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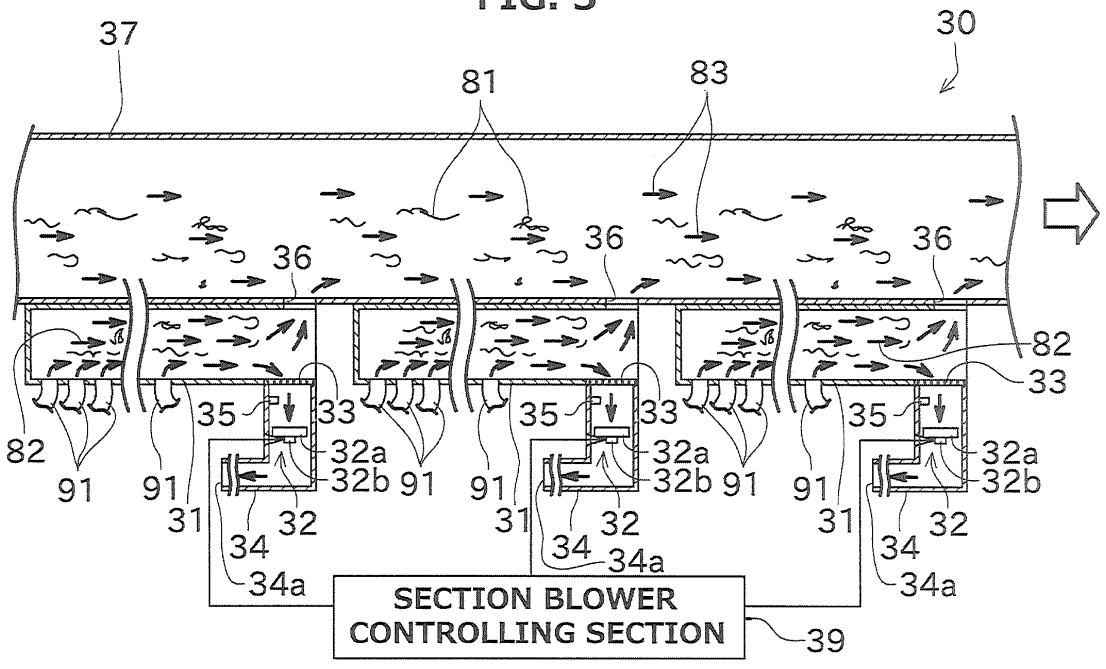
(54) **YARN WINDING MACHINE**

(57) A spinning frame (1) includes spinning units (2), section ducts (31), section blowers (32), filter members (33), a main duct (37), a main blower (38), and a section blower controlling section (39). The section blower controlling section (39) performs a deceleration control of maintaining a rotating state of blades (32a) of the section blower (32) while temporarily reducing a rotational speed of the blades (32a) thereby continuing the rotation.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention mainly relates to a yarn winding machine having a configuration to remove fly-waste, yarn waste, and the like.

2. Description of the Related Art

[0002] When the yarn winding machine processes a fiber bundle and / or a yarn and the like, unnecessary fly-waste, yarn waste, and the like (rejection material) is generated during its operation. Supposing that the rejection material is left unattended, not only it can cause a degradation of the quality of a package if the rejection material adheres to the package and the like, but can lead to malfunctioning of the yarn winding machine in itself. A yarn winding machine that generates a suction current at an appropriate point to suck and remove the rejection material is known in the art. Japanese Patent Application Laid-Open No. S63-50537 and Japanese Patent Application Laid-Open No. 2012-132112 disclose this kind of yarn winding machines.

[0003] The Japanese Patent Application Laid-Open No. S63-50537 discloses a yarn winding machine having a configuration in which a suction port of a blower, which removes fly-waste and the like by suction, is oriented downward. Moreover, a filter is attached to the suction port. When the blower is operated, the fly-waste and the like is deposited on the filter. When the operation of the blower is stopped thereby stopping application of the suction force, the fly-waste and the like falls in a lower part.

[0004] The Japanese Patent Application Laid-Open No. 2012-132112 discloses a yarn winding machine including a section duct and a section blower that are provided for each of a predetermined number of spinning units, and a main duct and a main blower that collectively transport the fly-waste and the like accumulated in the section duct. In the Japanese Patent Application Laid-Open No. 2012-132112, to prevent occurrence of variation in the effect of the suction current generated by the main blower according to a distance from the main blower, it is disclosed to set a rotational speed of blades of each of the section blowers different. Specifically, a control is provided so that the rotational speed of the blades of the section blower becomes slow as the one goes nearer the main blower.

[0005] However, in Japanese Patent Application Laid-Open No. S63-50537, no configuration to collect the fly-waste and the like that has fallen in the lower part is disclosed. Japanese Patent Application Laid-Open No. 2012-132112 discloses to set the rotational speed of the blades in each of the section blowers different; however, the document does not disclose to change the rotational speed of the blades of each of the section blowers with passage of time.

[0006] Moreover, Japanese Published Examined Application No. H5-29699 discloses to, while a common main blower is operating, discharge the accumulated fly-waste to the main duct by sequentially stopping the section blowers one by one. However, Japanese Published Examined Application No. H5-29699 does not disclose to change the rotational speed of the blades of each of the section blowers with passage of time.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is, in a yarn winding machine having a section duct, a section blower, a main duct, and a main blower, to provide a configuration that easily removes the rejection material that is deposited on a filter member by using the suction current generated by the main blower, and that reduces a load on the main blower.

[0008] A yarn winding machine according to one aspect of the present invention includes a plurality of winding units; a section duct through which rejection material generated in at least one of the winding units flows; a section suction device having a rotating blade and generating a suction current in the section duct for sucking the rejection material from the winding unit; a filter member arranged between the section duct and the section suction device; a main duct connected to the section duct and through which the rejection material from the section duct flows; a main suction device that generates a suction current in the main duct for moving the rejection material from the section duct; and a controlling section that performs, when the main suction device is generating the suction current, a deceleration control of temporarily reducing a rotational speed of the blade while maintaining the rotating state of the blade.

[0009] A suction control method according to another aspect of the present invention is for implementation in a yarn winding machine that includes a plurality of winding units; a section duct through which rejection material generated in at least one of the winding units flows; a section suction device having a rotating blade and generating a suction current in the section duct for sucking the rejection material from the winding unit; a filter member arranged between the section duct and the section suction device; a main duct connected to the section duct and through which the rejection material from the section duct flows; and a main suction device that generates a suction current in the main duct for moving the rejection material from the section duct. The suction control method includes performing, when the main suction device is generating the suction current, a deceleration control of temporarily reducing a rotational speed of the blade while maintaining the rotating state of the blade.

[0010] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments

of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a front view of a spinning frame according to one embodiment of the present invention.

FIG. 2 is a longitudinal cross-sectional view of the spinning frame.

FIG. 3 is a front cross-sectional view indicating a configuration of a fly-waste removing section.

FIG. 4 is a graph of a process to control a rotational speed of blades of a section blower according to a negative pressure.

FIG. 5 is an enlarged cross-sectional view of a state in which fly-waste is deposited on a filter member.

FIG. 6 is an enlarged cross-sectional view of a state in which the fly-waste deposited on the filter member has been removed.

FIG. 7 is a flowchart of a processing relating to a deceleration control.

FIG. 8 is an enlarged cross-sectional view indicating a position of a pressure detecting sensor of a fly-waste removing section according to a first variation.

FIG. 9 is a table indicating a schedule for determining a start timing of a deceleration control according to a second variation.

DETAILED DESCRIPTION

[0012] Exemplary embodiments of a spinning frame (a yarn winding machine) according to the present invention are explained in detail below with reference to the accompanying drawings. A spinning frame 1 as a yarn winding machine shown in FIG. 1 includes a large number of spinning units (winding units) 2 arranged side-by-side, a yarn joining cart 3, a blower box 4, and a motor box 5.

[0013] As shown in FIG. 1, each of the spinning units 2 includes, sequentially arranged from upstream to downstream, a drafting device 7, a spinning device 9, a fly-waste removing section 30, a yarn accumulating device 12, and a winding device 13. The terms "upstream" and "downstream" in the explanation of FIGS. 1 and 2 refer to upstream and downstream, respectively, in a running (transportation) direction of a sliver 15, a fiber bundle 8, and a spun yarn 10 during spinning.

[0014] The drafting device 7 is arranged near an upper end of a frame 6 of the spinning frame 1. The drafting device 7 includes four roller pairs of a back roller pair 16, a third roller pair 17, a middle roller pair 19, and a front roller pair 20 sequentially from upstream. An apron belt 18 is stretched over each of the rollers of the middle roller pair 19. The drafting device 7 drafts the sliver 15 supplied from a not-shown sliver case until the fiber bundle 8 attains a predetermined thickness. The fiber bundle 8 drafted by the drafting device 7 is supplied to the spinning device 9.

[0015] The spinning device 9 includes a swirling current generating chamber (not-shown) through which the fiber bundle 8 can be passed. The spinning device 9 generates a swirling current in the swirling current generating chamber by jetting compressed air from not-shown nozzles inside of the swirling current generating chamber. The spinning device 9 generates the spun yarn 10 by applying twists to the fiber bundle 8 by using the swirling current.

[0016] In the spinning device 9, fibers (fly-waste) that could not be twisted into the spun yarn 10 in the spinning are generated. The fly-waste removing section 30 includes suction pipes 91, section ducts 31, and a main duct 37. The fly-waste is transported through the suction pipes 91, the section ducts 31, and the main duct 37 of the fly-waste removing section 30 to a not-shown accumulation chamber (a cotton accumulation box). The accumulation chamber is connected to an end of the main duct 37. The fly-waste that flows through the main duct 37 is accumulated in the accumulation chamber. With this arrangement, because the fly-waste does not stay in the swirling current generating chamber, generation of the swirling current is not interfered. A detailed configuration of the fly-waste removing section 30 will be explained later.

[0017] The yarn accumulating device 12 is arranged downstream of the spinning device 9. As shown in FIG. 2, the yarn accumulating device 12 includes a yarn accumulating roller 21 and a motor 25 that rotationally drives the yarn accumulating roller 21.

[0018] The yarn accumulating roller 21 temporarily accumulates the spun yarn 10 by winding a certain amount of the spun yarn 10 on an outer peripheral surface thereof. The spun yarn 10 is pulled from the spinning device 9 and transported to the downstream side at a predetermined speed by causing the yarn accumulating roller 21 to rotate at a predetermined rotational speed with the spun yarn 10 wound on the outer peripheral surface thereof. Because the spun yarn 10 can be temporarily accumulated on the outer peripheral surface of the yarn accumulating roller 21, the yarn accumulating device 12 can function as a kind of buffer. The buffering function of the yarn accumulating device 12 avoids troubles (for example, slackening and the like of the spun yarn 10) caused by a mismatch in a spinning speed of the spinning device 9 and a winding speed (the speed of the spun yarn 10 being wound into a package 45) due to some reason.

[0019] An upstream guide 23 is arranged little upstream of the yarn accumulating roller 21. The upstream guide 23 guides the spun yarn 10 to the outer peripheral surface of the yarn accumulating roller 21.

[0020] A yarn clearer 52 is arranged between the spinning device 9 and the yarn accumulating device 12. The spun yarn 10 generated in the spinning device 9 passes the yarn clearer 52 before it is wound on the yarn accumulating device 12. The yarn clearer 52 monitors a thick-

ness of the running spun yarn 10. Upon detecting a yarn defect in the spun yarn 10, the yarn clearer 52 transmits a yarn-defect detection signal to a not-shown unit controller.

[0021] Upon receiving the yarn-defect detection signal from the yarn clearer 52, the unit controller cuts the spun yarn 10 by stopping driving of the spinning device 9, and stops winding and the like by the winding device 13. The unit controller sends a control signal to the yarn joining cart 3 to cause the yarn joining cart 3 to travel to the spinning unit 2. After completion of yarn joining by the yarn joining cart 3, the unit controller drives the spinning device 9 again to cause the winding device 13 to restart the winding.

[0022] As shown in FIGS. 1 and 2, the yarn joining cart 3 includes a yarn joining device 43, a suction pipe 44, and a suction mouth 46. When a yarn breakage or a yarn discontinuation occurs in a certain spinning unit 2, the yarn joining cart 3 travels on a rail 41 and stops at a work position corresponding to that spinning unit 2. The suction pipe 44 swings upward about a shaft to catch a spun yarn 10 from the spinning device 9, and then swings downward about the shaft to guide the spun yarn 10 to the yarn joining device 43. The suction mouth 46 swings downward about a shaft to catch a spun yarn 10 from the package 45, and then swings upward about the shaft to guide the spun yarn 10 to the yarn joining device 43. The yarn joining device 43 joins the spun yarns 10 guided thereto.

[0023] The winding device 13 includes a cradle arm 71, a winding drum 72, and a traversing device 75. The cradle arm 71 is supported so as to be pivotable around a support shaft 70. The cradle arm 71 rotatably supports a bobbin 48 on which the spun yarn 10 is to be wound. The winding drum 72 rotates in a state of being in contact with an outer peripheral surface of the bobbin 48 or the package 45. The traversing device 75 includes a traversing guide 76 that guides the spun yarn 10. The winding device 13 drives the winding drum 72 with a not-shown electric motor while causing the traversing guide 76 to perform a reciprocating movement with a not-shown driving member. As a result, the spun yarn 10 is wound into the package 45 while traversing the spun yarn 10.

[0024] A configuration of the fly-waste removing section 30 is explained below while referring to FIG. 3. The terms "upstream" and "downstream" in the explanation of the fly-waste removing section 30 refer to upstream and downstream, respectively, in a transportation direction (that is, a direction in which a suction current flows) of the rejection material.

[0025] The fly-waste removing section 30 includes, as shown in FIG. 3, the section ducts 31, section blowers (section suction devices) 32, filter members 33, pressure detecting sections 35 (negative pressure detecting sections), the main duct 37, and a main blower (a main suction device) 38 (See FIG. 1). The section blower 32 and the main blower 38 can be a suction device other than a blower.

[0026] In the spinning frame 1 according to the present embodiment, the suction pipe 91 shown in FIG. 2 is provided for each of the spinning units 2. The suction pipe 91 connects the spinning unit 2 to the section duct 31. In the present embodiment, an upstream end of the suction pipe 91 is connected to the spinning device 9 (specifically, to a not-shown exhaust chamber formed downstream of the swirling current generating chamber) of the spinning unit 2. As shown in FIG. 3, the suction pipes 91 of a predetermined number (20 in the present embodiment) of the spinning units 2 are connected to one section duct 31. In the present embodiment, because one suction pipe 91 is arranged per spinning unit 2, 20 suction pipes 91 are connected to one section duct 31. One section duct 31 is arranged for the predetermined number of the spinning units 2 (in the following explanation, the group of the predetermined number of the spinning units 2 will be referred to as a section). The number of the spinning units 2 can be the same or can be different in different sections. Accordingly, the number of the suction pipes 91 and the number of the spinning units 2 connected to one section duct 31 can be the same or can be different in different section ducts 31. Each section duct 31 is connected to the main duct 37 and to an exhaust duct 34 in the downstream side thereof. Accordingly, a suction current generated by the main blower 38 also acts inside the section duct 31.

[0027] The section blower 32 is arranged near the filter member 33 but inside the exhaust duct 34. The section blower 32 has blades 32a that generate a suction current by rotating and a section blower driving section (a section driving section) 32b that drives the blades 32a. The section blower driving section 32b is an electric motor and it is controlled by a section blower controlling section (a controlling section) 39. One section blower controlling section 39 can be arranged in a controlling device that controls the entire spinning frame 1, or can be arranged in each section.

[0028] As shown in FIG. 3, the filter member 33 is arranged at a connecting part of the section duct 31 and the exhaust duct 34. The filter member 33 is a net. The mesh of the net of the filter member 33 is set such that rejection material 81 cannot but air (a later-explained suction current 82) can pass through it.

[0029] The pressure detecting section 35 is arranged in a region between the filter member 33 and the section blower 32 but inside the exhaust duct 34. The pressure detecting section 35 detects the pressure (the negative pressure) in this region. At least the suction current 82 generated by the section blower 32 acts in this region. The pressure detecting section 35 outputs a pressure detection signal to the section blower controlling section 39.

[0030] The section blower 32 sucks air from the section duct 31 via the filter member 33 thereby generating the suction current 82 inside the section duct 31, inside the suction pipe 91, and the like. The suction current 82 is used mainly to move the rejection material 81, which is

generated in the spinning device 9, via the suction pipe 91 to a downstream end of the section duct 31.

[0031] The suction current 82 that passes through the filter member 33 is exhausted to the outside via an outlet 34a of the exhaust duct 34. The remaining suction current 82 along with the rejection material 81 flows into the main duct 37 via an opening 36 formed between the section duct 31 and the main duct 37. That is, in a state in which both the main blower 38 and the section blower 32 are being driven, a part of the suction current 82 in the section duct 31 flows toward the section blower 32 while the remaining part of the suction current 82 in the section duct 31 flows toward the main duct 37. In the present embodiment, the section duct 31 and the main duct 37 are directly connected to each other. The opening 36 is arranged in a connecting part of the section duct 31 and the main duct 37. The opening 36 is arranged in a downstream end of the section duct 31. The filter member 33 is arranged also in the downstream end of the section duct 31. In the present embodiment, a member to open and close (a shutter and the like) the opening 36 is not provided. Accordingly, because of a suction current 83 flowing in the main duct 37, the fly-waste moves into the main duct 37 from the section duct 31 via the opening 36.

[0032] The main blower 38 is arranged near one end of the main duct 37 but inside the blower box 4 (see FIG. 1). The main blower 38 generates a negative pressure downstream of the main duct 37 thereby causing the suction current 83 to flow inside the main duct 37. The main blower 38 is always operated. That is, blades of the main blower 38 are always rotated during the winding. The rotation of the main blower 38 is controlled by the section blower controlling section (the controlling section) 39. Alternatively, a main blower controlling section can be provided separately from the section blower controlling section 39, and the rotation of the main blower can be controlled by this main blower controlling section. The rejection material 81 is taken by this suction current 83 to the not-shown accumulation chamber (the cotton accumulation box) arranged at the one end of the main duct 37.

[0033] In the present embodiment, the fly-waste removing section 30 is configured so that a flow rate of the suction current 82 exhausted from the exhaust duct 34 is higher than a flow rate of the suction current 82 introduced into the main duct 37. As a result, a power consumption of the main blower 38 can be reduced because the flow rate of the suction current 83 sucked by the main blower 38 can be set low. However, the flow rate of the suction current 82 exhausted from the exhaust duct 34 can also be set lower than the flow rate of the suction current 82 introduced into the main duct 37.

[0034] A method to remove the rejection material 81 deposited on the filter member 33 is explained below with reference to FIGS. 4 to 7.

[0035] A curve labeled "rotational speed" in FIG. 4 shows an example of time variation of the rotational speed of the blades 32a of the section blower 32. As shown in FIG. 4, the section blower controlling section 39 performs a normal control and a deceleration control.

[0036] The normal control is a control in which the blades 32a are rotated at a substantially constant rotational speed (within a predetermined speed range). The section blower controlling section 39 performs the normal control not only when the spun yarn 10 is being wound but also when the winding of the spun yarn 10 is interrupted during the yarn joining and the like. In the present embodiment, the "predetermined speed range" is a speed range of the rotational speed, in the normal control, after an increase from the rotational speed at the time of ending of the deceleration control. In the example shown in FIG. 4, the "predetermined speed range" is the speed, represented by the horizontal line of the curve, that is higher than the speed for the deceleration control. The "predetermined speed range" can be a constant speed as shown in FIG. 4, or can be varied within a predetermined range so that the average speed is equal to the speed shown in FIG. 4.

[0037] The deceleration control is a control to maintain the rotation of the blades 32a while temporarily reducing the rotational speed of the blades 32a. A control to completely stop the rotation of the blades 32a is not included in the deceleration control. When returning to the normal control after the deceleration control, it is necessary to accelerate the blades 32a. The present embodiment has been explained with the assumption that such an acceleration is carried out while the normal control is being performed. In the present embodiment, because only the normal control and the deceleration control are performed while the winding of the spun yarn 10 is being performed, the normal control and the deceleration control are performed alternately (in other words, the deceleration control is performed after the normal control, and the normal control is performed after the deceleration control again). Because the main blower 38 is always operated as mentioned above, the main blower 38 is continuously operated while one change between the deceleration control and the normal control is being performed.

[0038] The section blower controlling section 39 removes the deposited rejection material 81 by switching the control between the normal control and the deceleration control according to an amount of the rejection material 81 deposited on the filter member 33. A specific explanation is given below.

[0039] When the rejection material 81 is deposited on the filter member 33, as shown in FIG. 5, the mesh of the filter member 33 is blocked by the rejection material 81. As a result, it is difficult for the suction current 82 generated by the section blower 32 to flow in the section duct 31. On the other hand, because it is easy for the suction current 82 to flow in the exhaust duct 34, the negative pressure in the exhaust duct 34 increases. Accordingly, the negative pressure detected by the pressure detecting section 35 increases as the amount of the rejection material 81 deposited on the filter member 33 increases. A curve labeled "pressure" in FIG. 4 shows that the pressure detected by the pressure detecting section 35 in-

creases with passage of time. An increase of the negative pressure means a change of the pressure in the negative direction.

[0040] The section blower controlling section 39 determines the amount of the rejection material 81 deposited on the filter member 33 based on a detection value indicative of the pressure detected by the pressure detecting section 35. Specifically, the section blower controlling section 39 judges whether the detection value obtained in the pressure detecting section 35 is higher than a predetermined threshold (S101 of FIG. 7).

[0041] Upon judging that the detection value obtained in the pressure detecting section 35 is higher than the predetermined threshold, the section blower controlling section 39 checks whether the other section blowers 32 are under the deceleration control (S102). Upon checking that none of the other section blowers 32 is under the deceleration control, the section blower controlling section 39 turns off an electric power supply to the corresponding section blower driving section 32b (that is, stops supply of the electric power to the corresponding section blower driving section 32b) (S103, start of the deceleration control).

[0042] When the electric power supply to the section blower driving section 32b is turned off, as shown in FIG. 4, the rotational speed of the blades 32a decreases. Therefore, the suction current 82 acting on the rejection material 81 deposited on the filter member 33 becomes weak. Accordingly, as shown in FIG. 5, the rejection material 81 is moved into the main duct 37 by the action of the suction current 83 generated by the main blower 38. Thus, the rejection material 81 deposited on the filter member 33 can be removed by performing the deceleration control.

[0043] A load on the main blower 38 increases when one section blower 32 is under the deceleration control. Accordingly, when the deceleration control is simultaneously performed in a plurality of the section blowers 32, the rejection material 81 may not be removed from the filter member 33. Accordingly, when the other section blowers 32 are under the deceleration control, the section blower controlling section 39 starts the deceleration control in the next section blower 32 at a timing at which the deceleration control in all the other section blowers 32 is completed (in other words, at a timing at which none of all the section blowers 32 is under the deceleration control) (the process in above-mentioned S102).

[0044] The section blower controlling section 39 counts an elapsed time from the start of the deceleration control. The section blower controlling section 39 judges whether the elapsed time exceeds a predetermined time (S104). At a timing of judging that the elapsed time exceeds the predetermined time, the section blower controlling section 39 turns on the electric power supply to the corresponding section blower driving section 32b (that is, restarts the supply of the electric power to the corresponding section blower driving section 32b), (S105, end of the deceleration control). As a result, as shown in FIG. 4, the rotational speed of the blades 32a of the section blower 32 increases and reaches the rotational speed for the normal control.

[0045] The predetermined time is set shorter than the time necessary for the rotation of the blades 32a of the section blower 32 to stop. Accordingly, the blades 32a can be prevented from completely stopping. As a result, because the suction force of the section blower 32 does not become zero, the load on the main blower 38 can be reduced.

[0046] Referring now to FIG. 8, a first variation of the present embodiment is explained below. In the first variation, the pressure detecting section 35 is arranged in a region that is inside the suction pipe 91. In this region, the suction current 82 of at least the section blower 32 acts. When the rejection material 81 deposits on the filter member 33, as shown in FIG. 5, the mesh of the filter member 33 is blocked by the rejection material 81. As a result, it is difficult for the suction current 82 generated by the section blower 32 to flow in the section duct 31. Accordingly, the negative pressure inside the section duct 31 and inside the suction pipe 91 decreases. An decrease of the negative pressure means a change of the pressure in the positive direction.

[0047] The section blower controlling section 39 according to this variation judges whether the negative pressure detected by the pressure detecting section 35 is lower than a predetermined threshold. Upon judging that the negative pressure detected by the pressure detecting section 35 is lower than the predetermined threshold, the section blower controlling section 39 performs the deceleration control.

[0048] The negative pressure in a region inside the flywaste removing section 30 and nearer to the spinning unit 2 than the filter member 33 decreases with deposition of the rejection material 81. Accordingly, it is allowable to arrange the pressure detecting section 35 at a point at which the suction current acts in the spinning unit 2. In the present variation, the pressure detecting section 35 is arranged in one of the plurality of the suction pipes 91; however, it is allowable to arrange the pressure detecting section 35 in each of the plurality of the suction pipes 91.

[0049] The pressure detecting section 35 is arranged between the filter member 33 and the section blower 32. Moreover, the pressure detecting section 35 can be arranged in the section duct 31, the suction pipe 91, and the like. The number and the installation locations of the pressure detecting sections 35 can be different in each of the sections. The pressure detecting section 35 may also be omitted in a certain section.

[0050] It is allowable to arrange the pressure detecting section 35 in the spinning unit 2. Specifically, the pressure detecting section 35 can be arranged in an exhaust channel arranged downstream of the swirling current generating chamber of the spinning device 9. That is, the pressure detecting section 35 can be arranged upstream of the suction pipe 91.

[0051] A second variation of the present embodiment is explained below while referring to FIG. 9. In the present embodiment and the first variation of the present embodiment, the timing of starting the deceleration control is determined based on a detection result obtained in the pressure detecting section 35. In contrast, in the second variation, the deceleration control is performed at a preset schedule.

[0052] An example of such a schedule is shown in FIG. 9. According to the schedule shown in FIG. 9, the spinning frame 1 has ten sections, and one deceleration control is performed in each of the sections for five seconds and the deceleration control is repeated after one hour while changing the sections. The schedule is set so that the timing of performing the deceleration control in each of the sections is different. The control performed by the section blower controlling section 39 can be simplified by determining the start timing of the deceleration control with the method explained in the second variation.

[0053] The schedule of the deceleration control can be set based on desired values input by an operator by using a not-shown setting section and the like, or can be set as default in the spinning frame 1. In the schedule of the deceleration control, it is allowable to set different number of times and / or duration from the number of times and / or the duration mentioned above.

[0054] As explained above, the spinning frame 1 includes the spinning units 2, the section ducts 31, the section blowers 32, the filter members 33, the main duct 37, the main blower 38, and the section blower controlling section 39. Each of the plurality of the section ducts 31 is arranged for at least one spinning unit 2. The rejection material 81 generated in the spinning unit 2 flows through the corresponding section duct 31. The rejection material 81 generated in a certain spinning unit 2 flows through the corresponding section duct 31. The section blower 32 generates the suction current 82 that sucks the rejection material 81 in the section duct 31. The filter member 33 is arranged between the section duct 31 and the section blower 32. The main duct 37 is connected to a plurality of the section ducts 31. The rejection material 81 flows through the section duct 31 to the main duct 37. The main blower 38 generates the suction current 83 in the main duct 37 to move the rejection material 81. When the main blower 38 is generating the suction current 83, the section blower controlling section 39 performs the deceleration control of temporarily reducing the rotational speed of the blades 32a while maintaining the rotating state of the blades 32a.

[0055] As a result, the suction force in the section duct 31 can be reduced by performing the deceleration control of reducing the rotational speed of the blades 32a of the section blower 32. While this deceleration control is being performed, the rejection material 81 deposited on the filter member 33 can be removed easily by using the suction current 83 generated by the main blower 38. Moreover, the load on the main blower 38 can be suppressed because the rotation of the blades 32a of the section blower 32 is not completely stopped.

[0056] The section blower controlling section 39 of the spinning frame 1 can perform the normal control of rotating the blades 32a of the section blower 32 in the predetermined speed range. The deceleration control is started after completion of the normal control.

[0057] The section blower controlling section 39 can send the rejection material 81, which is deposited by performing the normal control, to the main duct 37 by performing the deceleration control.

[0058] The section blower controlling section 39 of the spinning frame 1, after completion of the deceleration control, increases the rotational speed of the blades 32a of the section blower 32 so that the rotational speed falls in the predetermined speed range for the normal control.

[0059] As a result, the section blower controlling section 39 can recover the rotational speed of the blades 32a, which was reduced during the deceleration control, to the predetermined speed range for the normal control.

[0060] The section blower 32 of the spinning frame 1 includes the section blower driving section 32b that generates a power to rotate the blades 32a. The section blower controlling section 39 performs the deceleration control by turning off an electric power of the section blower driving section 32b.

[0061] As a result, the deceleration control of the rotational speed of the blades 32a of the section blower 32 can be performed easily.

[0062] The section blower controlling section 39 of the spinning frame 1 turns on the electric power of the section blower driving section 32b (that is, restarts the supply of the electric power to the section blower driving section 32b) before the rotation of the blades 32a of the section blower 32 stops.

[0063] As a result, complete stopping of the blades 32a of the section blower 32 can be prevented by a simple control.

[0064] Operation of the main blower 38 is continued while the section blower controlling section 39 of the spinning frame 1 is performing the deceleration control.

[0065] As a result, the rejection material 81 deposited on the filter member 33 can be removed surely by the suction current 83 generated by the main blower 38.

[0066] The spinning frame 1 includes the pressure detecting section 35 that detects the negative pressure in the region in which the suction current 82 generated by the section blower 32 acts (specifically, the region in the exhaust duct 34 between the filter member 33 and the section blower 32). When the negative pressure detected by the pressure detecting section 35 falls out of a predetermined range (that is, when the pressure is higher than the predetermined threshold), the section blower controlling section 39 starts the deceleration control.

[0067] Accordingly, because there is a correlation between the amount of the rejection material 81 deposited on the filter member 33 and the intensity of the suction current 82 generated by the section blower 32, the deceleration control can be started at an appropriate timing.

[0068] The spinning unit 2 of the spinning frame 1 winds the spun yarn 10 during at least the period in which the deceleration control is being performed in the corresponding section blower 32.

[0069] As a result, the spinning frame 1 can be operated effectively as the spun yarn 10 can be wound while the deceleration control is being performed.

[0070] Exemplary embodiments and variations of the present invention are explained above. The configuration explained above can, however, be modified as explained below.

[0071] In the above embodiments, the section blower controlling section 39 performs a control to turn off the electric power supply to the section blower driving section 32b for a predetermined time and then turns on the electric power supply after performing the deceleration control to return to the normal control; however, the turning on / off of the electric power supply can be repeated while the deceleration control is being performed. Moreover, the deceleration control can be performed by reducing a rotational speed of the section blower driving section 32b to a set value (a target value). Furthermore, in the above embodiments, the rotational speed of the blades 32a of the section blower 32 is reduced continuously; however, the rotational speed can be reduced once and then the blades 32a can be rotated at a substantially constant rotational speed (that is, at a rotational speed that is lower than the rotational speed for the normal control). Moreover, it is allowable to reduce the rotational speed of the blades 32a in steps or along a curve instead of linearly reducing the rotational speed as shown in FIG. 4. As long as the rotational speed of the blades 32a for the deceleration control is lower than the rotational speed for the normal control, the rotational speed of the blades 32a for the deceleration control can be set to a desired speed other than zero.

[0072] In the above embodiments, an arrangement is made so that the deceleration control is not performed simultaneously in a plurality of the section blowers 32. That is, the deceleration control in one of the section blowers 32 is started after a state in which the normal control is performed in all the section blowers 32. However, it is allowable to perform the deceleration control simultaneously in a plurality of the section blowers 32 by determining whether to start the deceleration control for each of the sections and the like.

[0073] In the above embodiments, a timing of ending the deceleration control (that is, the timing of turning on the electric power supply to the section blower driving section 32b) is determined based on the elapsed time. Alternatively, the timing of ending the deceleration control can be determined based on the negative pressure detected by the pressure detecting section 35 (that is, based on the amount of the rejection material 81 deposited on the filter member 33).

[0074] The number of the spinning units 2 connected to one section duct 31 is not limited to 20. That is, any number of the spinning units 2 between 1 and 20, or 21 or more can be connected to one section duct 31.

[0075] The location and the orientation of the filter member 33 are not particularly limited. For example, it is allowable to arrange the filter member 33 in an inclined manner, like in Japanese Patent Application Laid-Open No. 2012-132112, so that it approaches toward the opening 36 as one goes downstream.

[0076] In addition to connecting the suction pipe 91 to the section duct 31, a suction pipe through which fly-waste stuck to a drafting roller of the drafting device 7 is transported after sucking can be connected to the section duct 31. In the spinning unit 2, a suction port that sucks the yarn waste and the like can be arranged downstream of the spinning device 9. Moreover, a suction pipe having such a suction port can be connected to the section duct 31. In addition, in a spinning frame that includes one yarn joining device for each of the spinning units 2, a pipe that sucks and transports the yarn waste generated during the yarn joining and the like can be connected to the section duct 31.

[0077] In the spinning unit 2, the yarn accumulating device 12 pulls the spun yarn 10 from the spinning device 9; however, the invention is not limited to this configuration. For example, in the spinning unit, the spun yarn 10 can be pulled from the spinning device 9 by using a delivery roller and a nip roller, thereafter, the spun yarn 10 can be accumulated by using the yarn accumulating device 12 or a slack tube provided downstream. When a configuration in which the spun yarn 10 is pulled from the spinning device 9 by using the delivery roller and the nip roller is employed, the yarn accumulating device 12 can be omitted.

[0078] The application of the present invention is not limited to the spinning frame explained above. That is, the present invention can be applied, for example, to an open-end spinning frame, an automatic winder, a twisting frame, a doubling machine, and the like. When applying the present invention to, for example, the automatic winder, the present invention can be applied to a configuration for removing the yarn waste occurring during the yarn joining.

[0079] A yarn winding machine according to one aspect of the present invention includes a plurality of winding units, a section duct, a section suction device, a filter member, a main duct, and a main suction device, and a controlling section. Rejection material generated in at least one of the winding units flows through the section duct. The section suction device has a rotating blade and generates a suction current in the section duct for sucking the rejection material from the winding unit. The filter member is arranged between the section duct and the section suction device. The main duct is connected to the section duct and the rejection material from the section duct flows through it. The main suction device generates a suction current in the main duct for moving the rejection material from the section duct. The controlling section performs, when the main suction device is generating the suction current, a deceleration control of tem-

porarily reducing a rotational speed of the blade while maintaining the rotating state of the blade.

[0080] With the above configuration, the suction force in the section duct can be reduced by performing the deceleration control of reducing the rotational speed of the blade of the section suction device. While this deceleration control is being performed, the rejection material deposited on the filter member can be removed easily by using the suction current generated by the main suction device. Moreover, the load on the main suction device can be reduced because the rotation of the blade of the section suction device is not completely stopped.

[0081] It is preferable that the above yarn winding machine further includes an accumulation chamber that is connected to an end of the main duct for accumulating the rejection material that flows through the main duct.

[0082] With the above configuration, work for collection of the rejection material can be performed in a mass in one place, for example, in the accumulation chamber arranged at an end of the machine. That is, it is not necessary to perform the work for collection in every section.

[0083] It is preferable that the controlling section maintains a rotating state of a blade of the main suction device during a yarn winding operation.

[0084] With the above configuration, the section suction device can be downsized.

[0085] It is preferable to arrange an opening in a connecting part between the main duct and the section duct allowing passage of the rejection material.

[0086] With the above configuration, the rejection material in the section duct can be moved to the main duct through the opening by the action of the suction current in the main duct.

[0087] It is preferable to arrange the opening in a downstream end of the section duct.

[0088] With the above configuration, the rejection material can be moved to the main duct smoothly via the opening.

[0089] In the above yarn winding machine, it is preferable that the controlling section is capable of performing a normal control of rotating the blade of the section suction device in a predetermined speed range, and the controlling section starts the deceleration control after completion of the normal control.

[0090] With the above configuration, the controlling section can send the rejection material, which is deposited by performing the normal control, to the main duct by performing the deceleration control.

[0091] In the above yarn winding machine, it is preferable that the controlling section increases, after completion of the deceleration control, the rotational speed of the blade of the section suction device until the rotational speed falls in the predetermined speed range for the normal control.

[0092] As a result, the controlling section can recover the rotational speed of the blade, which was reduced during the deceleration control, to the predetermined speed range for the normal control.

[0093] In the above yarn winding machine, it is preferable that the section suction device includes a section driving section that generates a power to rotate the blade thereof, and the controlling section performs the deceleration control by turning off an electric power of the section driving section.

[0094] With the above configuration, the deceleration control can be performed easily on the rotational speed of the blade of the section suction device.

[0095] In the above yarn winding machine, it is preferable that the controlling section turns on the electric power of the section driving section before the rotation of the blade of the section suction device stops.

[0096] With the above configuration, complete stopping of the blade of the section suction device can be prevented with a simple control.

[0097] It is preferable that the above yarn winding machine includes a pressure detecting section that detects a pressure (a negative pressure) in at least a region in which the suction current generated by the section suction device acts, and in which the controlling section starts the deceleration control when the pressure detected by the pressure detecting section falls outside of a predetermined range.

[0098] Accordingly, because there is a correlation between the amount of the rejection material deposited on the filter member and the intensity of the suction current generated by the section suction device, the deceleration control can be started at an appropriate timing.

[0099] In the above yarn winding machine, it is preferable that the pressure detecting section is arranged between the filter member and the section suction device.

[0100] When an excessive amount of the rejection material is deposited on the filter member, the effect of the suction current of the section suction device becomes blunt. Accordingly, a negative pressure between the filter member and the section suction device increases. Therefore, by detecting the pressure in this region, the deceleration control can be started according to the amount of the rejection material deposited on the filter member.

[0101] In the above yarn winding machine, it is preferable to arrange the pressure detecting section at least one among in the winding unit, in the section duct, and in between the winding unit and the section duct.

[0102] When an excessive amount of the rejection material is deposited on the filter member, the effect of the suction current of the section suction device becomes blunt. Accordingly, by detecting the negative pressure in at least one of the above regions, the deceleration control can be started according to the amount of the rejection material deposited on the filter member.

[0103] In the above yarn winding machine, it is preferable that the controlling section starts the deceleration control at a preset timing.

[0104] With the above configuration, the deceleration control can be started with a simple control.

[0105] In the above yarn winding machine, it is preferable that the controlling section starts the deceleration

control in one among the section suction devices at a timing at which the deceleration control is not being performed in any of all the section suction devices.

[0106] Because the load on the main suction device increases when the deceleration control is performed on one section suction device, the load on the main suction device can be reduced by shifting the start timing of the deceleration control in each of the section suction devices.

[0107] In the above yarn winding machine, it is preferable that the winding unit winds a yarn during at least the period in which the deceleration control is being performed in the section suction device.

[0108] With the above configuration, the yarn winding machine can be operated effectively as the yarn can be wound while the deceleration control is being performed.

[0109] It is preferable that the yarn winding machine further includes an exhaust duct arranged for each of the section ducts and having an outlet for exhausting to outside the suction current that has passed through the filter member. Moreover, it is preferable that the filter member is arranged at a connecting part of the section duct and the exhaust duct, and the section suction device is arranged in the exhaust duct but between the filter member and the outlet.

[0110] With the above configuration, the suction current generated by the section suction device can be caused to effectively act in the section duct.

[0111] In the above explanation, the meaning of "a plurality of" also includes "a predetermined number of".

[0112] Although the invention has been explained with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the scope of the claims.

Claims

1. A yarn winding machine (1) comprising:

a plurality of winding units (2);
a section duct (31) through which rejection material generated in at least one of the winding units (2) flows;
a section suction device (32) having a rotating blade (32a) and generating a suction current (82) in the section duct (31) for sucking the rejection material from the winding unit (2);
a filter member (33) arranged between the section duct (31) and the section suction device (32);
a main duct (37) connected to the section duct (31) and through which the rejection material from the section duct (31) flows;
a main suction device (38) that generates a suction current (83) in the main duct (37) for moving the rejection material from the section duct (31);
characterized by
a controlling section (39) that performs, when the main suction device (38) is generating the suction current (83), a deceleration control of temporarily reducing a rotational speed of the blade (32a) while maintaining the rotating state of the blade (32a).

2. The yarn winding machine (1) as claimed in Claim 1, further **characterized by** an accumulation chamber that is connected to an end of the main duct (37) for accumulating the rejection material that flows through the main duct (37).

3. The yarn winding machine (1) as claimed in Claim 1 or 2, **characterized in that** the controlling section (39) maintains a rotating state of a blade of the main suction device (38) during a yarn winding operation.

4. The yarn winding machine (1) as claimed in Claim 3, further **characterized by** an opening (36) arranged in a connecting part between the main duct (37) and the section duct (31) allowing passage of the rejection material.

5. The yarn winding machine (1) as claimed in Claim 4, **characterized in that** the opening (36) is arranged in a downstream end of the section duct (31).

6. The yarn winding machine (1) as claimed in any one of Claims 1 to 5, **characterized in that** the controlling section (39) is capable of performing a normal control of rotating the blade (32a) of the section suction device (32) in a predetermined speed range, and the controlling section (39) starts the deceleration control after completion of the normal control.

7. The yarn winding machine (1) as claimed in Claim 6, **characterized in that** the controlling section (39) increases, after completion of the deceleration control, the rotational speed of the blade (32a) of the section suction device (32) until the rotational speed falls in the predetermined speed range for the normal control.

8. The yarn winding machine (1) as claimed in any one of Claims 1 to 7, **characterized in that**
the section suction device (32) includes a section driving section (32b) that generates a power to rotate the blade (32a), and
the controlling section (39) performs the deceleration control by turning off an electric power of the section driving section (32b).

9. The yarn winding machine (1) as claimed in Claim 8, **characterized in that** the controlling section (39)

turns on the electric power of the section driving section (32b) before the rotation of the blade (32a) of the section suction device (32) stops.

10. The yarn winding machine (1) as claimed in any one of Claims 1 to 9, further **characterized by** a pressure detecting section (35) that detects a pressure in at least a region in which the suction current (82) generated by the section suction device (32) acts, and
wherein the controlling section (39) starts the deceleration control when the pressure detected by the pressure detecting section (35) falls outside of a predetermined range.

11. The yarn winding machine (1) as claimed in Claim 10, **characterized in that** the pressure detecting section (35) is arranged between the filter member (33) and the section suction device (32).

12. The yarn winding machine (1) as claimed in Claim 10, **characterized in that** the pressure detecting section (35) is arranged at least one among in the winding unit (2), in the section duct (31), and in between the winding unit (2) and the section duct (31).

13. The yarn winding machine (1) as claimed in any one of Claims 1 to 12, **characterized in that** the controlling section (39) starts the deceleration control at a preset timing.

14. The yarn winding machine (1) as claimed in any one of Claims 1 to 12, **characterized in that** the controlling section (39) starts the deceleration control in one among the section suction devices (32) at a timing at which the deceleration control is not being performed in any of all the section suction devices (32).

15. The yarn winding machine (1) as claimed in any one of Claims 1 to 14, **characterized in that** the winding unit (2) winds a yarn during at least the period in which the deceleration control is being performed in the section suction device (32).

16. The yarn winding machine (1) as claimed in any one of Claims 1 to 15, further **characterized by** an exhaust duct (34) arranged for each of the section ducts (31) and having an outlet (34a) for exhausting to outside the suction current (82) that has passed through the filter member (33), and
wherein the filter member (33) is arranged at a connecting part of the section duct (31) and the exhaust duct (34), and
the section suction device (32) is arranged in the exhaust duct (34) but between the filter member (33) and the outlet (34a).

17. A suction control method for implementation in a yarn winding machine (1),
the yarn winding machine (1) comprising
a plurality of winding units (2);
a section duct (31) through which rejection material generated in at least one of the winding units (2) flows;
a section suction device (32) having a rotating blade (32a) and generating a suction current (82) in the section duct (31) for sucking the rejection material from the winding unit (2) ;
a filter member (33) arranged between the section duct (31) and the section suction device (32);
a main duct (37) connected to the section duct (31) and through which the rejection material from the section duct (31) flows; and
a main suction device (38) that generates a suction current (83) in the main duct (37) for moving the rejection material from the section duct (31), **characterized in that**
the suction control method includes performing, when the main suction device (38) is generating the suction current (83), a deceleration control of temporarily reducing a rotational speed of the blade (32a) while maintaining the rotating state of the blade (32a).

18. The suction control method as claimed in Claim 17, **characterized in that** when the main suction device (38) is generating the suction current (83), the method includes
causing a part of the suction current (82) in the section duct (31) to flow toward the section suction device (32), and
causing the remaining suction current (82) in the section duct (31) to flow in the main duct (37).

19. The suction control method as claimed in Claim 18, **characterized in that** the main suction device (38) maintains the generation of the suction current (83) during a winding operation.

FIG.1

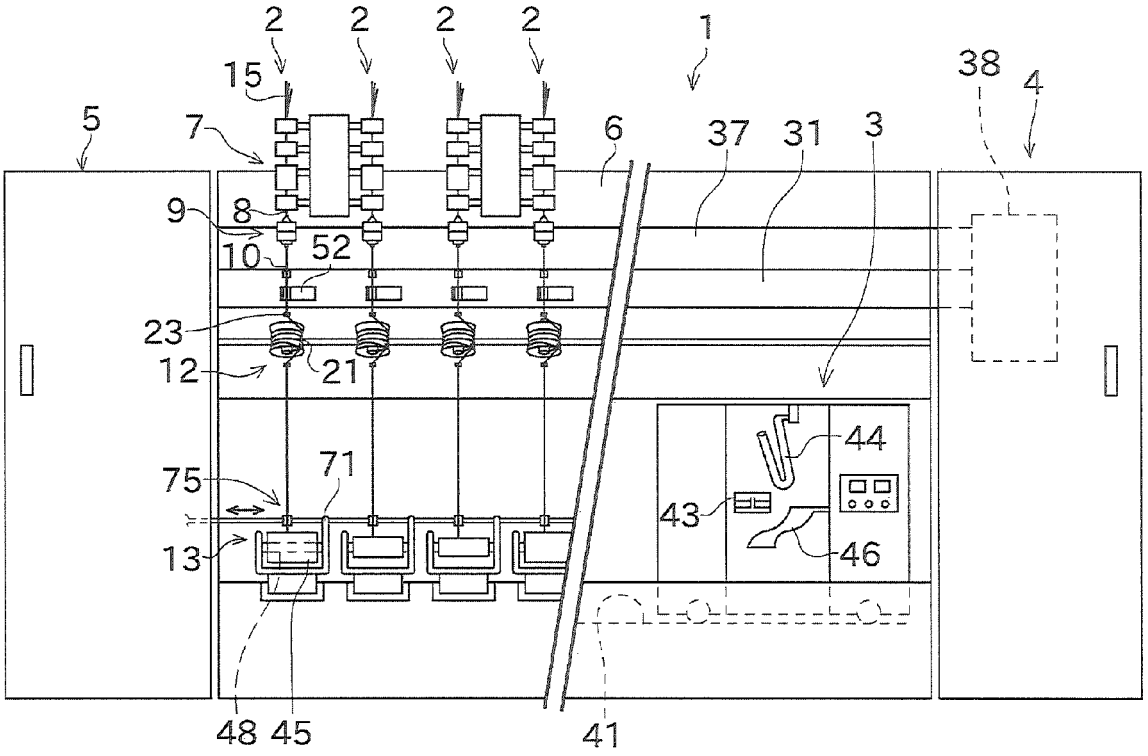
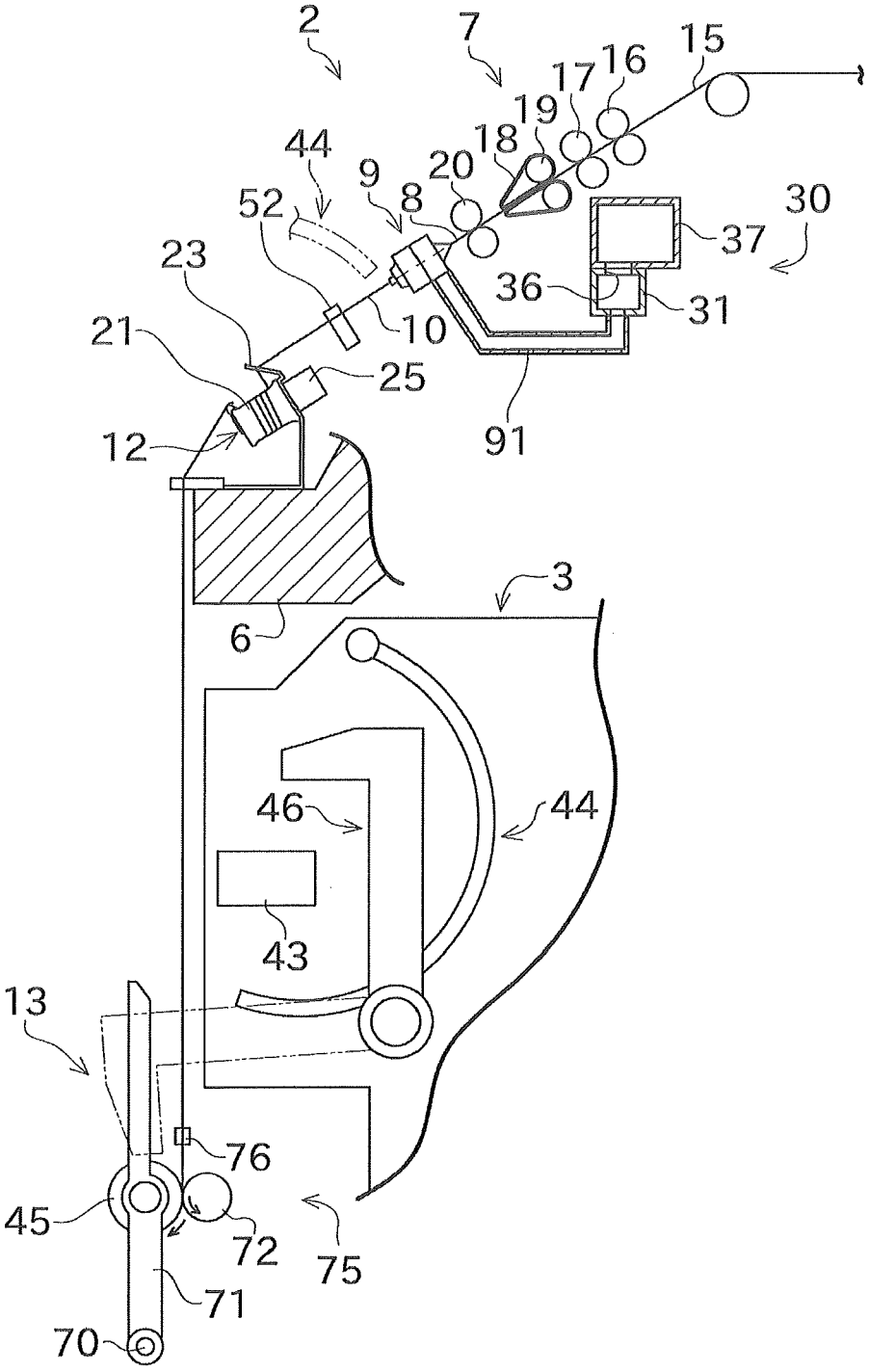


FIG.2


2
7
15
16
17
19
18
20
44
9
8
52
30
37
23
36
31
21
10
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91
3
6
46
44
43
13
76
45
72
75
71
70

FIG. 3

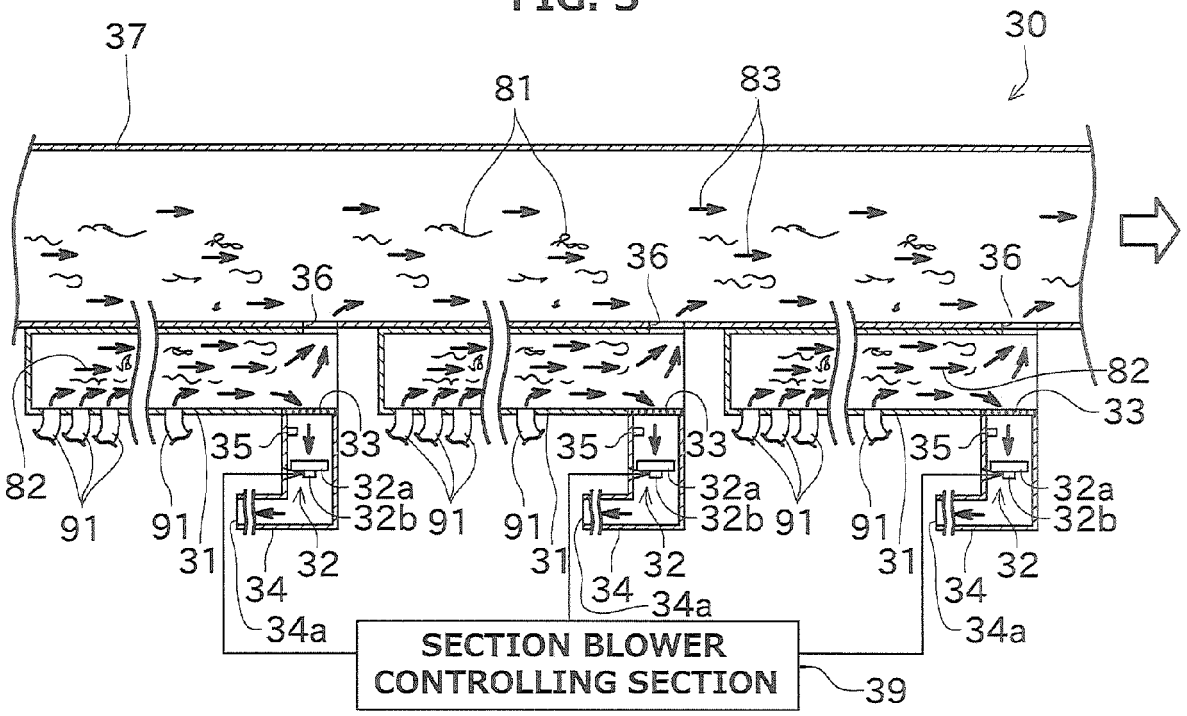
37
30
81
83
36
36
36
82
33
35
33
35
33
35
32a
32b
32a
32b
32a
32b
82
91
91
91
91
91
91
31
31
31
34
32
34
32
34
32
34a
34
34a
34a
SECTION BLOWER CONTROLLING SECTION
39

FIG.4

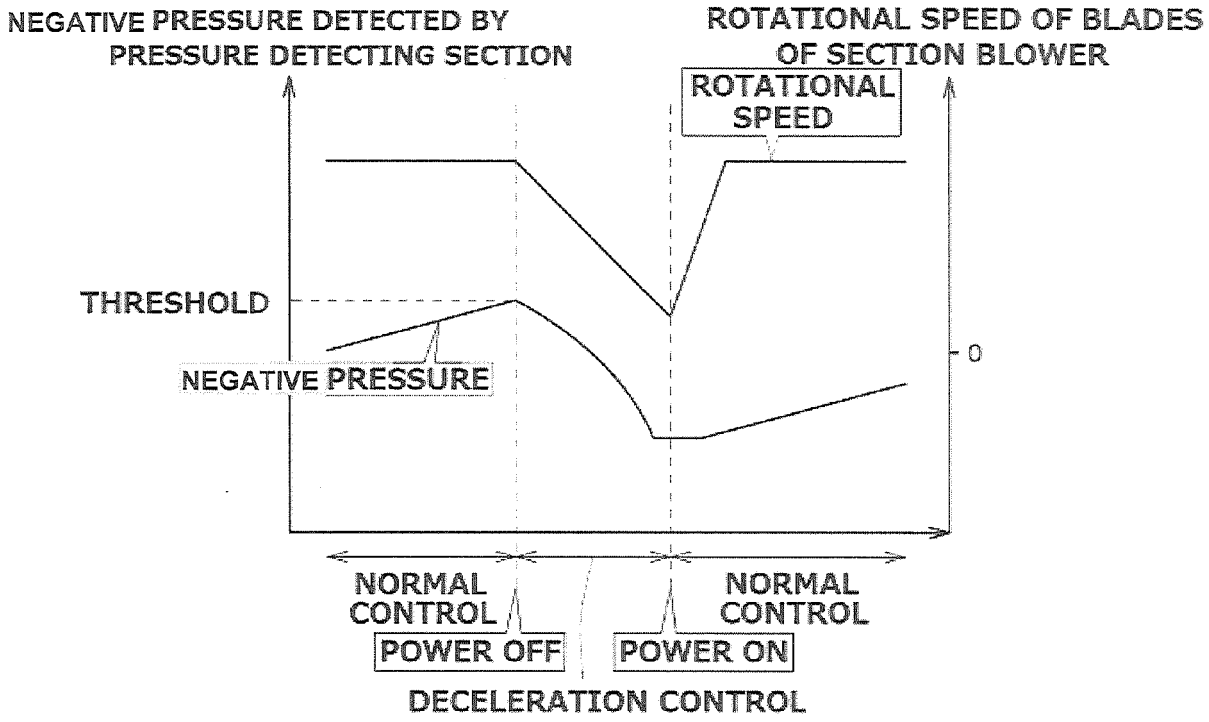
NEGATIVE PRESSURE DETECTED BY PRESSURE DETECTING SECTION
ROTATIONAL SPEED OF BLADES OF SECTION BLOWER
ROTATIONAL SPEED
THRESHOLD
NEGATIVE PRESSURE
0
NORMAL CONTROL
POWER OFF
DECELERATION CONTROL
POWER ON
NORMAL CONTROL

FIG.5

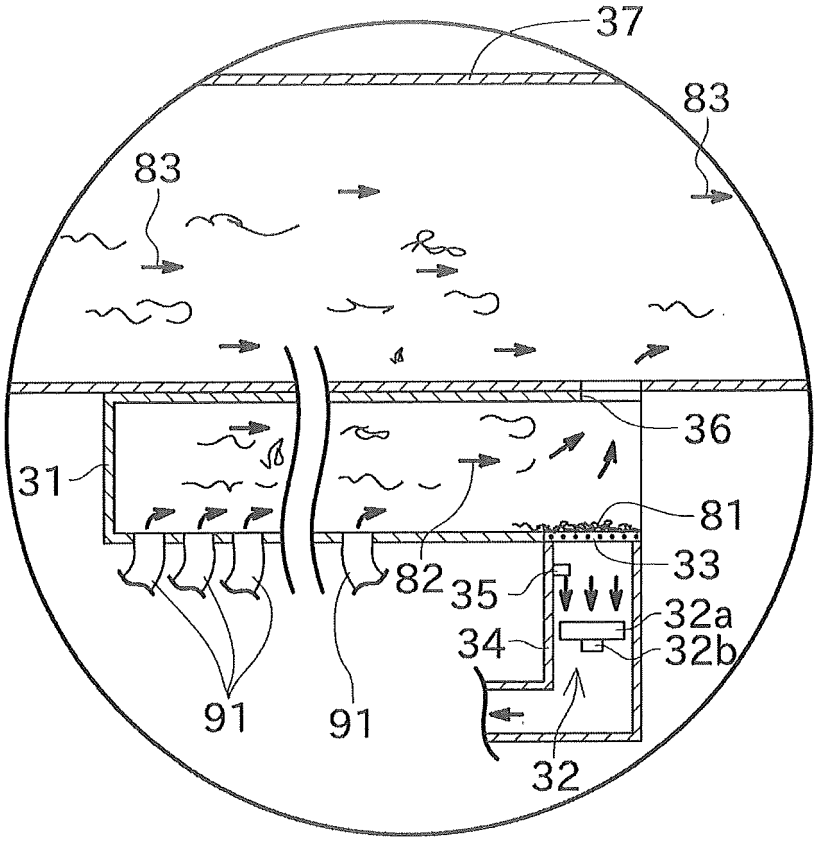

FIG.6

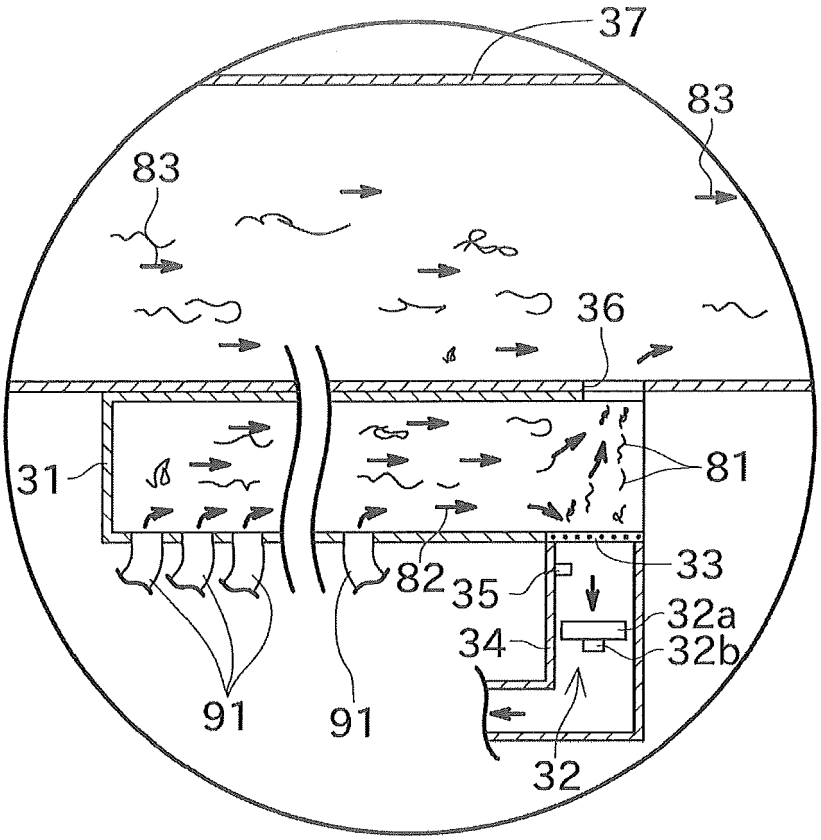

FIG.7

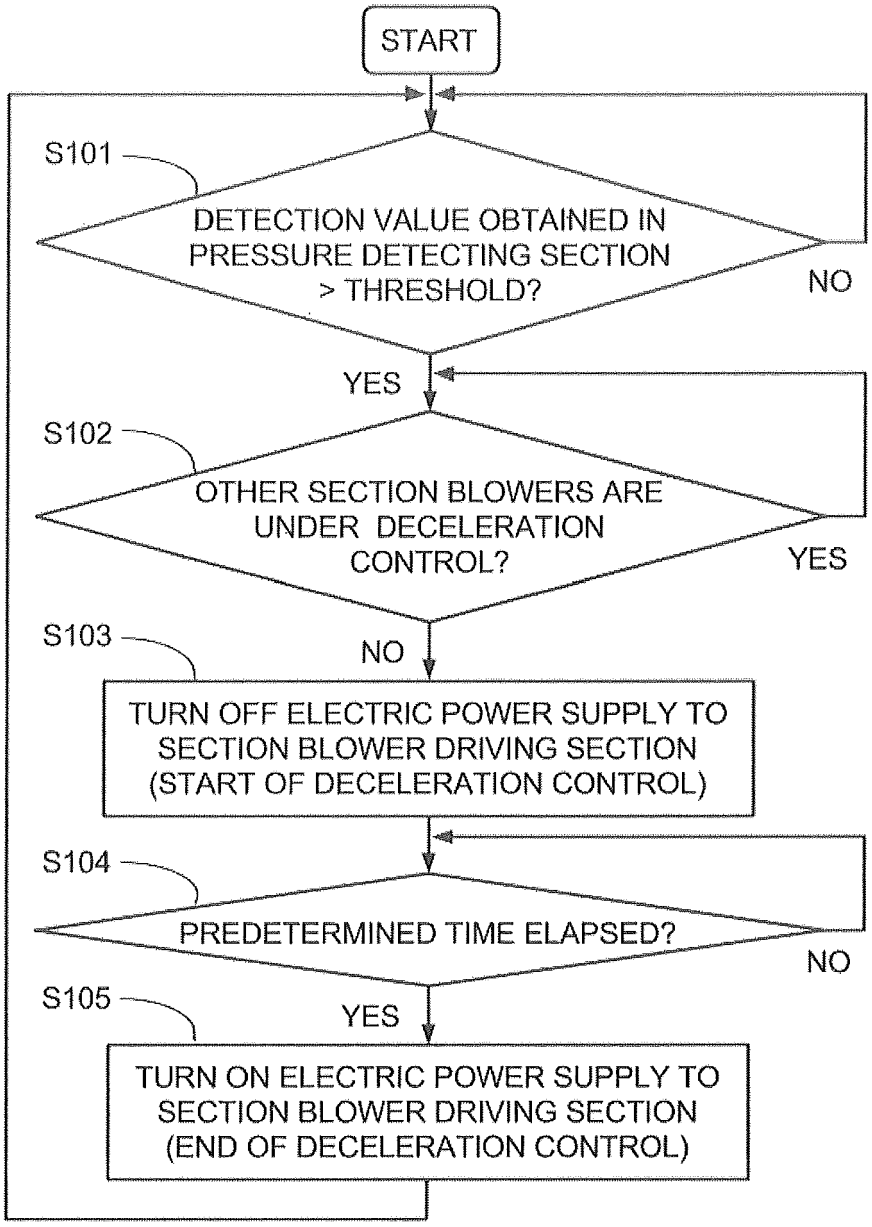
START
S101
DETECTION VALUE OBTAINED IN PRESSURE DETECTING SECTION > THRESHOLD?
NO
YES
S102
OTHER SECTION BLOWERS ARE UNDER DECELERATION CONTROL?
YES
S103
NO
TURN OFF ELECTRIC POWER SUPPLY TO SECTION BLOWER DRIVING SECTION (START OF DECELERATION CONTROL)
S104
PREDETERMINED TIME ELAPSED?
NO
S105
YES
TURN ON ELECTRIC POWER SUPPLY TO SECTION BLOWER DRIVING SECTION (END OF DECELERATION CONTROL)

FIG.8

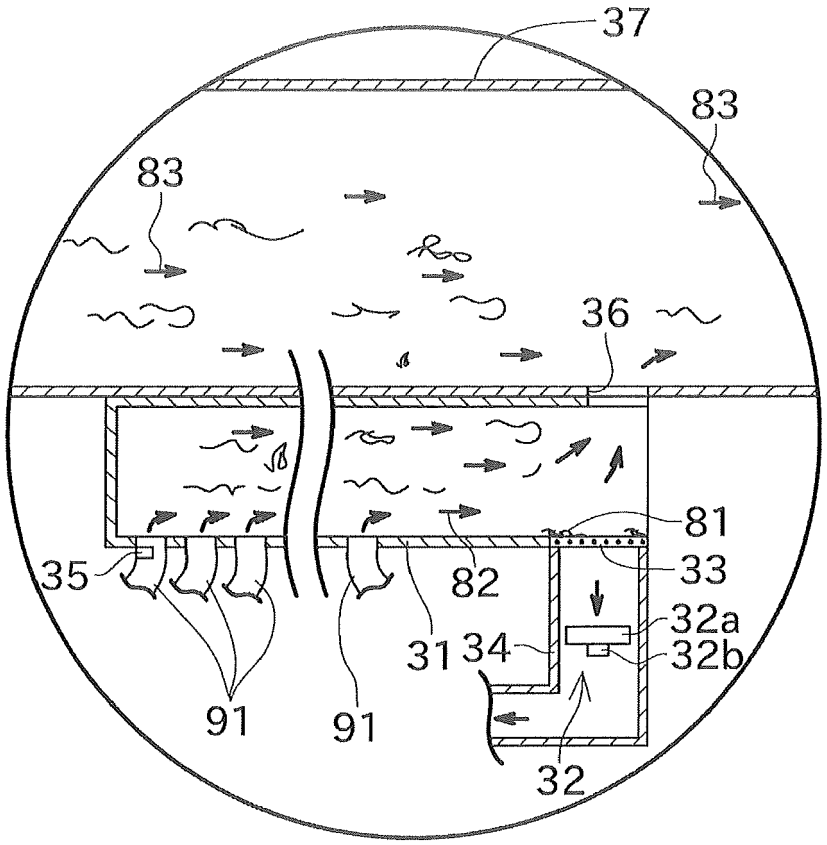

FIG. 9

DECELERATION CONTROL SCHEDULE	
SECTION	DECELERATION CONTROL IMPLEMENTATION TIME
SECTION 1	5 SECONDS FROM HOUR 1:00
SECTION 2	5 SECONDS FROM HOUR 2:00
SECTION 3	5 SECONDS FROM HOUR 3:00
SECTION 4	5 SECONDS FROM HOUR 4:00
:	:
SECTION 8	5 SECONDS FROM HOUR 8:00
SECTION 9	5 SECONDS FROM HOUR 9:00
SECTION 10	5 SECONDS FROM HOUR 10:00

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 4731

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 January 2017	Lemmen, René

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

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