S therefrom to the downstream location at the predetermined conveyance speed. Specifically, a mov-

able guide roller(s) 36 is moved so as to supply the sheet S from the gathering mechanism 35 to the downstream location to compensate for a deficiency being caused by a speed difference between the speed of receiving the upper portion of the sheet to the gathering mechanism 35 and a supply speed from the gathering mechanism 35 to the downstream location. The remainder of the joining step 60 is executed while the sheet S is supplied from the gathering mechanism 35 to the downstream location to compensate for the deficiency.

[0062] In other words, a second support shaft 12 is controlled by the controller 80 (the shaft control section 81B) so that a moving speed of an outer peripheral surface of a second roll R2 coincides with the running speed of the sheet S run from the first roll R1. That is, step S64 precedes step S63 in Fig. 4.

[0063] Subsequently, the joining mechanism 20 is controlled by the controller 80 (a unit control section 81C) so that an intermediate portion of the sheet S run from the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 at a time when the adhesive H on the outer peripheral surface of the second roll R2 passes a pressing position P1. Consequently, the sheet S of the second roll R2 and the sheet S of the first roll R1 are joined to each other while the ordinary operation is maintained (step S63).

[0064] In the joining step S60, the sheet S gathered in the gathering mechanism 35 is supplied to the line in the downstream location at the predetermined conveyance speed, and the sheet S run from the first roll R1 is received by the gathering mechanism 35. Here, since the running speed of the sheet S from the first roll R1 is lower than the predetermined conveyance speed, the gathered length of the sheet S in the gathering mechanism 35 gradually decreases in accordance with the difference between the two speeds.

[0065] After the joining operation is completed, the sheet S from the first roll R1 is cut by the cutter 25 at an upstream position of a joining section of the sheets while the unwinding of the sheet S from the first roll R1 is continued and the second roll R2 is kept rotating (step S65). The control for each of the rolls is shifted in the same manner as that in the first embodiment (step S66).

[0066] Thereafter, positional adjustment of the first and second rolls R1, R2 is performed (step S68). In this case, since the second support shaft 12 and the gathering mechanism 35 are kept under the feedback control depending on the sheet tension, step S67 in Fig. 4 is omitted. Besides, after the whole of the sheet S that has been gathered in the gathering mechanism 35 is supplied to the downstream location, the movable guide rollers 36 in the gathering mechanism 35 are controlled to stop and the running speed of the sheet S from the second roll R2 is controlled to coincide with a supply speed (i.e., the predetermined conveyance speed) of the sheet S from the drive part 70 to the downstream location. This operation is performed in place of step S69 (the winding-up of the sheet S onto the first roll R1) in Fig. 4.

[0067] In the second embodiment, the sheet S is supplied from the drive part 70 to the line in the downstream location at a high speed while the running speed of the sheet S from the first roll R1 is kept at such a suitable speed that ensures the easy joining operation, which thus facilitates the timing for the joining operation. Further, the accumulating mechanism 30 is allowed to counterbalance an excess or a deficiency of the sheet S which is caused by the speed difference between the running speed of the sheet S from the first roll R1 and the supply speed of the sheet from the drive part 70.

[0068] The features and operational effects of the sheet supply apparatus 1, 1A and the sheet supply method according to the first and second embodiments discussed above will be described below.

[0069] A sheet supply method according to the first and second embodiments is a method for sequentially unwinding a sheet S from a first roll R1 of sheet S and a second roll R2 of sheet S for sheet supply by using a sheet supply apparatus 1, 1A including: a first support shaft 11 which rotatably supports the first roll R1 of sheet S at a center position thereof; a second support shaft 12 which rotatably supports the second roll R2 of sheet S at a center position thereof; a joining mechanism 20 which joins the sheet S of the second roll R2 and the sheet S of the first roll R1 to each other; a drive part 70 which supplies the sheet S run from the first roll R1 or the second roll R2 to a downstream location; an accumulating mechanism 30 which is provided between the first support shaft 11 and the drive part 70, and accumulates a predetermined length of sheet S by receiving an upstream portion of the sheet S. The sheet supply method includes: unwinding step of controlling the first support shaft 11 to supply the sheet S from the drive part 70 to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location; and a joining step of controlling the first support shaft 11, the second support shaft 12, and the joining mechanism 20 to join the sheet S from the first roll R1 to the sheet S of the second roll R2 by pressing an intermediate portion of the sheet S run from the first roll R1 onto an outer peripheral surface of the second roll R2 in a condition where a running speed of the sheet S from the first roll R1 coincides with a moving speed of the outer peripheral surface of the second roll R2, and to cut the sheet S from the first roll R1 at an upstream position of a joining section where the sheet S from the first roll R1 has been joined to the sheet S of the second roll R2. In the joining step, the first support shaft 11 is controlled to make the running speed of the sheet S run from the first roll R1 lower than the predetermined conveyance speed in the unwinding step, and different from a supply speed of the sheet S from the drive part 70 in the joining step, thereby causing the accumulating mechanism 30 to decelerate or accelerate the sheet S running to counterbalance an excess or a deficiency of the sheet S which is caused by a speed difference between the running speed of the sheet S from the first roll R1 and the supply speed of the sheet S from

the drive part 70.

[0070] A sheet supply apparatus 1, 1A according to the first and second embodiments is a sheet supply apparatus for sequentially unwinding a sheet S from a first roll R1 of sheet S and a second roll R2 of sheet S for sheet supply. The sheet supply apparatus 1, 1A includes: a first support shaft 11 which rotatably supports the first roll R1 at a center position thereof; a second support shaft 12 which rotatably supports the second roll R2 at a center position thereof; a joining mechanism 20 which joins the sheet S of the second roll R2 and the sheet S of the first roll R1 to each other, and includes a cutter 25 for cutting the sheet S run from the first roll R1 at an upstream position of a joining section where the sheets S have been joined to each other after the sheet joining; a drive part 70 which supplies the sheet S run from the first roll R1 or the second roll R2 to a downstream location of the sheet supply apparatus 1, 1A; a controller 80 which controls the first support shaft 11 to supply the sheet S from the drive part 70 to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location in an ordinary operation where the sheet S is supplied from the sheet supply apparatus 1, 1A to the downstream location, and controls the first support shaft 11, the second support shaft 12, and the joining mechanism 20 to press an intermediate portion of the sheet S run from the first roll R1 onto an outer peripheral surface of the second roll R2 in a condition where a running speed of the sheet S from the first roll R1 coincides with a moving speed of the outer peripheral surface of the second roll R2 for the sheet joining; and an accumulating mechanism 30 which is provided between the first support shaft 11 and the drive part 70, and accumulates a predetermined length of sheet S by receiving an upstream portion of the sheet S. The controller 80 controls the first support shaft 11 to make the running speed of the sheet S from the first roll R1 lower than the predetermined conveyance speed for the sheet joining, and different from a supply speed of the sheet S from the drive part 70 for the sheet joining, thereby causing the accumulating mechanism 30 to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet S which is caused by a speed difference between the running speed of the sheet S from the first roll R1 and the supply speed of the sheet S from the drive part 70.

[0071] In this way, it is possible to make the running speed of the sheet S from the first roll R1 lower than the predetermined conveyance speed of the sheet S set for the apparatus in the downstream location for the sheet joining, and different from the supply speed of the sheet S supplied from the drive part 70 to the downstream location for the sheet joining. Therefore, the running speed of the sheet S from the first roll R1 in the sheet joining can be decreased to such a speed that ensures the easy joining operation even at a high speed of supplying the sheet S to the downstream location, which enables the joining operation to be performed more easily at an ac-

curate timing. Moreover, in the joining operation, the accumulating mechanism 30 receives and accumulates an excess of the sheet S which is caused by a speed difference between the running speed of the sheet S from the first roll R1 and the supply speed of the sheet S from the drive part 70. Owing to the accumulation, the sheet can be unwound from the first roll R1 at a predetermined running speed even in the state where the apparatus in the downstream location is stopped, i.e., even in the state where the conveyance speed of the sheet S to be supplied from the drive part 70 to the downstream location indicates "0". Consequently, it is possible to join the sheets S to each other in the state where the sheet supply to the downstream location is suspended.

[0072] In the sheet supply method according to the first embodiment, in a case where the supplying of the sheet S from the drive part 70 to the downstream location is suspended in the joining step, the first support shaft 11, the second support shaft 12, and the joining mechanism 20 are controlled so that the intermediate portion of the sheet S run from the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 in the condition where the running speed of the sheet S from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll R2, thereby causing the accumulating mechanism 30 to receive and accumulate the excess of the sheet which is caused by the speed difference between the running speed of the sheet S run from the first roll R1 and the supply speed of the sheet S from the drive part 70. In the sheet supply apparatus 1 according to the first embodiment, the first support shaft 11, the second support shaft 12, and the joining mechanism 20 are controlled by the controller 80 so that the intermediate portion of the sheet S run from the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 in the condition where the running speed of the sheet S from the first roll R1 coincides with the moving speed of the outer peripheral surface of the second roll R2. This control contributes to the operation of joining the sheets S to each other even when the line is stopped for use of a sheet S having a changed specification or the like.

[0073] In the sheet supply method according to the first embodiment, in the joining step, prior to the sheet joining, the first support shaft 11 is controlled to wind up the sheet S onto the first roll R1 until an accumulated length of the sheet S in the accumulating mechanism 30 comes to a minimum in advance. In the sheet supply apparatus 1 according to the first embodiment, prior to the sheet joining, the controller 80 controls the first support shaft 11 to wind up the sheet S onto the first roll R1 until an accumulated length of the sheet S in the accumulating mechanism 30 comes to a minimum in advance.

In this way, the accumulating mechanism 30 can accumulate a sufficiently large length of the sheet S even when the sheet S is unwound from the first roll R1 in the joining operation in the state where the supply of the sheet S from the drive part 70 to the downstream location

is suspended.

[0074] In the sheet supply method according to the first embodiment, in the joining step, the first support shaft 11, the second support shaft 12, and the joining mechanism 20 are controlled so that the intermediate portion of the sheet S of the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 in a condition where the unwinding of the sheet S from the first roll R1 is suspended and rotation of the second roll R2 is stopped, and the first roll R1 and the second roll R2 rotate thereafter. In the sheet supply apparatus 1 according to the first embodiment, in the joining step, the controller 80 controls the first support shaft 11, the second support shaft 12, and the joining mechanism 20 so that the intermediate portion of the sheet S of the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 in a condition where the unwinding of the sheet S from the first roll R1 is suspended and rotation of the second roll R2 is stopped, while allowing the first roll R1 and the second roll R2 to rotate thereafter. In this way, the sheets S can be pressed to each other in the state where the running of the sheet S from the first roll R1 and the second roll R2 is suspended. The adhesive H provided on the outer peripheral surface of the second roll R2 is therefore allowed to move to an appropriate position upstream of the pressing position P1 where the sheet S run from the first roll R1 is pressed in the rotational direction of the second roll R2. In this manner, the sheets S of the first roll R1 and the second roll R2 can be joined to each other via the adhesive H by displacing the rolls relative to each other with a small amount. Consequently, it is possible to reliably join the sheets S to each other without excessively increasing the accumulated length of the sheet S in the accumulating mechanism 30.

[0075] The supply method according to the first embodiment includes the joining preparation step of detecting a circumferential position of the adhesive H on the peripheral surface of the second roll R2 where the adhesive H is provided. In the joining step, the second support shaft 12 and the joining mechanism 20 are controlled so that the intermediate portion of the sheet of the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 at a position except the position of the adhesive H based on the detection result, and the second roll R2 rotates thereafter until the adhesive H passes the pressing position. In the sheet supply apparatus 1 according to the first embodiment, the joining mechanism 20 has the adhesive detector 22 which detects the circumferential position of the adhesive H on the outer peripheral surface of the second roll R2 where the adhesive H is provided. The controller 80 controls the second support shaft 12 and the joining mechanism 20 by using the detection result from the adhesive detector 22 so that the intermediate portion of the sheet S of the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 at a position except the position of the adhesive H, and the second roll R2 rotates thereafter until the adhesive H passes the pressing position PI. This conse-

quently achieves reliable joining of the sheets S to each other over the entire length of the adhesive H by allowing the adhesive H to surely pass the pressing position between the sheets S.

Other Embodiments

[0076] Finally, other embodiments of the present invention will be described below.

[0077] Although described in the first embodiment is the case where the sheet S of the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 in the state where the first roll R1 and the second roll R2 are kept from rotating, the pressing way should not be limited thereto. For example, the pressing operation may be performed while the sheet S is unwound from the first roll R1. Furthermore, the detection of the radius of the second roll R1, and the positional detection and the positional adjustment of the adhesive H also can be executed while the sheet S is unwound from the first roll R1.

[0078] Described in the first embodiment is the case where the sheet S of the first roll R1 is cut by the cutter 25 before the rotation of the first roll R1 and the second roll R2 is stopped. However, the sheet S may be cut after the rotation of the first roll R1 and the second roll R2 is stopped.

[0079] In the first embodiment, the accumulating mechanism 30 serves as the feedback control mechanism. Alternatively, another accumulating mechanism (i.e., the gathering mechanism 35) independent from the control mechanism may be provided as in the second embodiment. The gathering mechanism 35 may be omitted by increasing the accumulated length of the sheet S in the feedback control mechanism in the second embodiment.

[0080] Described in the second embodiment is the case where the sheet S from the first roll R1 is pressed onto the outer peripheral surface of the second roll R2 while the sheet S is unwound from the first roll R1. However, the pressing operation may be performed in a state where the first roll R1 and the second roll R2 are kept from rotating.

[0081] Described in each of the first embodiment and the second embodiment is the case where the rotary member 17 includes the first support shaft 11 and the second support shaft 12. However, the rotary member 17 may have three or more support shafts for rotatably supporting the rolls at their respective center positions.

[0082] The embodiments will be briefly discussed below.

[0083] A sheet supply method according to the embodiment is a sheet supply method for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply by using a sheet supply apparatus including: a first support shaft which rotatably supports the first roll of sheet at a center position thereof; a second support shaft which rotatably supports the second roll of sheet at a center position thereof; a joining mechanism

which joins the sheet of the second roll and the sheet of the first roll to each other; a supply part which supplies the sheet run from the first roll or the second roll to a downstream location; and an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet. The sheet supply method includes: an unwinding step of controlling the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location; and a joining step of controlling the first support shaft, the second support shaft, and the joining mechanism to join the sheet from the first roll to the sheet of the second roll by pressing an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll, and to cut the sheet from the first roll at an upstream position of a joining section where the sheet from the first roll has been joined to the sheet of the second roll. In the joining step, the first support shaft is controlled to make the running speed of the sheet run from the first roll lower than the predetermined conveyance speed in the unwinding step, and different from a supply speed of the sheet from the supply part in the joining step, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part.

[0084] With this sheet supply method, it is possible to make the running speed of the sheet from the first roll lower than the predetermined conveyance speed set for the apparatus in the downstream location for the sheet joining, and different from the supply speed of the sheet supplied from the supply part to the downstream location for the joining step. Therefore, the running speed of the sheet from the first roll in the sheet joining can be decreased to such a speed that ensures the easy joining operation even at a high speed of supplying the sheet to the downstream location, which enables the joining operation to be performed more easily at an accurate timing. Moreover, in the joining operation, the accumulating mechanism receives and accumulates an excess of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part. Owing to the accumulation, the sheet can be unwound from the first roll at a predetermined running speed even in the state where the apparatus in the downstream location is stopped, i.e., even in the state where the conveyance speed of the sheet to be supplied from the supply part to the downstream location indicates "0". Consequently, it is possible to join the sheets to each other in the state where the sheet supply to the downstream location is

suspended.

[0085] In the sheet supply method, in a case where the sheet supply from the supply part to the downstream location is suspended in the joining step, the first support shaft, the second support shaft, and the joining mechanism may be controlled so that the intermediate portion of the sheet run from the first roll is pressed onto the outer peripheral surface of the second roll in the condition where the running speed of the sheet from the first roll coincides with the moving speed of the outer peripheral surface of the second roll, thereby causing the accumulating mechanism to receive and accumulate the excess of the sheet which is caused by the speed difference between the running speed of the sheet run from the first roll and the supply speed of the sheet from the supply part.

[0086] With this method, it is possible to perform the sheet joining operation even when the line is stopped for use of a sheet having a changed specification or the like.

[0087] In the sheet supply method, in the joining step, prior to the sheet joining, the first support shaft may be controlled to wind up the sheet onto the first roll until an accumulated length of the sheet in the accumulating mechanism comes to a minimum in advance.

[0088] With this method, a sufficiently large length of the sheet can be accumulated in the accumulating mechanism even when the sheet is unwound from the first roll R1 in the joining operation in the state where the sheet supply from the supply part to the downstream location is suspended.

[0089] In this sheet supply method, in the joining step, the first support shaft, the second support shaft, and the joining mechanism may be controlled so that the intermediate portion of the sheet of the first roll is pressed onto the outer peripheral surface of the second roll in a condition where the unwinding of the sheet from the first roll is suspended and the rotation of the second roll is stopped, and the first roll and the second roll rotate thereafter.

[0090] With this method, the sheets can be pressed to each other in the state where the running of the sheet from the first roll and the second roll is suspended. The adhesive provided on the outer peripheral surface of the second roll is therefore allowed to move to an appropriate position upstream of the position where the sheet run from the first roll is pressed in the rotational direction of the second roll. In this manner, the sheets of the first roll and the second roll can be joined to each other via the adhesive by displacing the rolls relative to each other with a small amount. Consequently, it is possible to reliably join the sheets to each other without excessively increasing the accumulated length of the sheet in the accumulating mechanism.

[0091] A sheet supply apparatus according to the embodiment is a sheet supply apparatus for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply. The sheet supply apparatus includes: a first support shaft which rotatably supports

the first roll at a center position thereof; a second support shaft which rotatably supports the second roll at a center position thereof; a joining mechanism which joins the sheet of the second roll and the sheet of the first roll to each other, and includes a cutter for cutting the sheet run from the first roll at an upstream position of a joining section where the sheets have been joined to each other after the sheet joining; a supply part which supplies the sheet run from the first roll or the second roll to a downstream location of the sheet supply apparatus; a controller which controls the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location in an ordinary operation where the sheet is supplied from the sheet supply apparatus to the downstream location, and controls the first support shaft, the second support shaft, and the joining mechanism to press an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll for the sheet joining; and an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet. The controller controls the first support shaft to make the running speed of the sheet from the first roll lower than the predetermined conveyance speed for the sheet joining, and different from a supply speed of the sheet from the supply part for the sheet joining, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part.

[0092] The sheet supply apparatus makes it possible to make the running speed of the sheet from the first roll lower than the predetermined conveyance speed of the sheet set for the apparatus in the downstream location, and different from the supply speed of the sheet from the supply part to the downstream location for the sheet joining. Therefore, unlike conventional sheet supply apparatus, the sheet supply apparatus can decrease the running speed of the sheet from the first roll in the sheet joining step to such a speed that ensures the easy joining operation even at a high speed of supplying the sheet to the downstream location, which enables the joining operation to be performed more easily at an accurate timing. Moreover, in the joining operation, the accumulating mechanism receives and accumulates an excess of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part. Owing to the accumulation, the sheet can be unwound from the first roll at a predetermined running speed even in the state where the apparatus in the downstream location is stopped, i.e., even in the state where the conveyance

speed of the sheet to be supplied from the supply part to the downstream location indicates "0". Consequently, it is possible to join the sheets to each other in the state where the sheet supply to the downstream location is suspended.

[0093] In the sheet supply apparatus, in a case where the sheet supply from the supply part to the downstream location is suspended, the controller may control the first support shaft, the second support shaft, and the joining mechanism to press the intermediate portion of the sheet run from the first roll onto the outer peripheral surface of the second roll in the condition where the running speed of the sheet from the first roll coincides with the moving speed of the outer peripheral surface of the second roll.

[0094] With this configuration, it is possible to perform the sheet joining operation even when the line is stopped for use of a sheet having a changed specification or the like.

Claims

- 1. A sheet supply method for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply by using a sheet supply apparatus including: a first support shaft which rotatably supports the first roll of sheet at a center position thereof; a second support shaft which rotatably supports the second roll of sheet at a center position thereof; a joining mechanism which joins the sheet of the second roll and the sheet of the first roll to each other; a supply part which supplies the sheet run from the first roll or the second roll to a downstream location; and an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet, the sheet supply method comprising:

an unwinding step of controlling the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location; and

a joining step of controlling the first support shaft, the second support shaft, and the joining mechanism to join the sheet from the first roll to the sheet of the second roll by pressing an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll, and to cut the sheet from the first roll at an upstream position of a joining section where the sheet from the first roll has been joined to the sheet of the second roll, wherein in the joining step, the first support shaft is con-

trolled to make the running speed of the sheet run from the first roll lower than the predetermined conveyance speed in the unwinding step, and different from a supply speed of the sheet from the supply part in the joining step, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part.

- 2. A sheet supply method according to claim 1, wherein in a case where the sheet supply from the supply part to the downstream location is suspended in the joining step, the first support shaft, the second support shaft, and the joining mechanism are controlled so that the intermediate portion of the sheet run from the first roll is pressed onto the outer peripheral surface of the second roll in the condition where the running speed of the sheet from the first roll coincides with the moving speed of the outer peripheral surface of the second roll, thereby causing the accumulating mechanism to receive and accumulate the excess of the sheet which is caused by the speed difference between the running speed of the sheet run from the first roll and the supply speed of the sheet from the supply part.

- 3. A sheet supply method according to claim 1 or 2, wherein in the joining step, prior to the sheet joining, the first support shaft is controlled to wind up the sheet onto the first roll until an accumulated length of the sheet in the accumulating mechanism comes to a minimum in advance.

- 4. A sheet supply method according to any one of claims 1 to 3, wherein in the joining step, the first support shaft, the second support shaft, and the joining mechanism are controlled so that the intermediate portion of the sheet of the first roll is pressed onto the outer peripheral surface of the second roll in a condition where the unwinding of the sheet from the first roll is suspended and rotation of the second roll is stopped, and the first roll and the second roll rotate thereafter.

- 5. A sheet supply apparatus for sequentially unwinding a sheet from a first roll of sheet and a second roll of sheet for sheet supply, the sheet supply apparatus comprising:

a first support shaft which rotatably supports the first roll at a center position thereof;
a second support shaft which rotatably supports the second roll at a center position thereof;

a joining mechanism which joins the sheet of the second roll and the sheet of the first roll to each other, and includes a cutter for cutting the sheet run from the first roll at an upstream position of a joining section where the sheets have been joined to each other after the sheet joining; 5

a supply part which supplies the sheet run from the first roll or the second roll to a downstream location of the sheet supply apparatus; 10

a controller which controls the first support shaft to supply the sheet from the supply part to the downstream location at a predetermined conveyance speed set for an apparatus in the downstream location in an ordinary operation where the sheet is supplied from the sheet supply apparatus to the downstream location, and controls the first support shaft, the second support shaft, and the joining mechanism to press an intermediate portion of the sheet run from the first roll onto an outer peripheral surface of the second roll in a condition where a running speed of the sheet from the first roll coincides with a moving speed of the outer peripheral surface of the second roll for the sheet joining; and 20

an accumulating mechanism which is provided between the first support shaft and the supply part, and accumulates a predetermined length of sheet by receiving an upstream portion of the sheet, wherein 25

the controller controls the first support shaft to make the running speed of the sheet from the first roll lower than the predetermined conveyance speed for the sheet joining, and different from a supply speed of the sheet from the supply part for the sheet joining, thereby causing the accumulating mechanism to decelerate or accelerate the sheet running to counterbalance an excess or a deficiency of the sheet which is caused by a speed difference between the running speed of the sheet from the first roll and the supply speed of the sheet from the supply part. 30 35 40

6. A sheet supply apparatus according to claim 5, wherein 45
- in a case where the sheet supply from the supply part to the downstream location is suspended, the controller controls the first support shaft, the second support shaft, and the joining mechanism to press the intermediate portion of the sheet run from the first roll onto the outer peripheral surface of the second roll in the condition where the running speed of the sheet from the first roll coincides with the moving speed of the outer peripheral surface of the second roll. 50 55

FIG. 2

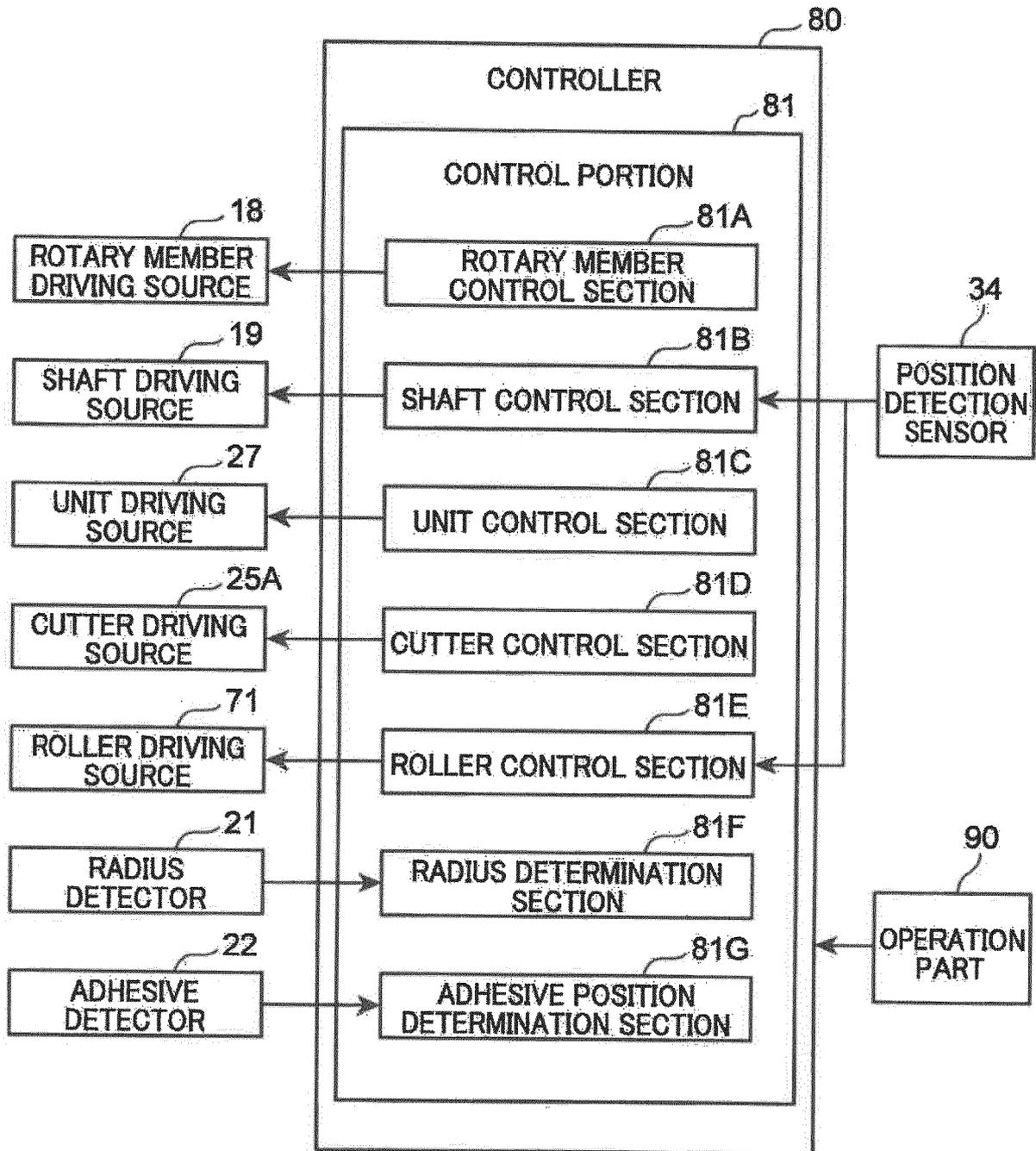


FIG. 3

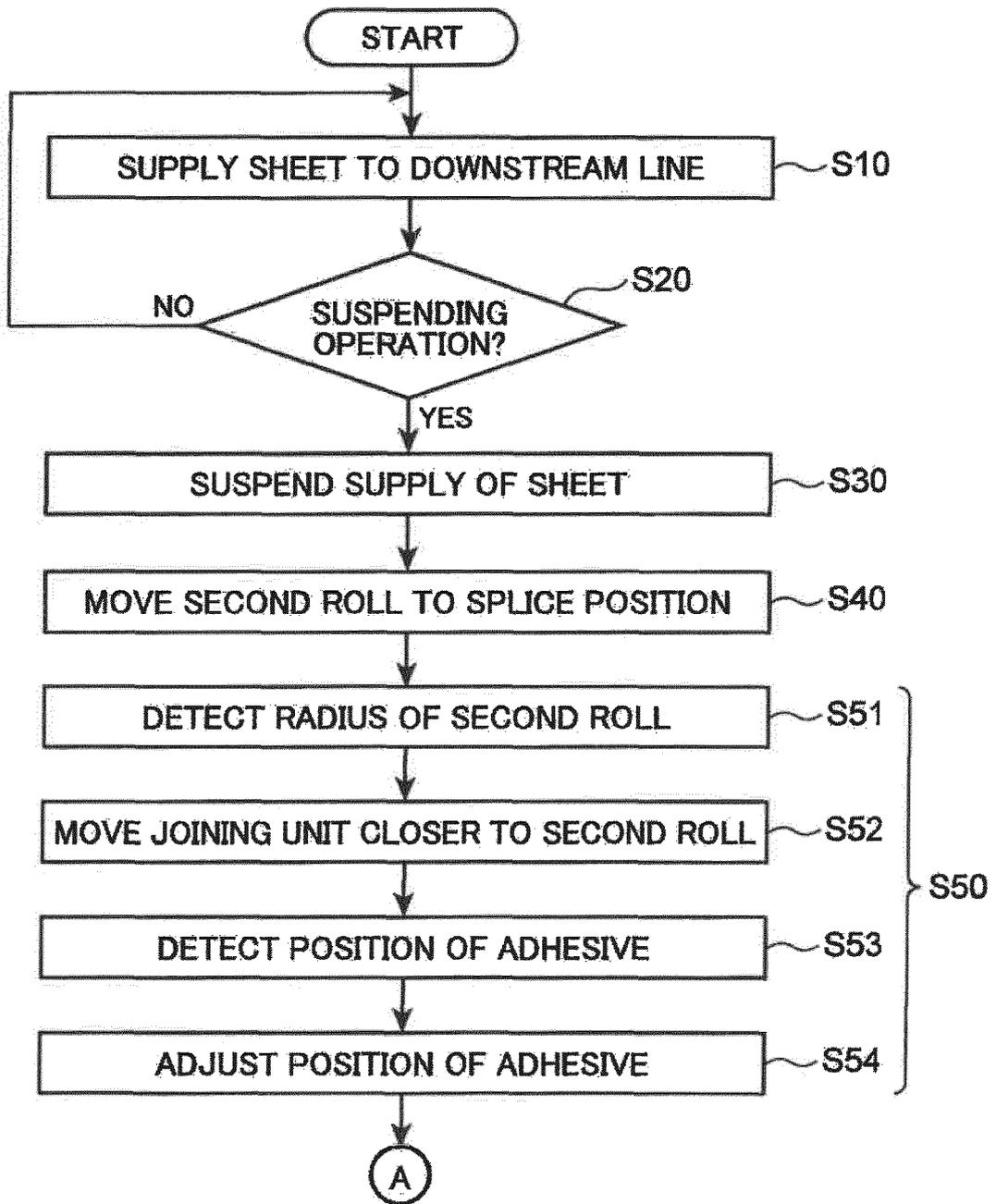


FIG. 4

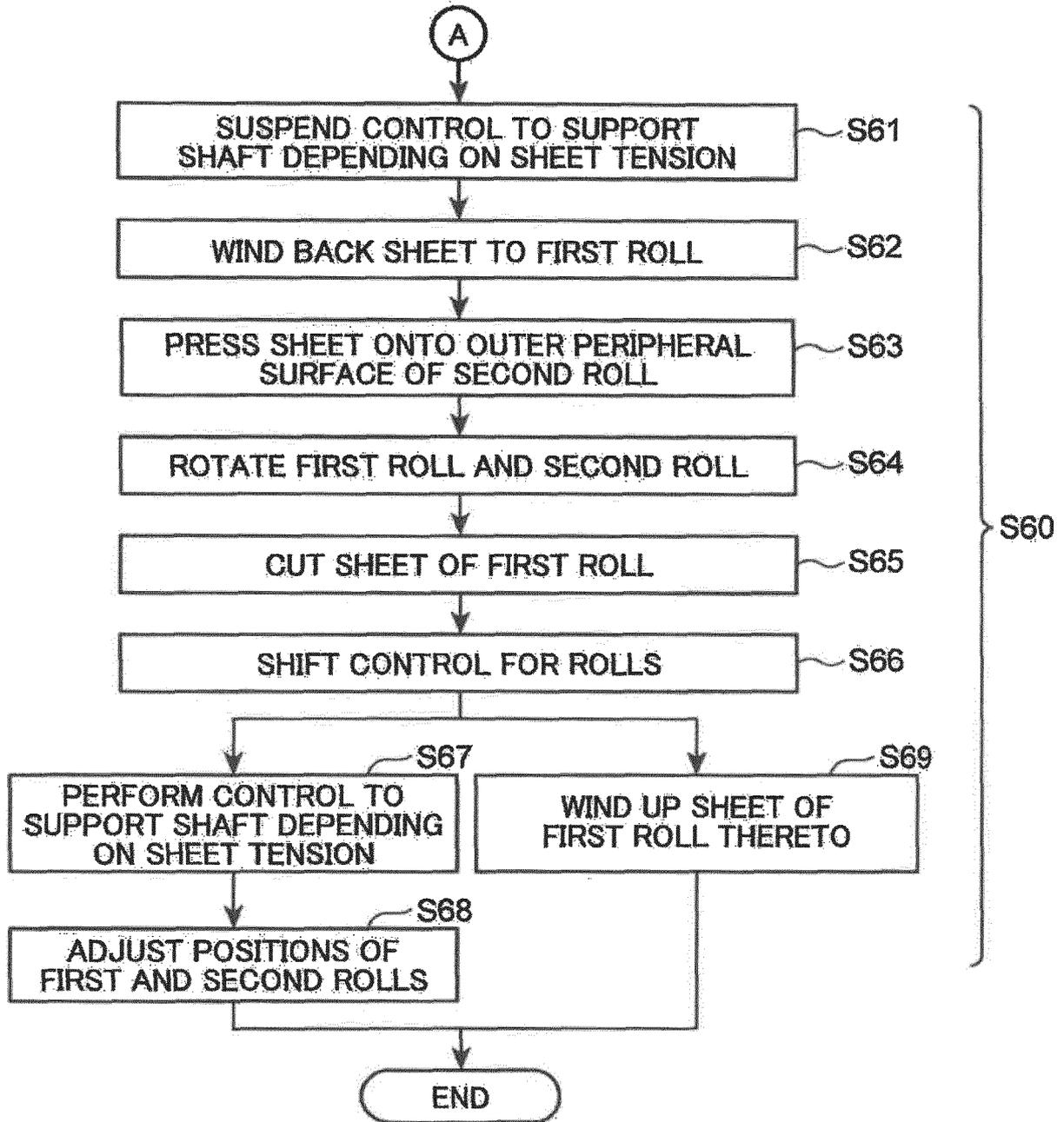


FIG. 5

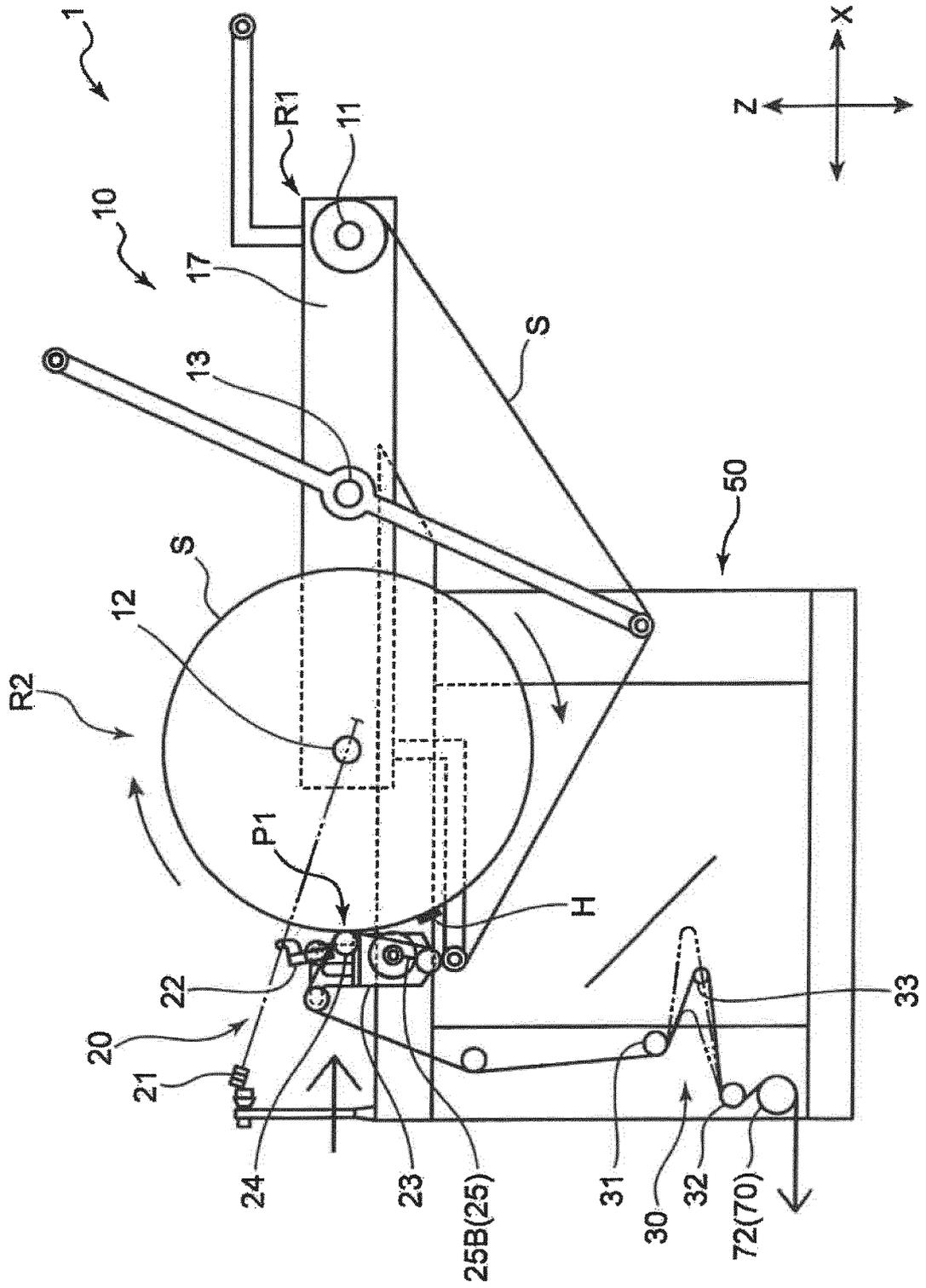
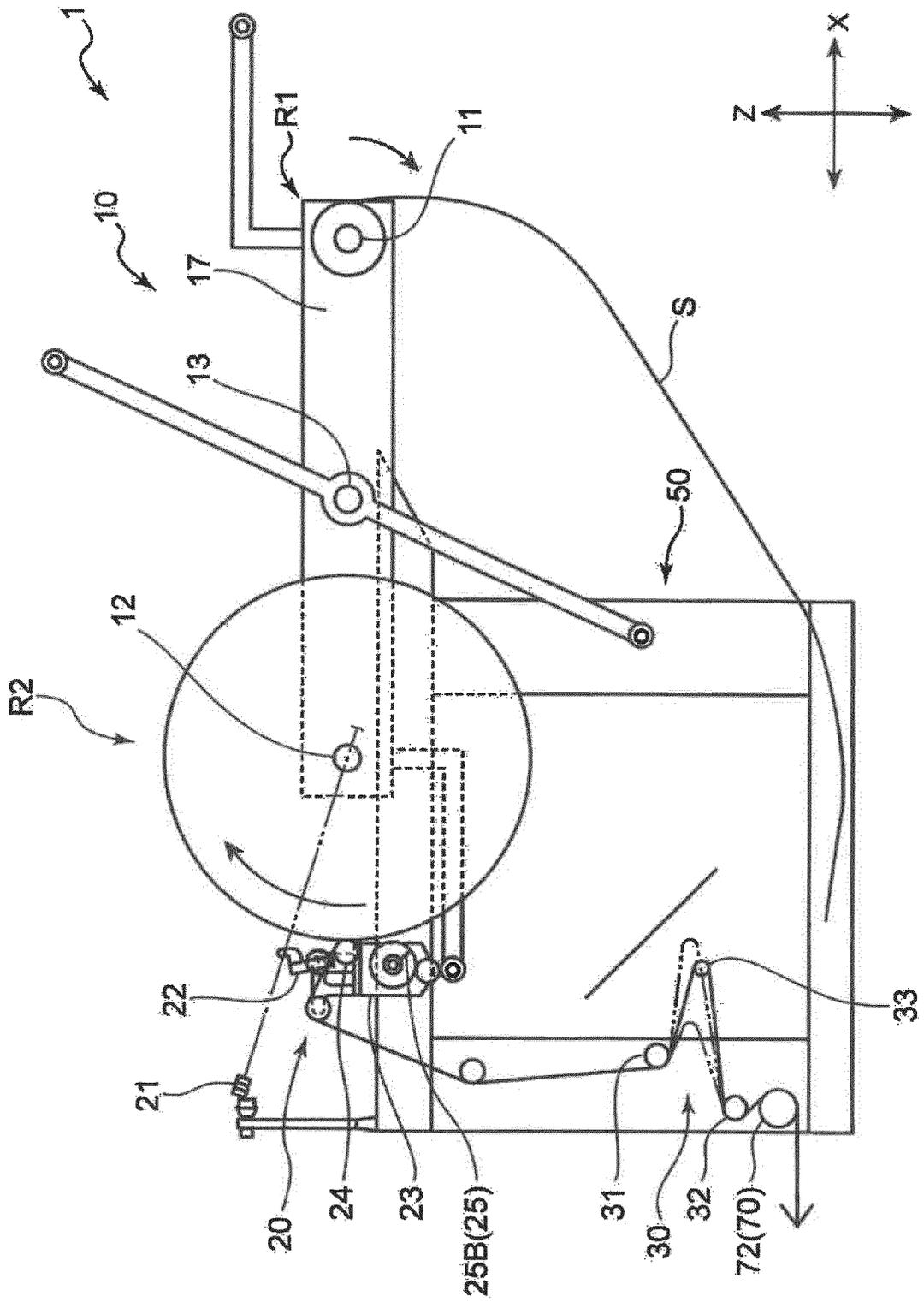


FIG. 6



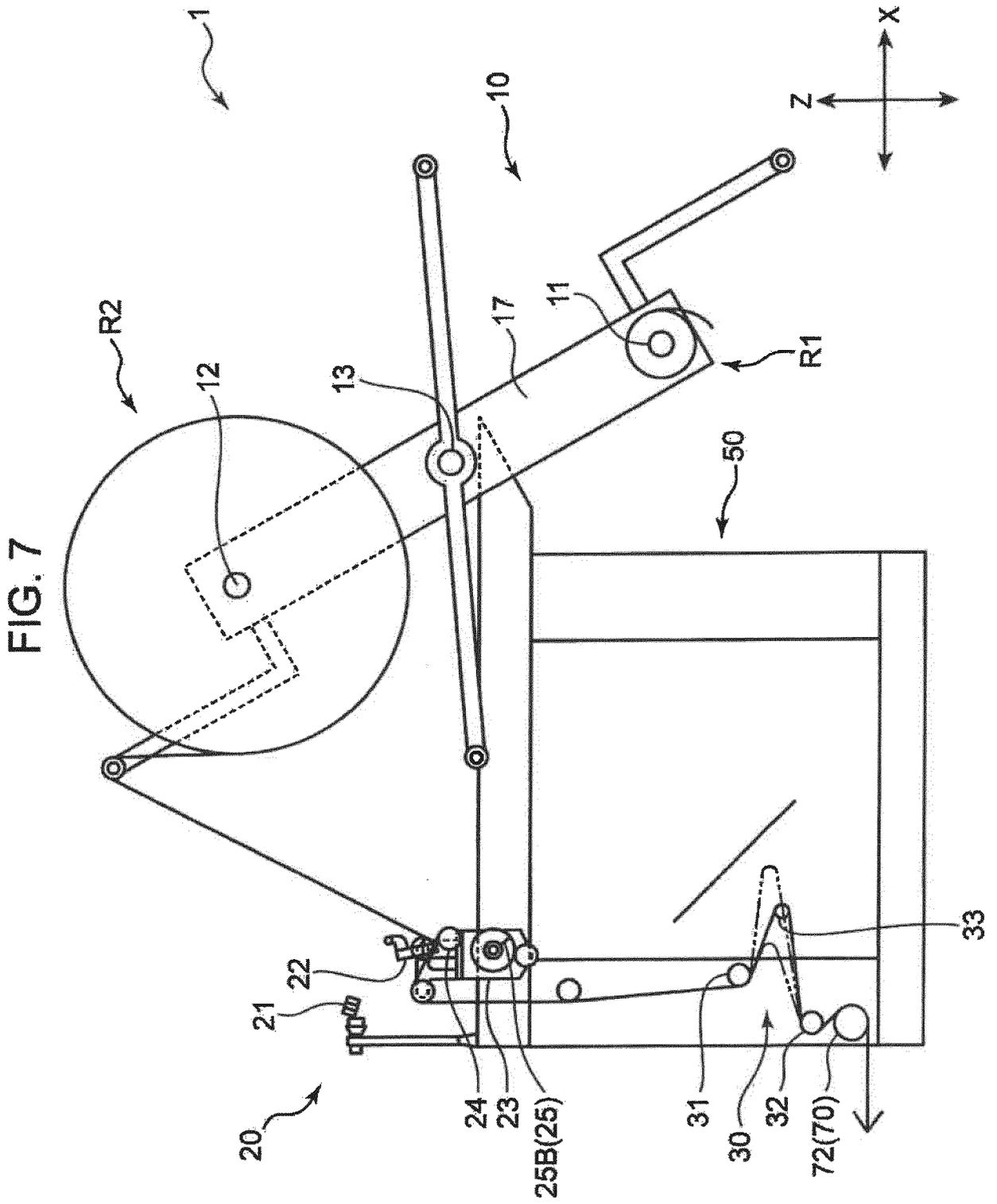
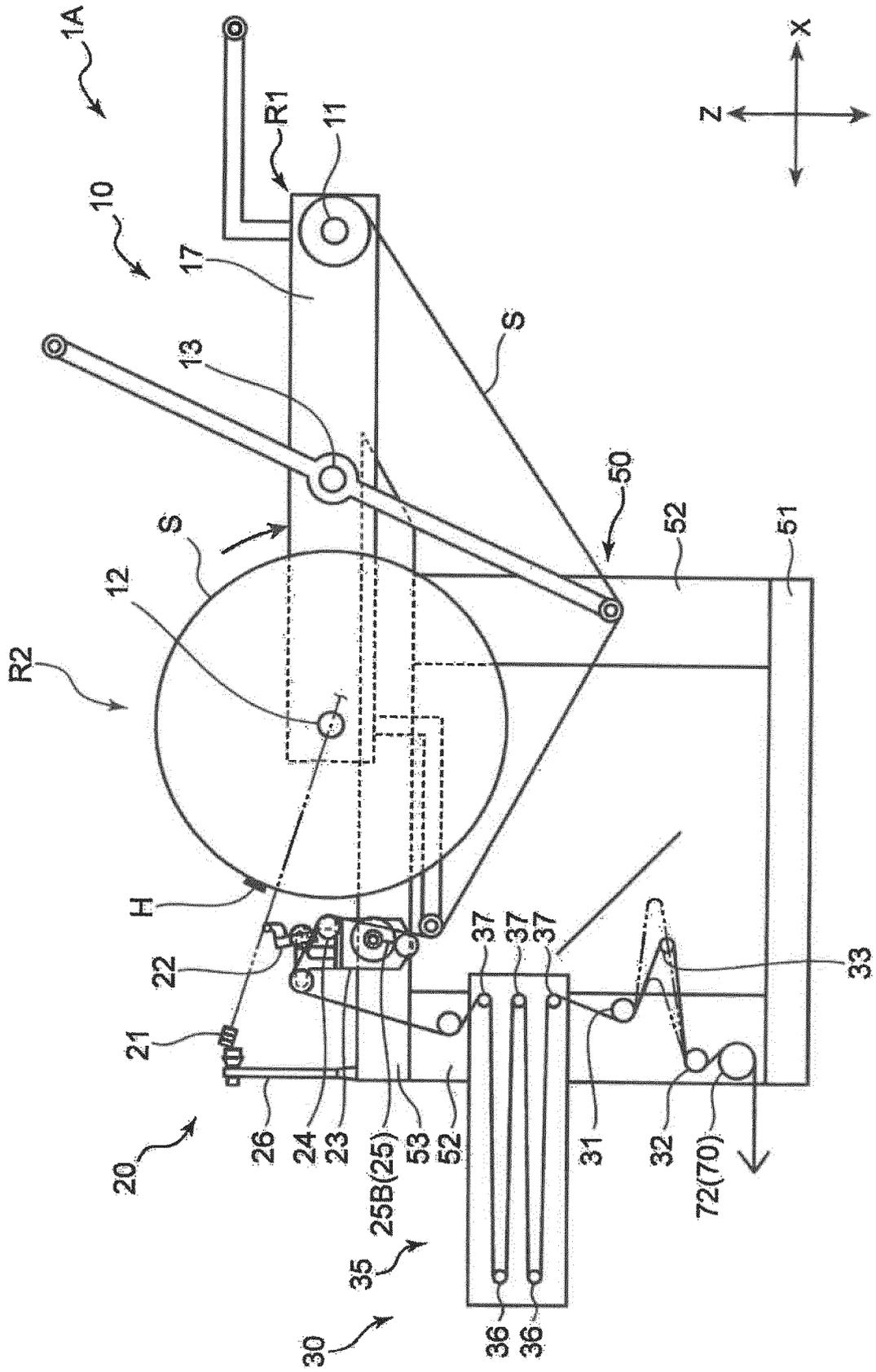


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/001877

5	A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. B65H19/18 (2006.01) i, B65H19/14 (2006.01) i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int. Cl. B65H19/00-19/30, B65H21/00-21/02	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2019 Registered utility model specifications of Japan 1996-2019 Published registered utility model applications of Japan 1994-2019	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	X	JP 09-136751 A (ISOWA-HOOPERSWIFT, LTD.) 27 May 1997, paragraphs [0016], [0021]-[0032], fig. 1-3, 5-13 (Family: none)
	Y	
30	Y	JP 05-270706 A (ISOWA-HOOPERSWIFT, LTD.) 19 October 1993, paragraphs [0023]-[0027], fig. 1, 2, 4 (Family: none)
35	A	US 4842681 A (BADER, B. Robert) 27 June 1989 (Family: none)
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
50	Date of the actual completion of the international search 09.04.2019	Date of mailing of the international search report 16.04.2019
55	Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- JP 2003118895 A [0007]
- WO 2017149610 A [0007]