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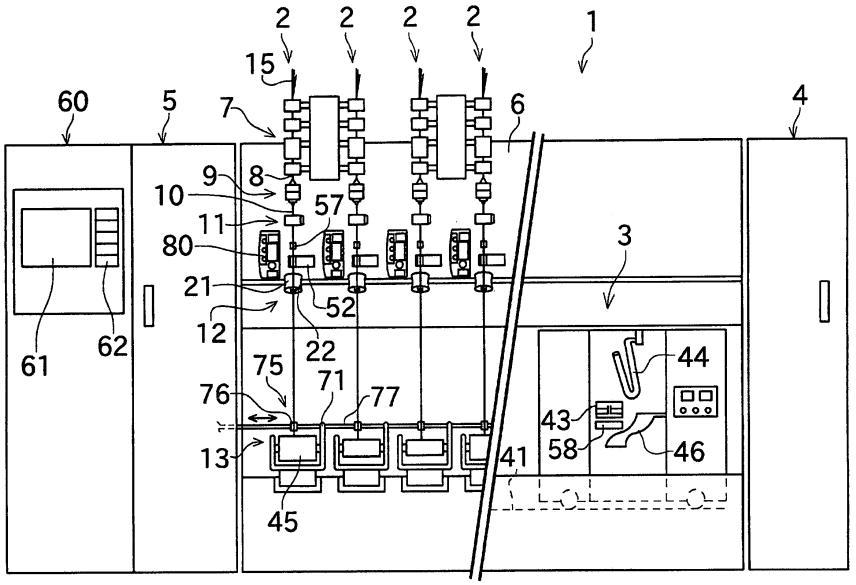
(54) Textile machine

(57) Each of a plurality of spinning units of a spinning machine includes a level display section, which displays an operation level that corresponds to an operation state of the spinning unit among a plurality of operation levels. The operation levels are classified such that a standard operation state, which is to be a standard, is located at a center. The standard operation state may be an average value of the operation states of the plurality of spinning units of the spinning machine or a given set value. Each of the plurality of spinning units further includes an operation panel, which displays an overall view illustrating an overall structure of the spinning unit. When an error has occurred in the spinning unit, the operation panel can carry out a display by identifying a section that corresponds to an error occurred section within the overall view.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a textile machine including a plurality of yarn processing units. More particularly, the present invention relates to a configuration for displaying an operation state of the yarn processing unit. The present invention also relates to a configuration for notifying an error occurred in the yarn processing unit.

2. Description of the Related Art

[0002] A conventional textile machine, such as a spinning machine including a plurality of spinning units and an automatic winder including a plurality of winder units, includes a plurality of yarn processing units. The textile machine of this type generally includes a central management device (machine control device) that collectively manages information relating to each of the yarn processing units. Japanese Unexamined Patent Application Publications No. H5-70040 (Patent Document 1), No. H6-128823 (Patent Document 2), and No. H7-90733 (Patent Document 3) disclose a textile machine including a central management device that centrally manages a plurality of yarn processing units. In such a central management device, various pieces of information such as an operation efficiency of each of the yarn processing units and an error occurrence state can be displayed on a monitor.

[0003] In a winder unit disclosed in German Patent Application Publication No. 102006045237 (Patent Document 4), a panel is provided on a front surface of each of the winder units, and a plurality of single images schematically illustrating error occurrence factors are displayed on each panel. When an error occurs, the winder unit of Patent Document 4 notifies an error occurred section by lighting the single image that corresponds to the occurred error.

[0004] In the textile machine including the central management device as described in Patent Documents 1 through 3, a yarn winding unit that meets a prescribed condition may be extracted by performing a prescribed operation from the central management device. In such a case, for example, an operator performs an appropriate operation to extract (select) a yarn processing unit having an operation efficiency lower than an average of the entire machine, and to display the extracted yarn processing unit on the monitor. Accordingly, the operator can check the monitor, and then walk to the place where the yarn processing unit in need of maintenance work is provided, and perform the maintenance work.

[0005] However, in the above configuration, in order to check the display on the monitor, the operator needs to go back and forth frequently between the central management device and the yarn processing unit. As a result, the operation efficiency was low, and the maintenance work posed burden on the operator.

[0006] Moreover, in the above configuration, the operator performs a prescribed operation from the central management device to display the yarn processing unit with a low operation efficiency on the monitor. Therefore, when the operation efficiency of a certain yarn processing unit decreases during the operation of the textile machine, the operator cannot realize the decrease in the operation efficiency of the yarn processing unit until the operator performs the prescribed operation from the central management device and checks the monitor. As a result, the operator could not confirm the yarn processing unit with a decreased operation efficiency at an early stage to perform an appropriate operation.

[0007] Meanwhile, the winder unit disclosed in Patent Document 4 displays the error occurrence factors or the like on the front panel. Therefore, when an error occurs, in order to obtain information about the error, the operator can immediately confirm the error occurring in the yarn processing unit without checking the monitor of the central management device. However, the winder unit disclosed in Patent Document 4 displays information relating to the yarn processing unit only when an error occurs in such a yarn processing unit. As a result, the operator could not confirm a current state of the yarn processing unit that is during operation.

[0008] In another point of view, various proposals are made to notify the operator of an error occurred section when an error occurs in a textile machine such as an automatic winder and a spinning machine.

[0009] For example, Japanese Unexamined Patent Application Publication No. S60-67374 (Patent Document 5) discloses a structure for displaying an error occurred section in a bobbin transportation device used in an automatic winder. An error display device disclosed in Patent Document 5 is provided with a light-emitting diode at an appropriate position on a panel illustrating a schematic view of the bobbin transportation device. By lighting the light-emitting diode that corresponds to the error occurred section, the error occurred section is displayed.

[0010] In the textile machine such as the automatic winder and the spinning machine, when an error occurs in any of the plurality of yarn processing units, through a method of lighting a lamp of the yarn processing unit in which an error has occurred, the operator is notified of the yarn processing unit that needs a maintenance work. Accordingly, the operator can confirm the location of the yarn processing unit in which an error has occurred, and goes to the location where such yarn processing unit is provided to perform an appropriate maintenance work. However, the operator has been judging, through own experience, which specific section in the yarn processing unit needs a maintenance work. Therefore, there were cases in which the operator performed a maintenance work on a section that is different from the error occurred

section, or used longer hours than required.

[0011] Another structure is known in which each yarn processing unit includes a seven-segment display or the like, and by displaying an error code in numbers and/or in alphabets on the display, an operator is notified of contents of an error occurred in the yarn processing unit. However, the operator cannot promptly perform an appropriate operation unless the operator knows a correspondence relation between the error code and an error occurred section (or the error contents). Even if the operator fully knows the error code, the operator cannot intuitively realize a specific error occurred section in the yarn processing unit. As a result, problems arise in that it is troublesome to check the contents indicated by the error code and that an operator may check an irrelevant section. Thus, the operation efficiency was low, and a large burden was posed on the operator.

[0012] Japanese Unexamined Patent Application Publication No. H11-107075 (Patent Document 6) discloses an automatic winder that visually displays error occurrence factors on a monitor that is connected with a central management device. With this structure, an operator can intuitively learn error contents as compared with the above-described error code display. Patent Document 6 describes that even an inexperienced operator can easily confirm a section that needs a maintenance work and contents of the error, and thus can promptly perform maintenance work.

[0013] Meanwhile, in the structure of Patent Document 4, since the error contents are represented by icon images provided on the panel of each of the winder units, the operator does not need to fully know the error code.

[0014] In the structure of Patent Document 6, when an error occurs in the yarn processing unit, the operator once goes to the central management device to obtain information on the error occurred section or the like, and then checks the display on the monitor. After printing the displayed contents on a paper, the operator is required to go back to such yarn processing unit to perform maintenance work.

[0015] The automatic winder disclosed in Patent Document 6 can display on the monitor, a plurality of yarn processing units that have a great number of error occurrences. However, when a plurality of yarn processing units in need of maintenance work exist, the operator needs to go back and forth several times between the central management device and the yarn processing unit and check the display on the monitor. Moreover, even when the displayed contents are printed on the paper, in a situation where a plurality of operators are working, an operator who does not have the paper cannot know the error occurred section, and the operators cannot concurrently perform the maintenance work.

[0016] In Patent Document 4, since each of the units is provided with the panel, the operator does not need to go to the central management device each time to check the monitor or does not need to check the printed paper. Therefore, the operator can promptly confirm the error contents.

[0017] However, the single images of the above Patent Document 4 are merely a substitute for the error code display, and an operator cannot intuitively confirm easily a correspondence relation between the display of the single images and the error occurred section. In other words, although the error contents are schematically illustrated by the single images, the operator cannot promptly understand the error occurred section by looking at the single images. The operator is still required to know in advance the correspondence relation between the single images and the error occurred section. Moreover, depending on graphic contents of the single images, there are cases where the operator cannot accurately understand the error contents even by looking at the graphics. As a result, an inexperienced operator cannot promptly perform an appropriate operation.

SUMMARY OF THE INVENTION

[0018] In order to overcome the problems described above, embodiments of the present invention provide a textile machine in which an operation state of a yarn processing unit can be easily confirmed.

[0019] According to a first aspect of the present invention, the textile machine includes a plurality of yarn processing units. Each of the yarn processing units includes a level display section, which displays an operation level that corresponds to an operation state of the yarn processing unit among a plurality of operation levels.

[0020] Thus, by checking the operation level of the yarn processing unit, an operator can easily confirm a state of the yarn processing unit. Further, since each of the yarn processing units includes the level display section, the operator can promptly check the operation level. Accordingly, the operator can easily confirm the yarn spinning unit that needs maintenance work and immediately perform necessary maintenance work on such spinning unit.

[0021] In the above-described textile machine, the operation levels are preferably classified such that a standard operation level, which is to be a standard, is located at a center. Thus, the operator can easily confirm whether the operation state of the yarn processing unit has a higher operation level or a lower operation level as compared with the standard operation state.

[0022] In the above-described textile machine, the standard operation state is preferably an average value of the operation states of the plurality of yarn processing units of the textile machine. Accordingly, the operator can easily confirm the operation state of the yarn processing unit is displaced in which direction from the average value. Moreover, since the average value is used as a central level of the level display, a comparison can be easily made with an operation state of other yarn processing units.

[0023] In the above-described textile machine, the standard operation state may be a prescribed set value.

Thus, the operator can easily confirm the operation state of the yarn processing unit is displaced in which direction from the set value.

[0024] In the above-described textile machine, the operation level of the yarn processing unit can be determined in accordance with operation data that is used for detecting the operation state of the yarn processing unit, and the yarn processing unit can detect a plurality of types of operation data. The textile machine can select which operation data is to be used for determining the operation level from among the plurality of types of operation data.

[0025] By enabling the operator to select and change a content to be displayed on the level display section, different types of information relating to the yarn processing unit can be displayed on one level display section.

[0026] In the above-described textile machine, the operation level preferably relates to at least one of an operation efficiency of the yarn processing unit, a yarn thickness of the yarn processing unit, and a yarn splicing error rate of the yarn processing unit.

[0027] The above-described operation data relating to the operation state is reference data that is frequently referred to by the operator. Therefore, the above-described operation data relating to the operation state is preferably displayed on the level display section.

[0028] In the above-described textile machine, each of the yarn processing units preferably includes a trend display section that displays whether the operation state of the yarn processing unit has an upward trend or a downward trend. Thus, the operator can easily confirm the latest trend of the operation state of the yarn processing unit. Accordingly, the operator can perform an appropriate operation on each of the yarn processing units.

[0029] According to a second aspect of the present invention, the textile machine includes the plurality of yarn processing units, and each of the yarn processing units includes an overall view display section that displays an overall view representing an overall structure of the yarn processing unit. When an error has occurred in the yarn processing unit, the overall view display section can carry out a display by identifying a section within the overall view that corresponds to the error occurred section.

[0030] Thus, the operator can intuitively confirm the error occurred section. Accordingly, even an inexperienced operator can easily understand the error contents and perform an appropriate maintenance work. Moreover, since the yarn processing unit includes the overall view display section, after checking the display on the overall view display section, the operator can immediately start an error recovery work.

[0031] The above-described textile machine further includes a control section that controls the yarn processing unit. The control section includes a determining section and an identifying section. The determining section receives a signal from the yarn processing unit and determines whether or not the error has occurred in accordance with the received signal. The identifying section identifies the error occurred section. The control section carries out the display on the overall view display section by identifying the error occurred section based on a determination of the determining section and an identification of the identifying section.

[0032] The control unit determines a presence or an absence of the error, and identifies the error occurred section. Accordingly, the error occurred section can be properly displayed and identified in the overall view display section.

[0033] In the above-described textile machine, the overall view display section includes a plurality of luminous sections arranged near the overall view. By changing a light-emitting state of a specific luminous section among the plurality of luminous sections, the control section can carry out the display by identifying a section that corresponds to the luminous section within the overall view. Accordingly, the error occurred section can be displayed and identified through a simple structure.

[0034] In the above-described textile machine, the overall view display section includes the plurality of luminous sections arranged within the overall view. By changing the light-emitting state of the specific luminous section among the plurality of luminous sections, the control section can carry out the display by identifying the section that corresponds to the luminous section within the overall view. Accordingly, the operator can more intuitively confirm the error occurred section.

[0035] The above-described textile machine further includes an analysis section. The analysis section receives information relating to the error from the control section, and analyzes an error occurrence state in each yarn processing unit in which the error has occurred. Thus, the textile machine can analyze the information relating to the error in each of the yarn processing units by the analysis section. Accordingly, for example, the textile machine can determine an error occurrence rate, or extract a yarn processing unit having a high error occurrence rate. As a result, the management of the yarn processing units can be facilitated, and the operator can promptly perform an appropriate operation for each of the yarn processing units.

[0036] In the above-described textile machine, the overall view display section preferably can distinguish and display at least three areas within the overall view. Thus, the operator can confirm the error occurred section by referring to the divided areas. Accordingly, the error occurred section can be easily identified, and the operator can promptly perform an error recovery work.

[0037] In the above-described textile machine, when the yarn processing unit is a spinning unit including a draft section, a spinning section, and a winding section, the overall view display section can carry out a display by identifying at least three areas that correspond to the draft section, the spinning section, and the winding section such that the areas can be distinguished. Thus, when an error occurs in the spinning unit, the textile machine can properly display the error occurred section in the

spinning unit.

[0038] In the above-described textile machine, independently of the structure for identifying and displaying the section that corresponds to the error occurred section within the overall view, each of the yarn processing units preferably includes an error occurrence display section that displays that the error has occurred in the yarn processing unit. Thus, by referring to the display of the error occurrence display section, the operator can promptly confirm the yarn processing unit in which an error has occurred among the plurality of yarn processing units. In addition, the operator can confirm the error occurred section in the yarn processing unit, and perform maintenance work. In other words, a period of time between the error occurrence and the start of the maintenance work can be shortened, and a production efficiency of the textile machine can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] Fig. 1 is a front view of an entire configuration of a spinning machine according to an embodiment of the present invention.

[0040] Fig. 2 is a longitudinal cross-sectional view of the spinning machine according to an embodiment of the present invention.

[0041] Fig. 3 is a block diagram illustrating a flow of a control signal or the like in the spinning machine according to a first embodiment of the present invention.

[0042] Fig. 4 is a front view of an operation panel according to the first embodiment of the present invention.

[0043] Fig. 5 is a block diagram illustrating a flow of a control signal or the like in the spinning machine according to a second embodiment of the present invention.

[0044] Fig. 6 is a front view of the operation panel according to a different example of the second embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0045] A spinning machine as a textile machine according to an embodiment of the present invention will be described with reference to the drawings. In the description, "upstream" and "downstream" respectively refer to upstream and downstream in a direction in which a yarn travels during a spinning operation.

[0046] A spinning machine 1 as the textile machine illustrated in Fig. 1 includes a plurality of aligned spinning units (yarn processing units) 2, a machine control device (an analysis section) 60, a yarn splicing cart 3, a blower box 4, and a motor box 5. The spinning machine 1 includes a not-illustrated automatic doffing device.

[0047] The machine control device 60 collectively manages each constituent element of the spinning machine 1. The machine control device 60 includes a monitor (display section) 61 and input keys 62. The machine control device 60 can transmit and/or receive information to and/or from each of the constituent elements of the spinning machine 1.

[0048] For example, the monitor 61 can display a graph of a production efficiency of each of the spinning units 2, and a spinning unit 2 in which an error has occurred. The monitor 61 can also display statistical information on the entire spinning machine 1. An operator can perform a prescribed operation using the input keys 62 to change a setting of a certain spinning unit 2 or collectively change settings of all of the spinning units 2. (Such setting change is performed by transmitting setting data from the machine control device 60 to a unit control section 73 which is to be described later.) The machine control device 60 can also control and manage the yarn splicing cart 3 and the not-illustrated automatic doffing device, for example, in addition to the spinning units 2.

[0049] As illustrated in Fig. 3, the spinning machine 1 includes a plurality of unit control sections 73 for controlling each of the spinning units 2. In the present embodiment, each of the unit control sections 73 controls and manages four spinning units 2. The unit control section 73 controls each of the spinning units 2 based on a control signal transmitted from the machine control device 60 and on a signal detected by various sensors of each of the spinning units 2, or the like. The unit control section 73 can transmit information relating to each spinning unit 2 to the machine control device 60.

[0050] As illustrated in Fig. 1, each of the spinning units 2 forms a package 45 from a sliver 15. Each of the spinning units 2 includes a draft device 7, a spinning device 9, a yarn feeding device 11, a yarn slack eliminating device 12, and a winding device 13, which are arranged in this order from the upstream to the downstream. The draft device 7 is provided in the vicinity of an upper end of a frame 6 of the spinning machine 1. The spinning device 9 spins a fiber bundle 8 fed from the draft device 7. A spun yarn 10 discharged from the spinning device 9 is fed by the yarn feeding device 11, and after passing through a yarn clearer 52 to be described later, the spun yarn 10 is wound by the winding device 13 into the package 45. Each of the spinning units 2 includes an operation panel 80 at a proper position on a front side of the unit.

[0051] The yarn splicing cart 3 can travel in a direction in which the spinning units 2 are aligned. At the time of yarn breakage (to be described later), the yarn splicing cart 3 travels to a position of the spinning unit 2 that needs a yarn splicing operation, and splices an upper yarn from the spinning device 9 and a lower yarn from the winding device 13.

[0052] Next, with reference to Fig. 2, a structure of each of the spinning units 2 will be described in detail. The draft device (draft section) 7 drafts the sliver 15 into the fiber bundle 8. The draft device 7 includes a back roller 16, a third roller 17, a middle roller 19, and a front roller 20. Further, an apron belt 18 is wound around the middle roller 19.

[0053] The draft device 7 includes a sliver run-out detecting sensor 59 that detects run-out of sliver. A sliver

run-out signal detected by the sliver run-out detecting sensor 59 is transmitted to the unit control section 73. The sliver run-out detecting sensor 59 may be omitted in the draft device 7.

[0054] Next, a structure of a spinning section will be described. The spinning section primarily includes the spinning device 9, the yarn feeding device 11, and the yarn slack eliminating device 12.

[0055] Although a detailed structure of the spinning device 9 is not illustrated in the drawings, the spinning device 9 according to the present embodiment is a pneumatic type which uses a whirling airflow to apply twists to the fiber bundle 8 and to form the spun yarn 10.

[0056] The yarn feeding device 11 includes a delivery roller 39 and a nip roller 40. The delivery roller 39 is supported by the frame 6 of the spinning machine 1. The nip roller 40 is in contact with the delivery roller 39. Under a state in which the spun yarn 10 discharged from the spinning device 9 is nipped between the delivery roller 39 and the nip roller 40, the delivery roller 39 is rotationally driven by a not-illustrated electric motor to feed the spun yarn 10 to the winding device 13.

[0057] The yarn clearer 52 is arranged at a position that is located on a front surface side of the frame 6 of the spinning machine 1 and on a slightly downstream side of the yarn feeding device 11. The spun yarn 10, which is spun by the spinning device 9, passes through the yarn clearer 52 before being wound by the winding device 13. The yarn clearer 52 monitors a thickness and a speed of the traveling spun yarn 10. When the yarn clearer 52 detects a yarn defect of the spun yarn 10, the yarn clearer 52 transmits a yarn defect detection signal to the unit control section 73. A cutter 57 is provided in the vicinity of the yarn clearer 52 for cutting the spun yarn 10 when detecting a yarn defect.

[0058] The yarn slack eliminating device 12 can eliminate a slack of the spun yarn 10 between the spinning device 9 and the winding device 13 (i.e., between the spinning device 9 and a splicer 43 to be described later) and apply an appropriate tension to the spun yarn 10. The yarn slack eliminating device 12 includes a slack eliminating roller 21, a yarn hooking member 22, an upstream guide 23, an air cylinder 24, an electric motor 25, and a downstream guide 26.

[0059] The slack eliminating roller 21 is rotationally driven by the electric motor 25 and accumulates the spun yarn 10 by winding the spun yarn 10 around an outer circumference thereof.

[0060] The yarn hooking member 22 can rotate about a rotation axis of the slack eliminating roller 21 and integrally with the slack eliminating roller 21. The yarn hooking member 22 can be engaged with a yarn path of the spun yarn 10. When the yarn hooking member 22 rotates integrally with the slack eliminating roller 21 in a state in which the spun yarn 10 is engaged with the yarn hooking member 22, the spun yarn 10 can be wound around the outer surface of the slack eliminating roller 21. A torque limiter using friction resistance, for example, is provided between the yarn hooking member 22 and the slack eliminating roller 21. Thus, when a prescribed amount of rotary torque or greater is applied to the yarn hooking member 22, the yarn hooking member 22 can rotate independently of the slack eliminating roller 21.

[0061] The upstream guide 23 is arranged slightly upstream of the slack eliminating roller 21, and can be moved between an advanced position and a receded position by the air cylinder 24. When the upstream guide 23 is moved to the receded position, the yarn path of the spun yarn 10 and the yarn hooking member 22 become engageable, and the spun yarn 10 can be wound around the slack eliminating roller 21. When not using the slack eliminating roller 21, the upstream guide 23 is moved to the advanced position so that the yarn path of the spun yarn 10 and the yarn hooking member 22 do not engage with each other. The downstream guide 26 is provided downstream of the slack eliminating roller 21.

[0062] The yarn slack eliminating device 12 includes a not-illustrated entangled yarn detecting mechanism for detecting that the spun yarn 10 is entangled with the slack eliminating roller 21 or the yarn hooking member 22. An entangled yarn detection signal detected by the entangled yarn detecting mechanism is transmitted to the unit control section 73.

[0063] When the upstream guide 23 is moved to the receded position in a state in which the slack eliminating roller 21 and the yarn hooking member 22 are integrally rotated, the spun yarn 10 engages with the yarn hooking member 22. At this time, when a tension of the spun yarn 10 falls below a prescribed tension, the yarn hooking member 22 rotates integrally with the slack eliminating roller 21 and winds the spun yarn 10 around the slack eliminating roller 21. When the tension of the spun yarn 10 exceeds the prescribed tension, the yarn hooking member 22 rotates independently of the slack eliminating roller 21 and steadily unwind the spun yarn 10 accumulated on the slack eliminating roller 21. Thus, when the tension of the spun yarn 10 decreases and the spun yarn 10 is likely to slacken, the yarn slack eliminating device 12 prevents the slackening by winding the spun yarn 10 around the slack eliminating roller 21. When the tension of the spun yarn 10 increases, the yarn slack eliminating device 12 suppresses the increase in the yarn tension by unwinding the accumulated spun yarn 10 from the slack eliminating roller 21.

[0064] Next, a description will be made on the winding device (winding section) 13. The winding device 13 includes a cradle arm 71 that is supported on a supporting shaft 70 in a manner that the cradle arm 71 can swing around the supporting shaft 70. The cradle arm 71 can support a bobbin, around which the spun yarn 10 is wound, in a manner that the bobbin can be rotated. The winding device 13 includes a winding drum 72 and a traverse device 75.

[0065] The winding drum 72 is driven in contact with an outer surface of the bobbin or the package 45, which is formed by winding the spun yarn 10 around the bobbin.

The traverse device 75 includes a traverse guide 76 that can be engaged with the spun yarn 10. The traverse guide 76 is fixed on a traverse rod 77 that is horizontally arranged across the plurality of spinning units 2. By driving the winding drum 72 by a not-illustrated electric motor while reciprocating the traverse rod 77 by a not-illustrated driving unit, the package 45 that is in contact with the winding drum 72 is rotated, and the spun yarn 10 is traversed and wound.

[0066] The yarn splicing cart 3 will now be described. As illustrated in Figs. 1 and 2, the yarn splicing cart 3 includes the splicer (a yarn splicing device) 43, a suction pipe 44, a suction mouth 46, and a lower yarn detecting sensor 58. The yarn splicing cart 3 travels on a rail 41 provided to the frame 6 of the spinning machine 1. When a yarn breakage or a yarn cutting occurs in a certain spinning unit 2, the yarn splicing cart 3 travels to such spinning unit 2, stops, and performs a yarn splicing operation.

[0067] The yarn splicing operation of the yarn splicing cart 3 will now be described in detail. As described above, when the yarn clearer 52 detects a yarn defect in the spun yarn 10, the yarn defect detection signal is transmitted to the unit control section 73. When the unit control section 73 receives the yarn defect detection signal, the unit control section 73 immediately cuts the yarn by the cutter 57, and stops the draft device 7, the spinning device 9 and the winding device 13 or the like. Then, the unit control section 73 controls the yarn splicing cart 3 to travel to the front of the spinning unit 2.

[0068] Then, the unit control section 73 re-drives the draft device 7 and the spinning device 9 or the like of the spinning unit 2, and starts catching of a yarn end by the suction pipe 44 and the suction mouth 46 of the yarn splicing cart 3. While vertically swinging around a shaft, the suction pipe 44 sucks and catches the yarn end of the upper yarn discharged from the spinning device 9, and then guides the yarn end to the splicer 43. At almost the same time, while vertically swinging around a shaft, the suction mouth 46 sucks and catches a yarn end of the lower yarn from the package 45, which is rotatably supported by the winding device 13, and then guides the yarn end to the splicer 43.

[0069] At this time, if the yarn clearer 52 does not detect a yarn even though the upper yarn guiding operation by the suction pipe 44 has been completed, a determination is made that the upper yarn catching operation has failed, and the upper yarn catching operation is re-tried a prescribed number of times. When the lower yarn detecting sensor 58 does not detect a yarn even though the lower yarn guiding operation by the suction mouth 46 has been completed, a determination is made that the lower yarn catching operation has failed, and the lower yarn catching operation is re-tried a prescribed number of times. When the yarn end catching operation continues to fail even by re-trying the yarn end catching operation for a prescribed number of times, the unit control section 73 determines that a yarn splicing error has occurred.

[0070] When the upper yarn and the lower yarn are guided to the splicer 43, the splicer 43 performs a yarn splicing operation on the guided yarn ends. Although a description of a detailed structure of the splicer 43 is omitted, for example, the yarn splicing operation may be performed through a method of twisting the yarn ends using fluid such as compressed airflow. When the yarn splicing operation is completed, a winding operation by the winding device 13 is resumed.

[0071] Next, with reference to Fig. 4, a structure of the operation panel (an overall view displaying section) 80 will be described. The operation panel 80 primarily includes an overall view 81, error display lamps 821, 822, 823, a seven-segment display 83, a maintenance call lamp (an error display lamp) 84, operation switches 85, a level display section 86, and a trend display section 87.

[0072] A simplified overall view 81 of a side view of the spinning unit 2 is illustrated on the operation panel 80. The overall view 81 corresponds to the longitudinal cross-sectional view of Fig. 2.

[0073] Three error display lamps 821, 822, and 823 composed of light-emitting diodes are vertically aligned in the vicinity of a side of the overall view 81. Each of the error display lamps 821, 822, and 823 corresponds to a specific area in the overall view 81. The overall view 81 is vertically divided into three areas so as to clarify which section in the overall view 81 corresponds to which one of the error display lamps 821, 822, and 823. In other words, the three divided partial views in the overall view 81 correspond to the error display lamps 821, 822, and 823, which are respectively arranged to a side of the corresponding partial view.

[0074] When an error occurs in the spinning unit 2, the control section (identify-and-display control section) 73 controls to light the error display lamp that corresponds to an error occurred section among the error display lamps 821, 822, and 823. Thus, the operator can be notified of the error occurred section. Since the error display lamps 821, 822, and 823 are provided to the side of the overall view 81, by lighting the error display lamp that corresponds to the error occurred section, the section that corresponds to the error occurred section can be identified within the overall view 81 and displayed. Thus, the operator can intuitively recognize the section where the error has occurred in the spinning unit 2. As a result, when an error occurs, the operator can immediately start maintenance work on the spinning unit 2.

[0075] The spinning unit 2 further includes a failure-to-identify lamp 824. The failure-to-identify lamp 824 is lighted when an error occurs in a section other than the above sections or when the error occurred section cannot be identified, or the like.

[0076] The seven-segment display 83 displays error codes etc. when an error occurs. In the spinning machine 1 according to the present embodiment, the operator can intuitively recognize the error occurred section through the display of the overall view 81 and the error display lamps 821, 822, and 823. Since an error code display by

the seven-segment display 83 is additionally provided, the operator can be notified more specifically of the content of the error that has occurred in the spinning unit 2.

[0077] The maintenance call lamp 84 is lighted when an error that needs to be solved by an operator occurs in the spinning unit 2 (regardless of a type of the error). The maintenance call lamp 84 is configured to be brighter and more prominent than the error display lamps 821, 822, and 823 so that even an operator working far away from such a spinning unit 2 can visually check a light-emitting state of the maintenance call lamp 84. By visually checking the light-emitting state of the maintenance call lamp 84, the operator can confirm the position of the spinning unit 2 that needs maintenance work. Then, to perform the maintenance work, the operator goes to the spinning unit 2, aiming for the light-emitting maintenance lamp 84.

[0078] The operation panel 80 includes a plurality of operation switches 85. By operating the operation switches 85, the operator can perform operations such as an emergency stop of the spinning unit 2. Since the operation switches 85 are provided separately from the overall view 81, the error display lamps 821, 822, 823, and the maintenance call lamp 84, the operator does not need to touch the overall view 81, the error display lamps 821, 822, 823, and the maintenance call lamp 84, thus preventing contamination. Accordingly, the visibility of the overall view 81 or the like can be maintained in good condition.

[0079] Next, the level display section 86 will be described. The level display section 86 according to the present embodiment can display an operation state of the spinning unit 2 in five operation levels. The "operation levels" are classified according to the operation state of each spinning unit 2. By checking the operation level of the spinning unit 2, the operator can confirm an approximate operation state of the spinning unit 2.

[0080] The level display section 86 is partially or entirely translucent, and thus light can be penetrated from a rear side of the level display section 86. More specifically, a first level display section 861, a second level display section 862, a third level display section 863, a fourth level display section 864, and a fifth level display section 865 are respectively provided as a substantially rectangular light-permeable section. A not-illustrated light-emitting diode is provided on a rear side of each of the first level display section 861 through the fifth light display section 865. By lighting either one of the light-emitting diodes, a corresponding level display section among the level display sections 861 through 865 can be lighted.

[0081] The level display sections 861 through 865 are arranged in a staircase pattern as illustrated in Fig. 4, for example, such that a hierarchical relation of the operation levels can be graphically and visually confirmed. More specifically, the first level display section 861 is disposed at the lowest position, and the fifth level display section 865 is disposed at the highest position. That is, the first level display section 861 represents the lowest operation level, and the operation level sequentially increases from the second level display section 862 to the fifth display section 865. Thus, the operator can intuitively understand that the fifth level display section 865 represents the highest operation level.

[0082] By lighting the level display section 86 that corresponds to the operation level of the spinning unit 2, the operation level of the spinning unit 2 can be displayed. Thus, the operator can intuitively confirm the operation level of the spinning unit 2 among the five operation levels.

[0083] In the present embodiment, the operation level of the spinning unit 2 is always displayed on the level display section 86. Thus, the operator can confirm the operation level of the spinning unit 2 at any time without performing a special operation. As compared with a conventional textile machine, since the operator does not need to travel to the machine control device 60 each time in order to check the operation state of the spinning unit 2, the operator can perform operations efficiently.

[0084] Next, the trend display section 87 will be described. Similarly to the level display section 86, the trend display section 87 is partially or entirely translucent, and thus light can be penetrated from a rear side of the trend display section 87. More specifically, an up-pointing arrow 871 and a down-pointing arrow 872 are respectively provided as an arrow-shaped light permeable section. A not-illustrated light-emitting diode is provided on a rear side of each of the up-pointing arrow 871 and the down-pointing arrow 872. Accordingly, the up-pointing arrow 871 and the down-pointing arrow 872 can be lighted.

[0085] The up-pointing arrow 871 is lighted when the operation state of the spinning unit 2 has an upward trend (i.e., a trend approaching towards a higher level). The down-pointing arrow 872 is lighted when the operation state of the spinning unit 2 has a downward trend (i.e., a trend approaching towards a lower level). When the operation state of the spinning unit 2 has a constant state (i.e., when the operation state has neither the upward trend nor the downward trend), neither the up-pointing arrow 871 nor the down-pointing arrow 872 is lighted.

[0086] By checking the display on the trend display section 87, the operator can intuitively confirm whether the operation state of the spinning unit 2 has the upward trend, the downward trend, or the constant state, and thus perform an appropriate operation.

[0087] Next, a description will be made on a flow from when the operation level of each spinning unit 2 is determined to when the operation level is displayed on the level display section 86.

[0088] First, the operator operates the machine control device 60 to select which operation data of each spinning unit 2 is to be used for determining the operation level. In other words, the operation state of the spinning unit 2 can be represented in various perspectives, such as an operation efficiency of the spinning unit 2, a yarn thickness detected by the yarn clearer 52 of the spinning unit 2, and a yarn splicing error occurrence rate (a yarn splic-

ing error rate)in the spinning unit 2. The machine control device 60 receives the operation data from various sensors etc. of the spinning unit 2, and thus can acquire various types of operation data such as the operation efficiency, the yarn thickness, and the yarn splicing error occurrence rate from the received operation data. In other words, the unit control section 73 functions as an operation data detecting section that can detect a plurality of types of operation data of the yarn processing unit 2. The machine control device 60 functions as a selecting section that selects operation data to be used for determining the operation level from among the plurality of types of the operation data detected by the operation data detecting section. The machine control device 60 also functions as an operation level determining section that determines the operation level of the yarn processing unit 2 in accordance with the operation data selected by the selecting section.

[0089] By designating a prescribed condition by operating the input keys 62 of the machine control device 60, the operator can select the operation data to be used for determining the operation level of the spinning unit 2. In the followings, a description will be made on an example in which the operation efficiency of the spinning unit 2 is used for determining the operation level.

[0090] After the above selection is made by the operator, the machine control device 60 acquires the latest operation data of each of the spinning units 2 by communicating with each of the unit control sections 73. Moreover, by referring to the operation data of a certain period of time in the past stored in the machine control device 60, the operation efficiency of each of the spinning units 2 is determined. The operation efficiency can be calculated by dividing an actual operating time of the spinning unit 2 during a certain period of time by an operable time of the spinning unit 2 during the certain period of time.

[0091] When the calculation of the operation efficiency of all of the spinning units 2 is completed, the machine control device 60 calculates an average value of the operation efficiency of all of the spinning units 2. Moreover, the machine control device 60 also determines the spinning unit 2 that has the highest operation efficiency and the spinning unit 2 that has the lowest operation efficiency among all of the spinning units 2.

[0092] Then, the machine control device 60 determines the operation level of each of the spinning units 2 based on the operation efficiency. In the spinning machine 1 of the present embodiment, since the level display section 86 displays the operation level in five stages, the machine control device 60 also classifies each of the spinning units 2 into any of the five operation levels. It is optional to classify which spinning unit 2 into which operation level. However, in the present embodiment, each of the spinning units 2 is classified into any of the five operation levels as described below.

[0093] First, a range of the third level, which is a central level of the five levels, is determined. The range of the third level is set such that the third level includes a standard operation state, which is to be a standard of the operation state. In other words, the range of the third level is set such that the spinning unit 2 that is operating in the standard operation state and the spinning unit 2 that is operating in an operation state that is close to the standard operation state are classified into the third level. In the present embodiment, the standard operation state corresponds to an average value of the operation states of all of the spinning units 2. Accordingly, among all of the spinning units 2, the spinning unit 2 having the operation efficiency that is close to the average operation efficiency is classified into the third level.

[0094] A spinning unit 2 that is not classified into the third level is classified into either one of two upper levels or two lower levels with respect to the third level within a certain range. Specifically, a spinning unit 2 having an operation efficiency that is within a prescribed range from the operation efficiency of the spinning unit 2 that has the highest operation efficiency is classified into the fifth level. A spinning unit 2 having an operation efficiency that is between the fifth level and the third level is classified into the fourth level. A spinning unit 2 having an operation efficiency that is within a prescribed range from the operation efficiency of the spinning unit 2 that has the lowest operation efficiency is classified into the first level. A spinning unit 2 having an operation efficiency that is between the first level and the third level is classified into the second level.

[0095] Then, based on a past operation efficiency record of each of the spinning units 2, the machine control device 60 determines whether the operation efficiency of each of the spinning units 2 has the upward trend, the downward trend, or the constant state.

[0096] When the determination on the classification and the trend of the operation level for all of the spinning units 2 is completed, the machine control device 60 transmits a level display requesting signal to the unit control sections 73. When receiving the level display requesting signal, each of the unit control sections 73 lights, among the level display sections 861 through 865 of each of the spinning units 2, the level display section that corresponds to the operation level into which the spinning unit 2 is classified. For example, when the spinning unit 2 has been classified into the first level, the unit control section 73 lights the first level display section 861, and when the spinning unit 2 has been classified into the second level, the unit control section 73 lights the second level display section 862. The unit control section 73 lights any of the level display sections 861 through 865 to display the operation level of the spinning unit 2. Each of the unit control sections 73 displays, on the trend display section 87 of each of the spinning units 2, whether the operation efficiency of the spinning unit 2 has the upward trend, the downward trend, or the constant state.

[0097] The machine control device 60 acquires the latest operation data from each of the spinning units 2 at a constant interval, and re-determines the operation level

of each of the spinning units 2 based on the latest operation data. Each time when the operation level is re-determined, the machine control device 60 transmits a level display request to each of the unit control sections 73, and updates the displays of the level display section 86 and the trend display section 87 of each of the spinning units 2. Thus, each of the spinning units 2 can always display the latest operation state.

[0098] Accordingly, by checking the operation level displayed on the level display section 86 of each of the spinning units 2, the operator can confirm the approximate operation efficiency of the spinning unit 2 and perform an appropriate operation. For example, when the level determined based on the operation efficiency is displayed as described above, a high operation level indicates a high operation efficiency. Accordingly, the operator can easily determine that the spinning unit 2 displaying a high operation level does not need the maintenance work, and determine that the spinning unit 2 displaying a low operation level needs the maintenance work (or the operation efficiency of such spinning unit 2 can be improved through the maintenance work).

[0099] The operation efficiency has been described above by way of example. However, when determining the operation level of the spinning unit 2 based on, for example, the yarn thickness, the spinning units 2 may be classified such that the spinning unit 2 producing a thin yarn is classified into a low operation level, and the spinning unit 2 producing a thick yarn is classified into a high operation level. In such a case, neither an exceedingly thick yarn nor an exceedingly thin yarn is preferable. Therefore, the spinning unit 2 preferably operates in the central level (third level). By checking the level display section 86 of each of the spinning units 2, the operator can easily determine that the spinning device 9 or the like needs to be adjusted in the spinning unit 2 having, for example, the first level (in which the yarn is exceedingly thin) or the fifth level (in which the yarn is exceedingly thick).

[0100] When determining the operation level based on the yarn splicing error rate, for example, each of the spinning units 2 may be classified such that the spinning unit 2 having a low yarn splicing error rate is classified into a low operation level, and the spinning unit 2 having a high yarn splicing error rate is classified into a high operation level. In such a case, since the low yarn splicing error rate is preferable, the spinning unit 2 preferably operates in the low operation level. By checking the level display section 86 of each of the spinning units 2, the operator can easily determine that the spinning unit 2 having the high operation level needs the maintenance work.

[0101] Since the average value is set as the central level (third level) in the present embodiment as described above, the operation efficiency of the spinning unit 2 can be easily compared with the operation efficiency of other spinning units 2. That is, a degree of operation efficiency of the spinning unit 2 among all of the spinning units 2 can be easily determined.

[0102] In place of the average value, the range of the central level (third level) may be set with a prescribed set value, for example, as the standard operation state. In this example, the operator can easily confirm the operation efficiency of each of the spinning units 2 is displaced in which direction and by how much degree from the operation efficiency set by the operator. Alternatively, the operator can easily confirm whether the thickness of the spun yarn 10 is thinner or thicker than a prescribed set thickness (i.e., a standard thickness).

[0103] By checking the display on the trend display section 87, the operator can intuitively confirm a transitional state of the operation efficiency of the spinning unit 2. Accordingly, even if the operation level is low, when the operation level has an upward trend, the operator may observe for a while. Even if the operation level is high, when such operation level has a downward trend, the operator may remain attentive and be prepared so as to be able to perform maintenance work or inspection work at an early stage once the operation level actually decreases. As described above, the operator can work flexibly.

[0104] Further, in the present embodiment, by performing an appropriate operation through the machine control device 60, even during the operation of the spinning unit 2, the operator can select and change operation data of the spinning unit 2 that is to be used for determining the operation level and display the selected operation data on the level display section 86. For example, the operator may select such that the operation level is determined based on the yarn thickness detected by the yarn clearer 52 of each of the spinning units 2, or based on the yarn splicing error occurrence rate (yarn splicing error rate) of each of the spinning units 2.

[0105] By enabling the operator to select and change the operation data for determining the operation level as described above, the operation state of the spinning unit can be evaluated from various perspectives, and as a result, the maintenance work for the spinning unit 2 can be efficiently performed.

[0106] As described above, the spinning machine 1 of the present embodiment includes the plurality of spinning units 2. Each of the spinning units 2 includes the level display section 86 carries out a display as to the operation state of the spinning unit 2 corresponds to which operation level among the plurality of operation levels. Thus, by checking the operation level of the spinning unit 2, the operator can easily confirm the state of the spinning unit 2. Moreover, since each of the spinning units 2 includes the level display section 86, the operator can instantaneously confirm the operation level. Therefore, the operator can easily confirm the spinning unit 2 that needs the maintenance work and also perform the necessary maintenance work immediately on such spinning unit 2.

[0107] In the spinning machine 1 of the present embodiment, the operation levels are classified such that the standard operation state, which is to be the standard, will be located at the center. Thus, the operator can easily

confirm whether the operation level of the spinning unit 2 is low or high as compared with the standard operation state.

[0108] In the spinning machine 1 of the present embodiment, the standard operation state is the average value of the operation states of the plurality of spinning units 2 of the spinning machine 1. Accordingly, the operator can easily confirm in which direction the operation state of the spinning unit 2 is displaced from the average value. Since the average value is used as the central level of the level display, a comparison can be easily made with the operation levels of other spinning units 2.

[0109] In the spinning machine 1 of the present embodiment, the standard operation state may be a prescribed set value. Thus, the operator can easily confirm in which direction the operation state of the spinning unit 2 is displaced from the set value.

[0110] In the spinning machine 1 of the present embodiment, the operation level of the spinning unit 2 can be determined based on the operation data that is used to detect the operation state of the spinning unit 2, and the spinning unit 2 can detect the plurality of types of operation data. The spinning machine 1 can select which operation data is to be used for determining the operation level from among the plurality of types of operation data.

[0111] By enabling the operator to select and change the content to be displayed, different types of information relating to the spinning unit 2 can be displayed on one level display section.

[0112] In the spinning machine 1 of the present embodiment, the operation level can be determined based on at least one of the operation efficiency of the spinning unit 2, the yarn thickness of the spinning unit 2, and the yarn splicing error rate of the spinning unit 2.

[0113] Since the operator frequently refers to the operation data relating to the operation state, it is particularly preferable that the operation data can be displayed on the level display section 83.

[0114] In the spinning machine 1 of the present embodiment, each of the spinning units 2 includes the trend display section 87 that displays whether the operation state of the spinning unit 2 has the upward trend or the downward trend. Since, the operator can easily confirm the latest trend of the operation state of the spinning unit 2, the operator can perform an appropriate maintenance work on each of the spinning units 2.

[0115] Preferred embodiments and modified examples thereof have been described above. The above-described embodiments may be modified as described below.

[0116] In the above description, although the type of operation data is described by way of example, any operation data that quantitatively represents the operation state (such as an operation condition and a quality of products or the like) of the spinning unit 2 may be adopted. For example, the operation level may be determined based on a yarn speed or a number of times the yarn breakage has occurred.

[0117] A method of classifying the operation levels is not limited to the method of classifying the operation levels based on the current highest operation efficiency and the current lowest operation efficiency of the spinning unit 2. For example, the operation levels may be classified such that, when an operation efficiency is higher than the average value of the operation efficiency of the spinning unit 2 by 5 to 15 percent, such operation efficiency may be classified into the fourth level, and when the operation efficiency is higher than the average value by more than 15 percent, such operation efficiency may be classified into the fifth level.

[0118] The number of levels displayed on the level display section 86 may be any number as long as such number is plural. For example, the levels may be displayed in two stages or in more than six stages. In the case of displaying the levels in six stages, the operation levels may be classified such that the standard operation state corresponds to a boundary between the third level and the fourth level.

[0119] In the above-described embodiments, the corresponding level display section is displayed by lighting the light-emitting diode. However, the present invention is not limited to the above-described embodiment and may adopt a structure in which the light-emitting diode is blinked. Alternatively, in place of the structure in which the light-emitting diode is lighted from the rear side through the light permeable section, the light-emitting diode may be exposed on a front surface.

[0120] The level display section 86 may also function as the trend display section. For example, when the current operation level is the third level and has the upward trend, the third level display section 863 may be lighted, and the fourth level display section 864 may be blinked. In this case, the trend display section 87 may be omitted.

[0121] The operation panel 80 may include an operation data content display section that displays the content of the operation level currently displayed on the level display section 86 (for example, the operation efficiency or the yarn thickness). Such configuration is particularly preferable when the content to be displayed on the level display section 86 can be switched.

[0122] The level display section 86 and the trend display section 87 may be provided not only on the operation panel 80 but also on other members. However, in view of improving the visibility of the operator, the level display section 86 or the like is preferably provided on the front of each of the spinning units 2.

[0123] Next, with reference to Figs. 4 through 6, a second preferred embodiment of the present invention will be described. A structure that is the same as or similar to the above embodiment is given like reference numerals in the drawings, the description thereof is omitted, and differences are primarily described below.

[0124] First, the operation panel 80 according to the second preferred embodiment will be described. In the operation panel 80 according to the second embodiment, the overall view 81 is vertically divided into three areas

and illustrated so as to clarify which section in the overall view 81 corresponds to which one of the error display lamps (identify-and-display sections) 821, 822, and 823 provided to the side of the overall view 81. The three sections in the overall view 81 correspond to the structure of the actual spinning unit 2. More specifically, a draft section chart 811 corresponds to the draft device (draft section) 7. A spinning section chart 812 corresponds to the spinning section (including the spinning device 9, the yarn feeding device 11, and the yarn slack eliminating device 12 or the like). A winding section chart 813 corresponds to the winding device (winding section) 13. A draft section error display lamp 821 is provided to the side of the draft section chart 811. A spinning section error display lamp 822 is provided to the side of the spinning section chart 812. A winding section error display lamp 823 is provided to the side of the winding section chart 813.

[0125] When an error occurs in the spinning unit 2, the error display lamp that corresponds to an error occurred section among the error display lamps 821, 822, and 823 is lighted. Thus, the operator can be notified of the error occurred section. Specific examples will be described below.

[0126] For example, when an error of sliver run-out occurs, since the error is occurring in the draft device 7, the draft section error display lamp 821 provided to the side of the draft section chart 811 is lighted. By checking the position where the draft section chart 811, which is illustrated to the side of the light-emitting error display lamp, is provided in the overall view 81, the operator can intuitively confirm the error occurred section in the spinning unit 2.

[0127] For example, when the suction pipe 44 fails to catch the upper yarn at the time of yarn splicing operation, the section where the upper yarn catching operation failed is located immediately downstream of the spinning device 9. Moreover, an error in which the spun yarn 10 is entangled in the yarn slack eliminating device 12 may occur. Since such errors occur in the spinning section, the spinning section error display lamp 822 arranged next to the side of the spinning section chart 812 is lighted. By checking the position where the spinning section chart 812, which is illustrated to the side of the light-emitting error display lamp, is provided in the overall view 81, the operator can intuitively confirm the error occurred section in the spinning unit 2.

[0128] For example, when the suction mouth 46 fails to catch the lower yarn at the time of yarn splicing operation, the section where the lower yarn catching operation failed is located in the winding device 13. Therefore, the winding section error display lamp 823 arranged next to the side of the winding section chart 813 is lighted. By checking the position where the winding section chart 813, which is illustrated to the side of the light-emitting error display lamp, is provided in the overall view 81, the operator can intuitively confirm the error occurred section in the spinning unit 2.

[0129] As described above, by providing the error display lamps 821, 822, and 823 right next to the overall view 81, and by lighting the error display lamp that corresponds to the error occurred section, the section that corresponds to the error occurred section in the overall view 81 can be displayed and identified. Thus, the error occurred section in the spinning unit 2 can be intuitively confirmed. Accordingly, when an error occurs, the operator can promptly start the maintenance work for such spinning unit.

[0130] Next, a process of actually lighting the error display lamps 821, 822, 823 will be described. As illustrated in Fig. 5, each of the unit control sections 73 includes an error determining section (determining section) 731 and an error identifying section (identifying section) 732, and receives signals from the four spinning units 2 and monitors the four spinning units 2. The signals include signals sent from various sensors of each of the spinning units 2, or the like, and include, for example, a signal sent from the above-described sliver run-out detecting sensor 59 and the lower yarn detecting sensor 58. When the unit control section 73 receives the signal, the error determining section 731 determines whether or not an error is occurring in the spinning unit 2 that has transmitted the signal.

[0131] For example, when a sliver run-out or the spun yarn 10 entangled in the yarn slack eliminating device 12 is detected, the error determining section 731 of the unit control section 73 immediately determines that an error has occurred. For example, when a failure of the yarn end catching operation is detected during the yarn splicing operation, the unit control section 73 controls to retry the yarn end catching operation a prescribed number of times. When the yarn end cannot be caught even after repeating the catching operation a prescribed number of times, the error determining section 731 determines that an error has occurred.

[0132] When the error determining section 731 of the unit control section 73 determines that the error has occurred in the spinning unit 2, the error identifying section 732 further identifies the section where the error has occurred in such spinning unit 2. Based on the above determination result and the identification result, the unit control section 73 lights the error display lamp that corresponds to the error occurred section and performs an appropriate operation such as a stopping operation of such spinning unit 2. Almost at the same time, the unit control section 73 lights the maintenance call lamp 84 of such spinning unit 2.

[0133] The unit control section 73 transmits information regarding the errors (for example, information about the error occurred section) to the machine control device 60. In the machine control device 60, various pieces of information can be checked on the monitor 61 when necessary. For example, the operator can check the position where the spinning unit 2 in which an error has occurred is provided, and the error occurrence rate of the spinning unit 2.

[0134] In place of the configuration in which the error is displayed in real time on the operation panel 80 when an error occurs as described above, or in addition to such configuration, the spinning unit 2 having an error may be extracted by the machine control device 60, and the error occurred section may be displayed on the operation panel 80 of each of the extracted spinning units 2. This configuration will be described below.

[0135] First, the operator performs an appropriate operation through the machine control device 60 to designate prescribed conditions and extract the spinning unit 2 having the error. The conditions may be designated so as to, for example, extract a spinning unit 2 having an error occurrence rate that is higher than a prescribed error occurrence rate. In the followings, a description will be made on a situation where the conditions are designated so as to extract a spinning unit 2 having a high error occurrence rate.

[0136] When the conditions are designated by the operator, the machine control device 60 acquires information relating to each of the spinning units 2 from the unit control section 73 through communication, and calculates the error occurrence rate of each of the spinning units 2 based on the acquired information. Then, the machine control device 60 extracts (selects) the spinning unit 2 having the error occurrence rate that is higher than the prescribed error occurrence rate.

[0137] Next, the machine control device 60 analyzes a type of the error that has occurred in each of the extracted spinning units 2, and determines a section in such spinning unit 2 where errors are frequently occurring.

[0138] Then, the machine control device 60 transmits a maintenance call request to the unit control section 73 that is managing the extracted spinning units 2. When receiving the maintenance call request, the unit control sections 73 lights the maintenance call lamp 84 of the spinning unit 2 extracted by the machine control device 60, and thus notifies the operator that such spinning unit 2 needs maintenance work due to the high error occurrence rate. In addition, the unit control section 73 lights the error display lamp, which corresponds to the section where the errors are frequently occurring, among the error display lamps 821, 822, 823 of the spinning unit 2 having the high error occurrence rate. Thus, the operator can intuitively confirm the section that needs the maintenance work in such spinning unit 2.

[0139] The section where the errors frequently occur may differ depending on each of the spinning units 2. For example, when a plurality of spinning units 2 each having a high error occurrence rate are extracted, some spinning units 2 may have errors frequently occurring in the spinning section, and/or other spinning units 2 may have errors frequently occurring in the winding section. In the present embodiment, by lighting the proper error display lamps 821, 822, 823 on the operation panel 80 of each of the spinning units 2, the error occurred section in each of the spinning units 2 can be individually displayed. Therefore, the operator can perform an appropriate operation on each of the spinning units 2. This configuration is particularly effective when a plurality of spinning units 2 need maintenance work and/or when a plurality of operators concurrently perform the maintenance work.

[0140] As described above, the spinning machine 1 of the present embodiment includes the plurality of spinning units 2, and each of the spinning units 2 includes the operation panel 80 that displays the overall view 81 illustrating the overall structure of the spinning unit 2. When an error is occurring in the spinning unit 2, the operation panel 80 can display and identify the section in the overall view 81 that corresponds to the error occurred section.

[0141] Thus, the operator can intuitively confirm the error occurred section. Accordingly, even an inexperienced operator can easily understand the error. Since the spinning unit 2 includes the operation panel 80, after checking the display on the operation panel 80, the operator can immediately start an error recovery operation.

[0142] The spinning machine 1 of the present embodiment includes the unit control section 73 that controls the spinning units 2. The unit control section 73 includes the error determining section 731 and the error identifying section 732. The error determining section 731 receives a signal from the spinning unit 2 and determines based on the received signal whether or not an error is occurring in the spinning unit 2. The error identifying section 732 identifies the error occurred section. The unit control section 73 identifies and displays on the operation panel 80, the error occurred section based on the determination made by the error determining section 731 and on the identification made by the error identifying section 732. Thus, the unit control section 73 can determine a presence or an absence of the error, identify the error occurred section, and display and identify the error occurred section in the operation panel 80.

[0143] In the spinning machine 1 of the present embodiment, the operation panel 80 includes the plurality of error display lamps 821, 822, 823 arranged in the vicinity of the overall view 81. By lighting a certain error display lamp among the plurality of error display lamps 821, 822, 823, the unit control section 73 can identify and display the section in the overall view 81 that corresponds to the lighted error display lamp. Thus, the error occurred section can be identified and displayed by a simple configuration.

[0144] The spinning machine 1 of the present embodiment includes the machine control device 60. When receiving information relating to the error from the unit control section 73, the machine control device 60 analyzes an error occurrence state of each of the spinning units 2. Since the information relating to the error in each of the spinning units 2 can be analyzed by the machine control device 60, the error occurrence rate can be calculated, and the spinning unit 2 having a high error occurrence rate can be extracted. Therefore, the management of the spinning units 2 can be facilitated, and the operator can promptly perform an appropriate maintenance work on each of the spinning units 2.

[0145] In the spinning machine 1 of the present embodiment, the operation panel 80 can distinguish and display the three areas in the overall view 81. Thus, since the operator can confirm the error occurred section by referring to the divided areas, the operator can easily confirm the error occurred section and promptly start an error recovery operation.

[0146] In the spinning machine 1 of the present embodiment, the spinning unit 2 includes the draft device 7, the spinning section (including the spinning device 9, the yarn feeding device 11, and the yarn slack eliminating device 12 or the like), and the winding device 13. The operation panel 80 can display and distinguish three areas, that is, the draft section chart 811, the spinning section chart 812, and the winding section chart 813, in the overall view 81. Thus, when an error occurs in the spinning unit 2, the error occurred section in the spinning unit 2 can be properly displayed.

[0147] In the spinning machine 1 of the present embodiment, each of the spinning units 2 includes the maintenance call lamp 84 that displays the occurrence of the error in the spinning unit 2, in addition to the error display lamps 821, 822, 823. Thus, by checking the maintenance call lamp 84, the operator can immediately confirm the spinning unit 2 in which an error has occurred among the plurality of spinning units 2. Accordingly, the operator can confirm the error occurred section, and perform the maintenance work. In other words, a required period of time between the error occurrence and the start of the maintenance work can be shortened, and the production efficiency of the spinning machine 1 can be improved.

[0148] Next, with reference to Fig. 6, a modified example of the operation panel 80 according to the above embodiment will be described.

[0149] A schematic overall view 91 of a side of the spinning unit 2 is illustrated on an operation panel 90. Accordingly, the operation panel 90 can be defined as an overall view display section. The overall view 91 also corresponds to the longitudinal cross-sectional view of Fig. 2.

[0150] The overall view 91 is illustrated on a transparent or translucent plate, and light can be penetrated from a rear surface. Error display lamps (identify-and-display sections) 921, 922, 923, 924 are provided on a rear side of the overall view 91. More specifically, a draft section error display lamp 921 is arranged on a rear side of the plate of the overall view 91 at a position that corresponds to the draft device 7. An upper yarn catching operation failure display lamp 922 is arranged on a rear side of the plate of the overall view 91 at a position that corresponds to a portion between the spinning device 9 and the yarn feeding device 11. A yarn slack eliminating device error display lamp 923 is arranged on a rear side of the plate of the overall view 91 at a position that corresponds to the yarn slack eliminating device 12. A winding section error display lamp 924 is arranged on a rear side of the plate of the overall view 91 at a position that corresponds to the winding device 13.

[0151] In the above-described structure, when an error occurs, the control section (identify-and-display control section) 73 lights any of the error display lamps 921, 922, 923, 924 that corresponds to the error occurred section. Accordingly, the section that corresponds to the error occurred section can be lighted in the overall view 91. In other words, in the operation panel 80 of the above-described embodiment, only the error display lamp arranged next to the overall view 81 is lighted. However, in the operation panel 90 in the present modified example, the area that corresponds to the error occurred section is directly lighted in the overall view 91. Therefore, the operation panel 90 can display and identify the error occurred section more specifically and intuitively.

[0152] In the above-described embodiments, the overall view 81 on the operation panel 80 is divided into three area. However, in the present modified example, the overall view 91 on the operation panel 90 is divided into four areas (in other words, four error display lamps are arranged in the overall view 91). Thus, by enabling the error occurred section to be displayed more specifically, the maintenance work can be performed more smoothly by the operator.

[0153] As described above, in the spinning machine of the modified example, the operation panel 90 includes the plurality of error display lamps 921, 922, 923, 924 arranged in the overall view 91. By lighting a certain error display lamp among the plurality of error display lamps 921, 922, 923, 924, the unit control section 73 can display and identify the section in the overall view 91 that corresponds to the light-emitting error display lamp. Thus, the operator can confirm the error occurred section more intuitively.

[0154] The preferred embodiments and modified example thereof have been described above. The above-described configuration can be modified as described below, for example.

[0155] The overall views 81 and 91 are not limited to the side view of the spinning unit 2 but may be, for example, a front view of the spinning unit 2. Further, the overall views 81 and 91 are not limited to a schematic view but may be, for example, a photograph.

[0156] In the above description, the types of errors are described by way of example. However, among errors that occur in the spinning unit 2, if an error is detectable, an error occurred section of such an error can also be displayed.

[0157] The operation panel 80 includes three error display lamps, and the operation panel 90 includes four error display lamps. However, the number of the error display lamps may be increased so that the error occurred section can be displayed more specifically.

[0158] When a plurality of error occurred sections exist, a plurality of corresponding error display lamps may simultaneously be lighted.

[0159] In the operation panel 90 of the modified example, the light of the error display lamp arranged on the rear side of the overall view 91 is penetrated through the

operation panel 90. However, the present invention is not limited to such structure. For example, the overall view may be composed of an opaque panel, and a penetration hole may be formed at a prescribed position in the panel so as to partially expose the error display lamp through the penetration hole from a rear side of the panel. This structure can also exert an effect that is similar to the effect in which the overall view is provided with the error display lamps to light the error occurred section.

[0160] In the above embodiments, the error occurred section is notified by lighting the error display lamp. However, the error display lamp may be lighted at a normal time, and the error display lamp that corresponds to the error occurred section may be turned off at the time of error occurrence. Alternatively, the error display lamp maybe blinked to notify the error occurred section.

[0161] The conditions for extracting the spinning unit 2 by the machine control device 60 are not limited to the spinning unit 2 having a high error occurrence rate. For example, conditions may be set to extract the spinning unit 2 having a production efficiency that is lower than a given production efficiency. In such a case, by carrying out the display on the operation panel 80 of each of the extracted spinning units 2 by identifying the section where the errors frequently occur in such spinning unit 2, the operator can intuitively confirm a factor that is reducing the efficiency of the spinning unit 2. For example, conditions may be set to extract the spinning unit 2 that needs a component thereof replaced. In such a case, by carrying out a display on the operation panel 80 of each of the extracted spinning units 2 by identifying the section in which the component to be replaced is arranged, the operator can intuitively recognize the component that needs to be replaced in such spinning unit 2.

[0162] The machine control device 60 and the motor box 5 are individually provided in the first and second embodiments. However, the machine control device 60 and the motor box 5 may be integrally provided.

[0163] In place of the configuration in which the unit control section 73 controls four spinning units as described above, one unit control section may be provided for each of the spinning units 2. Alternatively, the unit control sections 73 may be omitted, and the machine control device 60 and each of the spinning units 2 may directly communicate with each other.

[0164] The yarn splicing cart 3 and the automatic doffing device may be omitted. In case of omitting the yarn splicing cart 3, each of the spinning units 2 may include a yarn splicing device.

[0165] The configuration of the present invention is not limited to spinning machines, but may be applied to other textile machines including a plurality of yarn processing units, such as an automatic winder including a plurality of winder units.

Claims

1. A textile machine comprising a plurality of yarn processing units (2),
characterized in that each of the yarn processing units (2) includes a level display section (86), which carries out a display as to an operation level of an operation state of the yarn processing unit (2) corresponds to which one of a plurality of operation levels.

2. The textile machine according to claim 1, **characterized in that** the operation levels are classified such that a standard operation state, which is to be a standard, is located at a center.

3. The textile machine according to claim 2, **characterized in that** the standard operation state is an average value of the operation state of the plurality of the yarn processing units (2).

4. The textile machine according to claim 2, **characterized in that** the standard operation state is a prescribed set value.

5. The textile machine according to any one of claim 1 through claim 4, **characterized in that** the yarn processing unit (2) further includes an operation data detecting section (73), which can detect a plurality of types of operation data of the yarn processing unit (2), and
the textile machine further includes:

   a selecting section (60), which selects the operation data to be used for determining the operation level from the plurality of types of the operation data detected by the operation data detecting section (73), and
   an operation level determining section (60), which determines an operation level of the yarn processing unit (2) in accordance with the operation data selected by the selecting section (60).

6. The textile machine according to any one of claim 1 through claim 5, **characterized in that** the operation level relates to at least one of an operation efficiency of the yarn processing unit (2), a yarn thickness of the yarn processing unit (2), and a yarn splicing failure rate of the yarn processing unit (2).

7. The textile machine according to any one of claim 1 through claim 6, **characterized in that** each of the yarn processing units (2) further includes a trend display section (87), which displays whether the operation state of the yarn processing unit (2) has an upward trend or a downward trend.

8. The textile machine according to claim 1, **charac-**

terized in that each of the yarn processing units (2) further includes an overall view display section (80), which displays an overall view (81) showing an overall structure of the yarn processing unit (2), and
the overall view display section (80) includes identify-and-display sections (821, 822, 823; 921, 922, 923, 924), which, when an error occurs in a section of the yarn processing unit (2), carry out a display by identifying a section within the overall view (81) that corresponds to the error occurred section.

9. The textile machine according to claim 8, **characterized by** further comprising a control section (73), which controls the yarn processing unit (2),
the control section (73) further including:

a determining section (731), which receives a signal from the yarn processing unit (2) and determines whether or not the error has occurred in the yarn processing unit (2) in accordance with the signal,
an identifying section (732), which identifies the error occurred section, and
an identify-and-display control section (73), which controls the identify-and-display sections (821, 822, 823; 921, 922, 923, 924) to carry out the display by identifying the error occurred section in accordance with a determination result of the determining section (731) and an identification result of the identifying section (732).

10. The textile machine according to claim 9, **characterized in that** the overall view display section (80) includes a plurality of luminous sections (821, 822, 823), which are provided near the overall view (81), and
the control section (73) changes a light-emitting state of a specific luminous section (821, 822, 823) among the plurality of the luminous sections (821, 822, 832) in order to carry out the display by identifying a section corresponding to the luminous section (821, 822, 823) in the overall view (81).

11. The textile machine according to claim 9, **characterized in that** the overall view display section (80) includes a plurality of luminous sections (821, 822, 823), which are provided within the overall view (81), and
the control section (73) changes a light-emitting state of a specific luminous section (821, 822, 823) among the plurality of the luminous sections (821, 822, 832) in order to carry out the display by identifying a section corresponding to the luminous section (821, 822, 823) in the overall view (81).

12. The textile machine according to any one of claim 8 through claim 11, **characterized by** further comprising an analysis section (60), which receives information relating to the error from the control section (73) and analyzes an error occurrence state in each yarn processing unit (2) in which the error has occurred.

13. The textile machine according to any one of claim 8 through claim 12, **characterized in that** the overall view (81) of the overall view display section (80) includes at least three areas (811, 812, 813).

14. The textile machine according to claim 13, **characterized in that** the yarn processing unit (2) is a spinning unit (2), which includes a draft section (7), a spinning section (9), and a winding section (13), and the at least three areas (811, 812, 813) included in the overall view (81) of the overall view display section (80) correspond to the draft section (7), the spinning section (9), and the winding section (13) in the overall view (81).

FIG. 1

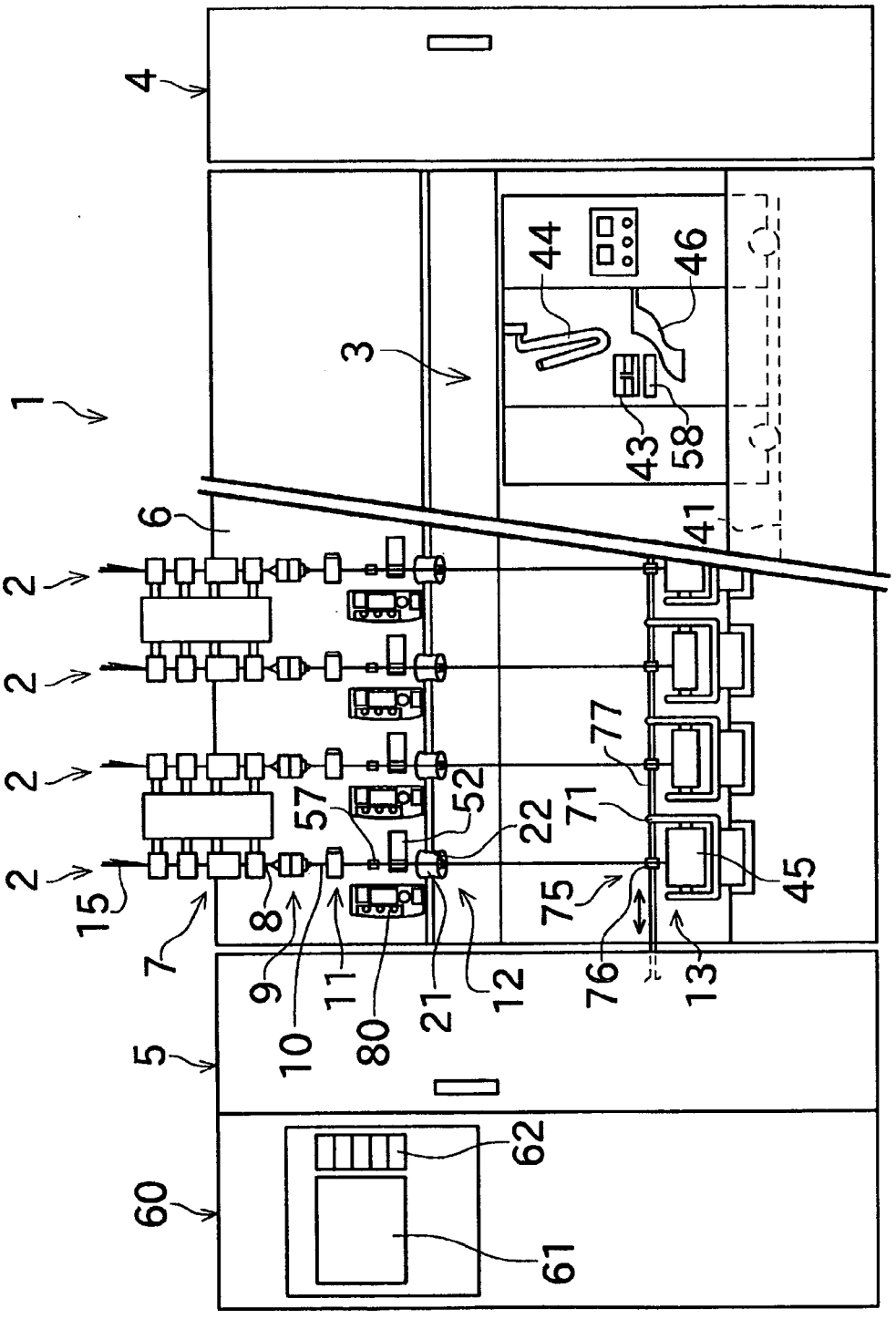
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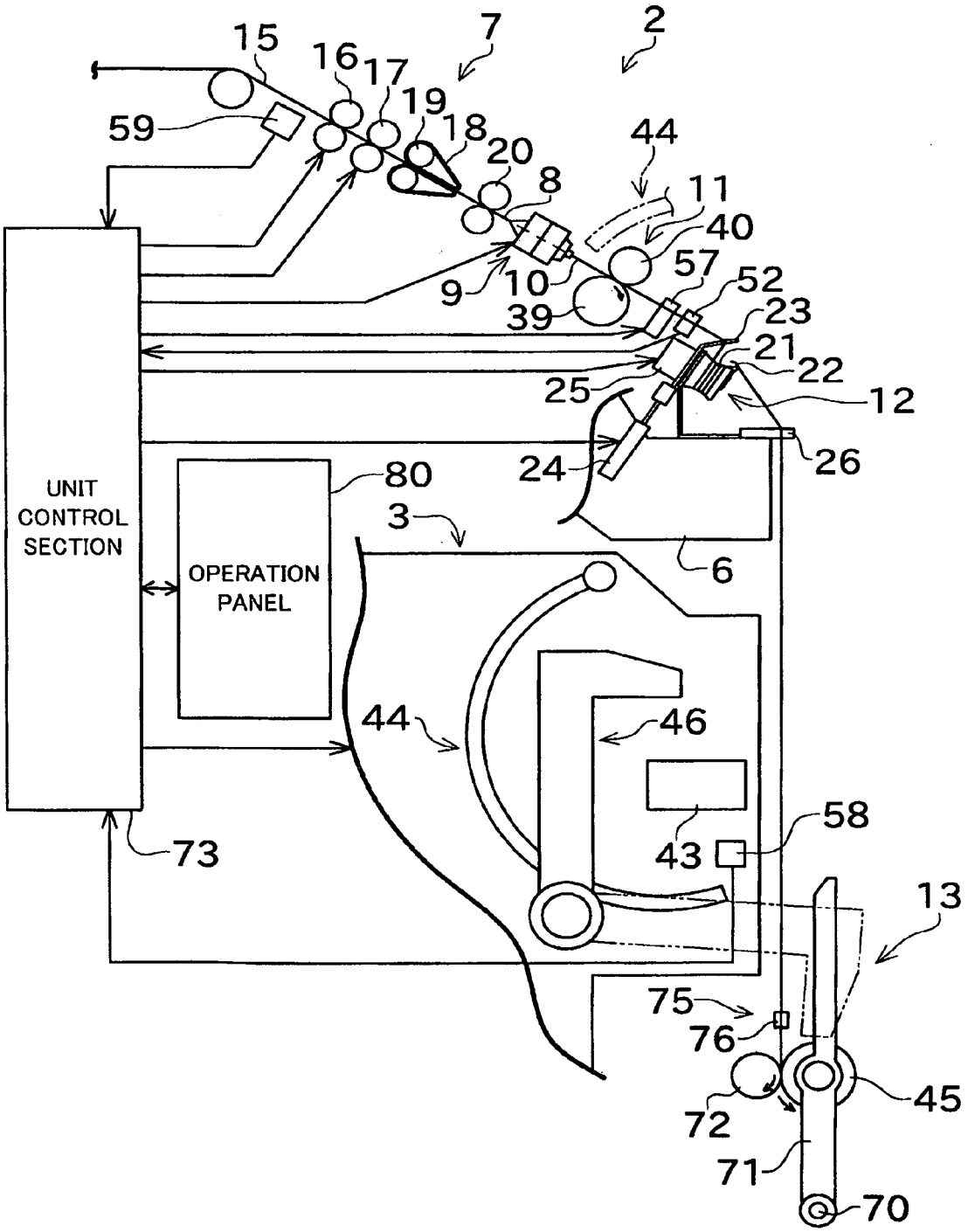
FIG. 2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25
12
26
24
80
3
UNIT CONTROL SECTION
OPERATION PANEL
6
44
46
58
43
73
13
75
76
45
72
71
70

FIG. 3

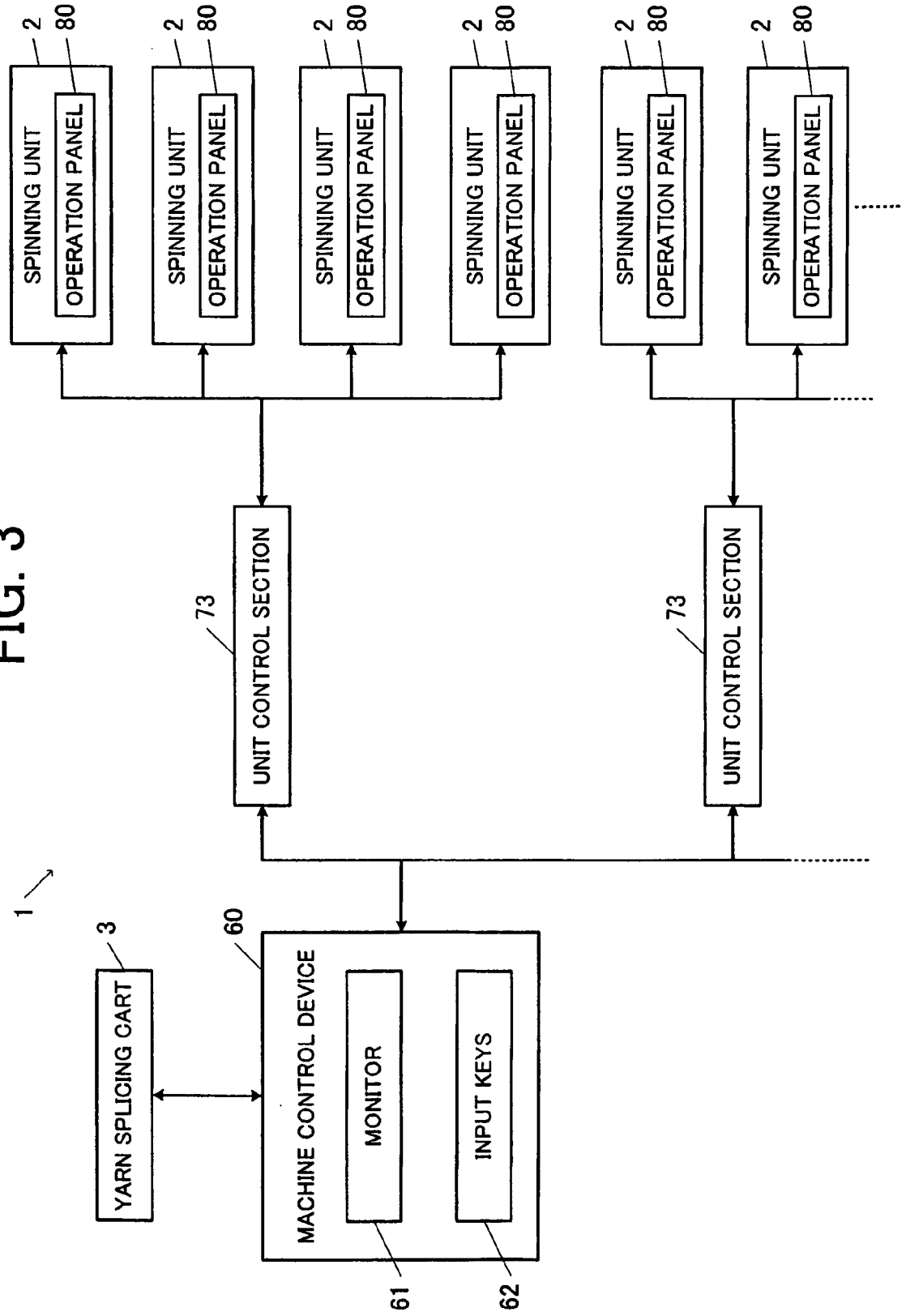
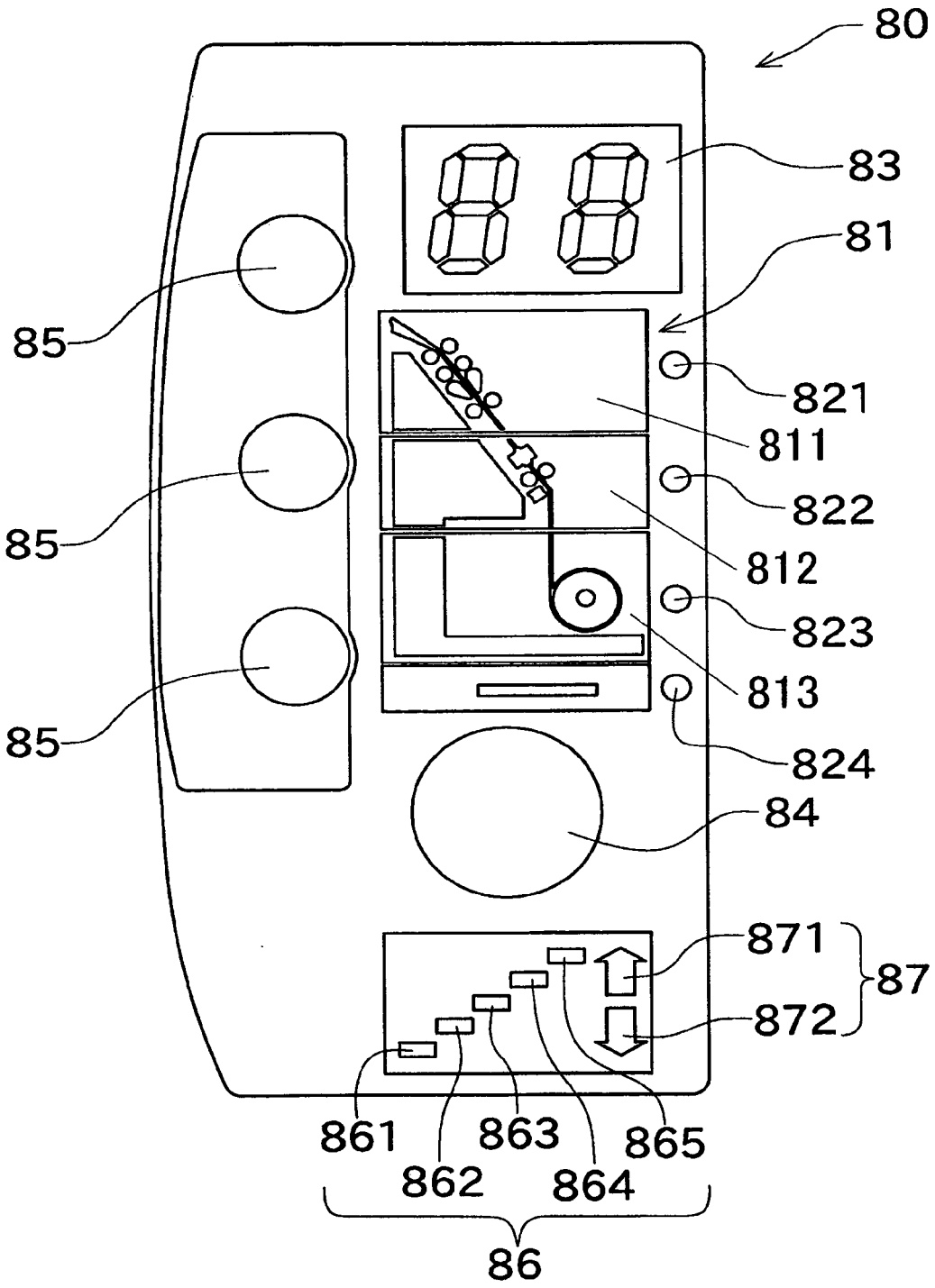

1
2
80
SPINNING UNIT
OPERATION PANEL
73
UNIT CONTROL SECTION
3
YARN SPLICING CART
60
MACHINE CONTROL DEVICE
MONITOR
INPUT KEYS
61
62

FIG. 4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83
81
85
821
811
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871
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862
864
86

FIG. 5

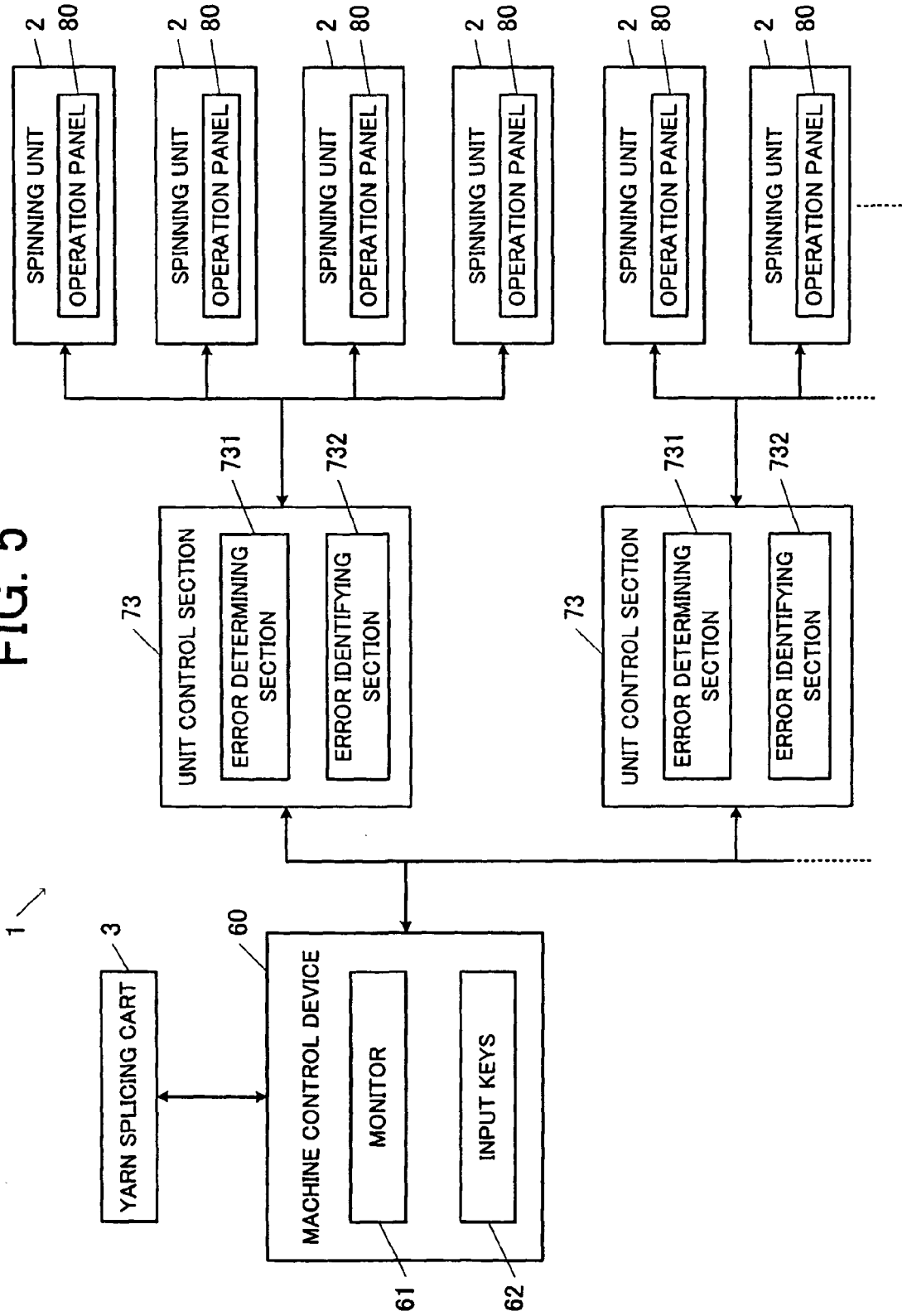
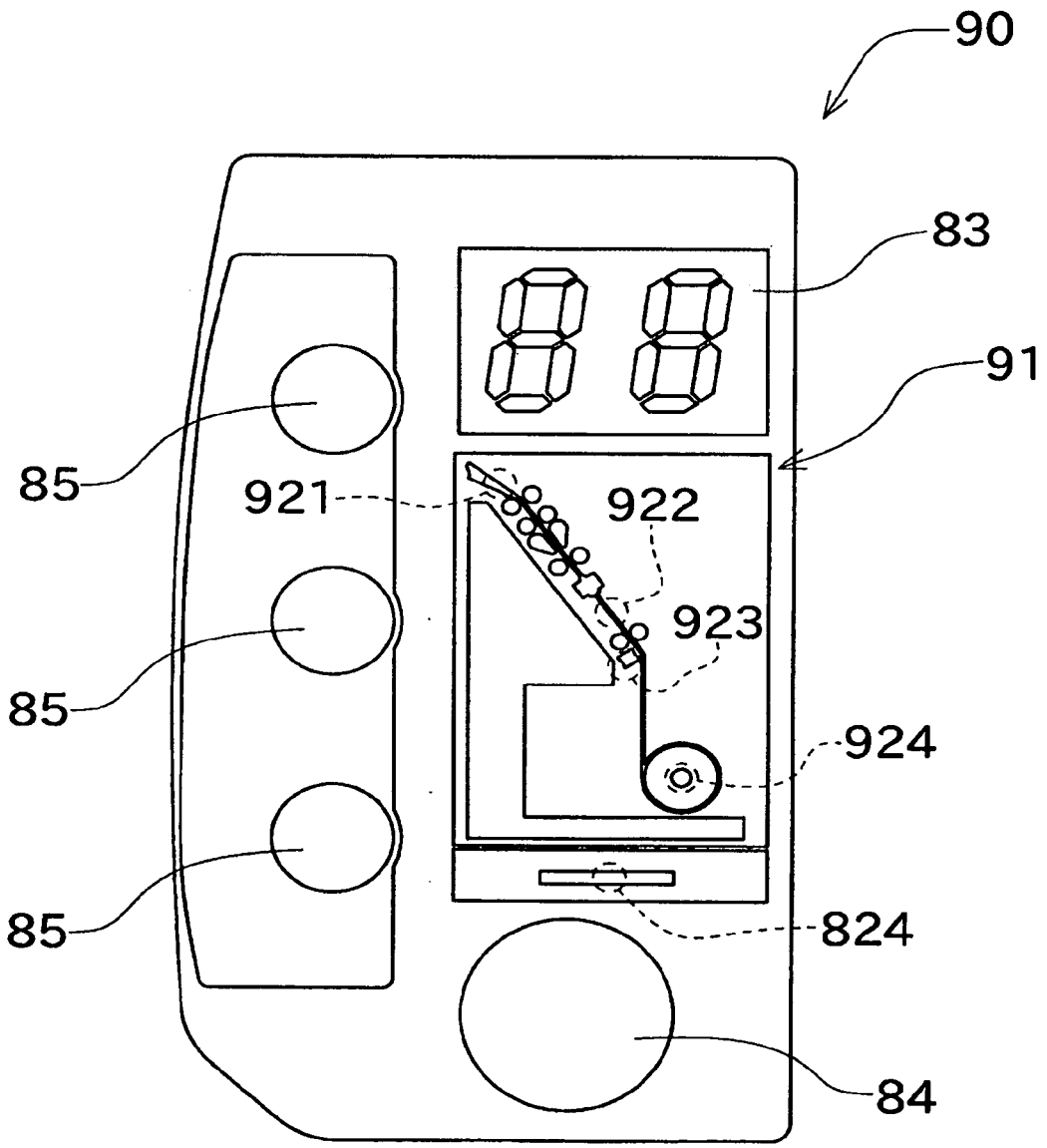

1
2
80
SPINNING UNIT
OPERATION PANEL
73
UNIT CONTROL SECTION
731
ERROR DETERMINING SECTION
732
ERROR IDENTIFYING SECTION
3
YARN SPLICING CART
60
MACHINE CONTROL DEVICE
MONITOR
INPUT KEYS
61
62

FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 8871

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 186 977 A2 (MURATA MACHINERY LTD [JP]) 13 March 2002 (2002-03-13) * figure 2 * -----	1-14	INV. D01H13/26 D01H13/14 D01H13/32
X	DE 40 08 794 A1 (MURATA MACHINERY LTD [JP]) 20 September 1990 (1990-09-20) * figure 4 * -----	1-14	
X	DE 42 20 533 A1 (RIETER AG MASCHF [CH]) 5 January 1994 (1994-01-05) * figures 10,24 * -----	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			D01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 January 2010	Dupuis, Jean-Luc

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1

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14-01-2010

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