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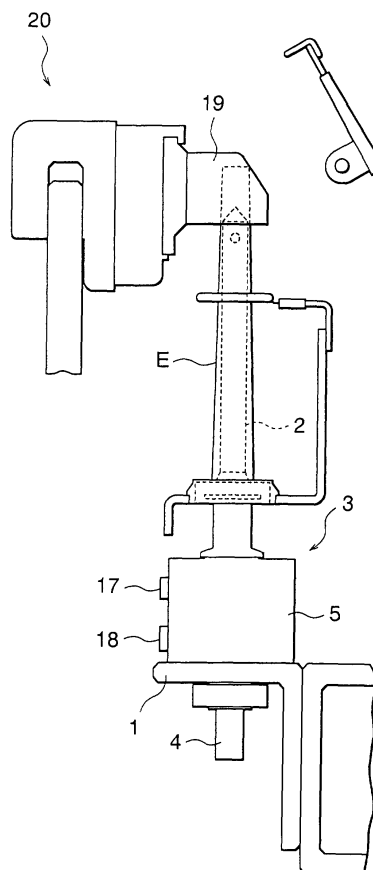
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(54) **Method and device of detecting an abnormality of a spool changing device of a single spindle driving type spinning machine**

(57) When performing a spool changing operation, with an empty bobbin (E) fitted onto a spindle (2) by a gripping device (19), a torque weaker than a normal gripping force of each gripping device is applied to each spindle by each spindle motor (3). The gripping device of a spindle unit whose spindle has rotated is judged to be in an abnormal gripping state. Next, the grip is canceled, and a similar weak torque is applied to each spindle again. The gripping device of a spindle unit whose spindle has not rotated is judged to have abnormality in grip canceling.

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method and a device of detecting an abnormality of a spool changing device of a single spindle driving type spinning machine which is mounted with a large number of spindles and which drives the spindles independently by motors provided in the respective spindles.

2. Description of the Related Art

[0002] In recent years, automation in spinning mills is making progress, and as to a spinning machine such as a ring spinner or a ring throwing machine, a doffing operation with a full spool and a spool changing operation for inserting a new empty bobbin into a spindle are automatically conducted by a spool changing device (bobbin exchanging device). In a spool changing device of an all-spindles simultaneous system which is provided for every spinning machine, during the spool changing operation, as shown in Fig. 8A, a bobbin holding device 61a mounted to a doffing bar 61 moves along a line indicated by an arrow, inserts an empty bobbin E pulled out of a peg 62a of a carrying device 62 into a middle peg 63, and reaches a position corresponding to the position above a full bobbin F on a spindle 64. Next, the bobbin holding device 61a moves along a line indicated by an arrow in Fig. 8B, pulls up the full bobbin F on the spindle 64, and then, inserts the full bobbin F into the peg 62a of the carrying device 62. Subsequently, the bobbin holding device 61a moves again along the line indicated by the arrow in Fig. 8A, inserts the empty bobbin E on the middle peg 63 into the spindle 64, then, moves along the line indicated by the arrow in Fig. 8B, and returns to a waiting position above the peg 62a.

[0003] When the operation of the spool changing device is continued in the state that an error of pulling the full bobbin F out of the spindle 64 occurs in the spool changing operation, the empty bobbin E and the full bobbin F interfere with each other in an inserting operation of the empty bobbin E into the spindle 64. As a result, the full bobbin F is damaged or the bobbin holding device 61a is damaged. Further, when the operation of the spinning machine is restarted in the state that an error in the insertion to the spindle 64 exists, there may be a case where a thread is directly wound around the spindle 64, in which the empty bobbin E is not mounted thereto.

[0004] In order to eliminate such inconvenience, a device for detecting the occurrence of an abnormality in the spool changing operation of the spool changing device and for avoiding the action of an unnatural force onto the bobbin holding device has been conventionally proposed and employed. For example, a bobbin holding

device has been used, in which the action of an excessive load onto a bobbin and a bobbin holding position due to the deviation of the bobbin holding portion from a regular position is avoided when an unnatural force acts on the bobbin holding portion.

[0005] When an abnormality occurs during the spool changing operation of the spool changing device, the operator has to resolve the abnormality or restore the device to normal and resume the spool changing operation, restarting the spinning machine. Thus, it is necessary to inform the operator of the occurrence of the abnormality in spool changing. Further, it is necessary to identify the spindle in which the abnormality has occurred, supplying the operator with the requisite information. Conventionally, a device has been used in which a light emitting portion and a light receiving portion are respectively provided at the ends of a spinning machine to detect the top portion of a bobbin fitted onto a spindle to thereby detect any full bobbin which has not been pulled out at the time of spool changing operation. Although incapable of identifying a spindle unit in which an abnormality in spool changing has occurred, this device enables the operator to easily identify a full bobbin based on the detection of any abnormality. Japanese Patent Application Laid-open No. 64-52827 and Japanese Patent Application Laid-open No. 4-263630 disclose devices capable of identifying a spindle unit to which any abnormality in spool changing has occurred.

[0006] In the device disclosed in Japanese Patent Application Laid-open No. 64-52827, a gripper (bobbin holding device) is held by upper and lower pair of holding elements. When an excessive force is applied to the gripper when pulling out a full bobbin, the gripper is detached from the holding elements. Thus, no excessive load is applied to the spindle and the gripper. Also, an arrangement is disclosed in which a signal is issued which identifies the position where the gripper has been detached.

[0007] In the device disclosed in Japanese Patent Application Laid-open No. 4-263630, there is provided a sensing member for detecting whether an empty bobbin or a full bobbin exists in a gripping mechanism. When an empty bobbin or a full bobbin ought to exist in the gripping mechanism, the operation of the sensing member makes it possible to detect whether an empty bobbin or a full bobbin exists or not. Further, the position where there is no empty or full bobbin is identified.

[0008] Apart from this, in recent years, in order to increase the number of spindle units and the spindle rotation speed of a spinning machine, a single spindle driving type spinning machine has been proposed, in which, instead of driving all the spindle units of a spinning machine by a single motor, a spindle driving motor is provided for each spindle unit.

[0009] In the devices disclosed in Japanese Patent Application Laid-open No. 64-52827 and Japanese Patent Application Laid-open No. 4-263630, it is possible to detect an error in gripping a bobbin or an error in fitting

a bobbin onto a spindle, identifying the position thereof. In these devices, however, it is necessary to provide the spool changing device with a device for detecting such gripping error and for identifying the position where the error has occurred, resulting in a rather complicated bobbin gripping device structure and high production cost.

SUMMARY OF THE INVENTION

[0010] The present invention has been made in view of the above problems inherent to the prior art. It is a primary object of the present invention to provide, making use of the feature of a single spindle driving type spinning machine, a method and a device for detecting any abnormality in a spool changing device of a single spindle driving type spinning machine which make it possible, with a simple structure, to detect any abnormality in gripping a full bobbin or an empty bobbin caused by each gripping device of the spool changing device and which enable the spindle unit in which the abnormality has occurred to be identified. A secondary object of the present invention is to provide, in addition to the first object, a device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine which enables the operator to easily identify a spindle unit to which an abnormality in gripping has occurred.

[0011] To achieve the primary object, according to claim 1 of the present invention, there is provided a method for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine which is equipped with a large number of spindle units, in which a spindle of each spindle unit is independently driven by a motor provided for each spindle unit, and which is equipped with a spool changing device, wherein when pulling out a bobbin from a spindle, a torque weaker than a normal gripping force of each gripping device is applied to each spindle by each motor, with the bobbin fitted onto the spindle so as to be integrally rotatable being gripped by each gripping device of the spool changing device, and a judgment is made as to whether there is any abnormality in gripping in each gripping device according to whether the spindle rotates or not, a gripping device corresponding to a spindle unit whose spindle rotates being judged to be in an abnormal gripping condition.

[0012] According to the present invention, a torque weaker than the normal gripping force of each gripping device is applied to each spindle from the motor of each spindle unit in a state in which each gripping device of the spool changing device grips a full bobbin or an empty bobbin fitted onto the spindle so as to be integrally rotatable. When there is no abnormality in each gripping device, the rotation of the spindle is prevented through the bobbin fitted onto the spindle. When there is any abnormality in gripping (gripping error), the spindle is rotated, and the gripping device corresponding to the spin-

dle unit whose spindle rotates is judged to be in an abnormal gripping state. Thus, it is possible to detect any abnormality in gripping in the spool changing device and to identify the position where the abnormality has occurred, without adding any new mechanism to the spool changing device, and solely through a simple change in the control program for the spindle drive side of each spindle unit and the spool changing device.

[0013] According to claim 2 of the invention, in claim 1 of the invention, the judgment as to whether there is any abnormality in gripping is made in a state in which the spool changing device has fitted an empty bobbin onto the spindle. Any error in gripping a full bobbin can be easily discovered by the operator by checking the spinning machine after pulling out the full bobbin. However, an error in fitting an empty bobbin onto a spindle is hard to discover. When the error is not discovered, it can happen that the thread is directly taken up on the spindle as a result of the re-starting of the spinning machine. In this invention, however, such malfunction can be avoided.

[0014] According to claim 3 of the invention, in claim 2 of the invention, when attaching a bobbin to a spindle, a torque weaker than the normal gripping force of each gripping device is applied to each spindle by each motor in a state in which the bobbin gripping of each gripping device is canceled, a gripping device corresponding to a spindle unit whose spindle does not rotate being judged to be in an abnormal grip canceling state.

[0015] In this invention, an error in bobbin grip canceling is detected in a state in which the bobbin grip of each gripping device is canceled. Thus, it is possible to prevent an empty bobbin gripped by the gripping device from being pulled out from a spindle as a result of a movement of the gripping device and from leaving the spindle empty.

[0016] According to claim 4 of the invention, in claim 1 of the invention, the judgment as to whether there is any abnormality in gripping is made in a state in which a full bobbin is gripped to pull out the full bobbin from a spindle.

[0017] To achieve the secondary object, according to claim 5 of the invention, there is provided a device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine which is equipped with a large number of spindle units, in which a spindle of each spindle unit is independently driven by a motor provided for each spindle unit, and which is equipped with a spool changing device, the device including: a fitted-bobbin grip state confirming means for confirming a fitted-bobbin grip state in which each gripping device of the spool changing device grips a bobbin fitted onto a spindle; a grip confirmation rotation command outputting means for outputting a grip confirmation rotation command to cause the motor of each spindle unit to slightly rotate the spindle when the gripping device is in the fitted-bobbin grip state; a judging means for making a judgment as to whether each spindle has

rotated or not after the outputting of the grip confirmation rotation command; and
 an informing means for causing a spindle unit whose spindle has been confirmed to have rotated by the judging means.

[0018] In the present invention, it is confirmed by the fitted-bobbin grip state confirming means that each gripping device of the spool changing device is in a fitted-bobbin grip state in which the gripping device grips the bobbin fitted onto the spindle. And, in this state, by a command from the grip confirmation rotation command outputting means, the motor of each spindle unit is driven so as to slightly rotate the spindle. The judging means makes a judgment as to whether the spindle has rotated or not, and the spindle unit whose spindle has been confirmed to have rotated is made known as a spindle unit with abnormality in gripping by the informing means. Thus, the same effect as the invention according to claim 1 can be achieved, and, at the same time, the operator can easily identify the spindle unit to which abnormality in gripping has occurred.

[0019] According to claim 6 of the invention, in claim 5 of the invention, the abnormal spindle unit detecting device is further equipped with a grip canceling confirmation rotation command outputting means for outputting a grip canceling confirmation rotation command to cause the motor of each spindle unit to slightly rotate the spindle after the outputting of a grip canceling command to each gripping device for the gripping of the bobbin fitted onto the spindle to be canceled, and wherein the judging means makes a judgment as to whether each spindle has rotated or not even after the outputting of the grip canceling confirmation rotation command.

[0020] According to the present this invention, as in claim 5 of the invention, any abnormality in gripping of each gripping device is judged and informed, and then, in the bobbin grip canceled state of each gripping device, the motor of each spindle unit is driven again so as to slightly rotate the spindle. Then, a spindle unit whose spindle does not rotate is made known as a spindle unit with abnormality in grip canceling by the informing means. Thus, it is possible to achieve the same effect as the invention according to claim 3.

[0021] According to claim 7 of the invention, in claim 5 of the invention, the informing means is equipped with a display device provided for each spindle unit, and a driving means for driving the display device of a spindle unit whose spindle has been confirmed to have rotated by the judging means. In this invention, when an abnormality in gripping (gripping error) or an abnormality in grip canceling has occurred, the display device of the spindle unit concerned is driven, so that the operator can easily identify the spindle unit to which the abnormality in gripping or the abnormality in grip canceling has occurred, thereby making it possible to quickly conduct the restoring operation.

[0022] According to claim 8 of the invention, in claim 5 of the invention, the single spindle driving type spin-

ning machine is equipped with a monitor device, and wherein a spindle unit whose spindle has been confirmed to have rotated by said judging means can be displayed on said monitor device.

[0023] In this invention, it is possible to identify a spindle unit to which abnormality in gripping or abnormality in grip canceling has occurred by a monitor device. Thus, when each spindle unit is equipped with a display device, the operator first identifies the number (position) of the spindle unit concerned, and then goes to that spindle unit, whereby it is possible to more quickly identify the spindle unit to which abnormality in gripping or abnormality in grip canceling has occurred, making it possible to conduct the restoring operation more speedily.

[0024] According to claim 9 of the invention, in claim 5 of the invention, the judging means is equipped with a hole element for detecting a magnet rotating integrally with a spindle.

[0025] In claim 10 of the invention, there is provided a device according to claim 5 of the invention, wherein the judging means is equipped with a current sensor for detecting the amount of electric current supplied to the motor for driving the spindle, and a comparison means for comparing an output signal thereof with a predetermined value.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] In the accompanying drawings:

Fig. 1A is a schematic side view, partly in section of a spindle unit, in accordance with an embodiment of the present invention, and Fig. 1B is a schematic diagram showing the relationship between a magnet and hole ICs;

Fig. 2 is a block diagram showing a spindle control device;

Fig. 3 is a block circuit diagram showing an electrical system configuration;

Fig. 4 is a schematic side view showing a state in which a spool changing device has fitted an empty bobbin onto a spindle;

Fig. 5 is a flowchart showing abnormality detection and informing procedures for a gripping device;

Fig. 6A is a time chart of an output signal of a hole IC when a spindle rotates;

Fig. 6B is a time chart showing a case in which the spindle does not rotate;

Fig. 7 is a block circuit diagram showing the electrical system configuration in accordance with another embodiment of the present invention; and

Figs. 8A and 8B are schematic side views illustrating the operation of a spool changing device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] An embodiment in which the present invention

is applied to a single spindle driving type ring spinner will be described with reference to Figs. 1 through 6.

[0028] As shown in Fig. 1A, a spindle rail 1 of a spinning machine is provided with a spindle driving motor (hereinafter referred to as a spindle motor) 3 for driving a spindle 2 for each spindle unit. The spindle motor 3 consists of a synchronous motor. In this embodiment, a switched reluctance motor (SR motor) is used.

[0029] The spindle motor 3 is integrated with the spindle 2 supported by a bolster 4. The bolster 4 is secured to the spindle rail 1, with its upper portion inserted into a housing 5. The spindle 2 is equipped with an upper blade 2a to which a bobbin is attached and a spindle shaft (not shown) fastened to the lower central portion of the upper blade 2a. The spindle 2, whose spindle shaft is inserted into the bolster 4, is rotatably supported by the bolster 4 through the intermediation of a bearing (not shown). A rotor 6 of the spindle motor 3 is attached to the lower end of the upper blade 2a so as to be capable of integral rotation. In the housing 5, a stator 7 opposed to the rotor 6 is secured.

[0030] A magnet 8 is secured to the portion of the spindle 2 above the rotor 6 so as to be capable of integral rotation. As shown in Fig. 1B, the magnet 8 is formed into an annular configuration and has two N-poles and two S-poles alternately arranged in the circumferential direction. In the housing 5, a hole IC board 9 is arranged so as to be positioned between the rotor 6 and the magnet 8. The outer peripheral portion of the hole IC board 9 is secured to the inner wall of the housing 5. Substantially at the center of the hole IC board 9, there is formed a hole 9a which allows passing of the rotor 6 when inserting the spindle 2 into the bolster 4 or when pulling it out from the bolster 4. Hole ICs (hole elements) 10 are mounted on the hole IC board 9 so as to be opposed to the magnet 8. In this embodiment, three hole ICs 10 are arranged at equal angular intervals. Each hole IC 10 outputs an ON signal when it is opposed to an N-pole of the magnet 8, and outputs an OFF signal when it is opposed to an S-pole thereof. Thus, it outputs a pulse signal corresponding to the rotating speed of the spindle 2.

[0031] The housing 5 is equipped with a motor control device 11 (shown in Figs. 2 and 3) for controlling the spindle motor 3. The motor control device 11 is supplied with a DC current obtained through the conversion of commercial power by an AC/DC converter (none of which is shown). As shown in Fig. 2, the motor control device 11 is equipped with an inverter 12 and a control unit 13. The control unit 13 is equipped with a CPU 14 and a memory 15. An output signal of the hole ICs 10 (Fig. 2 shows only one of them) is input to the CPU 14. An arbitrary one of three power supply lines connecting the inverter 12 and the spindle motor 3 is provided with a current sensor 16 for measuring the electric current supplied to each spindle motor 3 of the spindle unit concerned. The CPU 14 inputs the output of the current sensor 16 through an A/D converter and an interface (none of which is shown). When thread breakage occurs, the

CPU 14 stops the power supply to the spindle motor 3. The CPU 14 obtains a rate of change in current from the output signal of the current sensor 16. When the rate of change in current exceeds a set value, it determines that thread breakage has occurred. At the time of thread breakage, the power supply to the spindle motor 3 of the spindle unit concerned is stopped, and a display portion described below is driven.

[0032] The housing 5 is provided with a display portion 17. An LED (light emitting diode) is used in the display portion 17 and, as shown in Fig. 1A, the display portion 17 is provided in the front surface of the housing 5. Further, the housing 5 is equipped with a switch 18 for commanding the spindle motor 3 to start and stop.

[0033] Below the front-side portion (the left-hand portion in Fig. 1A) of the spindle rail 1, there is arranged a well-known spool changing device 20 (only a part of which is shown) equipped with a gripping device (gripper) 19. As in the prior-art technique described above, the spool changing device 20 performs exchange of a full bobbin and an empty bobbin between the spindle 2 and a conveying device (not shown) arranged below the spindle rail 1.

[0034] All the spindle units of the spinning machine are classified into a plurality of groups. As shown in Fig. 3, a plurality of spindle units (four example, forty eight spindle units) constitute one group, and each motor control device 11 is connected to a section control unit 21 through a communication line 22. Each section control unit 21 is connected to a spinning machine control device 23 exercising control over all the spindle units through the communication line 22a. A multi-drop connection using a serial interface is adopted in the communication line 22a. For example, RS-485 is used as the serial interface. Each section control unit 21 relays passing of signals between the control units 13 of the group connected thereto and the spinning machine control device 23.

[0035] The spinning machine control device 23 is equipped with a CPU 24, a ROM 25, a RAM 26, an input device 27, an input/output interface 28, and a display 29. The CPU 24 is connected to a winding amount detecting means 30 through the input/output interface 28. As the winding amount detecting means 30, a counter for counting the number of revolutions of a front roller (not shown) is used. Further, to the spinning machine control device 23, a control signal therefor can be input from the control device 31 of the spool changing device 20.

[0036] The ROM 25 stores program data and various items of data necessary for the execution thereof. The program data includes spinning conditions, such as various fiber materials, yarn number count, and twist number, the spindle rotating speed during normal operation, correspondence data on the rotating speed of the motors of the draft drive system and that of the lifting drive system, and program data for making a judgment as to whether there is any abnormality in the gripping

device 19 during spool changing operation.

[0037] When performing spool changing operation, the CPU 24 inputs from the control device 31 of the spool changing device 20 a signal indicating the position and condition of the gripping device 19, and makes a judgment as to whether there is any abnormality in the gripping device 19, with the gripping device 19 fitting an empty bobbin onto the spindle 2. When there is any abnormality, it performs a series of operations for informing the operator of it.

[0038] Next, the operation of this device, constructed as described above, will be illustrated. Prior to the operation of the spinning machine, the spinning conditions, such as fiber material, yarn number count, and twist number, are input to the spinning machine 23 by the input device 27. When the operation of the spinning machine is then started, the control unit 13 of each spindle unit performs control through the inverter 12 based on the command from the spinning machine control device 23 and in correspondence with the spinning conditions such that the spindle motor 3 rotates at a predetermined rotating speed.

[0039] Each control unit 13 inputs a detection signal of the current sensor 16 at a predetermined period to make a judgment as to whether any thread breakage has occurred. Thereafter, when it is determined that thread breakage has occurred, it stops the spindle motor 3, and drives (lights up) the display portion 17. The operator identifies the spindle unit to which thread breakage has occurred from the display portion 17 and performs a piecing operation. That is, during the operation of the spinning machine, the display portion 17 functions as a thread breakage informing means.

[0040] When the spool has become full as a result of the continuous spinning, the operation of the spinning machine is stopped. Then, a spool changing operation by the spool changing device 20 is started. In response to a spool changing operation start signal of the spool changing device 20, the CPU 24 of the spinning machine control device 23 starts the judgment as to whether there is any abnormality in the gripping device 19 and the process for informing the operator of it in accordance with the flowchart shown in Fig. 5.

[0041] In step S1, the CPU 24 makes a judgment, according to a signal from the control device 31, as to whether the gripping device 19 has been arranged at a position for fitting an empty bobbin E onto the spindle 2. At this time, the CPU 24 functions as a fitted-bobbin gripping state checking means. As shown in Fig. 4, a state is achieved in which the gripping device 19 is arranged at the empty bobbin fitting position. Upon confirming this by a signal from the control device 31, the CPU 24 advances to step S2. In step S2, the CPU 24 outputs to the CPU 14 of each spindle unit a drive command (grip confirming rotation command) to slightly drive the spindle motor 3. At this time, the CPU 24 functions as a grip confirming rotation command means. When this command signal is input, the CPU 14 applies to the spindle

2 a torque which is slightly weaker than the normal gripping force of each gripping device 19, driving the spindle motor 3 so as to rotate the spindle 2 slightly (e.g., 30 to 60 degrees). At this time, the spindle 2 corresponding to a gripping device 19 with insufficient grip or a gripping device 19 with no empty bobbin E is rotated.

[0042] Next, in step S3, the CPU 24 detects the spindle unit whose spindle 2 has rotated. The detection of the spindle unit whose spindle 2 has rotated is effected based on the judgment as to whether the spindle 2 has rotated, the judgment being made by each CPU 14 from the output signal of the hole ICs 10. To describe it in more detail, after outputting a drive command to the spindle motor 3, the CPU 14 makes a judgment as to whether the spindle 2 has rotated based on the output signal of the hole ICs 10. When the magnet 8 rotates by such an angle as to change the magnetic pole thereof opposed to each hole IC 10, the output signal of each hole IC 10 changes from high (H) to low (L) or from low (L) to high (H) each time the boundary between N- and S-poles passes by. Thus, when the spindle 2 rotates as a result of the driving of the spindle motor 3, the output of each hole IC 10 changes as shown, for example, in Fig. 6A. When the spindle 2 does not rotate, there is no change, as shown in Fig. 6B. When there is any change in the output of the ICs 10, the CPU 14 determines that the spindle 2 concerned has rotated. Then, the CPU 24 inputs data indicating as to whether the spindle 2 has rotated or not from the CPU 14 of each spindle unit. At this time, the hole ICs 10, the CPUs 14, and the CPU 24 function as a judging means for judging as to whether each spindle 2 has rotated or not. The gripping device 19 corresponding to the spindle unit whose spindle 2 has rotated is judged to be in an abnormal gripping state.

[0043] Next, in step S4, the CPU 24 outputs a command to drive the display portion 17 to the CPU 14 of the spindle unit whose spindle 2 has rotated, and the position of the spindle unit concerned is indicated on a display 29. And, when the command signal to drive the display portion 17 is input from the CPU 24, the CPU 14 drives (lights up) the display portion 17.

[0044] After the completion of the operation of step S4, a grip canceling command is output to the gripping device 19 from the control device 31 of the spool changing device 20. After the grip canceling command has been output, the CPU 24 advances to step S5, where a drive command (grip canceling confirmation rotation command) to slightly drive the spindle motor 3 is output to the CPU 14 of each spindle unit. At this time, the CPU 24 functions as a grip canceling confirmation rotation command means. When this command signal is input, the CPU 14 applies to the spindle 2 a torque weaker than the normal gripping force of each gripping device 19, driving the spindle motor 3 so as to slightly rotate the spindle 2.

[0045] Next, in step S6, the CPU 24 detects, as in step S3, a spindle unit whose spindle 2 has rotated. At this time, the gripping device 19 corresponding to a spindle

unit whose spindle 2 has not rotated is judged to be in an abnormal grip canceling state. Then, the CPU advances to step S7, where a command to drive the display portion 10 is output to the CPU 14 of the spindle unit whose spindle 2 has rotated, and the position of the spindle unit concerned is displayed on a display 29. When a command to drive the display portion 10 is input to the CPU 14 from the CPU 24, the CPU 14 drives (lights up) the display portion 10. A series of procedures such as a judgment as to whether there is any abnormality in the gripping device 19 are thus completed.

[0046] When the gripping device 19 has been arranged at a position where the fitting of the empty bobbin E onto the spindle 2 or the process for eliminating any abnormality in the gripping device 19 is not interfered with, the empty bobbin E is fitted onto the spindle 2 by the operator. After the spinning machine has been started again, the process for eliminating abnormality in the gripping device 19 is then conducted.

[0047] This embodiment provides the following advantages:

(1) In a state in which the bobbin fitted onto the spindle 2 so as to be capable of integrally rotating is gripped by the gripping device 19, a torque weaker than the normal gripping force of each gripping device 19 is applied to each spindle 2 by each spindle motor 3, and a judgment is made as to whether there is any abnormality in gripping in each gripping device 19 according to whether the spindle 2 rotates or not. Thus, it is possible to detect any abnormality in bobbin gripping of each gripping device 19 of the spool changing device 20 and to identify the spindle unit to which abnormality in bobbin gripping has occurred through the simple changing of the control program for the spindle drive side of each spindle unit and for the spool changing device 20, without adding any new mechanism to the spool changing device 20.

(2) The judgment as to whether there is any abnormality in gripping is made in a state in which the spool changing device 20 has fitted the empty bobbin E onto the spindle 2. Thus, if there is any error in fitting the empty bobbin E onto the spindle 2, the position concerned can be identified, and the error can be quickly coped with by the operator.

(3) In a state in which the bobbin gripping is canceled in each gripping device 19 after the empty bobbin E has been fitted onto the spindle 2 so as to be capable of integrally rotating, a torque weaker than the normal gripping force of each gripping device 19 is applied to each spindle 2 by the spindle motor 3, and any abnormality in grip canceling is detected according to whether the spindle 2 rotates or not. Thus, there is less possibility that any abnormality in the gripping device 19 will be overlooked.

(4) Since there is provided an informing means (display portion 17) for informing the operator of the

spindle unit whose gripping device 19 has been judged to be abnormal, the operator can easily identify the gripping device 19 to which abnormality has occurred.

(5) The informing means is equipped with a display portion 17 provided for each spindle unit, so that the operator can easily identify the gripping device 19 to which abnormality has occurred, and quickly conduct restoring operation.

(6) Since the spinning machine is equipped with a monitor device (display 29), it is possible to identify the spindle unit to which abnormality in gripping or abnormality in grip canceling has occurred by means of the monitor device. Thus, when each spindle unit is equipped with a display device, the operator first identifies the number (position) of the spindle unit concerned by the monitor device, and then goes to the position of the spindle unit concerned, whereby it is possible to identify the abnormal spindle unit more quickly, making it possible to execute the restoring operation more speedily and thus achieving an improvement in operational efficiency.

(7) A single display portion 17 provided for each spindle unit is used for both broken-thread display and display of abnormality in the gripping device 19. Thus, as compared with the case in which dedicated display portions are provided, a reduction in cost can be achieved and the device structure is simplified.

(8) The control unit 13 of each spindle unit is connected to the spinning machine control device 23 through the section control unit 21. Thus, when the CPU 24 obtains data on the presence/absence of abnormality in the gripping device 19 from each control unit 13 by a polling system, the CPU 24 performs polling solely by the number of the section control units 21, whereby it is possible to input data on all the spindle units and to achieve a reduction in data collecting time.

[0048] The above-described embodiment should not be construed restrictively. It is also possible, for example, to adopt the following arrangements.

[0049] The detection of any abnormality in gripping of the gripping device 19 may also be performed in a state in which a full bobbin is held to be pulled up from the spindle 2 instead of performing it in a state in which an empty bobbin E is fitted onto the spindle 2. In this case, it is possible to omit the sensor provided in the conventional spinning machine for detecting any full bobbin that has not been pulled out. However, to ensure reliability, the sensor may be used together therewith.

[0050] As the rotation detecting means constituting the means for making a judgment as to whether the spindle 2 rotates or not when a torque weaker than the normal gripping device 19 is applied, it is also possible to use, instead of the hole ICs 10, a rotary encoder or some

other type of magnetic sensor. Further, it is also possible to detect the current amount supplied to the spindle motor 3, and compare it with a predetermined amount, thereby making a judgment as to whether the spindle 2 has rotated or not.

[0051] It is also possible to detect abnormality in the gripping device 19 solely through the detection of abnormality in gripping. In this case, steps S5 through S7 in the flowchart of Fig. 5 are omitted.

[0052] It is also possible for each motor control device 11 to make a judgment as to whether there is any abnormality in the gripping device 19 corresponding to each spindle unit, and drive (light up) the display portion 17 when it is determined that there is abnormality in the gripping device.

[0053] As shown in Fig. 7, instead of providing the section control units 21, it is also possible to connect the control unit 13 of each motor control device 11 to the spinning machine control device 23 through a LAN 32. Ethernet is used as the LAN 32. In this construction, it is possible to output data to the spinning machine control device 23 from each control unit 13, without performing polling from the spinning machine control device 23 to effect passing of data with the control unit 13. As a result, it is possible to reduce the requisite time for the spinning machine control device 23 to obtain data, etc. on all the spindle units.

[0054] It is also possible to connect the spinning machine control device 23 to a host computer through a local area network (LAN), making it possible to monitor the condition of each spinning machine by a host computer.

[0055] It is possible to continue the spool changing operation and start and continue the operation of the spinning machine main body, with only the spindle unit where abnormality has been detected being kept at rest.

[0056] It is also possible to separately provide a display portion for informing thread breakage and a display portion for displaying abnormality in the gripping device.

[0057] The method of detecting thread breakage in each spindle unit is not restricted to the system in which the current supplied to the spindle motor 3 is detected by the current sensor 16. It is also possible to use some other type of thread breakage detection sensor.

[0058] Instead of providing an inverter 12 for each spindle unit, it is also possible to adopt an arrangement in which the spindle motors 3 of all the spindle units are drive-controlled through a single inverter, or an arrangement in which the spindle motors 3 are classified into a plurality of groups, one inverter being provided for each group. In this case, the number of inverters is reduced, resulting in a reduction in production cost.

[0059] Instead of an SR motor, the spindle motor 3 may also consist of a synchronous reactance motor, a permanent magnet type synchronous motor, a step motor or the like.

[0060] The present invention is applicable not only to a ring spinner but also to a single spindle driving type

ring twisting machine or the like.

[0061] Technical ideas (inventions) other than those claimed in the appended claims that can be grasped from the above embodiments will be described below along with their effects.

(1) In the invention as disclosed in one of claims 5 to 8 of the invention, the judgment means is equipped with hole elements (hole ICs) for detecting a magnet integrally rotating with the spindle.

(2) In the invention as disclosed in any one of claims 5 to 8 of the invention, the judgment means is equipped with a current sensor for detecting a current amount supplied to the motor for driving the spindle, and a comparison means for comparing the output signal thereof with a predetermined value.

[0062] As described above in detail, in accordance with the invention as disclosed in claims 1 to 10 of the invention, it is possible, utilizing the feature of a single spindle driving type spinning machine, to make a judgment, with a simple structure, as to whether there is any error in gripping a full bobbin or an empty bobbin in each gripping device of the spool changing device, and to identify the spindle unit to which the gripping error has occurred. Further, according to the invention as claimed in Claims 5 through 10, the operator can easily identify the spindle unit in which any abnormality in gripping has occurred.

Claims

1. A method for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine which is equipped with a large number of spindle units, in which a spindle of each spindle unit is independently driven by a motor provided for each spindle unit, and which is equipped with a spool changing device,

wherein when pulling out a bobbin from a spindle, a torque weaker than a normal gripping force of each gripping device is applied to each spindle by each motor, with the bobbin fitted onto the spindle so as to be integrally rotatable being gripped by each gripping device of the spool changing device, and a judgment is made as to whether there is any abnormality in gripping in each gripping device according to whether the spindle rotates or not, a gripping device corresponding to a spindle unit whose spindle rotates being judged to be in an abnormal gripping condition.

2. A method for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 1, wherein the judgment as to whether there is any abnormality in gripping is made in a state in which the spool chang-

ing device has fitted an empty bobbin onto the spindle.

3. A method for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 2, wherein when attaching a bobbin to a spindle, a torque weaker than the normal gripping force of each gripping device is applied to each spindle by each motor in a state in which the bobbin gripping of each gripping device is canceled, a gripping device corresponding to a spindle unit whose spindle does not rotate being judged to be in an abnormal gripping state. 5
4. A method for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 1, wherein the judgment as to whether there is any abnormality in gripping is made in a state in which a full bobbin is gripped to pull out the full bobbin from a spindle. 10
5. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine which is equipped with a large number of spindle units, in which a spindle of each spindle unit is independently driven by a motor provided for each spindle unit, and which is equipped with a spool changing device, said device comprising: 15
 - a fitted-bobbin grip state confirming means for confirming a fitted-bobbin grip state in which each gripping device of the spool changing device grips a bobbin fitted onto a spindle; 20
 - a grip confirmation rotation command outputting means for outputting a grip confirmation rotation command to cause the motor of each spindle unit to slightly rotate the spindle when the gripping device is in the fitted-bobbin grip state; 25
 - a judging means for making a judgment as to whether each spindle has rotated or not after the outputting of the grip confirmation rotation command; and 30
 - an informing means for causing a spindle unit whose spindle has been confirmed to have rotated by said judging means to be known. 35
6. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 5, wherein said device is further equipped with a grip canceling confirmation rotation command outputting means for outputting a grip canceling confirmation rotation command to cause the motor of each spindle unit to slightly rotate the spindle after the outputting of a grip canceling command to each gripping device 40

for the gripping of the bobbin fitted onto the spindle to be canceled, and wherein said judging means makes a judgment as to whether each spindle has rotated or not even after the outputting of the grip canceling confirmation rotation command.

7. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 5, wherein said informing means is equipped with a display device provided for each spindle unit, and a driving means for driving the display device of a spindle unit whose spindle has been confirmed to have rotated by said judging means. 45
8. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 5, wherein said single spindle driving type spinning machine is equipped with a monitor device, and wherein a spindle unit whose spindle has been confirmed to have rotated by said judging means can be displayed on said monitor device. 50
9. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 5, wherein said judging means is equipped with a hole element for detecting a magnet rotating integrally with a spindle. 55
10. A device for detecting an abnormality in a spool changing device of a single spindle driving type spinning machine according to Claim 5, wherein said judging means is equipped with a current sensor for detecting the amount of electric current supplied to the motor for driving the spindle, and a comparison means for comparing an output signal thereof with a predetermined value.

FIG. 1A

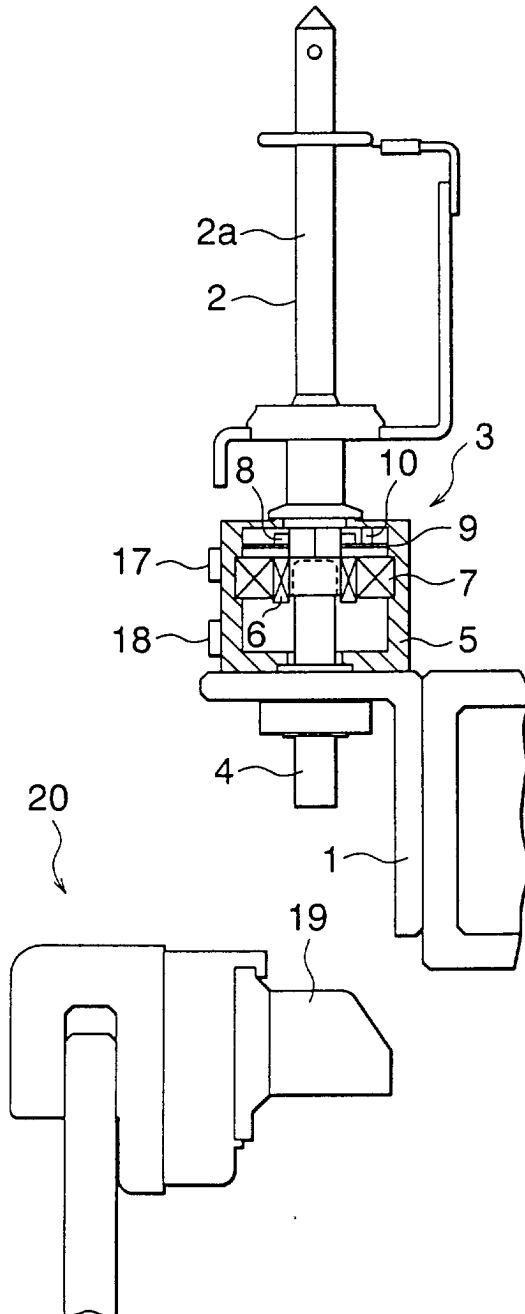


FIG. 1B

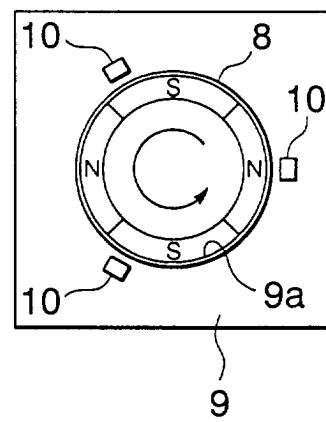


FIG. 2

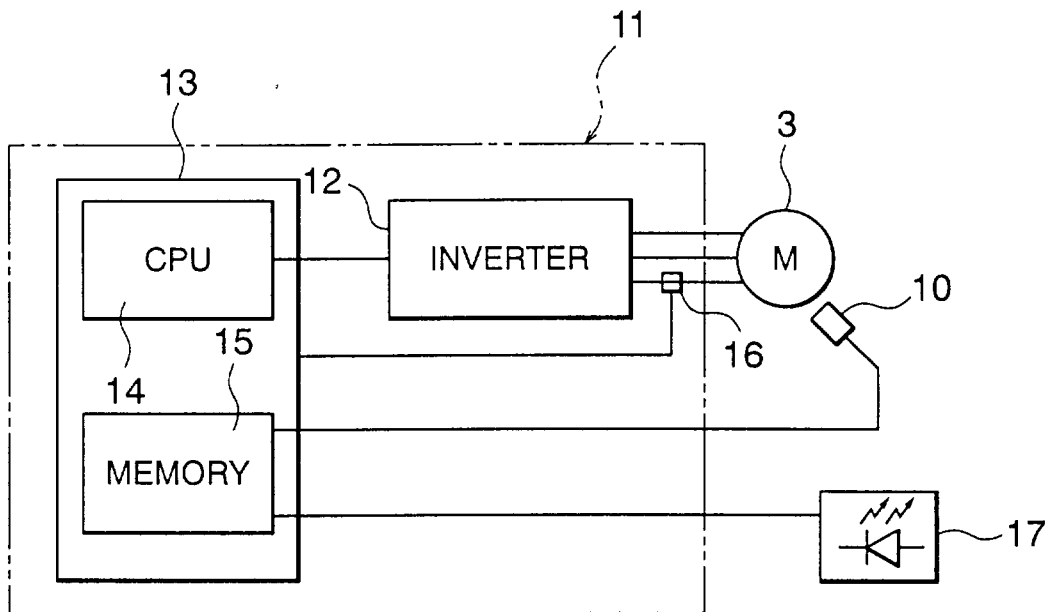


FIG. 3

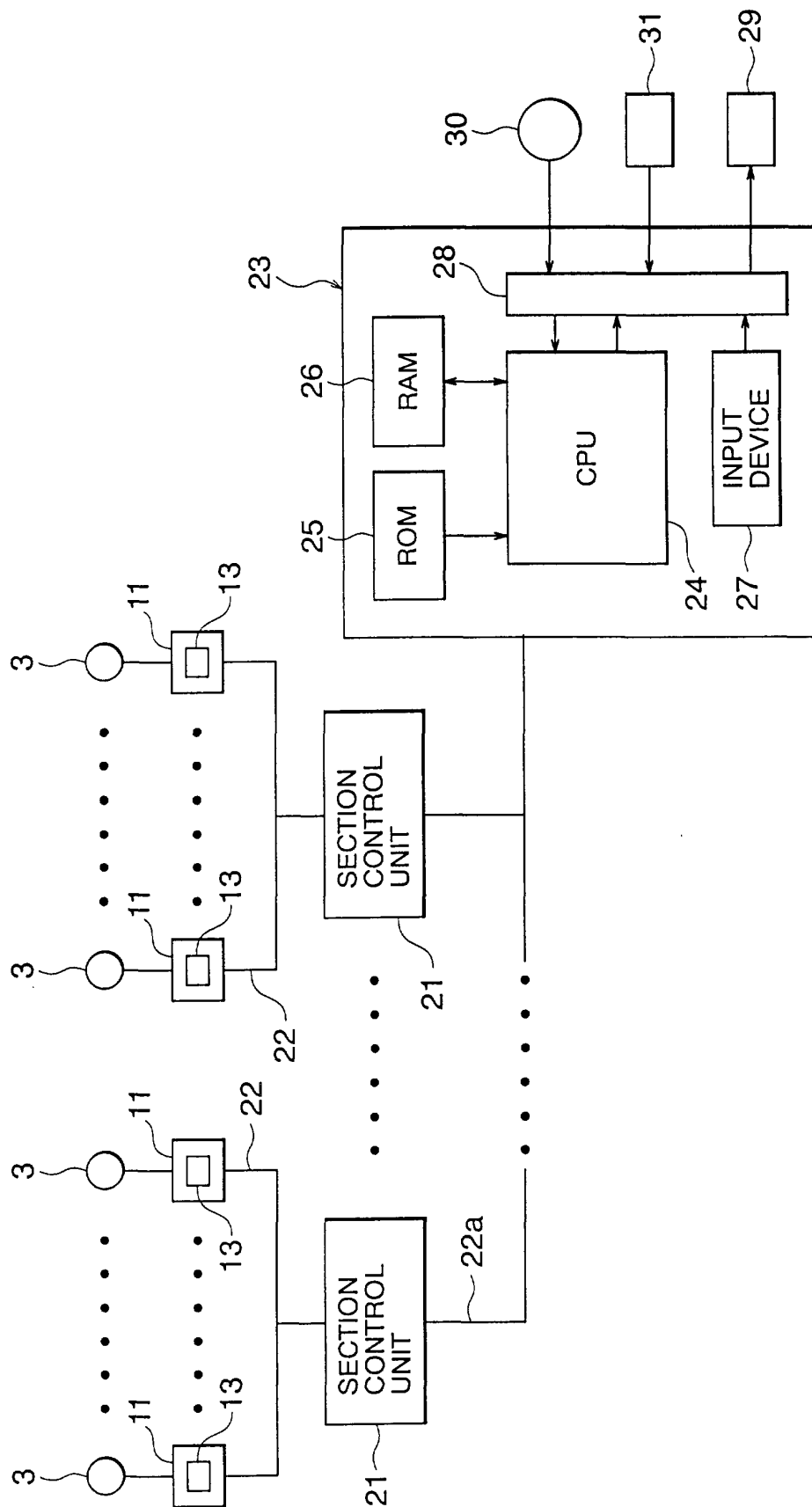
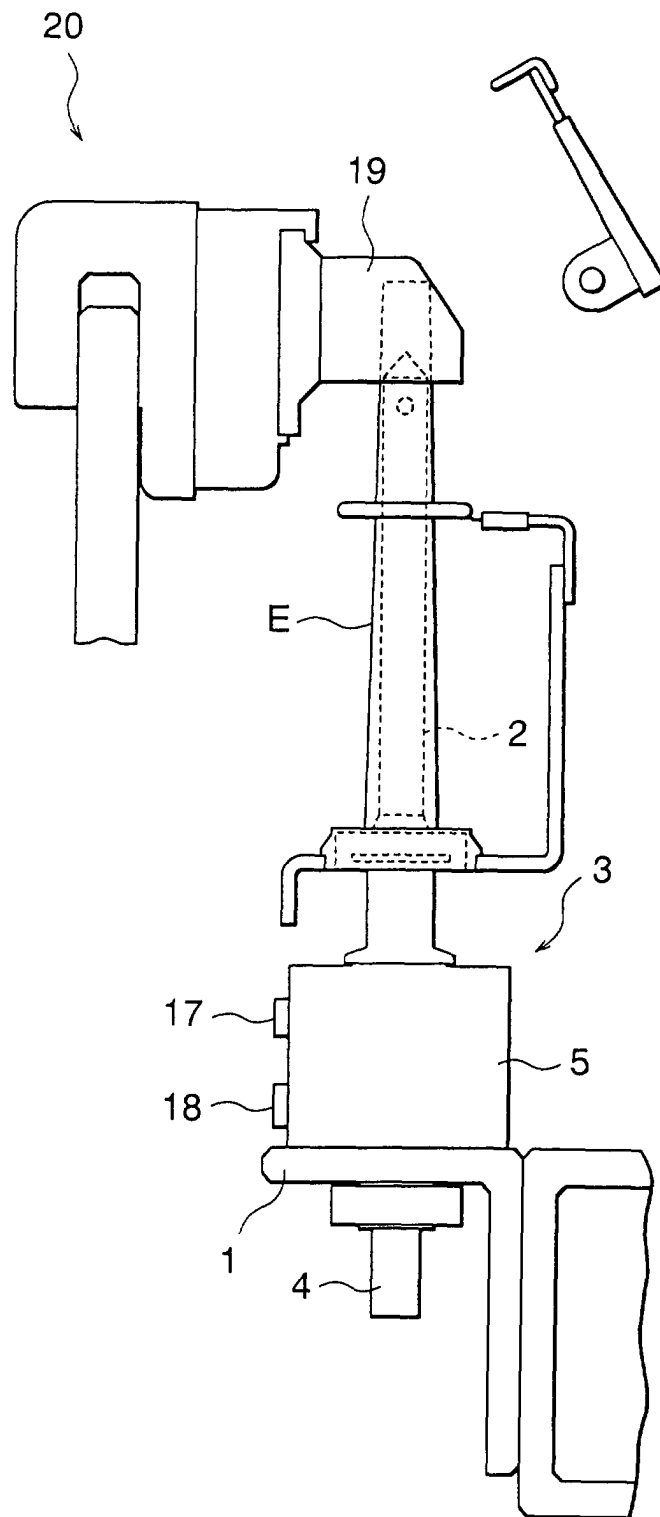
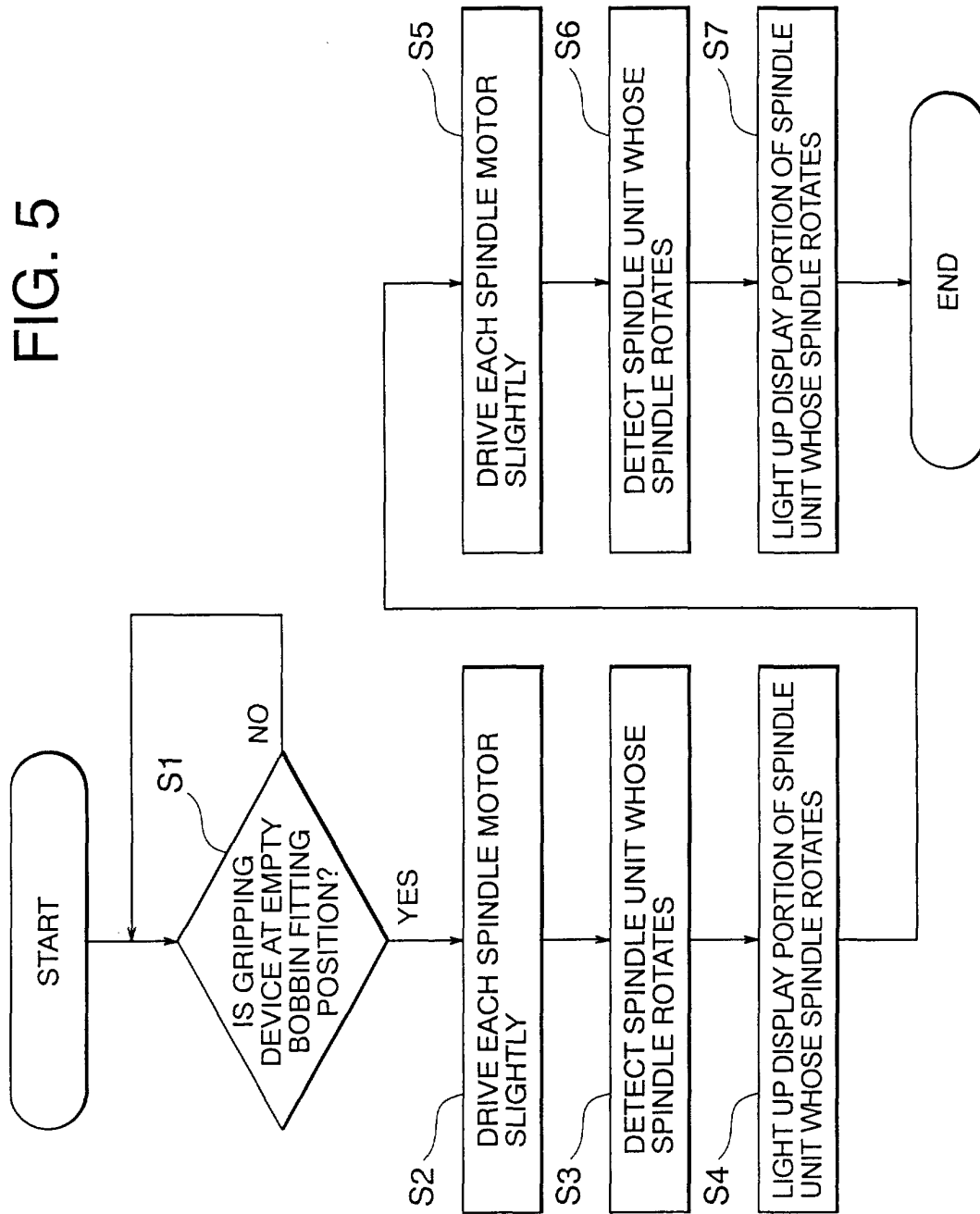


FIG. 4





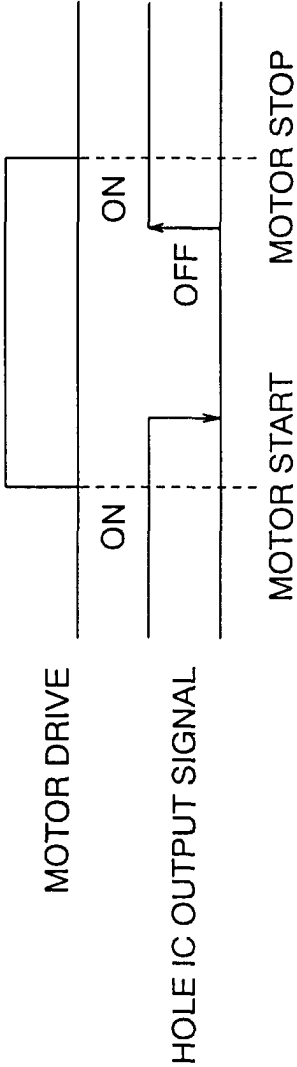


FIG. 6A

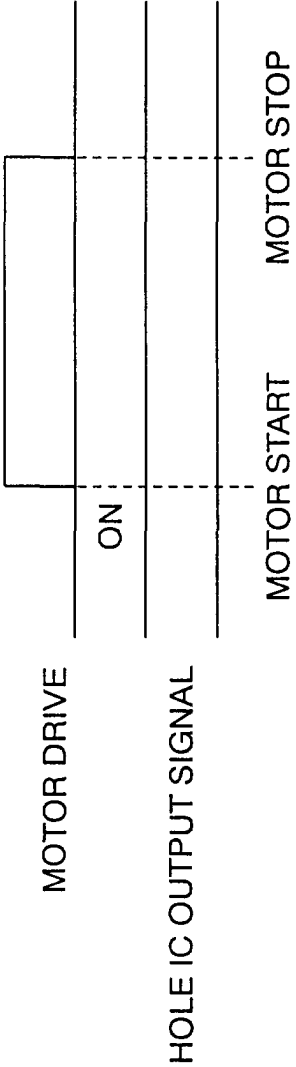


FIG. 6B

FIG. 7

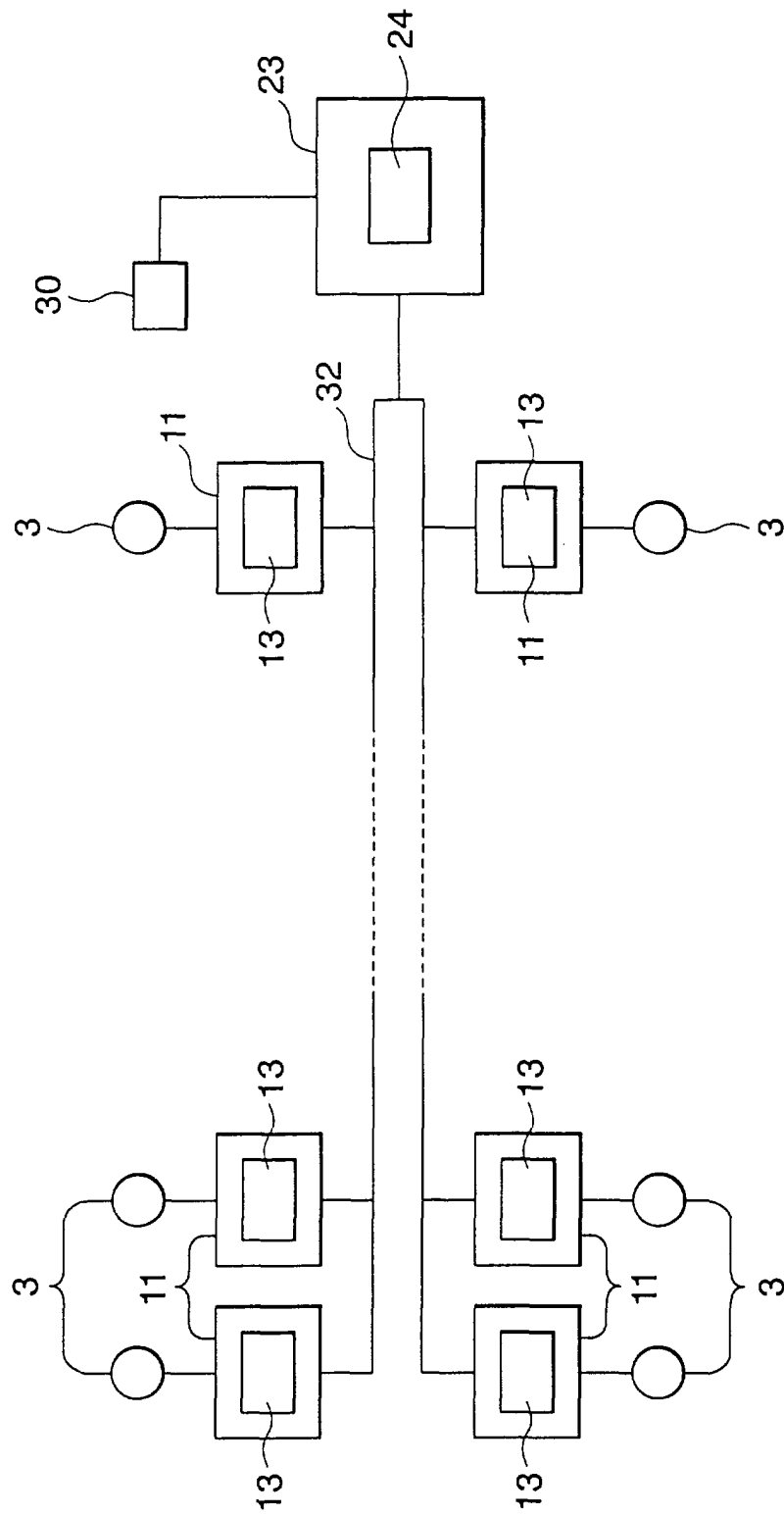


FIG. 8A

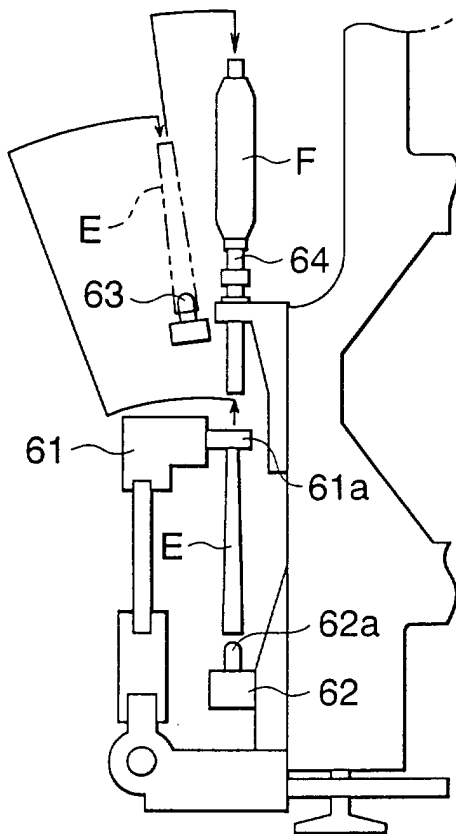
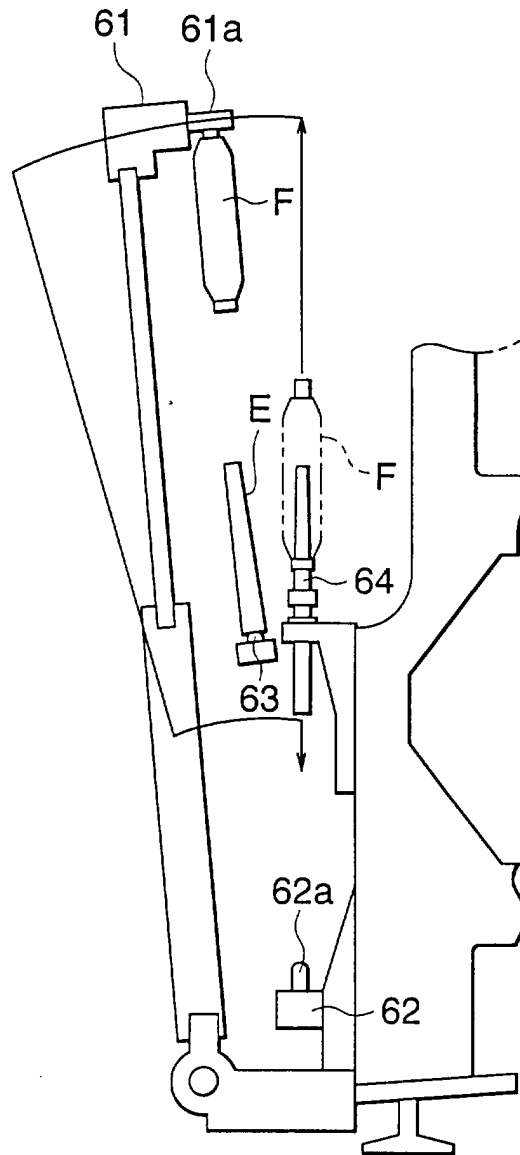


FIG. 8B





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 01 12 4227

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.7)
D,A	US 5 203 155 A (ZINSER TEXTILMASCHINEN GMBH) 20 April 1993 (1993-04-20) * the whole document *	1-10	D01H1/244 D01H9/04
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.CI.7) D01H
Place of search		Date of completion of the search	Examiner
THE HAGUE		11 February 2002	Henningsen, O
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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