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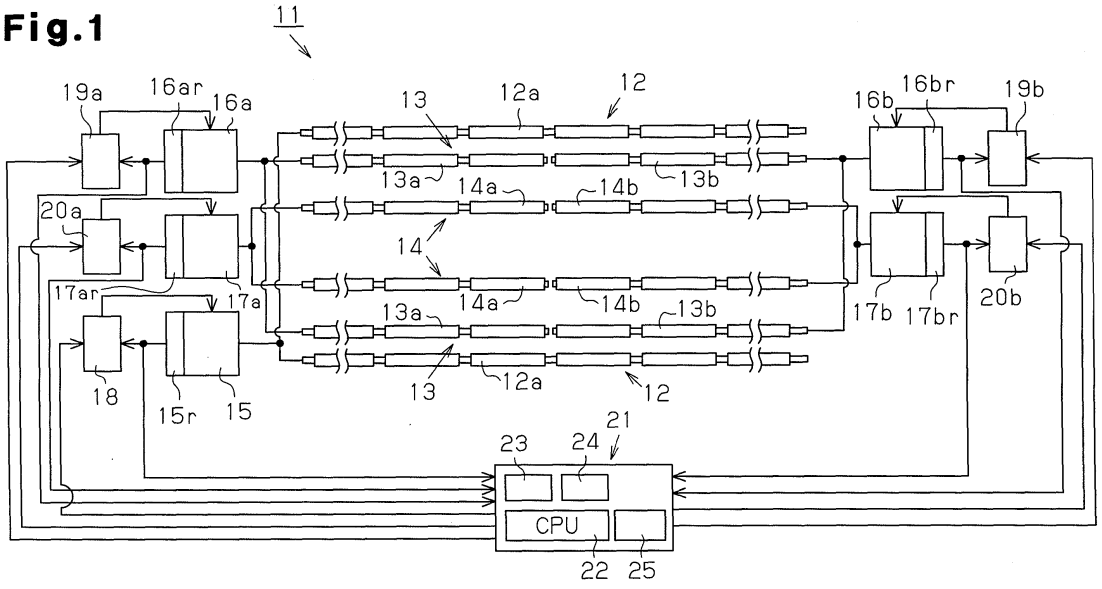
(54) Draft apparatus in spinning machine and control method of the same

(57) A draft apparatus (11) in a spinning machine is provided with a front bottom roller (12), a middle bottom roller (13), a back bottom roller (14), and motors (15, 16a, 16b, 17a, 17b) for independently driving the rollers (12, 13, 14). Lock means (21) inhibits the back bottom roller (14) from being rotated at least in a forward rotating direction, at least for a predetermined period after a spinning stop of the spinning machine. Accordingly, it is possible to inhibit a fiber from being excessively fed due to a torsional return of the bottom roller under the stop period of the machine, and it is possible to suppress yarn unevenness at a time of starting (Fig. 1).

Fig.1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a draft apparatus in a spinning machine and a control method of the same. More particularly, the present invention relates to a draft apparatus provided with a front bottom roller, a middle bottom roller, a back bottom roller, and motors independently driving the rollers, and to a control method of the same.

[0002] The spinning machine such as a ring spinning frame, a roving frame is provided with a machine and a lot of spinning spindles arranged along a longitudinal direction of the machine. The draft apparatus assembled in the spinning machine drives a plurality of bottom rollers by one end of the machine, for example, a gear end. Since the bottom rollers are very long, a torsional delay is generated in an out end in an opposite side to the gear end, at a time of starting the spinning machine. Particularly, the torsion is enlarged in a bottom apron roller around which an apron is wound in such a manner as to correspond to each of the spindles, for example, a middle bottom roller. There is a case that a yarn unevenness or a thread breakage is generated due to the torsional delay of the bottom apron roller mentioned above.

[0003] For example, Japanese Laid-Open Patent Publication No. 2002-220749 proposes a control method of substantially simultaneously starting a draft apparatus and a spindle at a time of starting a ring spinning frame and slowing acceleration of the draft apparatus, in order to prevent a yarn unevenness from being generated at a time of starting the ring spinning frame. Thereafter, it increases the acceleration of the draft apparatus, and thereafter accelerates the spindle and the draft apparatus to a predetermined operation rotating speed.

[0004] Further, Japanese Laid-Open Patent Publication No. 2002-220750 proposes a control method of first driving a spindle driving apparatus at a time of starting the ring spinning frame and slowly starting a draft mechanism driving apparatus after a fixed time. Thereafter, the draft mechanism driving apparatus is driven at a bottom roller acceleration having a magnitude which is sixfold to tenfold of the starting time.

[0005] Further, a draft apparatus in Japanese Laid-Open Patent Publication No. 58-18423 is provided with a front bottom roller arranged in a front side of a bottom apron roller, and a back bottom roller arranged in a rear side of the bottom apron roller. In this structure, a driving force is transmitted to the bottom apron roller via the front bottom roller or the back bottom roller in both ends of the machine. This publication proposes a structure in which a return preventing mechanism is arranged in a driving portion in an out end of the draft apparatus. The return preventing mechanism is actuated every time when the machine is stopped, for preventing the return of the bottom apron roller caused by the torsion of the front bottom roller or the back bottom roller generated during the operation of the machine. The return preventing apparatus locks the out end portion of the bottom apron roller or the back bottom roller by holding it by a pair of support plates and an actuating lever. If the holding is cancelled at a time of starting the spinning machine, a main motor is started on the basis of a cancel signal, and the draft apparatus is driven. As a result, for example, the back bottom roller maintains the torsion during the operation as it is even under stop of the machine. Accordingly, the back bottom roller is not twisted any more, and the out end and the gear end of the bottom apron roller are simultaneously started.

[0006] As mentioned above, Japanese Laid-Open Patent Publication No. 2002-220749 and Japanese Laid-Open Patent Publication No. 2002-220750 propose the structure that the draft apparatus is slowly rotated at a time of starting the machine. Therefore, it is intended to prevent the torsional delay in the opposite end to the driving end of the bottom roller, thereby preventing the yarn unevenness. However, the yarn unevenness in the spinning machine is caused not only by the torsional delay of the bottom roller at a time of starting the spinning machine, but also by the torsional return of the bottom roller during the stop period of the spinning machine.

[0007] The inventors of the present invention have found that the yarn unevenness tends to be generated at a time of starting the machine, in the fine spinning machine in which the front bottom roller, the middle bottom roller and the back bottom roller are respectively independently driven by the motor, in comparison with the structure in which the bottom rollers are coupled by the gear and driven by one motor. As a cause thereof, there can be considered a behavior of torsional return of the middle bottom roller during the stop period of the machine. In order to drive the middle bottom roller around which the apron is wound, a great torque is necessary. Accordingly, an amount of torsional return at a time of stop is great in the middle bottom roller around which the apron is wound, in comparison with the other bottom rollers. Therefore, in the case that the drive motor of each of the bottom rollers is stopped during the stop of the machine, that is, during the stop of the spinning, an amount at which a free end of the middle bottom roller rotates forward than the drive end is larger an amount at which the free end of the other bottom roller is rotated forward than the drive end. A fiber bundle is supplied to the front bottom roller excessively due to the torsional return of the middle bottom roller. This causes the yarn unevenness at a time of starting the machine.

[0008] However, Japanese Laid-Open Patent Publication No. 2002-220749 and Japanese Laid-Open Patent Publication No. 2002-220750 disclose nothing about the yarn unevenness mentioned above. Accordingly, the techniques in both the publications cannot prevent the yarn unevenness generated due to the torsional return behavior of the middle bottom roller during the stop period of the machine. Further, in the method described in both the publications, a ratio between a rotating speed of the

spindle and a rotating speed of the bottom roller at a time of starting the machine is different from a rotating speed ratio in a steady state. Accordingly, a twist unevenness is generated.

[0009] Further, the draft apparatus described in Japanese Laid-Open Patent Publication No. 58-18423 aims to prevent the return of the bottom apron roller, for example, the middle bottom roller at a time of stopping the machine. The publication describes that the return preventing apparatus can directly hold the bottom apron roller so as to prevent the return. Further, the publication describes that the torsion of the bottom apron roller may be prevented by holding the forward bottom roller, in the structure in which the bottom apron roller is driven through the forward bottom roller, or the return of the bottom apron roller may be prevented by holding the rearward bottom roller, in the structure in which the bottom apron roller is driven through the rearward bottom roller.

[0010] In other words, in the technique based on the description of Japanese Laid-Open Patent Publication No. 58-18423, the return of the bottom apron roller can be prevented by holding the bottom back roller, only in the case of the structure in which the bottom apron roller drives the back bottom roller. For example, in the case of the structure in which the bottom apron roller and the back bottom roller are independently driven, the return of the bottom apron roller is not prevented by holding the back bottom roller. Accordingly, in order to prevent the return of the bottom apron roller, in the draft apparatus having the structure in which each of the bottom rollers is independently driven by the technique in accordance with Japanese Laid-Open Patent Publication No. 58-18423, it is necessary to directly hold the bottom apron roller.

[0011] However, in the structure in which the end portion of the bottom apron roller is directly held as mentioned above, it is impossible to sufficiently suppress the torsional return of the intermediate portion of the bottom apron roller. As a result, it is impossible to prevent the yarn unevenness in the intermediate portion of the bottom apron roller.

SUMMARY OF THE INVENTION

[0012] An objective of the present invention is to provide a draft apparatus in a spinning machine which can suppress a yarn unevenness at a time of starting a machine by suppressing an excess fiber feeding due to a torsional return of a middle bottom roller during a stop period of the machine, and a control method of the same.

[0013] In accordance with an aspect of the present invention, there is provide a draft apparatus in a spinning machine. The draft apparatus is provided with a front bottom roller, a middle bottom roller, a back·bottom roller and a plurality of motors for independently driving the rollers. Lock means inhibits the back bottom roller from being rotated at least in a forward rotating direction at least for a predetermined period after a spinning stop of the spinning machine.

[0014] In accordance with the other aspect of the present invention, there is provided a control method of a draft apparatus in a spinning machine. The control method includes a step of independently driving a front bottom roller of a draft apparatus, a middle bottom roller and a back bottom roller by a plurality of motors. It is possible to inhibit the back bottom roller from being rotated at least in a forward rotating direction, at least for a predetermined period after a spinning stop of the spinning machine.

[0015] The other features and advantages of the present invention will be apparent from the following detailed description and the drawings attached for explaining the features of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

Fig. 1 is a plan view of a draft apparatus according to one embodiment of the present invention, in which a top roller is omitted;
Fig. 2 is a partial plan view of the draft apparatus in Fig. 1 at a time of a machine stop; and
Figs. 3A and 3B are schematic views showing other embodiments of lock means.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] A description will be given below of an embodiment obtained by embodying the present invention with reference to Figs. 1 and 2. Fig. 1 shows a draft apparatus 11 extending along a longitudinal direction of a machine of a ring spinning frame.

[0018] As shown in Fig. 1, the three-line type draft apparatus 11 is provided with a pair of front bottom rollers 12 extending along a longitudinal direction of a machine, a pair of middle bottom rollers 13 arranged in an inner side, and a pair of back bottom rollers 14 arranged in a further inner side thereof. The front bottom rollers 12 are supported at a predetermined position of a roller stand (not shown). The middle bottom rollers 13 and the back bottom rollers 14 are supported via a support bracket (not shown) the position of which can be adjusted in a direction moving close to and away from the front bottom rollers 12. The middle bottom roller 13 is provided with an apron (not shown). Further, a front top roller, a middle top roller and a back top roller (neither shown) are provided on the basis of the known structures in correspondence to the respective bottom rollers 12 to 14.

[0019] Each of a pair of front bottom rollers 12 is formed on one roller shaft 12a extending over an entire length of the machine. Each of the middle bottom rollers 13 is divided into two roller shafts 13a and 13b arranged on the same axis. Each of the back bottom rollers 14 is divided into two roller shafts 14a and 14b arranged on the same axis. In the present embodiment, the middle bottom roller 13 and the back bottom roller 14 are divided in the center in the longitudinal direction. As a result, two roller shafts 13a and 13b are formed symmetrically with each other, and the roller shafts 14a and 14b are formed symmetrically with each other.

[0020] Both the front bottom rollers 12 are driven by one front motor 15 in a gear end of the machine corresponding to a left side in Fig. 1, that is, a first end of the machine. A rotation of the front motor 15 is transmitted to both the roller shafts 12a via a gear train (not shown).

[0021] A pair of roller shafts 13a positioned in a left side in Fig. 1 are driven by a first middle motor 16a in the gear end of the machine, that is, the first end. A pair of roller shafts 13b positioned in a right side in Fig. 1 are driven by one second middle motor 16b in an out end of the machine, that is, a second end of the machine. A rotation of the first middle motor 16a is transmitted to each of the roller shafts 13a via a gear train (not shown). A rotation of the second middle motor 16b is transmitted to each of the roller shafts 13b via a gear train (not shown).

[0022] A pair of roller shafts 14a positioned in the left side in Fig. 1 are driven by a first back motor 17a in the first end of the machine. A pair of roller shafts 14b positioned in the right side in Fig. 1 are driven by one second back motor 17b in the second end of the machine. A rotation of the first back motor 17a is transmitted to each of the roller shafts 14a via a gear train (not shown). A rotation of the second back motor 17b is transmitted to each of the roller shafts 14b via a gear train (not shown).

[0023] Each of the motors 15, 16a, 16b, 17a and 17b has a feedback function. In the present embodiment, a servo motor is used in each of the motors 15, 16a, 16b, 17a and 17b. The motors 15, 16a, 16b, 17a and 17b are respectively provided with rotary encoders 15r, 16ar, 16br, 17ar and 17br. The motors 15, 16a, 16b, 17a and 17b are respectively connected to servo drivers 18, 19a, 19b, 20a and 20b, and are controlled by a control apparatus 21 via the servo drivers 18, 19a, 19b, 20a and 20b.

[0024] The control apparatus 21 is provided with a central processing unit (CPU) 22, a program memory 23, a working memory 24, and an input apparatus 25, and is further provided with an input interface, an output interface and a motor driving circuit (neither shown). The CPU 22 is connected to each of the rotary encoders 15r, 16ar, 16br, 17ar and 17br via the input interface. The CPU 22 is connected to each of the servo drivers 18, 19a, 19b, 20a and 20b via the output interface and the motor driving circuit.

[0025] The CPU 22 executes a control of a motor (not shown) driving a lifting drive system and a spindle drive system of a fine spinning machine. In other words, the control apparatus 21 also functions as a control apparatus of the fine spinning machine.

[0026] Program data and various data necessary for executing the program data are stored in the program memory 23. The program data includes spinning conditions such as various fiber materials, spun yarn counts, numbers of twist, corresponding data between a spindle rotating speed at a time of a steady operation of the machine, and a rotating speed of the motor driving the draft drive system and the lifting drive system, and the like.

[0027] The working memory 24 temporarily stores the data input from the input apparatus 25, the result of computing process of the CPU 22 and the like. The input apparatus 25 is used for inputting the spinning condition data such as the spun yarn count, the fiber material (the raw material), the highest spindle rotating speed at a time of spinning operation, a spinning length, a lift length, a chase length, a used bobbin length. The working memory 24 is provided with a backup power source (not shown).

[0028] The CPU 22 controls each of the motors 15, 16a, 16b, 17a and 17b so as to rotate the front bottom roller 12, the middle bottom roller 13 and the back bottom roller 14 in such a manner as to achieve a brake draft ratio and a total draft ratio which are previously set in correspondence to the spinning condition.

[0029] The CPU 22 inputs the signals of the rotary encoders 15r, 16ar, 16br, 17ar and 17br via the input interface, computes a rotation angle of the output shaft of each of the motors 15, 16a, 16b, 17a and 17b, and controls each of the motors 15, 16a, 16b, 17a and 17b. In order to inhibit the back bottom roller 14 and the front bottom roller 12 from being rotated in a forward rotating direction at least for a predetermined period from the spinning stop during the stop of the machine, the CPU 22 controls in such a manner as to keep the rotating angle of the driving shafts of the front motor 15 and both the back motors 17a and 17b to a fixed value. The predetermined period varies on the basis of the spinning condition such as the fiber raw material, the spun yarn count and the like. The predetermined period corresponds to a time for which an effect that the fiber bundle F existing between the back bottom roller 14 and the middle bottom roller 13 is kept in a tension state is carried over on the basis of the inhibition of the back bottom roller 14 rotating in the forward rotating direction, and is about sixty minutes at the longest. The control apparatus 21 structures lock means inhibiting the back bottom roller 14 from being rotated in the forward rotating direction, at least for a predetermined period from the spinning stop time. In the case that the operation of the machine is restarted before the elapse of the predetermined period, each of the motors 15, 16a, 16b, 17a and 17b is controlled so as to be forward rotated in correspondence to the restart of the machine.

[0030] Next, a description will be given of an operation of the apparatus structured as mentioned above. Prior to the operation of the fine spinning machine, the spinning

conditions such as the fiber raw material, the spun yarn count, the number of twist are input to the control apparatus 21 from the input apparatus 25. Further, if the operation of the fine spinning machine is started, the respective motors 15, 16a, 16b, 17a and 17b are controlled so as to be rotated at the rotating speed achieving the total draft ratio and the brake draft ratio which are previously set in correspondence to the spinning condition, via the servo drivers 18, 19a, 19b, 20a and 20b, on the basis of the command from the control apparatus 21. Further, the motors of the spindle drive system and the lifting system (not shown) are controlled so as to achieve a predetermined rotating speed.

[0031] When the fine spinning machine is operated, the roving is taken up by a bobbin integrally rotated with the spindle in a take-up portion (not shown) after being drafted through the back roller, the middle roller and the front roller of the draft apparatus 11.

[0032] When the machine is stopped for doffing or pausing, the current application to each of the motors 15, 16a, 16b, 17a and 17b is stopped and the machine is stopped on the basis of the rotation stop of each of the bottom rollers 12, 13 and 14, in the prior art. In a state in which the draft apparatus 11 is stopped, a torque intending to rotate the middle bottom roller 13 to a front side is applied to the middle bottom roller 13, due to the torsional return, as shown in Fig. 2. The torque becomes larger toward a free end in a right end in Fig. 2 from a drive end in a left side in Fig. 2 of the middle bottom roller 13. In this case, the torsional return is generated in the front bottom roller 12 and the back bottom roller 14. However, since the apron is not wound around the front bottom roller 12 and the back bottom roller 14 in comparison with the middle bottom roller 13 around which the apron is wound, a drive torque necessary for the front bottom roller 12 and the back bottom roller 14 is small. Accordingly, an amount at which the front bottom roller 12 and the back bottom roller 14 are rotated to the front side on the basis of the torsional return is small. Therefore, in a state in which the other force is not applied to each of the bottom rollers 12, 13 and 14, the amount of rotation to the front side due to the torsional return is greatest in the middle bottom roller 13 among the bottom rollers 12, 13 and 14. Further, a fiber amount of the fiber bundle F in the draft existing between the middle bottom roller 13 and the back bottom roller 14 is more than a fiber amount of the fiber bundle F existing between the middle bottom roller 13 and the front bottom roller 12. Accordingly, the fiber is excessively fed to the portion between the middle bottom roller 13 and the front bottom roller 12 on the basis of a difference between the rotating amount of the middle bottom roller 13 and the rotating amount of the back bottom roller 14. This causes the generation of the yarn unevenness at the next starting time of the machine.

[0033] However, in the present embodiment, the front motor 15 and both the back motors 17a and 17b are controlled in such a manner as to inhibit the front bottom roller 12 and the back bottom roller 14 from being rotated in the forward rotating direction, at least for a predetermined period from the spinning stop time of the machine. Specifically, the position controls of the motors 15, 17a and 17b are executed in such a manner that the angles of rotation of the drive shafts of the respective motors 15, 17a and 17b keep the angle of rotation at the stop time of the machine. The fiber bundle F exists between the back bottom roller 14 and the middle bottom roller 13. Accordingly, if the rotation of the back bottom roller 14 in the forward rotating direction is inhibited, the fiber bundle F existing between the back bottom roller 14 and the middle bottom roller 13 is kept in the tension state. Therefore, the force for inhibiting the middle bottom roller 13 from being rotated to the front side is applied to the middle bottom roller 13. As a result, it is possible to inhibit the fiber from being excessively fed to the portion between the middle bottom roller 13 and the front bottom roller 12, due to the torsional return of the middle bottom roller 13 under the stop of the machine. Accordingly, it is possible to inhibit the yarn unevenness from being generated at a time of starting the machine. Further, since the torsional return of the middle bottom roller 13 and the back bottom roller 14 is inhibited, the torsional delay of the free ends of the middle bottom roller 13 and the back bottom roller 14 is inhibited at a time of starting the machine. Accordingly, it is possible to further suppress the yarn unevenness.

[0034] Further, the amount of the torsional return of the front bottom roller 12 is smaller than the amount of the torsional return of the middle bottom roller 13. However, in the present embodiment, since the front bottom roller 12 is inhibited from forward rotating under the machine stop, the torsional delay of the free end of the front bottom roller 12 is suppressed at a time of starting the machine. As a result, it is possible to further inhibit the yarn unevenness from being generated.

[0035] The present embodiment has the following advantages.

(1) The front bottom roller 12, the middle bottom roller 13 and the back bottom roller 14 of the draft apparatus 11 are respectively independently driven by the motors 15, 16a, 16b, 17a and 17b. The draft apparatus 11 is provided with the lock means (control apparatus 21), and the lock means inhibits the back bottom roller 14 from being rotated at least in the forward rotating direction, at least for the predetermined period from the spinning stop time. The drive torque of the back bottom roller 14 is smaller than the drive torque of the middle bottom roller 13. Accordingly, the rotation of the back bottom roller 14 is substantially uniformly stopped in the entirety of the longitudinal direction, by the lock means. Therefore, the rotation of the back bottom roller 14 in the forward rotating direction is inhibited, at least for the predetermined period from the spinning stop time. Accordingly, the fiber bundle F existing between the back bottom roller 14 and the middle bottom roller 13 is

kept in the tension state, and the force for inhibiting the middle bottom roller 13 from being rotated to the front side is applied to the middle bottom roller 13. As a result, it is possible to inhibit the fiber from being excessively fed due to the torsional return of the middle bottom roller 13 under the machine stop, and it is possible to inhibit the yarn unevenness from being generated at a time of starting the machine. Further, since the torsional return of the middle bottom roller 13 and the back bottom roller 14 is suppressed, the torsional delay of the free ends of the middle bottom roller 13 and the back bottom roller 14 is suppressed at a time of starting the machine. Accordingly, the yarn unevenness is further suppressed.

(2) The first and second back motors 17a and 17b driving the back bottom roller 14 are constituted by the motor having the feedback function. The lock means is constituted by the control apparatus 21 controlling so as to keep the angle of rotation of the drive shaft of each of the motors 17a and 17b to the constant value. Accordingly, it is possible to inhibit the back bottom roller 14 from being rotated in the forward rotating direction, at least for the predetermined period from the spinning stop time, by changing the control of each of the motors 17a and 17b, and it is possible to inhibit the yarn unevenness from being generated. In other words, since the structure of the lock means is constituted by the structure for changing the control method of each of the motors 17a and 17b, it is not necessary to newly form a mechanism for inhibiting the back bottom roller 14 from being rotated. As a result, the present embodiment can be easily carried out by changing the control program of the existing draft apparatus 11.

(3) The front motor 15 driving the front bottom roller 12 is also constituted by the motor having the feedback function. The front motor 15 is controlled in such a manner as to inhibit the front bottom roller 12 from being rotated in the forward rotating direction, at least for the predetermined period from the spinning stop time. Accordingly, since the front bottom roller 12 is inhibited from being rotated in the forward rotating direction, at least for the predetermined period from the spinning stop time, it is possible to further inhibit the yarn unevenness from being generated at a time of starting the machine.

(4) The servo motor is used as the motor having the feedback function. The servo motor is normally used for the draft apparatus 11 changing the total draft ratio and the brake draft ratio by changing the rotating speed of each of the motors 15, 16a, 16b, 17a and 17b. Accordingly, the normally used motor of the draft apparatus 11 can be used without being changed, for achieving the control of the present embodiment.

[0036] The embodiment is not limited to the above, but can be embodied as follows, for example.

[0037] In the embodiment mentioned above, the servo motor is used as the motor having the feedback function driving the back bottom roller 14 and the front bottom roller 12. In place of this, a rotary encoder may be provided as well as using a stepping motor.

[0038] In the embodiment mentioned above, the lock means inhibiting the back bottom roller 14 or the front bottom roller 12 from being rotated in the forward rotating direction, at least for the predetermined period from the spinning stop time is structured such as to control so as to keep the angle of rotation of the drive shafts of the motors 15, 17a and 17b having the feedback function to the constant value by the control apparatus 21. However, the structure is not limited to this, but may be made, for example, such that an electromagnetic brake is provided at least one of the drive end and the free end of the back bottom roller 14, for example, the free ends of the roller shafts 14a and 14b. Further, it is possible to inhibit the back bottom roller 14 from forward rotating by controlling so as to keep the electromagnetic brake in a braked state, at least for the predetermined period from the spinning stop time, at a time of the machine stop time. Further, when starting the machine, the electromagnetic brake is controlled in a state allowing the forward rotation of the back bottom roller 14, that is, in a non-braked state. In this structure, it is possible to inhibit the fiber from being excessively fed due to the torsional return of the middle bottom roller 13 under the machine stop, and it is possible to inhibit the yarn unevenness from being generated at a time of starting the machine. In this case, the first and second back motors 17a and 17b are not constituted by the motor which can execute the feedback control, but may be constituted by a motor which can control a speed. In other words, the back motors 17a and 17b may employ a motor, for example, driven via an inverter, in place of the servo motor.

[0039] As shown in Fig. 3A, as the electromagnetic brake 30, for example, there is used a structure provided with a pair of discs 31 fixed to the roller shafts 14a and 14b so as to be integrally rotatable, and a braking portion 30a pressing and holding both the discs 31 on the basis of a force of an electromagnet. Since an interval between the free ends of the roller shafts 14a and 14b is narrow, it is hard to secure a mounting space for the electromagnetic brake having the structure applying the braking force to the shaft portions of the roller shafts 14a and 14b. However, the electromagnetic brake 30 in Fig. 3A is structured such as to hold the discs 31. Accordingly, it is easy to secure the mounting space for the electromagnetic brake 30.

[0040] The electromagnetic brake 30 may be structured such that the braking operation is applied at a time when the current is not applied, in place of the structure in which the braking operation is applied at a time of the current application. In the case that the machine is stopped due to a power outage, it is possible to inhibit

the back bottom roller 14 or the front bottom roller 12 from being rotated in the forward rotating direction. Accordingly, a backup power source for driving the electromagnetic brake 30 at a time of the power outage is not necessary.

[0041] In order to achieve lock means in accordance with the other aspect, a ratchet 32 is fixed to the roller shafts 14a and 14b so as to be integrally rotatable, as shown in Fig. 3B. Further, a pawl 33 capable of engaging with the ratchet 32 is provided so as to be movable to an engaged position inhibiting a forward rotation (a rotation in a counterclockwise direction in Fig. 3B) of the ratchet 32, and a retracted position allowing the forward rotation of the ratchet 32. The structure is made such that the pawl 33 is movable to the engaged position and the retracted position by driving means 34.

[0042] During the machine stop, the forward rotation of the back bottom roller 14 is inhibited by holding the pawl 33 at the engaged position, at least for a predetermined period from the spinning stop time. Further, during the machine operation, the pawl 33 is held at the retracted position. As the driving means 34, for example, a solenoid or an air cylinder is used. The lock means in Fig. 3B can easily secure the mounting space for the lock means, in comparison with the electromagnetic brake 30 in Fig. 3A.

[0043] The lock means of the front bottom roller 12 may be structured, in the same manner, such as to be provided with the electromagnetic brake 30 in Fig. 3A, or the ratchet 32 and the pawl 33 in Fig. 3B.

[0044] The present invention may be applied to a four-line or more type draft apparatus without being limited to the three-line type draft apparatus 11. A second bottom roller and a third bottom roller around which the apron is wound correspond to the middle bottom roller of the four-line type draft apparatus. Further, in the structure in which the apron is wound around only the second bottom roller of the four-line type draft apparatus, only the second bottom roller constitutes the middle bottom roller, and the third bottom roller constitutes the back bottom roller. In other words, "middle bottom roller" means a roller which is arranged between the front bottom roller and the back bottom roller, and around which the apron is wound.

[0045] In the case of dividing the bottom roller into two sections in the longitudinal direction, a divided position is not necessarily limited to the center of the bottom roller. In the case of dividing the bottom roller into two sections at a position deflected from the center, a load torque in proportion to the length and the number of spindles of each of the roller shaft is applied to two motors driving two bottom rollers after being divided. Accordingly, a deviation exists in the load torques of both the motors. Therefore, it is preferable to divide the bottom roller into two sections in the center, in the sight of the control.

[0046] In the embodiment mentioned above, the structure is made such that the middle bottom roller 13 and the back bottom roller 14 are driven by the motors 16a, 16b, 17a and 17b from both sides of the machine. The structure is not limited to this, but the structure may be made such that the partial bottom roller, for example, the middle bottom roller 13 is driven from both sides of the machine, and the back bottom roller 14 is driven from one side of the machine. Further, the structure may be made such that all the front bottom roller 12, the middle bottom roller 13 and the back bottom roller 14 are driven from one side of the machine, depending on the number of spindles of the machine.

[0047] In the case of the doffing stop of the ring spinning frame, the stop time is normally equal to or less than thirty minutes. Accordingly, the control apparatus 21 may control such as to keep the back bottom roller 14 in the state of inhibiting the back bottom roller 14 from being rotated in the forward rotating direction, during the spinning stop caused by the doffing stop of the machine, and allow the rotation of the back bottom roller 14 in the forward rotating direction together with the restart of the machine.

[0048] The application of the present invention is not limited to the ring spinning frame spinning from the roving. For example, the present invention may be applied to other spinning machines provided with the draft apparatus having the structure in which the roller shaft of the bottom roller is long and the apron is wound around the middle bottom roller, such as the ring spinning frame drafting a sliver without via the roving so as to directly spin the fine spinning yarn, a binding spinning machine, a coarse spinning machine or the like.

[0049] Although the multiple embodiments have been described herein, it will be clear to those skilled in the art that the present invention may be embodied in different specific forms without departing from the spirit of the invention. The invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

[0050] A draft apparatus (11) in a spinning machine is provided with a front bottom roller (12), a middle bottom roller (13), a back bottom roller (14), and motors (15, 16a, 16b, 17a, 17b) for independently driving the rollers (12, 13, 14). Lock means (21) inhibits the back bottom roller (14) from being rotated at least in a forward rotating direction, at least for a predetermined period after a spinning stop of the spinning machine. Accordingly, it is possible to inhibit a fiber from being excessively fed due to a torsional return of the bottom roller under the stop period of the machine, and it is possible to suppress yarn unevenness at a time of starting (Fig. 1).

Claims

1. A draft apparatus (11) in a spinning machine comprising a front bottom roller (12), a middle bottom roller (13), a back bottom roller (14), and a plurality of motors (15, 16a, 16b, 17a, 17b) for independently driving the rollers (12, 13, 14),
the draft apparatus (11) being **characterized by** lock means (21, 30, 32-34) that inhibits said back bottom

roller (14) from being rotated at least in a forward rotating direction at least for a predetermined period after a spinning stop of said spinning machine.

2. The draft apparatus (11) according to claim 1, **characterized in that** said motors include a back motor (17a, 17b) driving said back bottom roller (14), and said back motor (17a, 17b) has a feedback function, and
wherein said lock means includes a control apparatus (21) controlling said back motor (17a, 17b) in such a manner as to keep an angle of rotation of a drive shaft of said back motor (17a, 17b) to a constant value.

3. The draft apparatus (11) according to claim 1, **characterized in that** said back bottom roller (14) has a drive end coupled to said motor (17a, 17b), and a free end in an opposite side to the drive end, and
wherein said lock means includes a brake (30) provided at least in one of said drive end and the free end, and said brake (30) is held in a state of braking said back bottom roller (14) at least for a predetermined period from the spinning stop time of said spinning machine, and is set to a non-braked state at a time of the spinning of said spinning machine.

4. The draft apparatus (11) according to claim 2, **characterized in that** said motors includes a front motor (15) driving said front bottom roller (12), the front motor (15) has a feedback function, and said front motor (15) is controlled in such a manner as to inhibit said front bottom roller (12) from being rotated at least in a forward rotating direction at least for a predetermined period from a spinning stop time of said spinning machine.

5. A ring spinning frame **characterized by** the draft apparatus (11) according to any one of claims 1 to 4.

6. A control method of a draft apparatus (11) in a spinning machine, said control method comprising:

independently driving a front bottom roller (12) of the draft apparatus (11), a middle bottom roller (13) and a back bottom roller (14) by a plurality of motors (15, 16a, 16b, 17a, 17b),
said control method being **characterized by:**

inhibiting said back bottom roller (14) from being rotated at least in a forward rotating direction at least for a predetermined period after a spinning stop of said spinning machine.

7. The control method according to claim 6, **characterized by**:
in a case that the operation of the machine is restarted before the elapse of the predetermined period, keeping the state of inhibiting said back bottom roller (14) from being rotated in the forward rotating direction for a period from the spinning stop time to a restart of the machine, in the case that the machine of said spinning machine is stopped; and
allowing said back bottom roller (14) to be rotated in the forward rotating direction in accordance with the restart of said machine.

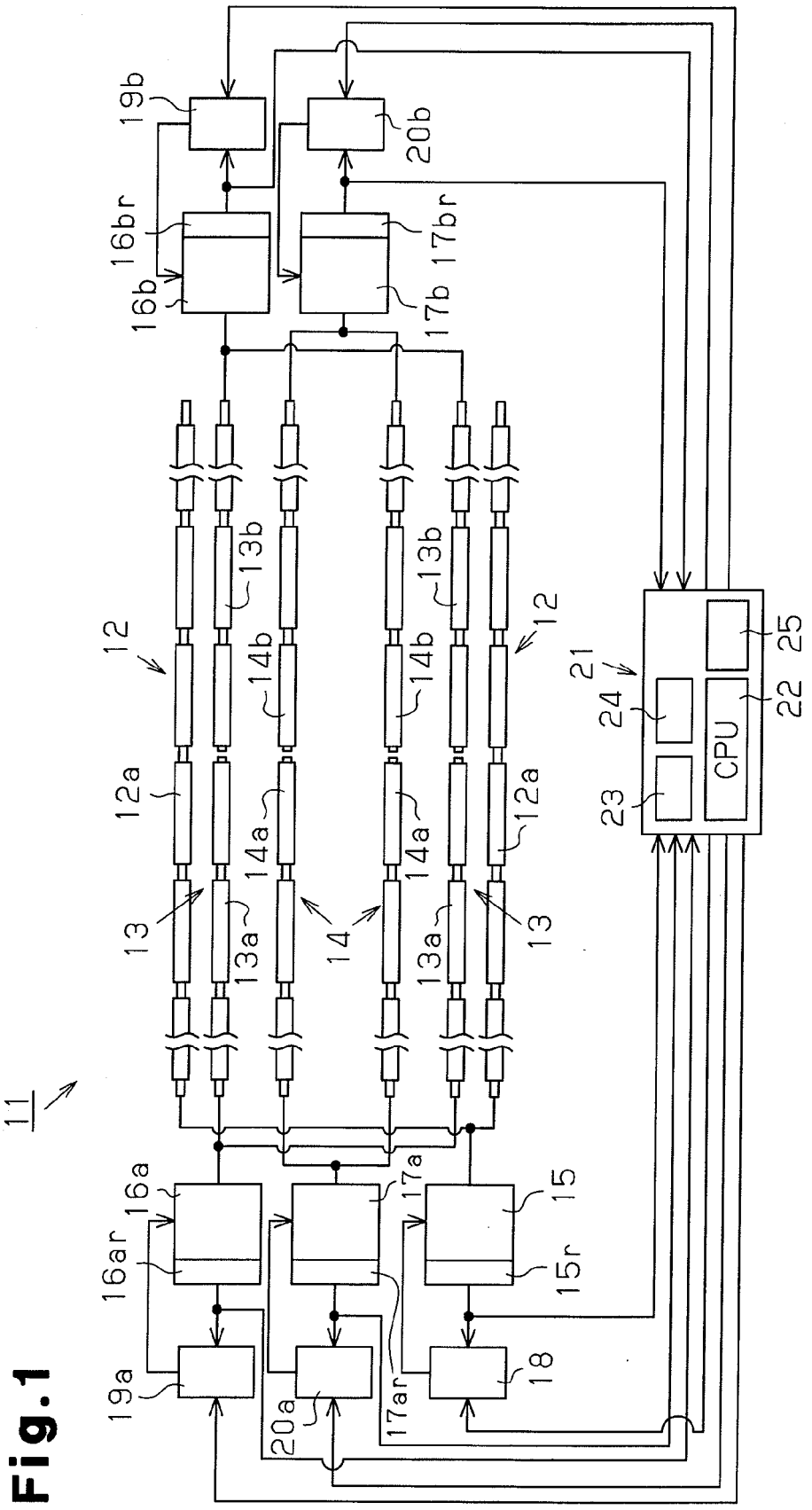
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Fig.1

Fig.2

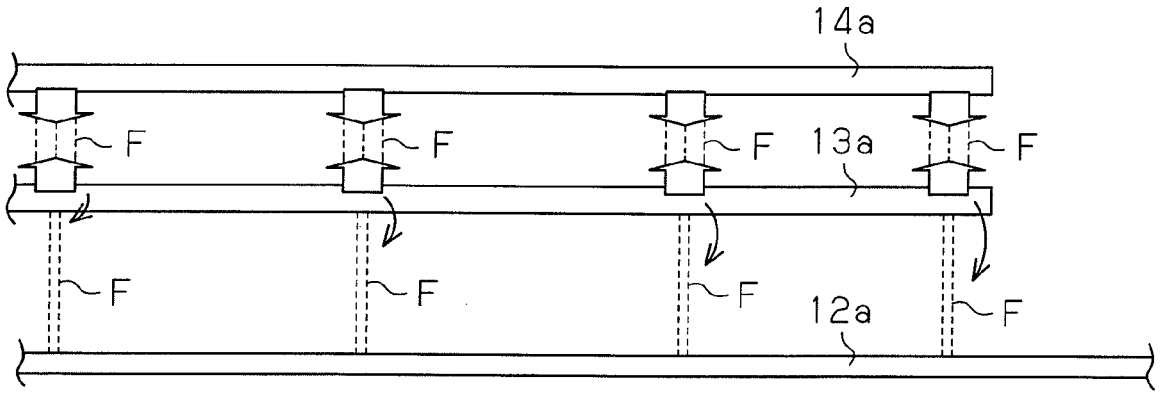


Fig.3A

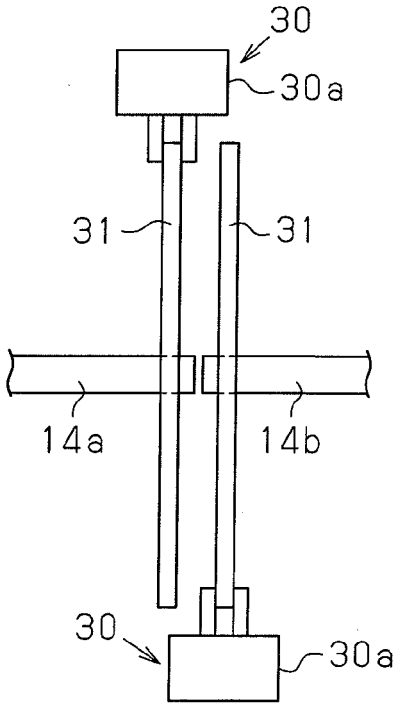
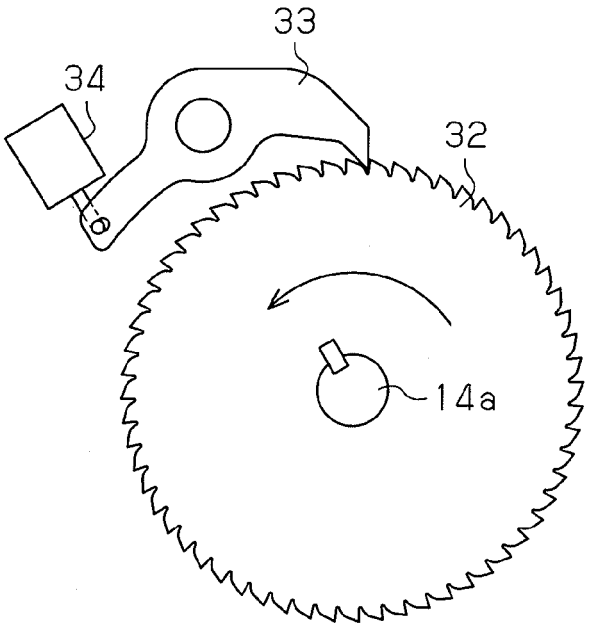


Fig.3B



REFERENCES CITED IN THE DESCRIPTION

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- JP 58018423 A **[0005] [0009] [0010] [0010]**