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(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi,
Kyoto 601-8326 (JP)

(72) Inventor: **NAKAYAMA, Noboru**
Kyoto-shi, Kyoto 612-8686 (JP)

(74) Representative: **Weickmann & Weickmann**
PartmbB
Postfach 860 820
81635 München (DE)

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(54) **YARN WINDING MACHINE, YARN WINDING METHOD, AND YARN STORAGE CONTROL PROGRAM**

(57) A yarn winding machine (1) includes : an air spinning device (4); a winding device (20); a yarn storage device (6); a drive part (28); and a control part (90) repeatedly performing acceleration control and deceleration control, the acceleration control being increasing rotation speed of the drive part (28) to a range upper-limit speed (V5) equal to or higher than a storage-amount decreasing speed (V1), the deceleration control being reducing the rotation speed of the drive part (28) to a range lower-limit speed (V4) equal to or lower than a storage-amount increasing speed (V3). The control part performs storage-amount decreasing control of increasing the rotation speed of the drive part (28) to a first set speed (V2) that is higher than the range upper-limit speed (V5) after winding for the package (P) is started.

Fig.1

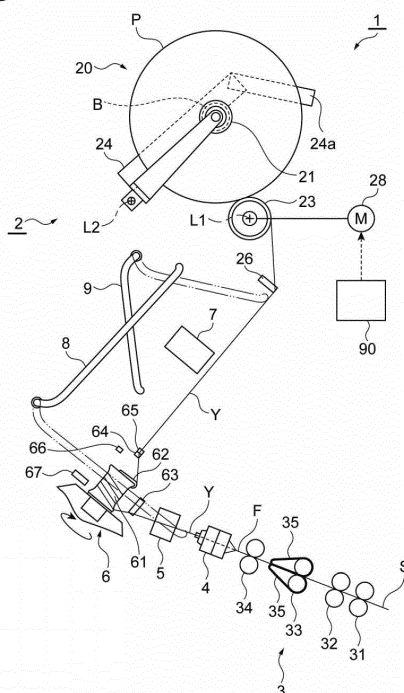
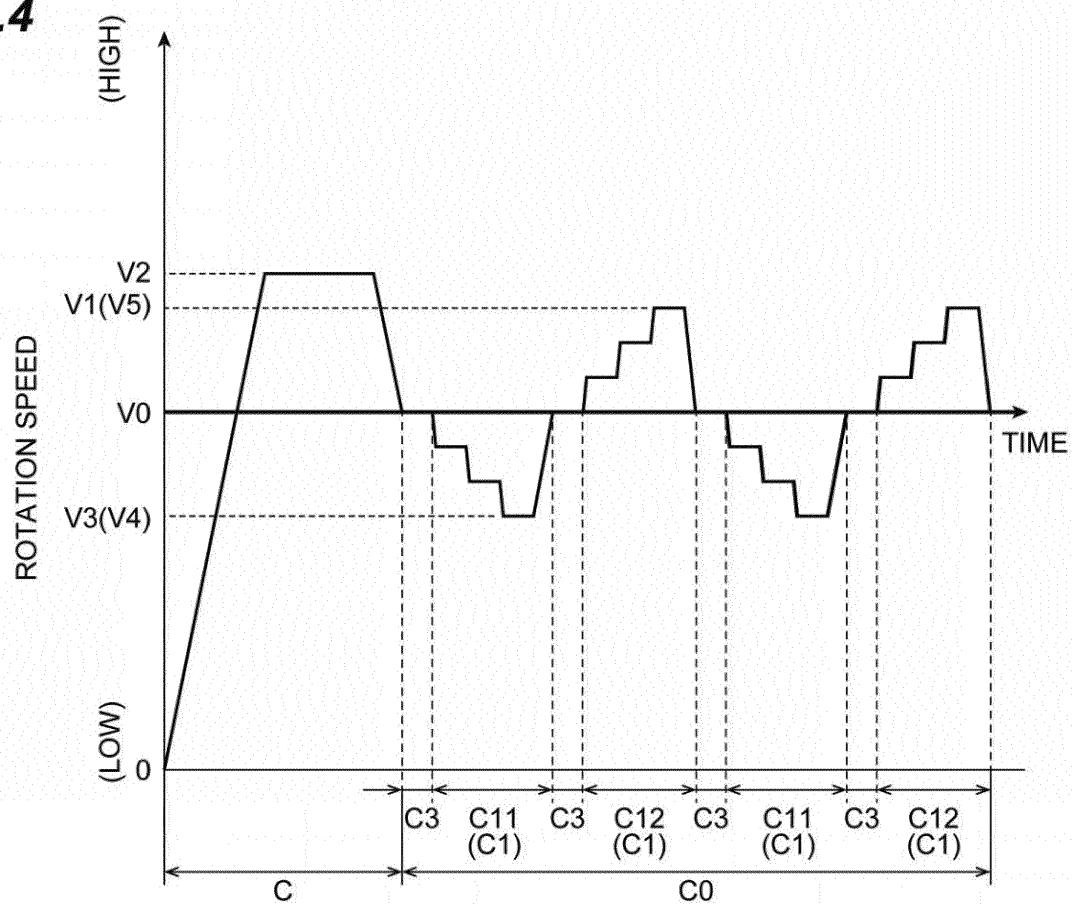


Fig.4



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a yarn winding machine, a yarn winding method, and a yarn storage control program.

BACKGROUND

[0002] In a yarn winding step of a spinning machine (yarn winding machine), winding tension is controlled by using a yarn storage device. For example, Japanese Unexamined Patent Publication No. 2004-277949 discloses a spinning machine (air spinning device) in which yarn formed by a spinning device is wound as a package by a winding device while slack of the yarn is being eliminated by storing the yarn in a yarn storage device (yarn slack eliminating device). In this spinning machine, when it is detected that the amount of slack retained in the yarn storage device (storage amount) has decreased below a predetermined amount, the package is separated from a rotating drum to reduce the winding speed, whereby the amount of the slack retained is increased.

SUMMARY

[0003] In a yarn winding machine including such a yarn storage device, the storage amount in the yarn storage device is preferably kept as constant as possible to keep the tension constant. In particular, at the time when winding of a winding device is started after yarn has been disconnected or a new bobbin has been set and during a predetermined period of time after this start of winding, the storage amount of yarn in the yarn storage device increases, and thus it is desired that the storage amount be reduced as quickly as possible.

[0004] In view of this, one aspect of the present disclosure aims to provide a yarn winding machine, a yarn winding method, and a yarn storage control program that makes it possible to quickly reduce the storage amount in a yarn storage device that has increased before winding of a package is started in a winding device.

[0005] A yarn winding machine according to one aspect of the present disclosure includes: an air spinning device configured to form yarn with airflow; a winding device configured to wind the yarn formed by the air spinning device to form a package; a yarn storage device disposed between the air spinning device and the winding device and configured to wind the yarn from the air spinning device around an outer peripheral surface of a yarn storage roller thereby temporarily storing the yarn; a drive part configured to rotate the package in the winding device; and a control part configured to perform storage-amount maintaining control of maintaining storage amount of the yarn in the yarn storage device within a predetermined storage range by repeatedly performing acceleration control and deceleration control. The accel-

eration control is control of increasing rotation speed of the drive part to a range upper-limit speed equal to or higher than a storage-amount decreasing speed that is a lower limit value at which the storage amount of the yarn in the yarn storage device can be reduced. The deceleration control is control of reducing the rotation speed of the drive part to a range lower-limit speed equal to or lower than a storage-amount increasing speed that is an upper limit value at which the storage amount of the yarn in the yarn storage device can be increased. The control part performs storage-amount decreasing control of increasing the rotation speed of the drive part to a first set speed that is higher than the range upper-limit speed after winding for the package is started.

[0006] Thus, after rotation of the package is started, the storage amount that has increased can be quickly reduced.

[0007] In the yarn winding machine according to one aspect of the present disclosure, one drive part may be provided with respect to each winding device. In other words, the drive part may rotate only one package. In the yarn winding machine thus configured, rotation of one package is controlled by one drive part, and thus the storage-amount decreasing control can be more accurately performed.

[0008] In the yarn winding machine according to one aspect of the present disclosure, the winding device may include a roller configured to rotate in contact with an outer peripheral surface of the package during winding for the package, and the control part may perform the storage-amount decreasing control with the roller being in contact with the package. In the yarn winding machine thus configured, contact pressure is always applied to yarn to be wound around the package, and thus a package without unevenness in tension can be formed.

[0009] In the yarn winding machine according to one aspect of the present disclosure, the first set speed in the storage-amount decreasing control may be identical regardless of diameter of the package. In the yarn winding machine thus configured, the storage amount in the yarn storage device can be reduced by simple control.

[0010] The yarn winding machine according to one aspect of the present disclosure may further include a yarn joining device configured to join the yarn formed by the air spinning device and the yarn wound by the winding device, and the control part may perform the storage-amount decreasing control simultaneously with completion or after the completion of the yarn joining operation in the yarn joining device. The storage amount that has increased due to the stoppage of winding of the winding device for the yarn joining operation can be quickly reduced.

[0011] In the storage-amount decreasing control of the yarn winding machine according to one aspect of the present disclosure, the drive part may be controlled such that the rotation speed of the drive part is increased to the first set speed and then the first set speed is maintained. Even when the rotation speed of the drive part is

continued to be increased and then the rotation speed is reduced, for example, the response speed of the drive part may cause a situation in which the rotation speed of the drive part cannot be reduced before the stored yarn runs out. In the yarn winding machine configured as described above, the rotation speed is prevented from becoming higher than a predetermined speed (first set speed), and thus a situation in which the storage amount is depleted can be avoided.

[0012] In the storage-amount decreasing control of the yarn winding machine according to one aspect of the present disclosure, the rotation speed of the drive part may be increased to the first set speed, and then the rotation speed of the drive part may be reduced to a second set speed that is a speed at which the storage amount of the yarn in the yarn storage device can be maintained within the storage range. With this configuration, after the storage amount that has increased during stoppage of winding of the winding device is quickly reduced, variation in storage amount can be reduced. Consequently, the tension of the yarn wound around a package is kept constant, whereby the quality of the package can be improved.

[0013] The yarn winding machine according to one aspect of the present disclosure may further include a first detecting part configured to detect the storage amount of the yarn stored in the yarn storage device, and the control part may end the storage-amount decreasing control when having determined based on a detection result of the first detecting part that the storage amount has become equal to or smaller than a first predetermined amount that has been set in advance. With this configuration, the storage-amount decreasing control can be ended at appropriate timing, and then variation in storage amount can be reduced. Consequently, the tension of the yarn wound around a package can be easily kept constant, whereby the quality of the package can be improved. Furthermore, a situation in which the storage amount is depleted can be reliably avoided.

[0014] In the yarn winding machine according to one aspect of the present disclosure, after ending the storage-amount decreasing control, the control part may repeatedly perform first control and second control. The first control is control of reducing the rotation speed of the drive part until the rotation speed becomes lower than the second set speed and reaches the range lower-limit speed and then increasing the rotation speed of the drive part to the second set speed. The second control is control of increasing the rotation speed of the drive part until the rotation speed becomes higher than the second set speed and reaches the range upper-limit speed and then reducing the rotation speed of the drive part to the second set speed. In the yarn winding machine thus configured, the storage amount can be maintained within the storage range.

[0015] The yarn winding machine according to one aspect of the present disclosure may further include a second detecting part configured to detect the storage

amount of the yarn stored in the yarn storage device, and the control part may increase the rotation speed of the drive part to the second set speed when having determined, based on a detection result of the second detecting part, that the storage amount has become equal to or larger than a second predetermined amount that is a lower limit value of the storage range, and may reduce the rotation speed of the drive part to the second set speed when having determined, based on a detection result of the second detecting part, that the storage amount has become equal to or smaller than a third predetermined amount that is an upper limit value of the storage range. With this configuration, the rotation speed of the drive part can be increased or reduced to the second set speed at appropriate timing, whereby variation in storage amount can be reduced.

[0016] In the first control of the yarn winding machine according to one aspect of the present disclosure, the rotation speed of the drive part may be reduced to a predetermined lower-limit speed value, and in the second control thereof, the rotation speed of the drive part may be increased to a predetermined upper-limit speed value. With this configuration, the storage amount can be prevented from increasing excessively, and also the stored yarn can be prevented from running out.

[0017] In the yarn winding machine according to one aspect of the present disclosure, the control part may perform stepwise at least one of reduction of the rotation speed of the drive part in the first control and increase of the rotation speed of the drive part in the second control. When the reduction of the rotation speed in the first control and the increase of the rotation speed in the second control are performed linearly instead of being performed stepwise, differences in speed between before and after the reduction and between before and after the increase may become excessively large. In this case, slip may occur between the package and the roller, which may cause a situation in which the storage amount cannot be controlled accurately. In the yarn winding machine configured as described above, the reduction of the rotation speed in the first control or the increase of the rotation speed in the second control is performed stepwise, and thus slippage as described above can be avoided and the storage amount can be controlled accurately.

[0018] In the yarn winding machine according to one aspect of the present disclosure, change of the rotation speed of the drive part from the speed reduced in the first control or the speed increased in the second control to the second set speed may be performed linearly. In the yarn winding machine thus configured, after the first control or the second control is performed, the state of control of the drive part is quickly shifted to a state in which variation in storage amount has been reduced, and thus variation in storage amount can be reduced.

[0019] The yarn winding machine according to one aspect of the present disclosure may further include a drafting device configured to draft a fiber bundle to be fed to the air spinning device, and the air spinning device may

include: a fiber guiding part configured to guide the fiber bundle fed from the drafting device; a spinning chamber in which fibers of the fiber bundle guided from the fiber guiding part are swirled by a swirling flow; and a hollow guide shaft member configured to guide the fibers swirled in the spinning chamber to outside. With this configuration, although there is a situation in which yarn is continuously fed before winding of a package is started in the winding device and the storage amount in the yarn storage device increases, the storage amount that has increased can be quickly reduced even in this situation.

[0020] A yarn winding method according to one aspect of the present disclosure is a yarn winding method performed in a yarn winding machine including: an air spinning device configured to form the yarn with airflow; a winding device configured to wind the yarn formed by the air spinning device to form a package; a yarn storage device disposed between the air spinning device and the winding device and configured to wind the yarn from the air spinning device around an outer peripheral surface of a yarn storage roller thereby temporarily storing the yarn; a drive part configured to rotate the package in the winding device; and a control part configured to maintain a storage amount of the yarn in the yarn storage device within a predetermined storage range by repeatedly performing acceleration control and deceleration control. The acceleration control is control of increasing rotation speed of the drive part to a range upper-limit speed equal to or higher than a storage-amount decreasing speed that is a lower limit value at which the storage amount of the yarn in the yarn storage device can be reduced. The deceleration control is control of reducing the rotation speed of the drive part to a range lower-limit speed equal to or lower than a storage-amount increasing speed that is an upper limit value at which the storage amount of the yarn in the yarn storage device can be increased. In the yarn winding method, after winding of the package is started, the rotation speed of the drive part is increased to a first set speed that is higher than the range upper-limit speed.

[0021] By this yarn winding method, in the same manner as in the above-described yarn winding machine, the storage amount that has increased can be quickly reduced after rotation of the package is started.

[0022] A yarn storage control program according to one aspect of the present disclosure is a yarn storage control program used in a yarn winding machine including: an air spinning device configured to form the yarn with airflow; a winding device configured to wind the yarn formed by the air spinning device to form a package; a yarn storage device disposed between the air spinning device and the winding device and configured to wind the yarn from the air spinning device around an outer peripheral surface of a yarn storage roller thereby temporarily storing the yarn; a drive part configured to rotate the package in the winding device; and a control part configured to control the drive part. The yarn storage control program causes the control part to perform a storage-

amount maintaining control of maintaining storage amount of the yarn in the yarn storage device within a predetermined storage range by repeatedly performing an acceleration control and a deceleration control. The acceleration control is a control of increasing the rotation speed of the drive part to a range upper-limit speed equal to or higher than a storage-amount decreasing speed that is a lower limit value at which the storage amount of the yarn in the yarn storage device can be reduced. The deceleration control is a control of reducing the rotation speed of the drive part to a range lower-limit speed equal to or lower than a storage-amount increasing speed that is an upper limit value at which the storage amount of the yarn in the yarn storage device can be increased. The yarn storage control program also causes the control part to perform a storage-amount decreasing control of increasing rotation speed of the drive part to a first set speed that is higher than the range upper-limit speed after winding of the package is started.

[0023] By this yarn winding program, in the same manner as in the above-described yarn winding machine, the storage amount that has increased can be quickly reduced after rotation of the package is started.

[0024] According to one aspect of the present disclosure, the storage amount in the yarn storage device that has increased before winding of a package is started in the winding device can be quickly reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a schematic configuration diagram illustrating a configuration of a spinning machine according to one embodiment;

FIG. 2 is a sectional view of an air spinning device in FIG. 1;

FIG. 3 is a functional block diagram of the air spinning device in FIG. 1; and

FIG. 4 is a graph illustrating rotation speed of a motor controlled by a control part in FIG. 1.

DETAILED DESCRIPTION

[0026] One embodiment will now be described in detail with reference to the attached drawings. In the description of the drawings, like or equivalent elements are designated by like numerals, and duplicate description is omitted.

[0027] As depicted in FIG. 1, a spinning machine (yarn winding machine) 1 includes a plurality of spinning units (yarn winding units) 2 and a control part 90. The spinning units 2 are aligned in a row. Each spinning unit 2 drafts a sliver (fiber bundle) S to form a fiber bundle F, twists the fiber bundle F using a swirling flow of air to form yarn Y, and winds the yarn Y around a bobbin B to form a package P. The control part 90 controls operation of the spinning machine 1.

[0028] The control part 90 is configured with a machine control device and a plurality of unit controllers, for example. The machine control device is a host controller of the unit controllers. Each unit controller is provided for every predetermined number of (one or more) spinning units 2, and controls operation of each spinning unit 2. In this embodiment, the control part 90 may be a unit controller. Details of control of the control part 90 will be described later.

[0029] Hereinafter, the upstream side of a sliver S, a fiber bundle F, and yarn Y in their traveling direction is called "upstream side", and the downstream side in the traveling direction is called "downstream side". One side in a horizontal direction orthogonal to a direction in which the spinning units 2 are aligned (e.g., working passage side) is called "front side", and the other side in the horizontal direction is called "rear side". The upper side in the vertical direction is called "upper side", and the lower side in the vertical direction is called "lower side".

[0030] Each spinning unit 2 includes, in the order from the upstream side toward the downstream side, a drafting device 3, an air spinning device 4, a yarn monitoring device 5, a yarn storage device (pull-out device) 6, a yarn joining device 7, and a winding device 20. The spinning unit 2 further includes a first catching-and-guiding device 8 and a second catching-and-guiding device 9. As one example, the traveling direction of a sliver S, a fiber bundle F, and yarn Y from the drafting device 3 to the yarn storage device 6 is a direction extending from the front side toward the rear side and is inclined upward with respect to the horizontal direction. The traveling direction of yarn Y from the yarn storage device 6 to winding device 20 is a direction extending from the lower side toward the upper side, and is inclined forward with respect to the vertical direction. In each spinning unit 2, the traveling direction of yarn Y is turned at the yarn storage device 6.

[0031] The drafting device 3 drafts a sliver S to form a fiber bundle F, and feeds the fiber bundle F to the air spinning device 4. The drafting device 3 includes, in the order from the upstream side toward the downstream side, a back roller pair 31, a third roller pair 32, a middle roller pair 33, and a front roller pair 34. Around the rollers constituting the middle roller pair 33, apron belts 35 are each wound.

[0032] The air spinning device 4 twists a fiber bundle F from the drafting device 3 using a swirling flow to form yarn Y. More specifically, the air spinning device 4 includes a nozzle block 40 and a hollow guide shaft member 50 as depicted in FIG. 2. In the nozzle block 40, while a fiber bundle F fed from the drafting device 3 is guided to the inside thereof, a swirling flow acts on the fiber bundle F. The fiber bundle F thus twisted is fed to outside through the hollow guide shaft member 50. Generation and shutoff of the swirling flow is controlled by the unit controller.

[0033] The nozzle block 40 includes a fiber guiding part 41 and a swirling flow generating part 42. The fiber guiding part 41 and the swirling flow generating part 42 may

be integrally formed, and may be separately formed. In the fiber guiding part 41, a guide hole 41a for guiding a fiber bundle F fed from the drafting device 3 is formed. An end part of the guide hole 41a on the drafting device 3 side is an inlet 41b for a sliver S. In the swirling flow generating part 42, a spinning chamber 43 and a plurality of first nozzles 44 are formed. In the spinning chamber 43, a tip 45a of a needle 45 held by the fiber guiding part 41 is positioned.

[0034] In the spinning chamber 43, rear ends of fibers of a fiber bundle F introduced through the guide hole 41a are swirled by a swirling flow. In order to form the swirling flow in the spinning chamber 43, air is injected into the spinning chamber 43 from the first nozzles 44. In the swirling flow generating part 42, an opening part 42a is formed so as to be continuous with the spinning chamber 43. The opening part 42a is formed in the shape of a truncated cone that tapers off toward the upstream side. The needle 45 prevents twisting of the fiber bundle F from being transmitted to the upstream side of the air spinning device 4. The needle 45 may be omitted, and a downstream end part of the fiber guiding part 41 may serve as the needle 45 instead.

[0035] An upstream end part 50a of the hollow guide shaft member 50 is formed in the shape of a truncated cone that tapers off toward the upstream side, and is disposed inside the opening part 42a with a clearance therebetween. A flange-like cap 57 is attached to the hollow guide shaft member 50. The nozzle block 40 is supported by a frame-like holder 46. Due to the cap 57 and the holder 46 coming into contact with each other, the hollow guide shaft member 50 is positioned with respect to the spinning chamber 43. Air injected into the spinning chamber 43 from the first nozzles 44 flows through the clearance between the upstream end part 50a of the hollow guide shaft member 50 and the opening part 42a of the swirling flow generating part 42 and into a reduced-pressure chamber 47 formed in the holder 46, and is discharged together with fibers that have not become a portion of the yarn Y.

[0036] In the hollow guide shaft member 50, a passage 51 and a plurality of second nozzles 54 are formed. The passage 51 guides yarn Y (fibers swirled in the spinning chamber 43) to outside. For example, when generation of yarn Y is started (restarted), air is injected into the passage 51 from the second nozzles 54. The passage 51 extends along the central axis of the hollow guide shaft member 50, and is formed so as to become wider from an inlet 52 toward an outlet 53. Air is supplied to each second nozzle 54 through an air supply path 56 and an air flow path 55.

[0037] As depicted in FIG. 1, the yarn monitoring device 5 monitors information on traveling yarn Y to detect the presence or absence of a yarn defect on the basis of the monitored information. When having detected a yarn defect, the yarn monitoring device 5 transmits a yarn defect detection signal to the control part 90. When having received the yarn defect detection signal, in order to cut

the yarn Y, the control part 90 causes the drafting device 3 and the air spinning device 4 to stop operating such that feeding of yarn Y is stopped. For example, a cutter may be provided to the yarn monitoring device 5, and the yarn Y may be cut by operating the cutter.

[0038] The yarn storage device 6 is disposed between the air spinning device 4 and the winding device 20, and includes a yarn storage roller 61 and a yarn hooking member 62. The yarn storage device 6 winds the yarn Y fed from the air spinning device 4 around the yarn storage roller 61 thereby temporarily storing the yarn Y.

[0039] The yarn storage roller 61 is rotated by an electric motor (not depicted). The yarn hooking member 62 is attached to a downstream end part of the yarn storage roller 61, and is rotatable relative to the yarn storage roller 61. Magnetic force acts upon the yarn hooking member 62 to interfere with rotation of the yarn hooking member 62 relatively to the yarn storage roller 61. Thus, when a tension equal to or higher than a predetermined value is not applied to the yarn Y, the yarn hooking member 62 rotates together with the yarn storage roller 61, whereby the yarn Y is wound (stored) around the yarn storage roller 61. When a tension equal to or higher than the predetermined value is applied to the yarn Y, the yarn hooking member 62 rotates relatively to the yarn storage roller 61, whereby the yarn Y is unwound from the yarn storage roller 61. The yarn storage device 6 stores the yarn Y in this manner, thereby absorbing variation in tension applied to the yarn Y on the downstream side of the yarn storage device 6, and also stably pulling out the yarn Y from the air spinning device 4.

[0040] On the upstream side of the yarn storage device 6, a first guide 63 is disposed. The first guide 63 guides the yarn Y traveling from the upstream side to the yarn storage device 6. The first guide 63 is movable, and pulls the yarn Y from the air spinning device 4 to the yarn storage device 6 when yarn joining is performed, for example. On the downstream side of the yarn storage device 6, a second guide 64, a third guide 65, and a fourth guide 66 are disposed. The second guide 64 and the third guide 65 guide the yarn Y traveling from the yarn storage device 6 to the downstream side. The second guide 64 is movable, and can guide the yarn Y to the third guide 65. The fourth guide 66 is movable, and hooks the yarn Y onto the yarn hooking member 62 and removes the yarn Y from the yarn hooking member 62.

[0041] When the yarn Y has been cut or the yarn Y has broken due to some reason, the yarn joining device 7 joins the yarn Y from the air spinning device 4 and the yarn Y from the package P. The yarn joining device 7 is a splicer device configured to twist yarn ends together using swirling flow. However, the yarn joining device 7 may be a mechanical knotter, for example. Each of the first catching-and-guiding device 8 and the second catching-and-guiding device 9 can swing about its base end part in both directions. When performing yarn joining, the first catching-and-guiding device 8 swings downward to catch the yarn Y from the air spinning device 4 using

suction airflow, and then swings upward to guide the yarn Y from the air spinning device 4 to the yarn joining device 7. When performing yarn joining, the second catching-and-guiding device 9 swings upward to catch the yarn Y from the package P using suction airflow, and then swings downward to guide the yarn Y from the package P to the yarn joining device 7.

[0042] The winding device 20 winds the yarn Y, which has been pulled out from the air spinning device 4 by the yarn storage device 6, around a bobbin B to form a package P. The winding device 20 includes a drum (roller) 23, a pair of bobbin holders 21, a cradle 24, a motor (drive part) 28 configured to rotate the drum 23. In the present embodiment, one motor 28 rotates only one package P. In other words, a rotation shaft of the motor 28 is connected to the drum 23, and this one motor 28 rotates this one drum 23 only. One motor 28 is provided with respect to each of the pair of bobbin holders 21. In the spinning machine 1, one motor 28 is provided to each spinning unit 2. On the upstream side of the winding device 20, a fifth guide 26 is disposed. The fifth guide 26 guides the yarn Y traveling from the upstream side toward the drum 23.

[0043] The drum 23 rotates the bobbin B while making contact with a bobbin B. When the yarn Y is being wound around the bobbin B, the drum 23 rotates while being in contact with an outer peripheral surface of the package P, thereby rotating the package P. On a surface of the drum 23, a traverse groove (not depicted) is formed. By this traverse groove, the yarn Y is traversed when the yarn Y is wound around the bobbin B. Herein, instead of forming the traverse groove on the surface of the drum 23, the yarn Y may be traversed by an additionally provided traversing device when the yarn Y is wound around the bobbin B.

[0044] The cradle 24 is provided so as to be swingable about a swinging axis L2 in both directions, and can absorb an increase in diameter of the package P when the yarn Y is wound around the bobbin B. The cradle 24 is provided with the pair of bobbin holders 21, which rotatably support both end parts of the bobbin B.

[0045] A yarn detection sensor (a first detecting part and a second detecting part) 67 detects the storage amount of yarn Y stored in the yarn storage device 6. The yarn detection sensor 67 can detect an upper-limit storage amount (a first predetermined amount and a third predetermined amount) that is an upper limit value of an appropriate storage amount (storage range) and a lower-limit storage amount (second predetermined amount) that is a lower limit value of the appropriate storage amount. The yarn detection sensor 67 is disposed so as to face an outer peripheral surface of the yarn storage roller 61.

[0046] The control part 90 is an electronic control unit including a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM). The control part 90 loads a program (yarn storage control program) stored in the ROM into the RAM, and causes

the CPU to execute the program, thereby performing various controls. For example, the control part 90 mainly uses information input from the yarn detection sensor 67 to control the motor 28 of the winding device 20, the drafting device 3, the air spinning device 4, and the yarn joining device 7 as depicted in FIG. 3, thereby performing storage-amount decreasing control C of quickly reducing the storage amount in the yarn storage device 6 that has increased before winding of a package P in the winding device 20 is started.

[0047] The yarn storage control program causes the control part 90 to perform a storage-amount maintaining control and a storage-amount decreasing control. The storage-amount maintaining control is a control of maintaining the storage amount of the yarn Y in the yarn storage device 6 within a predetermined storage range by repeatedly performing an acceleration control and a deceleration control. The acceleration control is a control of increasing the rotation speed of the motor 28 to a fourth set speed (range upper-limit speed) V5 equal to or higher than a storage-amount decreasing speed V1 that is a lower limit value at which the storage amount of the yarn Y in the yarn storage device 6 can be reduced. The deceleration control is a control of reducing the rotation speed of the motor 28 to a third set speed (range lower-limit speed) V4 equal to or lower than a storage-amount increasing speed V3 that is an upper limit value at which the storage amount of the yarn Y in the yarn storage device 6 can be increased. The storage-amount decreasing control is a control of increasing the rotation speed of the motor 28 to a first set speed V2 that is higher than the fourth set speed V5 after winding of the package P is started. This yarn storage control program may be stored in a non-transitory recording medium that can be read by an electronic control part (computer). The non-transitory recording medium may, for example, include a compact disc, a floppy disk, a hard disk, a magneto-optical disk, digital video disc, magnetic tape and semiconductor memory.

[0048] The following describes in detail the storage-amount decreasing control C to be performed by the control part 90 with reference to FIG. 4. A second set speed V0, the storage-amount decreasing speed V1, the storage-amount increasing speed V3, the third set speed V4, and the fourth set speed V5 are defined as follows.

[0049] Second set speed V0: a rotation speed of the motor 28 that is set in advance as a speed at which variation in storage amount in the yarn storage device 6 can be reduced

[0050] Storage-amount decreasing speed V1: a rotation speed of the motor 28 that is set in advance as a speed that is higher than the second set speed V0 and has a lower-limit at which the storage amount in the yarn storage device 6 can be reduced

[0051] Storage-amount increasing speed V3: a rotation speed of the motor 28 that is set in advance as a speed that is lower than the second set speed V0 and has an upper-limit at which the storage amount in the

yarn storage device 6 can be increased

[0052] Third set speed V4 (range lower-limit speed) : a rotation speed of the motor 28 that is equal to or lower than the storage-amount increasing speed V3 (the third set speed V4 = the storage-amount increasing speed V3 in the present embodiment)

[0053] Fourth set speed V5 (range upper-limit speed) : a rotation speed of the motor 28 that is equal to or higher than the storage-amount decreasing speed V1 (the fourth set speed V5 = the storage-amount decreasing speed V1 in the present embodiment)

[0054] As depicted in FIG. 4, immediately after winding of the package P is started (simultaneously with this start), the control part 90 controls the motor 28 to perform the storage-amount decreasing control C of increasing the rotation speed of the motor 28 to the first set speed V2 that is a speed higher than the storage-amount decreasing speed V1. The control part 90 performs the storage-amount decreasing control C simultaneously with completion or after the completion of yarn joining operation in the yarn joining device 7. The storage-amount decreasing control C may be performed at the time when winding is started after an empty bobbin B has been set on the winding device 20 by a doffer (not depicted) and during a predetermined period of time after this start of winding. The control part 90 performs the storage-amount decreasing control C with the drum 23 being in contact with the package P. The first set speed V2 in the storage-amount decreasing control C is identical regardless of the diameter of the package P. In other words, the motor 28 has sufficient torque with which the package P can be rotated at the first set speed V2 even when the diameter of the package P increases.

[0055] After the rotation speed of the motor 28 is increased to the first set speed V2, the control part 90 controls the motor 28 such that the first set speed V2 is maintained. When having determined that the storage amount has become equal to or lower than the upper-limit storage amount (first predetermined amount) on the basis of detection of the yarn Y by the yarn detection sensor 67, the control part 90 controls the motor 28 such that the rotation speed is reduced from the first set speed V2 to the second set speed V0 to end the storage-amount decreasing control C. Change from the first set speed V2 to the second set speed V0 is performed linearly instead of being performed stepwise .

[0056] After performing the storage-amount decreasing control C, the control part 90 controls the motor 28 to perform storage-amount maintaining control C0 of maintaining the storage amount in the yarn storage device 6 within a predetermined storage range. In the storage-amount maintaining control C0, the control part 90 controls the motor 28 to perform storage-amount control C1 and a third control C3. The storage-amount control C1 is control of repeating first control C11 and second control C12. The third control C3 is control of controlling the rotation speed of the motor 28 such that the second set speed V0 is maintained.

[0057] The first control C11 is control of reducing the rotation speed of the motor 28 to the third set speed V4 that is a speed equal to or lower than the storage-amount increasing speed V3 (the storage-amount increasing speed V3 and the third set speed V4 are the same in the present embodiment) and then, if it is determined that the storage amount has become equal to or larger than the upper-limit storage amount (third storage amount) on the basis of detection of the yarn Y by the yarn detection sensor 67, increasing the rotation speed of the motor 28 to the second set speed V0. In the present embodiment, an example has been described in which the third set speed V4 is set to the same speed as the storage-amount increasing speed V3. However, the third set speed V4 may be set to a speed lower than the storage-amount increasing speed V3.

[0058] The control part 90 reduces stepwise the rotation speed of the motor 28 in the first control C11 until the storage amount becomes equal to or larger than the upper-limit storage amount (third storage amount). This stepwise reduction of the rotation speed of the motor 28 in the first control C11 is performed until the rotation speed reaches the third set speed V4 that is a predetermined lower-limit speed value. In other words, in the first control C11, when the rotation speed of the motor 28 has reached the third set speed V4, this third set speed V4 is maintained. The rotation speed of the motor 28, which has been reduced to the third set speed V4 in the first control C11, is increased linearly to the second set speed V0, instead of being increased stepwise. Accordingly, the storage amount is prevented from excessively increasing.

[0059] The second control C12 is control of increasing the rotation speed of the motor 28 to the fourth set speed V5 equal to or higher than the storage-amount decreasing speed V1 (the storage-amount decreasing speed V1 and the fourth set speed V5 are the same in the present embodiment) and then, if it is determined that the storage amount has become equal to or smaller than the lower-limit storage amount (second storage amount) on the basis of detection of the yarn Y by the yarn detection sensor 67, reducing the rotation speed of the motor 28 to the second set speed V0. In the present embodiment, an example has been described in which the fourth set speed V5 is set to the same speed as the storage-amount decreasing speed V1. However, the fourth set speed V5 may be set to a speed higher than the storage-amount decreasing speed V1 and lower than the first set speed V2.

[0060] The control part 90 increases stepwise the rotation speed of the motor 28 in the second control C12 until the storage amount becomes equal to or smaller than the lower-limit storage amount (second storage amount). This stepwise increase of the rotation speed of the motor 28 in the second control C12 is performed until the rotation speed reaches the fourth set speed V5 that is a predetermined upper-limit speed value. In other words, in the second control C12, when the rotation

speed of the motor 28 has reached the fourth set speed V5, this fourth set speed V5 is maintained. The rotation speed of the motor 28, which has been increased to the fourth set speed V5 in the second control C12, is changed linearly to the second set speed V0, instead of being changed stepwise. Accordingly, the storage amount is prevented from excessively decreasing.

[0061] Although the control part 90 is performing the third control C3 between the storage-amount decreasing control C and the storage-amount control C1, this third control C3 may be omitted. Although the control part 90 is performing the third control C3 between the first control C11 and the second control C12, this third control C3 may be omitted.

[0062] When performing the third control C3 between the storage-amount decreasing control C and the storage-amount control C1, this third control C3 may be performed within a period of time that is short as possible. In other words, shifting from the storage-amount decreasing control C to the first control C11 in the storage-amount control C1 may be performed as quickly as possible. In this case, even when the second set speed V0 becomes higher than the speed at which the yarn Y is fed from the air spinning device 4, the storage amount of the yarn Y is increased by starting the first control C11, which can thereby reduce the possibility that the storage amount in the yarn storage device 6 becomes zero. Consequently, a situation in which the storage amount becomes zero and the spinning unit 2 stops can be avoided. Shifting from the first control C11 to the second control C12 in the storage-amount control C1 does not have to be performed as quickly as described above.

[0063] The following describes functional effects of the spinning machine 1 according to the embodiment described above. In the spinning machine 1 of the embodiment above, by controlling the motor 28 configured to drive the drum 23 for rotating a package P, the storage-amount decreasing control C is performed, and thus the storage amount in the yarn storage device 6 that has increased before winding of the package P in the winding device 20 is started can be quickly reduced.

[0064] In the spinning machine 1 according to the embodiment, one motor 28 is provided for each winding device 20 provided to each of the spinning units 2. With this configuration, rotation of one package P is controlled by one motor 28, and thus winding control for the package P can be more accurately performed.

[0065] In the spinning machine 1 according to the embodiment, the control part 90 performs the storage-amount decreasing control C with the drum 23 being in contact with a package P. With this configuration, contact pressure is always applied to the yarn Y to be wound around the package P, and thus a good-quality package P without unevenness in tension can be formed.

[0066] In the spinning machine 1 according to the embodiment, the control part 90 performs the storage-amount decreasing control C simultaneously with completion of yarn joining operation in the yarn joining device

7. Thus, the storage amount in the yarn storage device 6 that has increased due to the stoppage of winding of the winding device 20 for yarn joining operation can be quickly reduced.

[0067] In the storage-amount decreasing control C of the spinning machine 1 according to the embodiment, as depicted in FIG. 4, the motor 28 is controlled such that the rotation speed of the motor 28 is increased to the first set speed V2 and then the first set speed V2 is maintained. This solves the problem that the rotation speed cannot be reduced sufficiently due to, for example, the response speed of the motor 28 before the storage amount of the yarn Y runs out. Consequently, the storage amount can be prevented from running out.

[0068] In the spinning machine 1 according to the embodiment, the control part 90 ends the storage-amount decreasing control C when having determined that the storage amount has become equal to or smaller than the lower-limit storage amount on the basis of detection of the yarn Y by the yarn detection sensor 67. Thus, the storage-amount decreasing control C can be ended at an appropriate timing, and then variation in storage amount in the yarn storage device 6 can be reduced thereafter. Consequently, the tension of the yarn Y wound around a package P can be easily kept constant, whereby the quality of the package P can be improved. Furthermore, a situation in which the storage amount runs out in the yarn storage device 6 can be reliably avoided.

[0069] If the winding speed of the yarn Y in the winding device 20 can be matched to a feeding speed at which the air spinning device 4 feeds yarn Y, the storage amount in the yarn storage device 6 can be made constant. Thus, in the spinning machine 1 according to the embodiment, the second set speed V0 that is predetermined as a speed at which variation in storage amount in the yarn storage device 6 can be reduced is matched to the feeding speed at which the yarn Y is fed from the air spinning device 4. However, a difference in speed may arise between the rotation speed of the motor 28 and the actual winding speed of a package P depending on various conditions, and the feeding speed may vary, and accordingly a difference in speed may arise between the second set speed V0 and the feeding speed. In this case, even when the third control C3 of controlling the rotation speed of the motor 28 such that the rotation speed becomes the second set speed V0 is performed, the storage amount in the yarn storage device 6 cannot be maintained within a predetermined storage range. The control part 90 of the spinning machine 1 according to the embodiment controls the motor 28 to perform the storage-amount control C1 (storage-amount maintaining control C0) of repeating the first control C11 and the second control C12, whereby the storage amount can be maintained within a predetermined storage range even if there is a difference in speed between the second set speed V0 and the feeding speed.

[0070] In the spinning machine 1 according to the em-

bodiment, the control part 90 increases or reduces the rotation speed of the motor 28 on the basis of detection by the yarn detection section 67 of the lower-limit storage amount and the upper-limit storage amount which are an appropriate storage amount. With this configuration, the rotation speed of the motor 28 can be increased or reduced to the second set speed V0 at an appropriate timing, whereby variation in storage amount in the yarn storage device 6 can be reduced.

[0071] In the spinning machine 1 according to the embodiment, limitations are imposed on the first control C11 such that the rotation speed of the motor 28 can be reduced only to the predetermined lower-limit speed value, and limitations are imposed on the second control C12 such that the rotation speed of the motor 28 can be increased only to the predetermined upper-limit speed value. Thus, a situation in which the storage amount in the yarn storage device 6 excessively increases can be avoided, and also a situation in which the storage amount in the yarn storage device 6 runs out can be avoided.

[0072] In the spinning machine 1 according to the embodiment, the control part 90 performs stepwise at least one of a reduction of the rotation speed of the motor 28 in the first control C11, and an increase of the rotation speed of the motor 28 in the second control C12. Consequently, slippage between a package P and the drum 23 can be avoided in the winding device 20, and thus the storage amount in the yarn storage device 6 can be controlled accurately. Herein, this control does not have to be performed stepwise, and the reduction or increase in the rotation speed of the motor 28 may be performed linearly.

[0073] In the spinning machine 1 according to the embodiment, change of the rotation speed of the motor 28 to the second set speed V0 from the third set speed V4, which is the rotation speed that has been reduced in the first control C11, or from the fourth set speed V5, which is the rotation speed that has been increased in the second control C12, is performed linearly instead of being performed stepwise. Consequently, the state of control of the motor 28 is quickly shifted to a state in which variation in storage amount in the yarn storage device 6 is decreased, and thus variation in storage amount in the yarn storage device 6 can be reduced.

[0074] In the spinning machine 1 according to the embodiment, the motor 28 has sufficient torque with which a package P can be rotated at the first set speed V2 even when the diameter of the package P has increased so that the first set speed V2 in the storage-amount decreasing control C is identical regardless of the diameter of the package P. This eliminates the need of performing winding control of the package P in consideration of weight and inertia, for example, depending on the diameter of the package P, and thus the storage amount in the yarn storage device 6 can be reduced by simple control.

[0075] By the yarn winding method performed in the spinning machine 1, after winding of the package P is started, the rotation speed of the motor 28 is increased

to the first set speed V2 that is higher than the storage-amount decreasing speed V1 at which the storage amount of yarn Y in the yarn storage device 6 can be reduced. By this winding method, the storage amount in the yarn storage device 6 that has increased before winding of the package P is started can be quickly reduced.

[0076] Although an embodiment according to one aspect of the present disclosure has been described above, one aspect of the present disclosure is not limited to the embodiment above.

[0077] In the embodiment, an example has been described in which the winding device 20 is of a type in which the drum 23 is rotationally driven, whereby the bobbin B being in contact with the drum 23 is rotated accompanying the rotation of the drum 23. One aspect of the present disclosure is not limited to this example, and the winding device may be of a type in which the bobbin B is rotationally driven, whereby the drum 23 being in contact with the bobbin B is rotated depending on the rotation of the bobbin B. In this case, the motor 28 rotationally drives the bobbin B.

[0078] In the embodiment, an example has been described in which rotation of the drum 23 is controlled in order to perform the storage-amount decreasing control C and the storage-amount control C1 (storage-amount maintaining control C0). Instead of this example, in one aspect of the present disclosure, a motor (not depicted) configured to drive a reversing roller included in a work carriage (not depicted), which is movable along a direction in which the spinning units 2 are aligned, may be controlled. The reversing roller is a roller configured to rotate a package P in a direction (yarn unwinding direction) opposite to a direction in which a package P supported by the winding device 20 is rotated by the drum 23 while being in contact therewith. The control part 90 may control the motor so as to cause the reversing roller to rotate in a direction opposite to the yarn unwinding direction (yarn winding direction of the package P), thereby performing the storage-amount decreasing control C and the storage-amount control C1 (storage-amount maintaining control C0). In this case, even when drums 23 in a plurality of winding devices 20 included in the spinning machine 1 are configured to be driven all together, by lifting up a package P from a drum 23 and using the reversing roller of the work carriage to rotate the package P, storage-amount decreasing control C and storage-amount control C1 (storage-amount maintaining control C0) that are similar to those in the embodiment can be performed.

[0079] In the embodiment, an example has been described in which the timing of reducing the rotation speed from the first set speed V2 to the second set speed V0 in the storage-amount decreasing control C is controlled based on detection of the yarn Y by the yarn detection sensor 67. One aspect of the present disclosure is not limited to this example. For example, if control duration from the start of winding of a package P to the timing of reducing the rotation speed is set in advance based on

empirical values, controls similar to those in the embodiment can be performed without providing the yarn detection sensor 67. If control durations are set in advance also for the timing of increasing the rotation speed from the third set speed V4 to the second set speed V0 in the storage-amount control C1 and the timing of reducing the rotation speed from the fourth set speed V5 to the second set speed V0 in the storage-amount control C1, controls similar to those in the embodiment can be performed without providing the yarn detection sensor 67.

[0080] Instead of the configuration in which one yarn detection sensor 67 detects the lower-limit storage amount that is a lower limit value of an appropriate storage amount and the upper-limit storage amount that is an upper limit value of the appropriate storage amount, for example, two yarn detection sensors 67 may be provided such that one yarn detection sensor 67 detects the lower-limit storage amount and the other yarn detection sensor 67 detects the upper-limit storage amount.

[0081] Instead of the control of repeatedly increasing and reducing the rotation speed on the basis of two thresholds (the lower-limit storage amount and the upper-limit storage amount) detected by one or two yarn detection sensors 67, the rotation speed may be repeatedly increased and reduced, for example, on the basis of detection results of a yarn detection sensor 67 configured to detect one threshold, that is, whether a predetermined storage amount is stored. For example, in a case in which the yarn detection sensor 67 is provided so as to detect the lower-limit storage amount, the control part 90 reduces the rotation speed of the motor 28 when yarn Y is not detected by the yarn detection sensor 67, and increases the rotation speed of the motor 28 when yarn Y is detected by the yarn detection sensor 67.

[0082] The control part 90 may control the rotation speed of the motor 28 such that the rotation speed of the motor 28 is increased to the first set speed V2 and then, without being maintained at the first set speed V2, is continued to be increased beyond the first set speed V2, and then is reduced to the second set speed V0. In this case, by controlling the rotation speed of the motor 28 so as not to exceed the storage-amount decreasing speed V1 significantly, a situation in which the storage amount becomes zero can be avoided.

[0083] Changes of the rotation speed of the motor 28 from the first set speed V2 to the second set speed V0 in the storage-amount decreasing control C, from the third set speed V4 to the second set speed V0 in the first control C11, and from the fourth set speed V5 to the second set speed V0 in the second control C12 may be controls that are performed stepwise instead of controls that are performed linearly.

[0084] An example has been described in which, in the first control C11, the rotation speed of the motor 28 is reduced stepwise to the third set speed V4 that is a predetermined lower-limit speed value. However, this reduction of the rotation speed may be stopped when the storage amount reaches the upper-limit storage amount

(third storage amount). In other words, the third set speed V4 does not have to be the same. Similarly, an example has been described in which, in the second control C12, the rotation speed of the motor 28 is increased to the fourth set speed V5 that is a predetermined upper-limit speed value. However, this increase of the rotation speed may be stopped when the storage amount reaches the lower-limit storage amount (second storage amount). In other words, the fourth set speed V5 does not have to be the same. It should be noted that the fourth set speed V5 is a speed lower than the first set speed V2.

[0085] The stepwise reduction of the rotation speed in the first control C11 does not necessarily have to be performed in three steps, and may be performed in one step, two steps, or four or more steps. The stepwise increase of the rotation speed in the second control C12 does not necessarily have to be performed in three steps, and may be performed in one step, two steps, or four or more steps.

[0086] In each spinning unit 2, the traveling direction of the yarn Y is turned at the yarn storage device 6. However, the traveling direction of the yarn Y does not have to be turned at the yarn storage device 6. In order to pull out the yarn Y from the air spinning device 4, a delivery roller and a nip roller may be disposed between the air spinning device 4 and the yarn storage device 6. The yarn monitoring device 5 may be disposed between the yarn storage device 6 and the winding device 20.

[0087] A yarn winding machine according to the present disclosure includes: an air spinning device configured to form yarn with airflow; a winding device configured to wind the yarn formed by the air spinning device to form a package; a yarn storage device disposed between the air spinning device and the winding device and configured to temporarily store the yarn from the air spinning device and to feed the yarn to the winding device; a drive part configured to rotate the package in the winding device; and a control part configured to perform storage-amount decreasing control of increasing rotation speed of the drive part, by controlling the drive part, to a first set speed equal to or higher than a storage-amount decreasing speed at which the storage amount of the yarn in the yarn storage device can be reduced after winding of the package is started.

[0088] A yarn winding method according to present disclosure is a yarn winding method performed in a yarn winding machine including: an air spinning device configured to form yarn with airflow; a winding device configured to wind the yarn formed by the air spinning device to form a package; a yarn storage device disposed between the air spinning device and the winding device and configured to temporarily store the yarn from the air spinning device and to feed the yarn to the winding device; and a drive part configured to rotate the package in the winding device. The yarn winding method includes increasing the rotation speed of the drive part to a first set speed equal to or higher than a storage-amount decreasing speed at which the storage amount of the yarn in the

yarn storage device can be reduced after winding for the package is started.

[0089] At least some of the embodiments disclosed above may be optionally combined.

[0090] A yarn winding machine includes: an air spinning device; a winding device; a yarn storage device; a drive part; and a control part repeatedly performing acceleration control and deceleration control, the acceleration control being increasing rotation speed of the drive part to a range upper-limit speed equal to or higher than a storage-amount decreasing speed, the deceleration control being reducing the rotation speed of the drive part to a range lower-limit speed equal to or lower than a storage-amount increasing speed. The control part performs storage-amount decreasing control of increasing the rotation speed of the drive part to a first set speed that is higher than the range upper-limit speed after winding for the package is started.

Claims

1. A yarn winding machine (1) comprising:

an air spinning device (4) configured to form a yarn (Y) with airflow;
a winding device (20) configured to wind the yarn (Y) formed by the air spinning device (4) to form a package (P);
a yarn storage device (6) disposed between the air spinning device (4) and the winding device (20) and configured to wind the yarn (Y) from the air spinning device (4) around an outer peripheral surface of a yarn storage roller (61) thereby temporarily storing the yarn (Y);
a drive part (28) configured to rotate the package (P) in the winding device (20); and
a control part (90) configured to perform storage-amount maintaining control (C0) of maintaining a storage amount of the yarn (Y) in the yarn storage device (6) within a predetermined storage range by repeatedly performing acceleration control and deceleration control, the acceleration control being increasing rotation speed of the drive part (28) to a range upper-limit speed (V5) equal to or higher than a storage-amount decreasing speed (V1) that is a lower limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be reduced, the deceleration control being reducing the rotation speed of the drive part (28) to a range lower-limit speed (V4) equal to or lower than a storage-amount increasing speed (V3) that is an upper limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be increased, **characterized in that**
the control part (90) is configured to perform storage-amount decreasing control (C) of in-

creasing the rotation speed of the drive part (28) to a first set speed (V2) that is higher than the range upper-limit speed (V5) after winding of the package (P) is started.

2. The yarn winding machine (1) according to claim 1, wherein, one drive part (28) is provided with respect to each winding device (20) .
3. The yarn winding machine (1) according to claim 1 or 2, wherein
the winding device (20) includes a roller (23) configured to rotate while being in contact with an outer peripheral surface of the package (P) during winding of the package (P), and
the control part (90) is configured to perform the storage-amount decreasing control (C) with the roller (23) being in contact with the package (P).
4. The yarn winding machine (1) according to any one of claims 1 to 3, wherein
the first set speed (V2) in the storage-amount decreasing control (C) is identical regardless of diameter of the package (P).
5. The yarn winding machine (1) according to any one of claims 1 to 4 further comprising a yarn joining device (7) configured to join the yarn (Y) formed by the air spinning device (4) and the yarn (Y) wound by the winding device (20), wherein
the control part (90) performs the storage-amount decreasing control (C) simultaneously with completion or after the completion of yarn joining operation in the yarn joining device (7).
6. The yarn winding machine (1) according to any one of claims 1 to 5, wherein, in the storage-amount decreasing control (C), the drive part (28) is controlled such that the rotation speed of the drive part (28) is increased to the first set speed (V2) and then the first set speed (V2) is maintained.
7. The yarn winding machine (1) according to any one of claims 1 to 6, wherein, in the storage-amount decreasing control (C), the rotation speed of the drive part (28) is increased to the first set speed (V2), and then the rotation speed of the drive part (28) is reduced to a second set speed (V0) that is a speed at which a storage amount of the yarn (Y) in the yarn storage device (6) can be maintained within the storage range.
8. The yarn winding machine (1) according to claim 7 further comprising a first detecting part (67) configured to detect the storage amount of the yarn (Y) stored in the yarn storage device (6), wherein
the control part (90) is configured to end the storage-amount decreasing control (C) when having deter-

mined based on a detection result of the first detecting part (67) that the storage amount has become equal to or smaller than a first predetermined amount that has been set in advance.

9. The yarn winding machine (1) according to claim 7 or 8, wherein, after ending the storage-amount decreasing control (C), the control part (90) repeatedly performs first control (C11) and second control (C12), the first control (C11) being control of reducing the rotation speed of the drive part (28) until the rotation speed becomes lower than the second set speed (V0) and reaches the range lower-limit speed (V4) and then increasing the rotation speed of the drive part (28) to the second set speed (V0), the second control (C12) being control of increasing the rotation speed of the drive part (28) until the rotation speed becomes higher than the second set speed (V0) and reaches the range upper-limit speed (V5) and then reducing the rotation speed of the drive part (28) to the second set speed (V0).
10. The yarn winding machine (1) according to claim 9 further comprising a second detecting part (67) configured to detect the storage amount of the yarn (Y) stored in the yarn storage device (6), wherein
the control part (90) is configured to increase the rotation speed of the drive part (28) to the second set speed (V0) when having determined, based on a detection result of the second detecting part (67), that the storage amount has become equal to or larger than a second predetermined amount that is a lower limit value of the storage range, and to reduce the rotation speed of the drive part (28) to the second set speed (V0) when having determined, based on a detection result of the second detecting part (67), that the storage amount has become equal to or smaller than a third predetermined amount that is an upper limit value of the storage range.
11. The yarn winding machine (1) according to claim 9 or 10, wherein in the first control (C11), the rotation speed of the drive part (28) is reduced to a predetermined lower-limit speed value (V4), and in the second control (C12), the rotation speed of the drive part (28) is increased to a predetermined upper-limit speed value (V5) .
12. The yarn winding machine (1) according to any one of claims 9 to 11, wherein the control part (90) is configured to perform stepwise at least one of reduction of the rotation speed of the drive part (28) in the first control (C11) and increase of the rotation speed of the drive part (28) in the second control (C12).
13. The yarn winding machine (1) according to any one of claims 9 to 12, wherein change of the rotation speed of the drive part (28) from the speed reduced

in the first control (C11) to the second set speed (V0) or change of the rotation speed of the drive part (28) from the speed increased in the second control (C12) to the second set speed (V0) is performed linearly.

14. The yarn winding machine (1) according to any one of claims 1 to 13 further comprising a drafting device (3) configured to draft a fiber bundle (F) to be fed to the air spinning device (4), wherein the air spinning device (4) includes:

a fiber guiding part (41) configured to guide the fiber bundle (F) fed from the drafting device (3); a spinning chamber (43) in which fibers of the fiber bundle (F) guided by the fiber guiding part (41) are swirled by a swirling flow; and a hollow guide shaft member (50) configured to guide the fibers swirled in the spinning chamber (43) to outside.

15. A yarn winding method with the following steps:

forming yarn (Y) with airflow;
winding the yarn (Y) formed with the airflow around an outer peripheral surface of a yarn storage roller (61) of a yarn storage device (6) thereby temporarily storing the yarn (Y);
winding the yarn (Y) from the yarn storage device (6) to form a package (P) by rotating the package (P) by a drive part (28); and
maintaining a storage amount of the yarn (Y) in the yarn storage device (6) within a predetermined storage range by repeatedly performing an acceleration control and a deceleration control, the acceleration control being increasing the rotation speed of the drive part (28) to a range upper-limit speed (V5) equal to or higher than a storage-amount decreasing speed (V1) that is a lower limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be reduced, the deceleration control being reducing the rotation speed of the drive part (28) to a range lower-limit speed (V4) equal to or lower than a storage-amount increasing speed (V3) that is an upper limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be increased,

characterized by increasing the rotation speed of the drive part (28) to a first set speed (V2) that is higher than the range upper-limit speed (V5) after winding of the package (P) is started.

16. A yarn storage control program used in a yarn winding machine (1) including: an air spinning device (4) configured to form yarn (Y) with airflow; a winding device (20) configured to wind the yarn (Y) formed by the air spinning device (4) to form a package (P);

a yarn storage device (6) disposed between the air spinning device (4) and the winding device (20) and configured to wind the yarn (Y) from the air spinning device (4) around an outer peripheral surface of a yarn storage roller (61) thereby temporarily storing the yarn (Y); a drive part (28) configured to rotate the package (P) in the winding device (20); and a control part (90) configured to control the drive part (28), the yarn storage control program causing the control part (90) to perform:

a storage-amount maintaining control of maintaining a storage amount of the yarn (Y) in the yarn storage device (6) within a predetermined storage range by repeatedly performing an acceleration control and a deceleration control, the acceleration control being increasing the rotation speed of the drive part (28) to a range upper-limit speed (V5) equal to or higher than a storage-amount decreasing speed (V1) that is a lower limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be reduced, the deceleration control being reducing the rotation speed of the drive part (28) to a range lower-limit speed equal to or lower than a storage-amount increasing speed (V3) that is an upper limit value at which the storage amount of the yarn (Y) in the yarn storage device (6) can be increased; **characterized by** a storage-amount decreasing control of increasing rotation speed of the drive part (28) to a first set speed (V2) that is higher than the range upper-limit speed (V5) after winding of the package (P) is started.

Fig.1

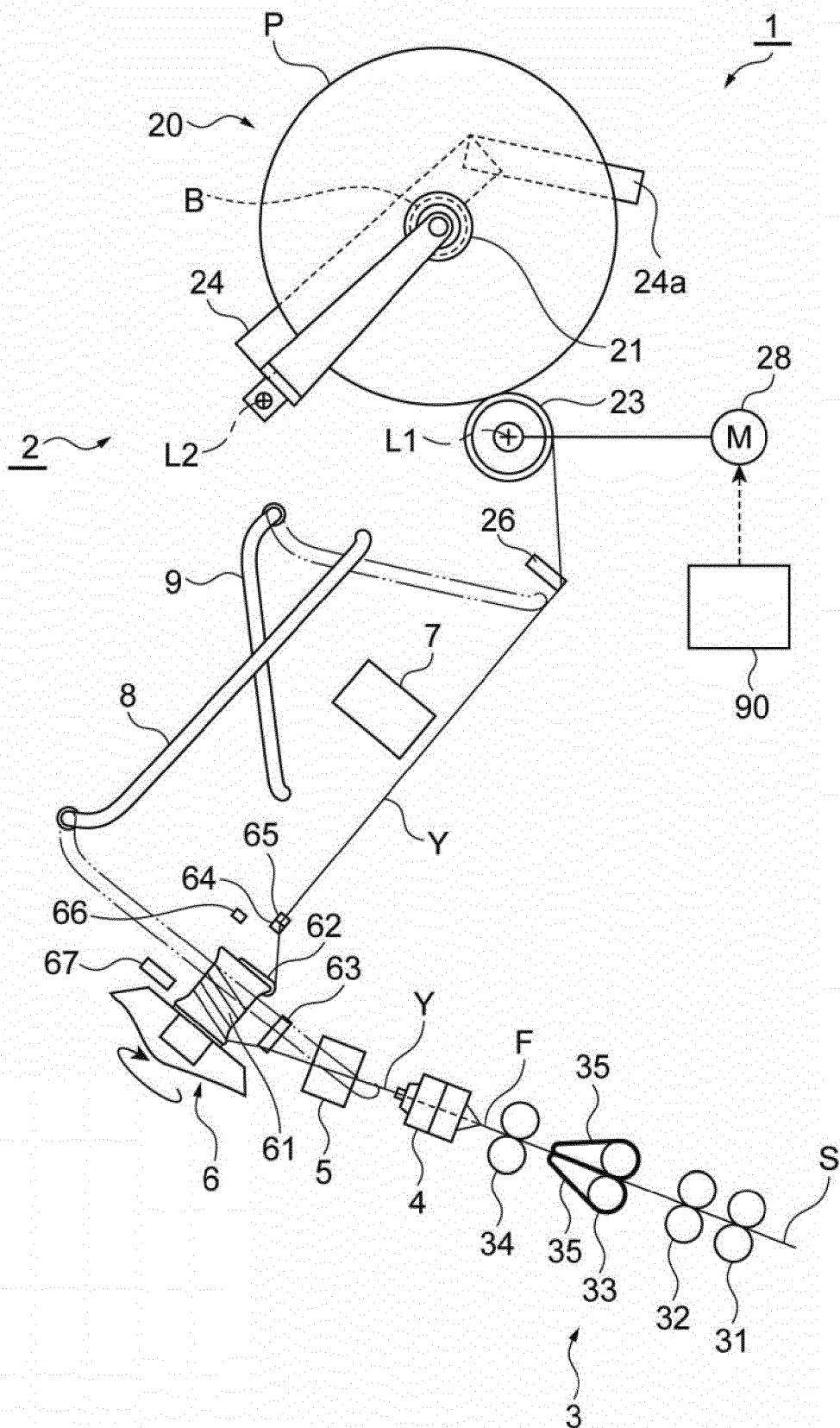


Fig. 2

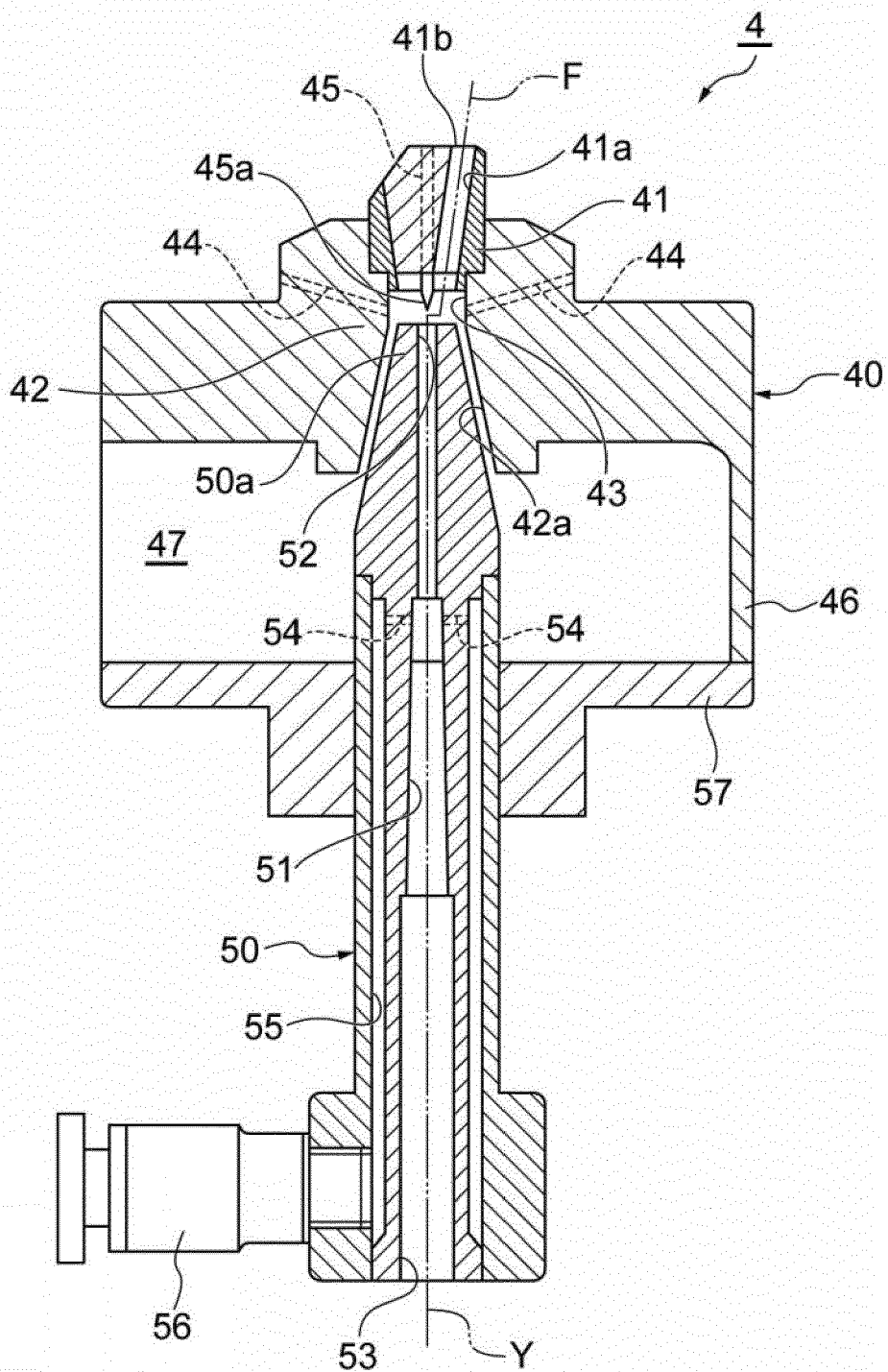
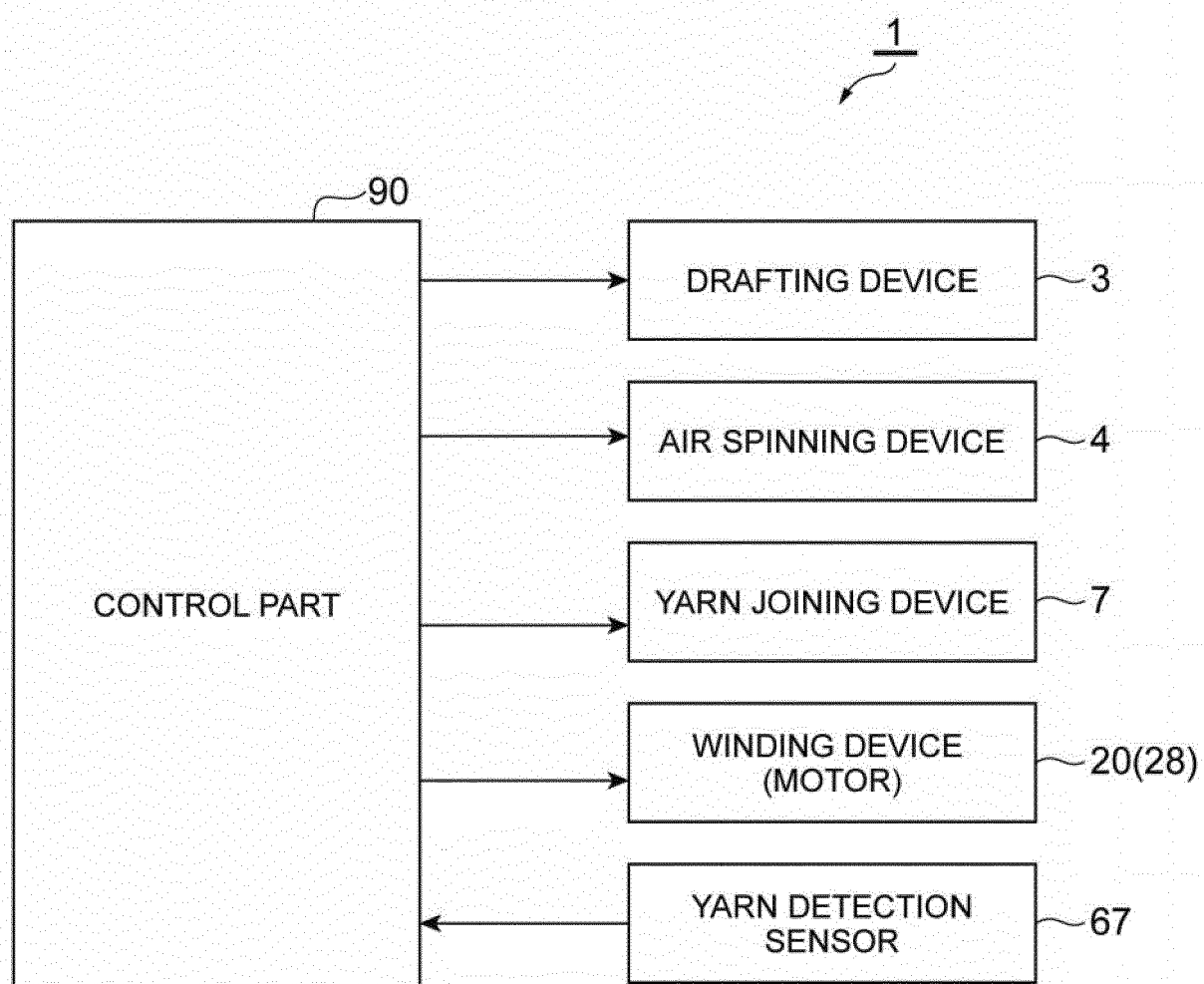
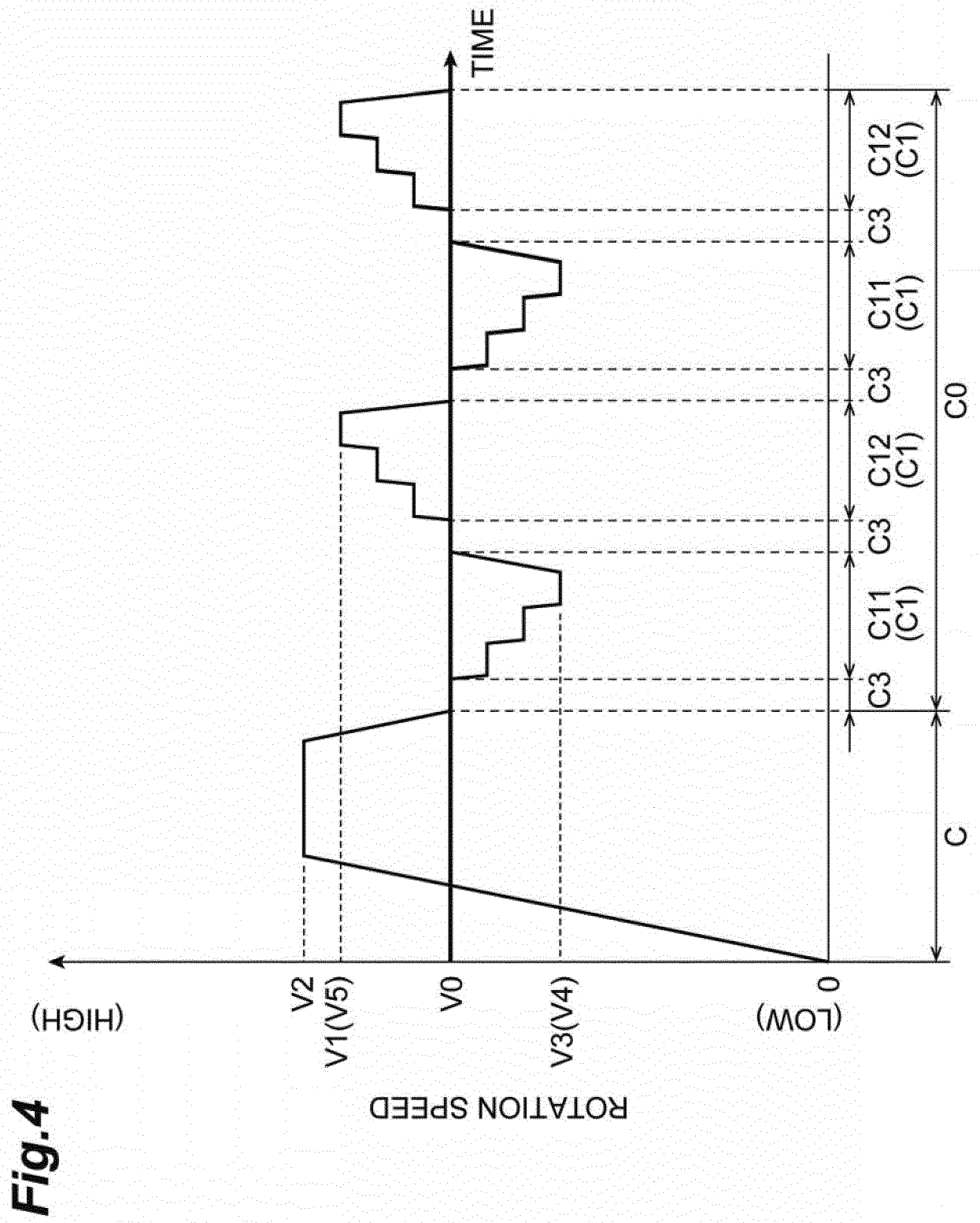


Fig.3





EUROPEAN SEARCH REPORT

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2004 277949 A (MURATA MACHINERY LTD) 7 October 2004 (2004-10-07) * abstract *	1-16	INV. B65H51/22 B65H59/38
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