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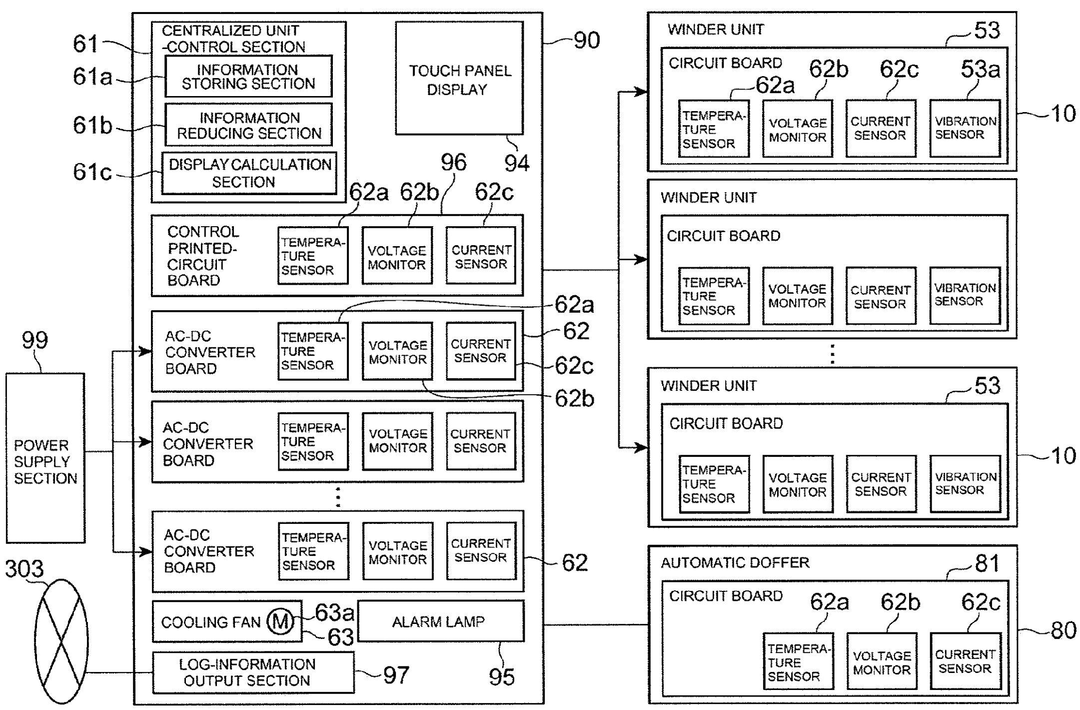
(54) **Textile machine and information transmission system for textile machine**

(57) An automatic winder (1) includes an AC-DC converter board (62), on which an electric circuit is formed by mounting electronic components, sensors (62a, 62c, and 62c) that detect a temperature, a voltage, and an electric current which are loads on the AC-DC converter board (62), and an information storing section (61a) that accumulates and stores therein the temperature values, voltage values, and electric current values detected at different points in time as load log information.

FIG.3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to a textile machine according to the preamble of claim 1 and an information transmission system for a textile machine.

2. Description of the Related Art

[0002] There has been a strong desire for enhancing production efficiency of textile machines such as automatic winders and spinning machines. To fulfill such a desire, textile machines are generally operated continuously around-the-clock. However, an around-the-clock operation puts a heavy load on electronic components of the textile machines. Meanwhile, malfunction of an electronic component or a circuit board on which an electronic component is mounted in a textile machine can be a direct cause of operation halt of the textile machine. Accordingly, it is particularly important to avoid malfunction of the circuit board and the like. Factors that can cause a malfunction of a circuit board and the like of a textile machine include heat, electric current, voltage, vibrations, etc. Japanese Patent Application Laid-open No. H2-148296 discloses an alarm device as a countermeasure technique to the factors that can cause a malfunction of a circuit board. This alarm device monitors temperature of a heating element mounted on a printed circuit board and outputs an anomaly signal upon detecting an anomalous temperature rise.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a textile machine that, even when an anomaly occurs in a circuit board in the textile machine, facilitates diagnosis of a cause of the anomaly and an information transmission system for the textile machine.
This objects is achieves by a textile machine according to claim 1 or by a transmission system for textile machine claim 16.

[0004] Although an alarm device, e.g. the alarm device of Japanese Patent Application Laid-open No. H2-148296, detects the temperature as a factor that can cause a malfunction of the circuit board, the alarm device does not store a log of the temperature measurement. Therefore, the alarm device cannot trace back and refer to past information when an anomaly occurs. Accordingly, even when the function of this alarm device is applied to a textile machine, a maintenance process to be performed at occurrence of an anomaly in a circuit board by a textile-machine maintenance service staff disadvantageously takes time. More specifically, the maintenance process to be performed at occurrence of an anomaly of a textile machine includes:

(1) replacing the anomalous circuit board, a circuit board that shows anomalous behavior, with another board and adjusting setting values and the like of the textile machine in a facility where a textile machine is used (hereinafter, "textile mill");
(2) analyzing and finding a cause of the anomaly of the anomalous board in a company that has designed the textile machine or the like; and
(3) sending a feedback of the cause of the anomaly to the textile mill to remove the cause.

Thus, the maintenance process undesirably requires much time and efforts.

[0005] It is also possible that operation of a textile machine on which inappropriate maintenance is performed is continued. More specifically, causes of anomalies of a circuit board of a textile machine can be divided into internal causes relating to the textile machine itself, and external causes not relating to the textile machine. When an anomaly is caused by an external cause, even when board replacing and setting-value adjustment of Step (1) described above are performed, the anomaly in the circuit board can recur because the fundamental cause of the anomaly remains unsolved. Such anomaly recurrence makes the time of the maintenance service staff, the replaced circuit board, and the operation time of the textile machine involved in Step (1) useless. Furthermore, a designer of the textile machine cannot obtain information about a load put on the circuit board at occurrence of the anomaly. Accordingly, it is not easy for the designer to improve design of the textile machine for load reduction.

[0006] According to an aspect of the present invention, a textile machine includes a circuit board on which an electronic circuit is formed; a load-value detecting section that detects a load value representing a load on the circuit board; and a load-value log storing section that accumulates and stores therein load values detected at different points in time by the load-value detecting section as load log information.

[0007] According to another aspect of the present invention, an information transmission system for a textile machine includes the above textile machine; a log-information output section that retrieves from the textile machine the load log information stored in the load-value log storing section; and a log-information managing section connected to the log-information output section over a network, the log-information managing section managing the load log information retrieved from the log-information output section.

[0008] The above and other objects, features, advantages and the technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic diagram of an automatic winder according to a first embodiment of the present invention;

[0010] FIG. 2 is a block diagram showing a schematic configuration of a winder unit;

[0011] FIG. 3 is a block diagram mainly showing the configuration of a centralized control box and a centralized unit-control section;

[0012] FIG. 4 is a diagram showing an example of a display screen of a "load-value log-information list mode" on a touch panel display;

[0013] FIG. 5 is a diagram showing an example of another display screen of the "load-value log-information list mode" on the touch panel display;

[0014] FIG. 6 is a diagram showing an example of a display screen of a "desired load-value log-information list mode" on the touch panel display;

[0015] FIG. 7 is a diagram showing an example of a display screen of an "alarm-log list mode" on the touch panel display;

[0016] FIG. 8 is a diagram showing an example of another display screen of the "alarm-log list mode" on the touch panel display;

[0017] Fig. 9 is a block diagram of an information transmission system according to an embodiment of the present invention;

[0018] FIG. 10 is a schematic diagram of an air spinning machine according to a second embodiment of the present invention;

[0019] FIG. 11 is a diagram showing an example of a display screen of a "load-value log-information list mode" on a touch panel display according to the second embodiment; and

[0020] FIG. 12 is a diagram showing an example of a display screen of a "desired load-value log-information list mode" on the touch panel display according to the second embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0021] Exemplary embodiments of a textile machine and an information transmission system for a textile machine according to the present invention are described in detail below with reference to the accompanying drawings.

First Embodiment

[0022] As a textile machine according to a first embodiment of the present invention, an automatic winder 1 shown in FIG. 1 is explained below. As shown in FIG. 1, the automatic winder (textile machine) 1 mainly includes a plurality of winder units 10 arranged side-by-side, an automatic doffer 80, and a centralized control box 90.

[0023] Each of the winder units 10 can wind a yarn 20 unwound from a yarn feeding bobbin 21 while causing the yarn 20 to traverse, thereby forming a package 30.

[0024] The automatic doffer 80, when one of the winder units 10 has fully wound the package 30, move to a position of the winder unit 10 to collect the fully-wound package 30 and supply a bobbin on which a yarn is not wound yet.

[0025] The centralized control box 90 includes a setting section 91 and a display section 92. A maintenance service staff can perform settings of each of the winder units 10 by inputting predetermined setting values and/or selecting appropriate control methods using the setting section 91. The display section 92 is used to display information about a winding condition, details about a problem that has occurred, and the like concerning each of the winding units 10.

[0026] FIG. 2 is a block diagram illustrating a schematic configuration of one of the winder units 10. As shown in FIG. 2, the winder unit 10 includes a winding unit body (a textile machine body) 16 and a unit control section 50.

[0027] The unit control section 50 physically includes an electronic circuit board that includes a central processing unit (CPU), a random access memory (RAM), a read only memory (ROM), and an input-output (I/O) port. Computer programs for controlling various components of the winding unit body 16 are stored in the ROM. Various sections of the winding unit body 16 and the centralized control box 90 (see FIG. 1) are connected to the I/O port and a communication port such that control information and the like can be exchanged. Accordingly, the unit control section 50 can control operations of the various sections of the winding unit body 16. The unit control section 50 also controls the setting section 91 and the display section 92. The centralized control box 90 also includes a CPU, a RAM, a ROM, and an I/O port, and controls the setting section 91 and the display section 92.

[0028] The winding unit body 16 includes an unwinding assisting device 12, a tension applying device 13, a splicer device 14, and a clearer 15 that are arranged on a yarn feed path between the yarn feeding bobbin 21 (FIG. 1) and a traversing drum 29 in this order from the side of the yarn feeding bobbin 21. An upper-yarn guiding pipe 26 and a lower-yarn guiding pipe 25 are arranged above and below the splicer device 14, respectively. A not shown yarn feeding section that feeds a yarn to the winding unit body 16 is arranged below the winding unit body 16. The yarn feeding section holds the yarn feeding bobbin 21 conveyed thereto by a not shown bobbin conveying system at a predetermined position.

[0029] The unwinding assisting device 12 assists unwinding of a yarn from the yarn feeding bobbin 21. The tension applying device 13 applies a predetermined tension to the running yarn 20. The splicer device 14 joins a lower yarn coming from the yarn feeding bobbin 21 and an upper yarn coming from the package 30 when the clearer 15 detects a defect in a yarn and cuts the yarn, when a yarn breakage during unwinding from the yarn feeding bobbin 21 is detected, or similar situations. The clearer 15 monitors presence/absence and a thickness of the running yarn 20. The clearer 15 includes a not shown cutter that cuts the yarn 20 immediately upon detecting a yarn defect such as a slub. A not shown negative-pressure source is connected to the lower-yarn guiding pipe 25. When the yarn 20 is cut, the lower-yarn guiding pipe 25 sucks and catches a yarn end of the yarn 20 coming from the yarn feeding bobbin 21 and guides the yarn end to the splicer device 14. Similarly, a negative-pressure source is also connected to the upper-yarn guiding pipe 26. When the yarn 20 is cut, the upper-yarn guiding pipe 26 sucks and catches a yarn end of the yarn 20 coming from the package 30 and guides the yarn end to the splicer device 14.

[0030] The winding unit body 16 further includes a cradle 23 and the traversing drum 29. The cradle 23 rotatably supports the winding bobbin, which is a core tube of the package 30. The traversing drum 29 causes a yarn to traverse and drives the winding bobbin. A spiral traversing groove is defined in an outer peripheral surface of the traversing drum 29. The traversing groove causes the yarn 20 to traverse. Rotation of the traversing drum 29 causes the package 30 that is in contact with the peripheral surface of the traversing drum 29 to rotate. As a result, the yarn 20 is wound to form the package 30.

[0031] The configuration of the centralized control box 90 is explained in detail below. The centralized control box 90 includes a casing arranged on one side of the automatic winder 1. The centralized control box 90 performs centralized control of the entire automatic winder 1. As shown in FIG. 3, the centralized control box 90 includes a centralized unit-control section (control section) 61 housed in the casing and a touch panel display 94 arranged outside of the casing. The centralized unit-control section 61 performs various information processing according to various computer programs. The touch panel display 94 has both a function as the display section 92 (FIG. 2) that outputs a result of information processing as a screen display and a function as the setting section 91 (FIG. 2) that receives various input operations performed by a maintenance service staff. The centralized control box 90 further includes an alarm lamp (anomaly notifying section) 95 for notifying an anomalous operation and the like to a maintenance service staff and a control printed-circuit board 96 on which various electrical circuits are formed.

[0032] The centralized unit-control section 61 is physically an electronic component that includes a CPU, a RAM, a ROM, and the like. The centralized unit-control section 61 also includes an information storing section (load-value log storing section) 61a that stores information, an information reducing section (load-value log-information reducing section) 61b that reduces the stored information, and a display calculation section 61c that creates a screen to be displayed on the touch panel display 94. The information storing section 61a, the information reducing section 61b, and the display calculation section 61c are components that are implemented by software as a result of synergistic functioning of the hardware components such as the CPU, the RAM, and the ROM of the centralized unit-control section 61 according to computer programs. For example, the information storing section 61a is implemented as a portion of an information storage area of the RAM of the centralized unit-control section 61.

[0033] A plurality of AC-DC converter boards (circuit boards) 62 are housed in the casing of the centralized control box 90. The AC-DC converter boards 62 convert AC power supplied from a power supply section (power supply source) 99 into DC power and supply the DC power to the winder units 10. In this embodiment, a single AC-DC converter board 62 supplies electric power to plural winder units 10. For example, when the automatic winder 1 includes 72 units of the winder units 10, the automatic winder 1 can include 6 units of the AC-DC converter boards 62, each AC-DC converter board 62 supplying electric power to 12 winder units 10. The AC-DC converter board 62 is a printed circuit board on which a number of electronic components are mounted. A cooling fan 63 is arranged near each of the AC-DC converter boards 62. The cooling fan 63 is driven by a cooling-fan motor (fan driving section) 63a to generate cooling air for cooling the respective AC-DC converter board 62. The cooling fan 63 circulates cooling air in the centralized control box 90. Accordingly, by driving the cooling fan 63 not only the AC-DC converter board 62 is cooled but also various electronic components housed in the centralized control box 90 are also cooled.

[0034] In addition to the AC-DC converter circuit, load value detectors that quantitatively detect respective load put on the AC-DC converter boards 62 are arranged on the AC-DC converter boards 62. The load value detectors include a temperature sensor (load-value detecting section) 62a that measures a temperature of a location where the AC-DC converter board 62 is arranged, a voltage monitor 62b that measures a voltage applied to the AC-DC converter board 62, and a current sensor 62c that measures an electric current flowing through the AC-DC converter board 62. The temperature sensor 62a, the voltage monitor 62b, and the current sensor 62c are mounted on the AC-DC converter board 62.

[0035] The temperature sensors 62a successively transmit temperature values measured at different points in time as electrical signals to the centralized unit-control section 61. The temperature values measured at the different points in time are temperature values periodically measured at predetermined time intervals (e.g., every 10 seconds). The information storing section 61a of the centralized unit-control section 61 accumulates and stores log information as electronic data. This log information contains each measurement time and the temperature value in a related manner. Similarly, the information storing section 61a also accumulates and stores log information. This log information contains each of voltage values measured by the voltage monitor 62b and the measurement time in a related manner, and the electric currents measured by the current sensor 62c and the measurement time in a related manner. The information storing section 61a also accumulates and stores log information. This log information contains electric power values each obtained by multiplying the voltage value and the electric current and the measurement time in a related manner.

[0036] Hereinafter, the log information accumulated and stored in the information storing section 61a as described above are referred to as "temperature log information", "voltage log information", "current log information", and "power log information", respectively. The values, such as the temperature values, the voltage values, the electric current values, and the electric power values, each representing a quantity of a load put on the electronic circuit board in the automatic winder 1 are collectively referred to as "load values". The log information about the load values are collectively referred to as "load log information". These load log information are stored in the information storing section 61a as electronic data. Accordingly, a maintenance service staff can handle the load log information more efficiently in subsequent processes than load log information stored in a medium such as paper.

[0037] When a load, such as temperature, voltage, electric current, or electric power, put on the AC-DC converter board 62 is excessively large, an electronic component mounted on the AC-DC converter board 62 may be damaged and may lead to a failure of the AC-DC converter board 62. For example, if the automatic winder 1 is operated under an abnormal environment, such as an environment where an air conditioner of a textile mill is not operating, the temperature of a location where the AC-DC converter board 62 is arranged increases, and the chances that the AC-DC converter board 62 does not function properly due to a temperature load increases. Also when settings of the automatic winder 1 are inappropriate whereby its electric power consumption is high, the temperature of the AC-DC converter board 62 increases, and the chances that the AC-DC converter board 62 does not function properly due to a temperature load increases.

[0038] If the mill-power-supply voltage is anomalous, an overvoltage can be applied to the AC-DC converter board 62. In such a case, a voltage load can cause function failure of the AC-DC converter board 62. Also, when an electric discharge circuit of the AC-DC converter board 62 is anomalous, an overvoltage can be applied to the AC-DC converter board 62. In such a case, a voltage load can damage the AC-DC converter board 62. When a defective bearing or the like puts an overload on rotation of the traversing drum 29, an overcurrent can flow through the AC-DC converter board 62. In such a case, an electric current load can damage the AC-DC converter board 62.

[0039] A minimum temperature load value, a minimum voltage load value, and a minimum current load value, above which a potential for a damage to the electronic components mounted on the AC-DC converter board 62 increases, are stored in the centralized unit-control section 61 as "critical temperature value", "critical voltage value", and "critical current value", respectively. These critical load values are input and set using the touch panel display (critical-load setting section) 94 by a maintenance service staff in advance and stored in the information storing section 61a. When a load value equal to or greater than a corresponding critical load value is detected, the centralized unit-control section 61 performs a process to take measures to decrease the load value. As a result, not only a damage to the AC-DC converter board 62 is prevented but also putting a heavy load on the AC-DC converter board 62 is avoided. This leads to prolongation of usable life of the AC-DC converter boards 62.

[0040] A concrete example of the process is explained below. When the temperature value detected by the temperature sensor 62a is equal to or higher than the critical temperature value, the centralized unit-control section 61 transmits a drive signal to the cooling-fan motor 63a so that the cooling fan 63 is driven. As a result, the temperature of the AC-DC converter board 62 falls by being cooled with a cooling air, and a damage to the AC-DC converter board 62 is prevented. Simultaneously, the centralized unit-control section 61 stores driving log in the information storing section 61a stating that the cooling fan 63 has been driven. Thus, information indicating that an overload on the AC-DC converter board 62 has occurred is stored as the driving log. Accordingly, when a damage occurs to the AC-DC converter board 62 at a later time, a maintenance service staff can utilize the driving log in diagnosis of a cause.

[0041] Another concrete example of the process is explained below. When the temperature value detected by the temperature sensor 62a is equal to or higher than the critical temperature value, or when the voltage value detected by the voltage monitor 62b is equal to or higher than the critical voltage value, or when the electric current detected by the current sensor 62c is equal to or higher than the critical current value, the centralized unit-control section 61 stops the operation of the automatic winder 1. As a result, an overload on the AC-DC converter board 62 is avoided, and a damage to the AC-DC converter board 62 is prevented. Simultaneously, the centralized unit-control section 61 stores operation-stoppage log in the information storing section 61a stating that the operation has been stopped. As a result, information indicating that an overload on the AC-DC converter board 62 has occurred is stored as the operation-stoppage log. Accordingly, when a damage occurs to the AC-DC converter board 62 at a later time, a maintenance service staff can utilize the operation-stoppage log in diagnosis of a cause of the damage.

[0042] When the temperature value detected by the temperature sensor 62a is equal to or higher than the critical temperature value, or when the voltage value detected by the voltage monitor 62b is equal to or higher than the critical voltage value, or when the electric current detected by the current sensor 62c is equal to or higher than the critical current value, the centralized unit-control section 61 determines that anomalous operation has occurred and transmits a drive signal to the alarm lamp 95 so that the alarm lamp 95 is lit. As a result, a maintenance service staff can prevent a damage to the AC-DC converter board 62 by being informed about an anomalous phenomenon and adopting an appropriate measure. Simultaneously, the centralized unit-control section 61 stores in the information storing section 61a alarm log stating that the alarm about the anomalous operation has been issued. As a result, information indicating that an overload on the AC-DC converter board 62 has occurred is stored as the alarm log. Accordingly, when a damage occurs to the AC-DC converter board 62 at a later time, a maintenance service staff can utilize the alarm log in diagnosis of a cause of the damage.

[0043] When the temperature value detected by the temperature sensor 62a is equal to or higher than the critical temperature value, when the voltage value detected by the voltage monitor 62b is equal to or higher than the critical voltage value, or when the electric current detected by the current sensor 62c is equal to or higher than the critical current value, the centralized unit-control section 61 displays on the display section (message display section) 92 a message prompting to perform an operation to bring the value to a normal value. The message displayed on the display section 92 include, for example, a message prompting to check an operation status of the cooling fan 63 and a message prompting to clean a filter through which internal heat of the casing of the centralized control box 90 dissipates when an overload on the AC-DC converter board 62 has occurred.

[0044] Meanwhile, a large number of electronic circuit boards, including the AC-DC converter boards 62, that could be damaged due to overload, are arranged inside the automatic winder 1. Representative examples of circuit boards on which electronic circuits are formed include the AC-DC converter boards 62, the control printed-circuit board 96 inside the casing of the centralized control box 90, a printed circuit board 81 inside the automatic doffer 80, and printed circuit boards 53 each of which is arranged inside the unit control section 50 of each of the winder units 10. These electronic circuit boards are collectively simply referred to as "board" in the following explanation. For distinction among these boards, they are referred to as "the boards 62", "the board 96", "the board 81", and "the boards 53" with a corresponding reference numeral affixed thereto.

[0045] The arrangement explained above in which the load log information related to the board 62 is accumulated and, stored and the configuration for preventing a damage to the board 62 due to a load are also similarly applicable to the boards 96, 81, and 53. Furthermore, a similar arrangement is applicable to any other electronic circuit board arranged in the automatic winder 1. FIG. 3 shows an example in which the temperature sensor 62a, the voltage monitor 62b, and the current sensor 62c are also arranged on each of the boards 96, 81, and 53, and the temperature log information, voltage log information, current log information, and power log information relating to each of the boards 96, 81, and 53 are accumulated in the information storing section 61a.

[0046] A vibration sensor (load-value detecting section) 53a that detects vibrations is further arranged on the board 53 of each of the winder units 10. Meanwhile, because the winder unit 10 causes the package 30 to rotate at a high speed, the winder unit 10 is likely to be vibrated due to, such as eccentricity of a rotating member (for example, the winding bobbin on which the package 30 is to be wound). Accordingly, the board 53 arranged on the winder unit 10 is susceptible to the vibrations. The vibrations act as a load to the board 53. However, a configuration in which vibrations in the board 53 are detected with the vibration sensor 53a each time vibrations occur and "vibration log information" is accumulated and stored in the information storing section 61a makes it possible to prevent a damage to the board 53 caused by a vibration load. Specific examples of the board 53 include a slave board and an I/O slave board that perform motor control.

[0047] The information reducing section (load-value log storing section) 61b of the centralized unit-control section 61 discards load log information of relatively low importance among load log information. More specifically, the information reducing section 61b performs a process of retaining information about load values in a predetermined time slot straddling a point in time when a load value equal to or higher than a critical load value is detected in the load log information and discarding other information from the load log information. The information reducing section 61b can, alternatively or in addition, perform a process of discarding older information from the thus-left load log information in chronological order so as to give priority to and retain more recent information. The information reducing section 61b can, alternatively or in addition, associate an importance level of an alarm in the automatic winder 1 to load log information in advance and perform a process of discarding information in a descending order of the importance level. These processes performed by the information reducing section 61b reduce an amount of data contained in the load log information and retain only important information related to damages to the electronic circuit boards in the load log information.

[0048] If a damage should occur to such a board as described above in the automatic winder 1, a maintenance service staff is required to diagnose a cause of the damage. The load log information is stored in the information storing section 61a in the automatic winder 1 as described above. Accordingly, the maintenance service staff can read out the load log information and utilize them in post-diagnosis of the cause. The centralized unit-control section 61 can visually display the load log information on the touch panel display (load-value log display section) 94 to assist a maintenance service staff at such diagnosis of a cause.

[0049] On-screen display of the load log information is explained below with reference to FIGS. 4 to 6. Each of display screens explained below is created by calculation performed by the display calculation section (graph-conversion processing section) 61c of the centralized unit-control section 61 and displayed on the touch panel display 94. Meanwhile, in the following explanation, "input" denotes a predetermined touch input operation performed on the touch panel display 94. Meanwhile, a known method can be used to cause a maintenance service staff to perform the touch input operation by, for example, prompting the maintenance service staff to press a touch operation button arranged on the screen. Accordingly, description about the operation and illustration of the touch operation button on the screen and the like are omitted. Illustration of other portions on the display screen explanations thereabout are unnecessary is also omitted.

Load-value log-information list mode

[0050] First, the temperature log information, the voltage log information, the current log information, and the power log information about the boards 62, 96, 81, and 53 are read out from the information storing section 61a. As illustrated in FIG. 4, a table B1 is displayed on a screen upper area A1 on the touch panel display 94. Temperature values, voltage values, electric current values, electric power values, and cumulative operating time of the individual boards at a certain time are displayed as numerical data in the table B1. In the example shown in FIG. 4, the table B1 contains four columns corresponding to the board 96 (MAIN BODY BOARD), the board 81 (DOFFER BOARD), a first one of the boards 62 (AC-DC 1), and a second one of the boards 62 (AC-DC 2). However, the displayed box can be switched to an information box about other boards in response to a predetermined screen switching operation (e.g., scrolling in a lateral direction of the screen).

[0051] When the table B1 contains a load value equal to or higher than a critical load value, text of the load value is highlighted. Any highlighting can be employed so long as the highlighting makes a target text stand out by imparting an appearance that differs from those of other texts. Examples of the highlighting include displaying the text in a color different from that of other texts and causing a pointer, such as an arrow, affixed to the text to be highlighted to be displayed. This highlighting allows a maintenance service staff to notice the information about the load value equal to or higher than the critical load value more clearly when viewing the load-value log display section.

[0052] When a maintenance service staff inputs designation of any one of load value items on the screen, a time series of load values of the designated item is converted into a graph, and this load value graph (time-series load-value graph) B2 in which the horizontal axis is taken as a date-time axis is displayed in a screen lower area A2. The display calculation section (graph-conversion processing section) 61c performs calculation for creating the graph from the load log information. In the example shown in FIG. 4, when the temperature value is designated, the text "TEMPERATURE" in the table B1 is highlighted, and time series of temperature values of the boards 96, 81, 62, 62 are displayed in an overlapped manner as the graph B2. In this example where four overlapped curves are shown in the graph B2, different color coding can be used to make the four curves distinguishable from one another. It is also possible to cause a time series of temperature values of a selected one of the boards to be singly displayed in the graph B2 in response to a predetermined designated input.

[0053] When a maintenance service staff selects a desired time on the horizontal axis of the graph B2 using a time-designating button displayed below the graph B2 on the touch panel display (time-point designating section) 94, temperature values at the designated time are displayed on the table B1. In the example shown in FIG. 4, "3/3, 17:10" (date/month, hour:minute) is designated as indicated by a dashed line in the graph B2. In response to this designation, temperature values of the boards at 17:10 of March 3 are displayed in the table B1. This function allows the maintenance service staff to check load values at a desired point in time quickly by designating the desired point in time on the touch panel display 94, thereby performing maintenance work more efficiently.

[0054] It is also possible that, while the screen shown in FIG. 4 is displayed, the maintenance service staff selects another load value item to switch the graph B2 displayed in the screen lower area A2. For example, when a "VOLTAGE" column in the table B1 on the screen shown in FIG. 4 is touched, the text "VOLTAGE" in the table B1 is highlighted, and the graph B2 is changed to a graph representing voltage values related to the boards 96, 81, 62, 62 as illustrated in FIG. 5. Such a graph display makes it possible for the maintenance service staff to visually recognize the time series of load values converted into the graph and therefore diagnose a cause of a damage more easily. As a result, accuracy of maintenance work can be increased.

Desired load-value log-information list mode

[0055] In a desired load-value log-information list mode, as illustrated in FIG. 6, a table C1 containing a list of load values of the board 96 (MAIN BODY BOARD), multiple units of the boards 62 (AC-DC BOARD), the board 81 (DOFFER BOARD), and multiple units of the boards 53 (UNIT BOARD), is displayed on the screen upper area A1. Although FIG. 6 shows an example in which temperature values of the boards are displayed, the table can be switched to a table that contains other load values (electric power values, voltage values, electric current values, or vibration values) in response to a predetermined operation. In the example shown in FIG. 6, each of a set of the temperature values of the multiple units of the boards 62 and a set of the temperature values of the multiple units of the boards 53 is displayed in a single horizontal row. Although only data about six the boards 53 is presented in a "UNIT BOARD" row, for example, the displayed box can be switched to an information box about other one of the boards 53 in response to a predetermined screen switching operation (e.g., scrolling in a lateral direction of the screen).

Alarm-log list mode

[0056] In an alarm-log list mode, as illustrated in FIG. 7, the above-described alarm log stored in the information storing section 61a is displayed as a list. FIG. 7 shows an example in which date and time of alarms, boards related to the alarms, a unit number of the winder unit 10, importance levels of the alarms, alarm information describing contents of the alarms, and alarm codes are displayed in a table. A maintenance service staff can input designation of a desired board from the screen shown in FIG. 7 to thereby extract only an alarm log related to the designated board and cause the alarm log to be displayed as illustrated in FIG. 8. As shown in FIG. 8, in response to designation of the board 53 of the winder unit 10 of which unit number is 7, only an alarm log related to the board 53 are selectively displayed.

[0057] Effects yielded by the automatic winder 1 described above are explained below.

[0058] In the automatic winder 1, the load log information about the boards 62, 96, 81, and 53 obtained at different points in time is accumulated and stored in the information storing section 61a. Accordingly, even when a damage occurs to the board 62, 96, 81, or 53, a maintenance service staff can utilize the stored load log information in post-diagnosis of a cause of the damage. Thus, the automatic winder 1 allows a maintenance service staff to diagnose the cause of the damage of the board 62, 96, 81, or 53 easily. Meanwhile, there can be a case in which a cause of a damage is found only by referring to the load log information. In such a case, a series of operations including removing the damaged board and sending the damaged board to a maintenance service staff can become unnecessary, and speedy diagnosis of a cause of a damage is achieved.

[0059] As a result, a rate of operation of the automatic winder 1 is increased, and accordingly production efficiency is increased. Furthermore, when a cause of a damage is definitely found, the cause of the damage can be fundamentally resolved. Accordingly, it becomes possible to avoid an undesirable situation that the automatic winder 1 on which inappropriate maintenance is performed is kept to be operated, and also to avoid useless consumption of working hours of a maintenance service staff, a circuit board to be changed, and operating hours of the automatic winder 1.

[0060] Furthermore, by obtaining the load-value history information, a designer of the automatic winder 1 can grasp what and how loads are put on the boards of the automatic winder 1 that is actually operated in a textile mill. Accordingly, the designer can efficiently improve the design of the automatic winder 1 and the like to reduce the loads put on the boards with accurate understanding about operational environment and conditions including climate of a region where the automatic winder 1 is operated, air-conditioning status of the mill, and a mill-power-supply voltage.

[0061] In the automatic winder 1, the load log information is displayed on the touch panel display 94. If the automatic winder 1 does not have such a display section, operations of connecting another display device that is accessible to the centralized unit-control section 61, reading out the load log information, and causing the load log information to be displayed would be required. However, the automatic winder 1 allows a maintenance service staff to skip the operations and diagnose a cause of a damage speedily by causing the load log information to be displayed on the touch panel display 94.

[0062] Furthermore, the automatic winder 1 stores load log information about a plurality of the boards, and is capable of displaying the information in a manner that the information are switchable among multiple types of the load values and among the boards. This configuration allows a maintenance service staff to compare the information about the load values among a plurality of the electronic circuit boards, thereby locating a damaged portion and estimating a cause of a damage with correlation among the information taken into account. Accordingly, the maintenance service staff can locate the damaged portion more accurately and estimate the cause of the damage in more detail.

[0063] The automatic winder 1 employs, as the load values of a board to be detected, a value of the temperature of a location where the board is arranged, a value of the voltage supplied to the board, a value of the electric current supplied to the board, and a value of the vibrations that occur to the board. A maintenance service staff can efficiently narrow down maintenance works that are necessary to recover operation of the automatic winder 1 by obtaining these load values. More specifically, the automatic winder 1 can provide the voltage value, the temperature value, and the vibration value, which are environment-dependent load values, and the electric current, which is an electrical-factor-dependent load value, collectively as the load values. The electric power value calculated from the electric current and the voltage value is also stored as the load log information. The electric power value can also serve as useful information for narrowing down maintenance works necessary to recover operation of the automatic winder 1.

[0064] Particularly, load values of the AC-DC converter boards 62 are monitored and accumulated as the load log information in the automatic winder 1. The AC-DC converter boards 62 are interposed between and connected to the power supply section 99 and the winder units 10. Accordingly, information that reflect both a status of the power supply section 99 and conditions of the winder units 10 is obtained as the load log information by monitoring the AC-DC converter boards 62. As a result, efficiency of information collection increases, making the load log information also useful in improvement of design of the automatic winder 1.

[0065] An information transmission system 300 shown in FIG. 9 is explained below as an information transmission system according to an embodiment of the present invention.

[0066] As shown in FIG. 9, each of the automatic winders 1 installed in textile mills at remote sites is connected to a log-management computer terminal (log-information managing section) 301 via a network 303 thereby forming the information transmission system 300 for the automatic winders 1. A dedicated network can be constructed as the network 303; alternatively, the Internet can be used as the network 303. The centralized control box 90 of each of the automatic winders 1 includes a log-information output section 97 (see FIG. 3) that includes a communication port. The load log information accumulated in the information storing section 61a is output to the network 303 via the log-information output section 97. The load log information is then transmitted to the log-management computer terminal 301 over the network 303.

[0067] Causes of damages to circuit boards of the automatic winder 1 can be divided into simple causes that can be diagnosed by a general maintenance service staff of a textile mill where the automatic winder 1 is installed, and complex causes that are desirably diagnosed by a senior-level maintenance service staff having knowledge equivalent to a designer of the automatic winder 1. Therefore, when a damage occurs to a circuit board of the automatic winder 1 in a textile mill, typically, a general maintenance service staff makes an attempt to diagnose a cause of the damage first; if the general maintenance service staff does not succeed, the diagnosis is consigned to a senior-level maintenance service staff stationed at a remote site.

[0068] In contrast, according to the information transmission system 300, because the log-management computer terminal 301 is arranged at a site of the senior-level maintenance service staff, senior-level maintenance service staff can obtain the load log information without involvement by general maintenance service staff. With this arrangement, the senior-level maintenance service staff stationed at a place remote from the automatic winder 1 can directly diagnose the cause of the board damage. The information transmission system 300 enables the senior-level maintenance service staff to perform remote maintenance of the automatic winder 1 also at times other than when a damage has occurred to a board. Furthermore, because the log-management computer terminal 301 is arranged at a site of the designer, a designer of the automatic winder 1 can obtain consolidated information about damages occurred to the circuit boards of the automatic winders 1 in textile mills at remote sites, thereby improving design of the automatic winders 1 efficiently. The information transmission system 300 also allows a general maintenance service staff to correct an anomaly of a circuit board of the automatic winder 1 under instructions from a senior-level maintenance service staff stationed at a remote site. Thus, possibility of anomaly recurrence because the automatic winder 1 on which inappropriate maintenance is performed is kept to be operated can be reduced.

Second Embodiment

[0069] As a textile machine according to a second embodiment of the present invention, an air spinning machine 201 shown in FIG. 10 is explained below. Components identical or similar to those of the automatic winder 1 according to the first embodiment are indicated by like reference numerals as those of the first embodiment in the drawings, and repeated description thereof is omitted.

[0070] The air spinning machine (textile machine) 201 includes a plurality of spinning units 202 arranged side-by-side, a plurality of yarn-joining carriers 203, one automatic doffer 205, and a centralized control box 206. Each of the spinning units 202 performs spinning utilizing a swirling airflow. The air spinning machine 201 includes, for example, 96 units of the spinning units 202. When a yarn is broken or cut in a certain spinning unit 202, the yarn-joining carrier 203 moves on a rail to and stops at a position corresponding to that spinning unit 202, and performs yarn joining. In the air spinning machine 201, for example, 4 to 6 units of the yarn-joining carriers 203 are arranged for 96 units of the spinning units 202. When one of the spinning units 202 has fully wound a package, the automatic doffer 205 moves to the spinning unit 202 on a rail to collect the fully wound package and supplies a bobbin on which a yarn is not wound yet to the spinning unit 202.

[0071] The centralized control box 206 controls the entire air spinning machine 201. The centralized control box 206 includes a plurality of control boards 207 that control plural units of the spinning units 202. For example, when it is assumed that 1 unit of the control board 207 controls 8 units of the spinning units 202, the air spinning machine 201 includes 12 units of the control board 207 for the 96 units of the spinning units 202. The centralized control box 206 includes the centralized unit-control section 61 and the log-information output section 97 similar to those of the automatic winder 1 described above. The centralized unit-control section 61 includes the information storing section 61a, the information reducing section 61b, and the display calculation section 61c.

[0072] The air spinning machine 201 also includes a plurality of electronic circuit boards that can be possibly damaged due to an overload. Representative examples of such boards include a printed circuit board 213 mounted inside the yarn-joining carrier 203, a printed circuit board 215 mounted inside the automatic doffer 205, and a printed circuit board 216 mounted inside the centralized control box 206. As in the automatic winder 1 according to the first embodiment, sensors for detecting load values (temperature, electric current, voltage, and vibration) are arranged on or near each of the boards. Load values detected at different points in time by these sensors are accumulated and stored as load log information in the information storing section 61a. As in the automatic winder 1, the load log information can be displayed on the screen of the touch panel display 94 arranged on a casing of the centralized control box 206.

[0073] On-screen display of the load log information is explained below with reference to FIGS. 11 and 12. Each of display screens described below is created by calculation performed by the display calculation section 61c of the centralized unit-control section 61 and displayed on the touch panel display 94. Meanwhile, in the following explanation, "input" denotes a predetermined touch input operation performed on the touch panel display 94.

Load-value log-information list mode

[0074] In a load-value log-information list mode, the load log information about the boards is read out from the information storing section 61a. As illustrated in FIG. 11, the table B1 is displayed on the screen upper area A1 on the touch panel display 94, while a load value graph B2 in which the horizontal axis is taken as the time axis is displayed in the screen lower area A2. Display forms and screen switching operations for the table B1 and the graph B2 are similar to those of the display screen of the automatic winder 1, and detailed description thereof is omitted.

Desired load-value log-information list mode

[0075] In a desired load-value log-information list mode, as illustrated in FIG. 12, the table C1 indicating a list of load values of the boards is displayed on the screen upper area A1. Display form and screen switching operation for the table C1 are similar to those of the display screen of the automatic winder 1, and detailed description thereof is omitted.

[0076] Although not shown, the touch panel display 94 of the air spinning machine 201 can be configured to display alarm log stored in the information storing section 61a as a list, and extract only an alarm log about a desired board and display the extracted alarm logs as in the alarm-log list mode of the automatic winder 1.

[0077] The air spinning machine 201 configured as above yields similar effects to those yielded by the automatic winder 1 according to the first embodiment. It is also possible to construct an information transmission system for load log information involving the air spinning machines 201 by replacing the automatic winders 1 in the information transmission system shown in FIG. 9 with the air spinning machines 201. The information transmission system involving the air spinning machines 201 also yields similar effects to those yielded by the information transmission system 300 according to the first embodiment.

[0078] The first and second embodiments of the present invention have been explained above. The present invention is not limited to these embodiments. For example, the load log information accumulated and stored in the textile machine is displayed on the screen in the embodiments; however, the present invention is applicable to a textile machine that does not include a screen display device. In such a case, a maintenance service staff can connect another device (e.g., a USB memory) to the textile machine to read out the load log information. Alternatively, a maintenance service staff can connect a personal computer or the like to the textile machine and cause the load log information to be displayed on the personal computer or the like. Alternatively, a textile machine that does not include a screen display device can be configured to transmit the load log information to a textile-machine design company stationed at a remote site. In the present embodiment, an on-screen display is made on the touch panel display 94 of the centralized control box 90; alternatively, the load log information can be displayed on an information display section of the winder unit 10.

[0079] In the embodiments, the load log information is stored in the centralized unit-control section 61 separated from the board. Alternatively, a configuration in which a memory chip or the like serving as a storing section for the load log information is arranged on the board can be employed. Accordingly, a maintenance service staff can diagnose a cause of a damage using the load log information simply by obtaining a damaged board. In the embodiments, the load log information about the boards 53 of the winder units 10 is also stored in the centralized unit-control section 61. Alternatively, a storing section for the load log information about each of the boards 53 can be arranged in each of the winder units 10. However, collecting and storing the load log information about all the boards in the centralized unit-control section 61 as in the embodiments facilitates data management.

[0080] In the embodiments, the load log information is stored as electronic data; alternatively, the load log information can be stored in a form of a hard copy printed on a paper medium or the like. The boards about which load log information is to be stored are not limited to the boards 62, 96, 81, and 53 as in the embodiments. For example, load log information about the controller boards assembled into the textile machine, and slave boards and I/O boards that perform motor control in the winder units and/or the spinning units can be stored.

[0081] In the embodiments, all the load values about the boards are accumulated and stored in a serial manner and subjected to reduction of the load log information performed by the information reducing section later. Alternatively, a configuration that stores only load values each of which is equal to or higher than a corresponding critical load value can be employed. This configuration reduces a memory capacity of the information storing section and a process load. Furthermore, in this case, the load log information to be used by a maintenance service staff in diagnosis of a cause of a damage occurred to a board is reduced. Accordingly, the diagnosis of the cause can be performed speedily. Components of the automatic winder 1, the air spinning machine 201, and the information transmission system 300 in the embodiments can be combined appropriately.

[0082] In the embodiments, the setting section 91 that receives various input operations performed by a maintenance service staff is arranged in the screen displayed on the touch panel display 94; however, the setting section 91 can be provided in other form. For example, physical buttons can be arranged independently from the display. A configuration that uses a display having a touch-panel function and physical buttons in a combined manner can alternatively be employed.

[0083] In the embodiments, the alarm lamp 95 is arranged on the centralized control box 90; however, location of the alarm lamp 95 is not limited thereto. For example, the alarm lamp can be arranged on a panel of a winding unit as in a technique disclosed in Japanese Patent Application Laid-open No. 2011-016630. Further alternatively, the green lamp disclosed in Japanese Patent Application Laid-open No. H6-127827 can be used as the alarm lamp.

[0084] In the embodiments, when the temperature detected by the temperature sensor 62a is equal to or higher than the critical temperature value, when the voltage detected by the voltage monitor 62b is equal to or higher than the critical voltage value, or when the electric current detected by the current sensor 62c is equal to or higher than the critical current value, a message prompting to perform an operation to bring the critical value to a normal value is displayed on the display section 92. However, a position where the message is displayed is not limited thereto. For example, a display can be arranged in each of the winder units 10 so that the message is displayed on the display.

[0085] A textile machine according to an aspect of the present invention includes a circuit board on which an electronic circuit is formed, a load-value detecting section that detects a load value representing a load on the circuit board, and a load-value log storing section that accumulates and stores therein load values detected at different points in time by the load-value detecting section as load log information.

[0086] In the above textile machine, the information about values of the load on the circuit board at the different points in time are stored in the load-value log storing section as the load log information. Accordingly, when a damage should occur in the circuit board, a maintenance service staff can access and utilize the load log information about the circuit board in posterior diagnosis of a cause of the damage. Thus, the textile machine facilitates diagnosis of a cause of an anomaly in the circuit board.

[0087] The textile machine can further include a load-value log display section that displays a log of the load value based on the load log information stored in the load-value log storing section. If the textile machine does not have such a load-value log display section, operations of connecting another display device to the load-value log storing section of the textile machine, reading out the load log information, and causing the load log information to be displayed are required. However, the textile machine configured as described above makes it possible for a maintenance service staff to skip these operations and diagnose the cause of the anomaly speedily by causing the load log information to be displayed on the load-value log display section.

[0088] The textile machine can further include a graph-conversion processing section that converts a time series of the load values stored as the load log information into a time-series load-value graph plotted along a time axis, and a time-point designating section that designates a desired point in time on the time axis of the graph, and be configured such that the load-value log display section displays the time-series load-value graph obtained by the graph-conversion processing section; and a load value among the load values at the desired point in time designed by the time-point designating section. According to this configuration, the time series of load values of the circuit board is converted into the graph for visual recognition. Accordingly, a maintenance service staff can diagnose the cause of the anomaly more easily, thereby increasing accuracy of maintenance work. Furthermore, the maintenance service staff can perform the maintenance work efficiently by designating a desired point in time to check a load value at the desired point in time.

[0089] In the above textile machine, the load-value detecting section can detect a plurality of types of load values about each of the plurality of circuit boards, and the load-value log display section displays information pieces about the plurality of types of load values in a manner that the information pieces are switchable among the plurality of types and among the plurality of circuit boards. This makes it possible for a maintenance service staff to compare information about the load values among the plurality of circuit boards to locate a position where the anomaly has occurred and estimate a cause of the anomaly with correlation among the information taken into account. Accordingly, the maintenance service staff can locate the position where the anomaly has occurred more accurately and estimate the cause of the anomaly in more detail.

[0090] The load value can include at least any one of a value of temperature of a location where the circuit board is arranged, a value of voltage supplied to the circuit board, a value of electric current supplied to the circuit board, and a value of vibrations occurred to the circuit board. This makes it possible for a maintenance service staff to efficiently narrow down necessary maintenance works by obtaining the temperature value, the voltage value, the electric current value, and the vibration value related to the textile machine.

[0091] The load-value log storing section can further store an electric power value calculated from the electric current and the voltage as the load log information. The electric power value stored as the load log information can also serve as useful information for narrowing down necessary maintenance works at occurrence of an anomaly in the circuit board.

[0092] The textile machine can further include a control section that controls operation of a textile machine body, and a critical-load setting section that sets a critical load value which is a load value above which a potential for occurrence of an anomaly in the circuit board increases, and be configured such that when the load-value detecting section detects a load value equal to or higher than the critical load value, the control section controls the operation of the textile machine body so as to decrease the load value. According to this configuration, when possibility of anomaly occurrence in the circuit board has increased, a load on the circuit board that can be a cause of the anomaly is reduced. Accordingly, occurrence of an anomaly in the circuit board caused by the load can be prevented. Furthermore, useful life of the circuit board is prolonged because placing a heavy load on the circuit board is prevented.

[0093] More specifically, the textile machine can further include a cooling fan that sends cooling air to the circuit board, and a fan driving section that drives the cooling fan, and when the load-value detecting section detects a load value equal to or higher than the critical load value, the control section controls the fan driving section to drive the cooling fan; and, when the cooling fan has been driven, the load-value log storing section stores cooling-fan driving log. According to this configuration, occurrence of an anomaly in the circuit board resulting from a high temperature can be prevented. Furthermore, information indicating that there has been a possibility of occurrence of an anomaly in the circuit board is stored as the cooling-fan driving log. Accordingly, a maintenance service staff can utilize the information later.

[0094] More specifically, the textile machine can be configured such that when the load-value detecting section detects a load value equal to or higher than the critical load value, the control section stops the operation of the textile machine body; and, when the operation of the textile machine body has been stopped, the load-value log storing section stores a log of operation stoppage of the textile machine body. According to this configuration, occurrence of an anomaly in the circuit board resulting from a load can be prevented by stopping the operation of the textile machine body. Furthermore, information indicating that there has been a possibility of occurrence of an anomaly in the circuit board is stored as the log of the operation stoppage of the textile machine body. Accordingly, a maintenance service staff can utilize the information later.

[0095] The textile machine can further include an anomaly notifying section that issues a notice of anomalous operation of a textile machine body, and a critical-load setting section that sets a critical load value which is a load value above which a potential for occurrence of an anomaly in the circuit board increases, and be configured such that when the load-value detecting section detects a load value equal to or higher than the critical load value, the anomaly notifying section issues the notice of anomalous operation; and when the notice of anomalous operation has been issued, the load-value log storing section stores a log of the notice of anomalous operation. According to this configuration, when a possibility of occurrence of an anomaly in the circuit board has increased, the notice of anomalous operation is issued. Accordingly, a maintenance service staff can prevent occurrence of an anomaly in the circuit board caused by a load by performing appropriate operation in response to the notice. Furthermore, information indicating that there has been the possibility of anomaly occurrence in the circuit board is stored as the notice history. Accordingly, a maintenance service staff can utilize the information later.

[0096] The textile machine can further include a load-value log-information reducing section that reduces the load log information stored in the load-value log storing section, and a critical-load setting section that sets a critical load value which is a load value above which a potential for occurrence of an anomaly in the circuit board increases, and be configured such that the load-value log-information reducing section retains in the load log information only information pertaining to a load value in a predetermined time slot straddling a point in time at which a load value equal to or higher than the critical load value is detected by the load-value detecting section, and discards other information from the load log information. According to this configuration, information selection is performed such that only the information that highly possibly relate to occurrence of an anomaly in the circuit board are left as the load log information. Consequently, an amount of information to be stored in the load-value log storing section is reduced. Therefore, the textile machine can perform information processing more efficiently.

[0097] The textile machine can further include a control section that controls operation of a textile machine body, a critical-load setting section that sets a critical load value which is a load value above which a potential for occurrence of an anomaly in the circuit board increases, and a message display section that displays a message prompting to perform an operation to decrease a load value of the circuit board, and be configured such that when the load-value detecting section detects a load value equal to or higher than the critical load value, the control section causes the message display section to display the message instructing to perform an operation to decrease the load value of the circuit board. According to this configuration, a maintenance service staff can perform the operation to decrease the load value of the circuit board more efficiently.

[0098] Furthermore, in this textile machine, the load-value log-information reducing section can discard older information of the information left in the load log information in chronological order. This makes it possible to further reduce the amount of information to be stored in the load-value log storing section by selecting only newer information that are considered as being more important.

[0099] When the load-value detecting section detects a load value equal to or higher than the critical load value, the load-value log display section can display information about the load value in an appearance that differs from an appearance of information about other load values. According to this configuration, a maintenance service staff can become aware of the information about the load value equal to or higher than the critical load value more clearly when viewing the load-value log display section.

[0100] The circuit board can be interposed between and connected to an electric-power supply source that supplies electric power to the textile machine body and a component of the textile machine body. With this configuration, information that reflect both a status of the electric-power supply source and statuses of the component of the textile machine body can be obtained as the load log information by monitoring the load values of the circuit board. Accordingly, efficiency in information collection increases, making the load log information useful also in improvement of design of the textile machine.

[0101] The textile machine can further include a winding unit that winds a yarn to form a wound package, and be configured such that the circuit board is arranged in the winding unit. The winding unit that causes the wound package to rotate is likely to act as a source of vibrations. When the configuration described above is employed, the circuit board is susceptible to the vibrations, and hence the vibrations serve as a load on the circuit board. Accordingly, the circuit board is relatively prone to an anomaly. However, even when an anomaly should occur in the circuit board, a maintenance service staff can access and utilize the load log information about the circuit board in posterior diagnosis of a cause of an anomaly.

[0102] The textile machine can be an automatic winder or a spinning machine. The configuration of the textile machine described above is suitably applicable to an automatic winder or a spinning machine.

[0103] An information transmission system according to another aspect of the present invention includes the textile machines described above, a log-information output section that retrieves from the textile machine the load log information stored in the load-value log storing section, a log-information managing section that is connected to the log-information output section over a network and manages the load log information retrieved from the log-information output section. According to this information transmission system, it is possible for a maintenance service staff to obtain the load log information over the network even from a place remote from the textile machine. Accordingly, even the maintenance staff stationed at the remote place can easily diagnose a cause of an anomaly occurred in the circuit board by utilizing the load log information. It is possible for a maintenance service staff to correct an anomaly of the circuit board of the textile machine under instructions from a maintenance service staff having advanced knowledge at a remote site. Accordingly, possibility of recurrence of the anomaly as a result that the textile machine on which inappropriate maintenance is performed is kept to be operated can be reduced.

[0104] In the information transmission system, the load-value log storing section can store the load log information as electronic data. According to this configuration, the load log information can be handled more efficiently as compared with a system that stores the load log information in a medium such as paper.

[0105] According to the textile machine and the information transmission system for the textile machine, even when an anomaly occurs in the circuit board, a cause of the anomaly can be diagnosed easily.

Claims

1. A textile machine comprising:

   a circuit board (62) on which an electronic circuit is formed;
   a load-value detecting section (62a, 62b, 62c, 53a) that is adapted to detect a load value representing a load on the circuit board (62); and
   a load-value log storing section (61a) that is adapted to accumulate and to store therein load values detected at different points in time by the load-value detecting section (62a, 62b, 62c, 53a) as load log information.

2. The textile machine according to Claim 1, further comprising a load-value log display section (94) that is adapted to display a log of the load values based on the load log information stored in the load-value log storing section (61a).

3. The textile machine according to Claim 2, further comprising:

   a graph-conversion processing section (61c) that is adapted to convert a time series of the load values stored as the load log information into a time-series load-value graph plotted along a time axis; and
   a time-point designating section (94) that is adapted to designate a desired point in time on the time axis of the graph, wherein
   the load-value log display section (94) is adapted to display
   the time-series load-value graph obtained by the graph-conversion processing section (61c), and
   a load value among the load values at the desired point in time designed by the time-point designating section (94).

4. The textile machine according to Claim 2, wherein a plurality of the circuit boards (62, 53, 81, 96) are provided,
the load-value detecting section (62a, 62b, 62c, 53a) is adapted to detect a plurality of types of load values about each of the circuit boards (62, 53, 81, 96), and the load-value log display section (94) is capable of displaying information about the types of load values in a manner that the information pieces are switchable among the plurality of types and among the plurality of circuit boards (62, 53, 81, 96).

5. The textile machine according to any one of Claims 1 to 4, wherein the load value includes at least any one of a value of temperature of a location where the circuit board (62, 53, 81, 96) is arranged, a value of voltage supplied to the circuit board (62, 53, 81, 96), a value of electric current supplied to the circuit board (62, 53, 81, 96), and a value of vibrations occurred to the circuit board (62, 53, 81, 96).

6. The textile machine according to any one of Claims 1 to 5, further comprising:

a control section (61) that is adapted to control operation of a textile machine body (16); and
a critical-load setting section (94) that is adapted to set a critical load value representing a load value above which a potential for occurrence of an anomaly in the circuit board (62, 53, 81, 96) increases, wherein
when the load-value detecting section (62a, 62b, 62c, 53a) detects a load value equal to or higher than the critical load value, the control section (61) is adapted to control the operation of the textile machine body (16) so as to decrease the load value.

7. The textile machine according to Claim 6, further comprising:

a cooling fan (63) that is adapted to send cooling air to the circuit board (62, 53, 81, 96); and
a fan driving section (63a) that is adapted to drive the cooling fan (63), wherein
when the load-value detecting section (62a) detects a load value equal to or higher than the critical load value, the control section (61) is adapted to control the fan driving section (63a) to drive the cooling fan (63), and
when the cooling fan (63) has been driven, the load-value log storing section (61a) is adapted to store cooling-fan driving log.

8. The textile machine according to Claim 6, wherein when the load-value detecting section (62a, 62b, 62c, 53a) detects a load value equal to or higher than the critical load value, the control section (61) is adapted to stop the operation of the textile machine body (16), and
when the operation of the textile machine body (16) has been stopped, the load-value log storing section (61a) is adapted to store a log of operation stoppage of the textile machine body (16).

9. The textile machine according to any one of Claims 1 to 5, further comprising:

a control section (61) that is adapted to control operation of a textile machine body; and
a critical-load setting section (94) that is adapted to set a critical load value representing a load value above which a potential for occurrence of an anomaly in the circuit board increases; and
a message display section (92) that is adapted to display a message prompting to perform an operation to decrease a load value of the circuit board, wherein
when the load-value detecting section (62a, 62b, 62c, 53a) detects a load value equal to or higher than the critical load value, the control section (61) is adapted to cause the message display section (92) to display the message instructing to perform an operation to decrease the load value of the circuit board (62, 53, 81, 96).

10. The textile machine according to any one of Claims 1 to 5, further comprising:

an anomaly notifying section (95) that is adapted to issue a notice of anomalous operation of a textile machine body (16); and
a critical-load setting section (94) that is adapted to set a critical load value representing a load value above which a potential for occurrence of an anomaly in the circuit board increases, wherein
when the load-value detecting section (62a, 62b, 62c, 53a) detects a load value equal to or higher than the critical load value, the anomaly notifying section (94) is adapted to issue the notice of anomalous operation, and
when the notice of anomalous operation has been issued, the load-value log storing section (61a) is adapted to store a log of the notice of anomalous operation.

11. The textile machine according to any one of Claims 1 to 5, further comprising:

a load-value log-information reducing section (61b) that is adapted to reduce the load log information stored in the load-value log storing section (61a); and
a critical-load setting section (94) that is adapted

to set a critical load value representing a load value above which a potential for occurrence of an anomaly in the circuit board increases, wherein

the load-value log-information reducing section (61b) is adapted to retain in the load log information only information pertaining to a load value in a predetermined time slot straddling a point in time at which a load value equal to or higher than the critical load value is detected by the load-value detecting section (62a, 62b, 62c, 53a), and is adapted to discard other information from the load log information.

12. The textile machine according to any one of Claims 6 to 11, wherein when the load-value detecting section (62a, 62b, 62c, 53a) is adapted to detect a load value equal to or higher than the critical load value, the load-value log display section (94) is adapted to display information about the load value in an appearance that differs from an appearance of information about other load values.

13. The textile machine according to any one of Claims 1 to 12, wherein the circuit board is interposed between and connected to an electric-power supply source (99) that is adapted to supply electric power to the textile machine body and a component of the textile machine body.

14. The textile machine according to any one of Claims 1 to 13, further comprising a winding unit (10) that is adapted to wind a yarn (20) to form a package (30), wherein

the circuit board is arranged in the winding unit (10).

15. The textile machine according to any one of Claims 1 to 14, wherein the textile machine is an automatic winder(1) or a spinning machine(201).

16. An information transmission system for a textile machine (300), comprising:

the textile machine according to any one of Claims 1 to 15;

a log-information output section (97) that is adapted to retrieve from the textile machine the load log information stored in the load-value log storing section (61); and

a log-information managing section (301) connected to the log-information output section (97) over a network, the log-information managing section (301) adapted to manage the load log information retrieved from the log-information output section (97).

FIG.1

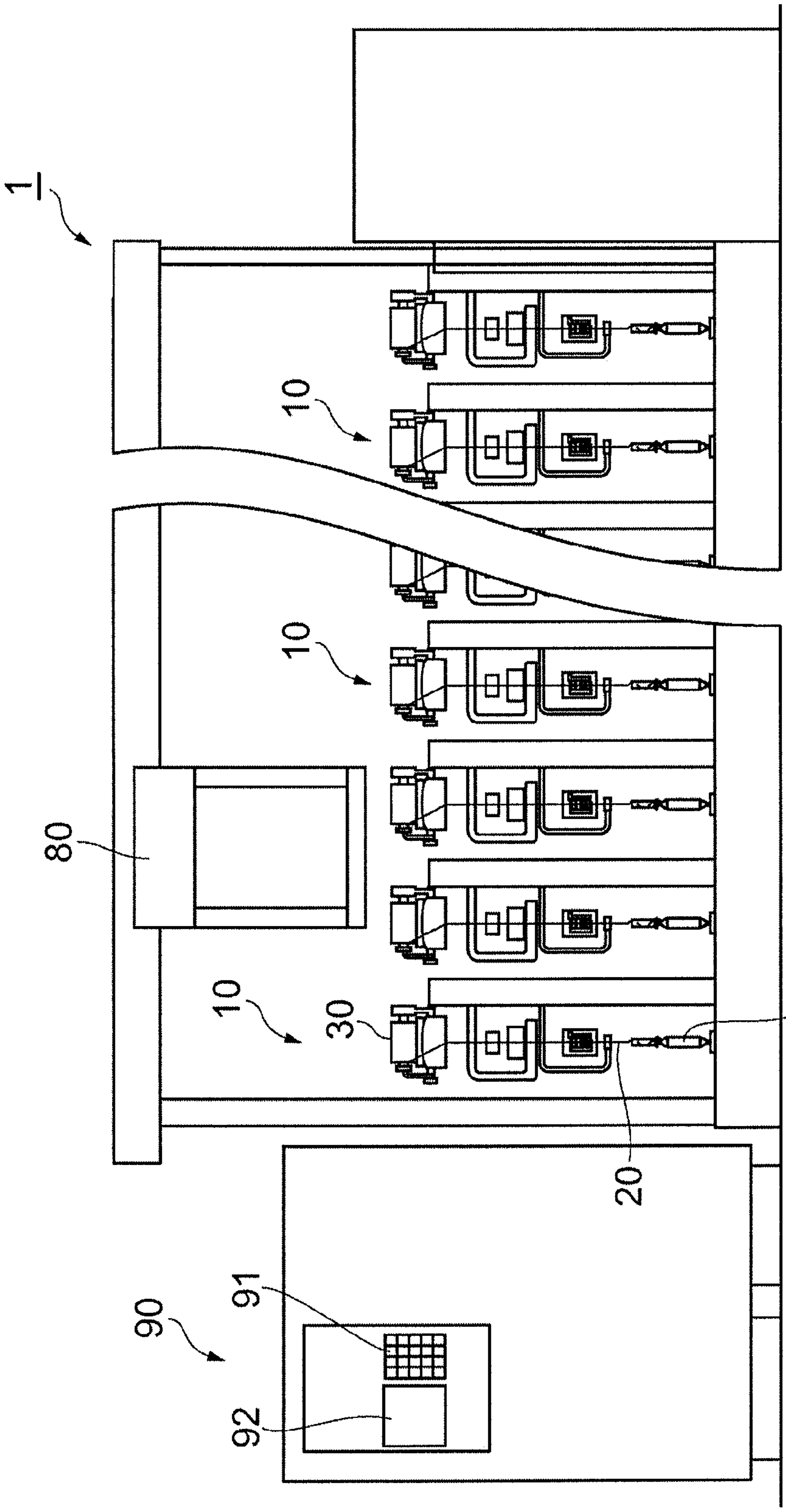


FIG.2

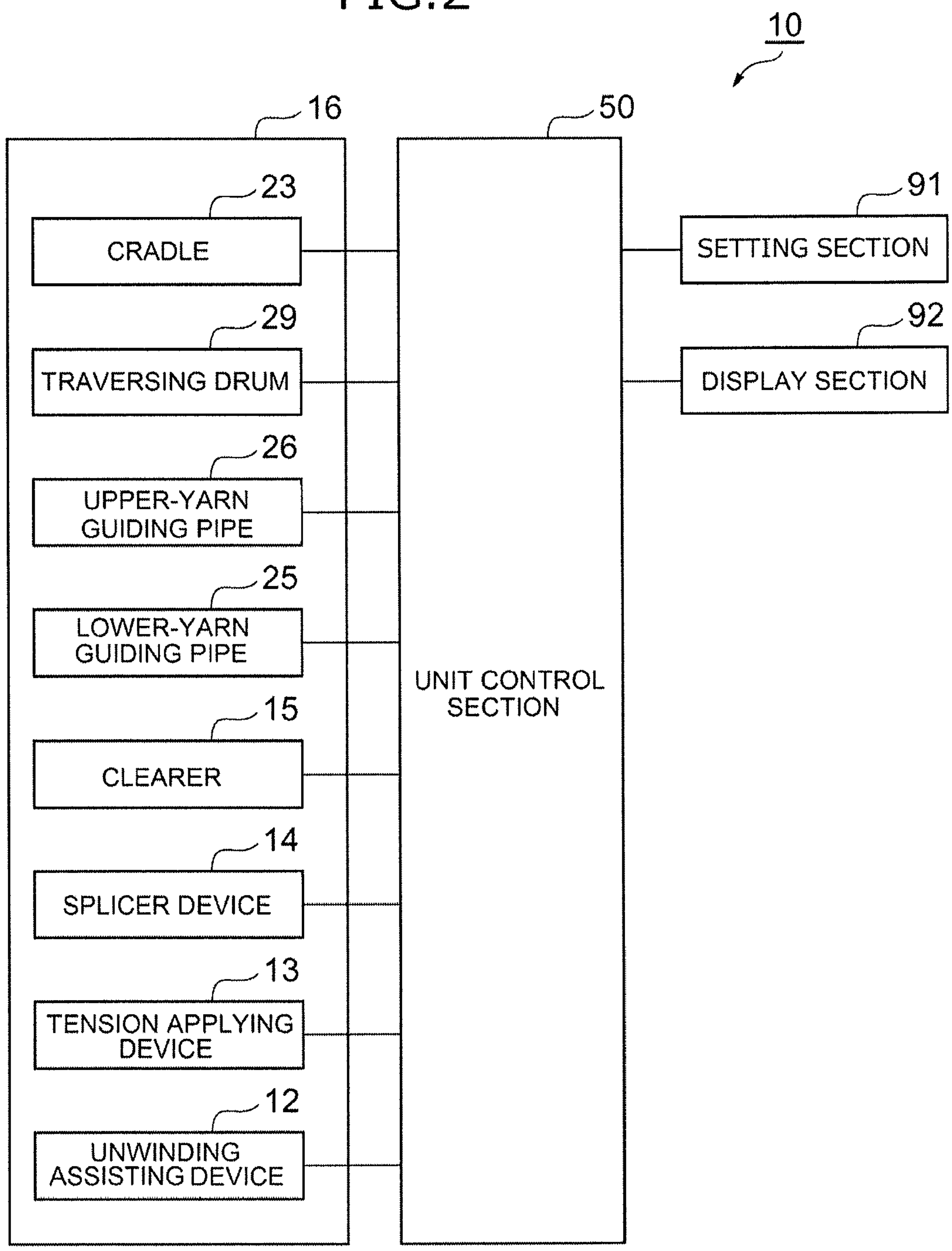

10
16
50
23
CRADLE
29
TRAVERSING DRUM
26
UPPER-YARN GUIDING PIPE
25
LOWER-YARN GUIDING PIPE
15
CLEARER
14
SPLICER DEVICE
13
TENSION APPLYING DEVICE
12
UNWINDING ASSISTING DEVICE
UNIT CONTROL SECTION
91
SETTING SECTION
92
DISPLAY SECTION

FIG.3

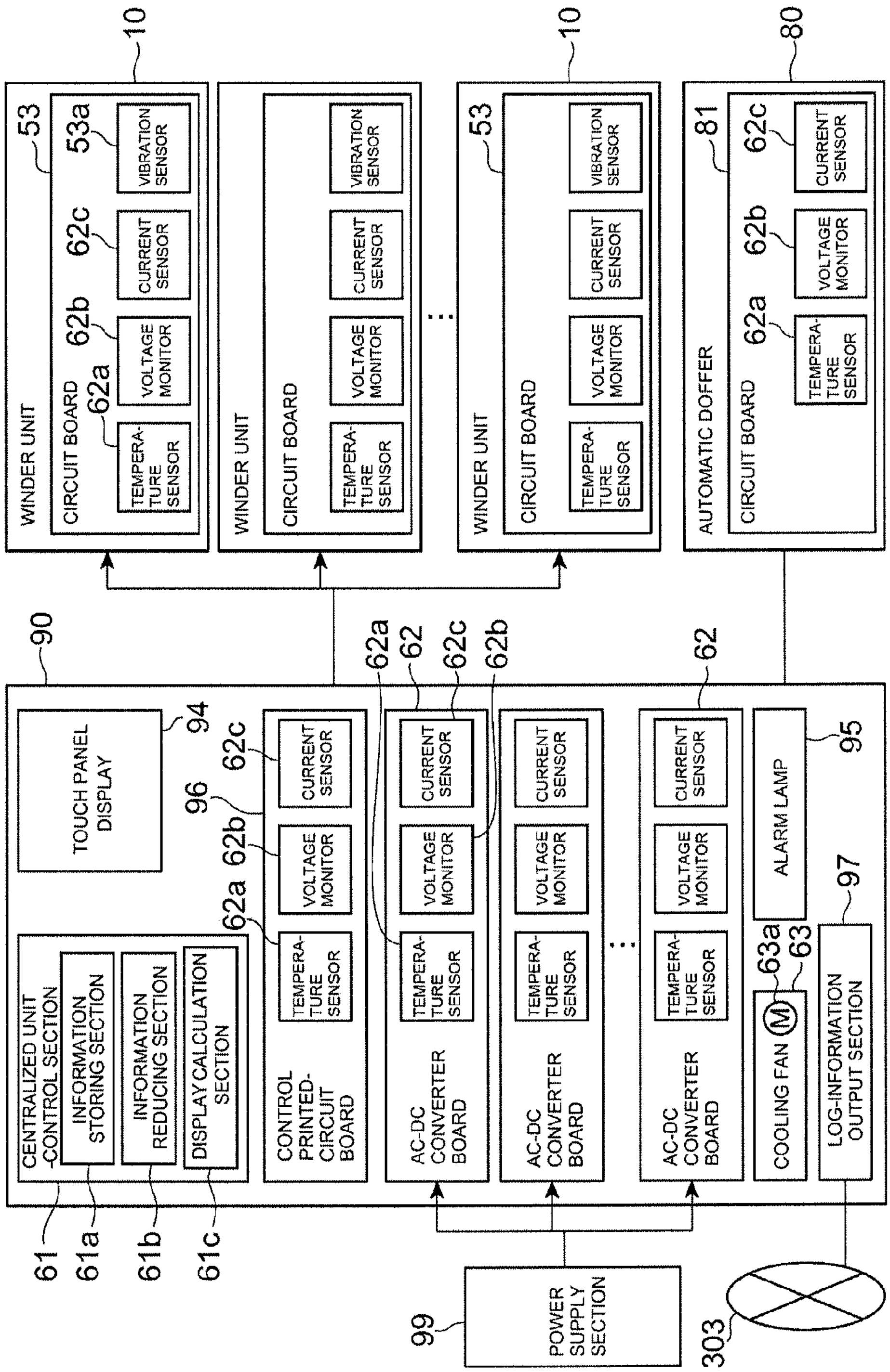

WINDER UNIT
CIRCUIT BOARD
TEMPERA-TURE SENSOR
VOLTAGE MONITOR
CURRENT SENSOR
VIBRATION SENSOR
AUTOMATIC DOFFER
TOUCH PANEL DISPLAY
CENTRALIZED UNIT -CONTROL SECTION
INFORMATION STORING SECTION
INFORMATION REDUCING SECTION
DISPLAY CALCULATION SECTION
CONTROL PRINTED-CIRCUIT BOARD
AC-DC CONVERTER BOARD
COOLING FAN
ALARM LAMP
LOG-INFORMATION OUTPUT SECTION
POWER SUPPLY SECTION
10
53
53a
62a
62b
62c
80
81
90
94
96
62
95
97
63
63a
61
61a
61b
61c
99
303

FIG.4

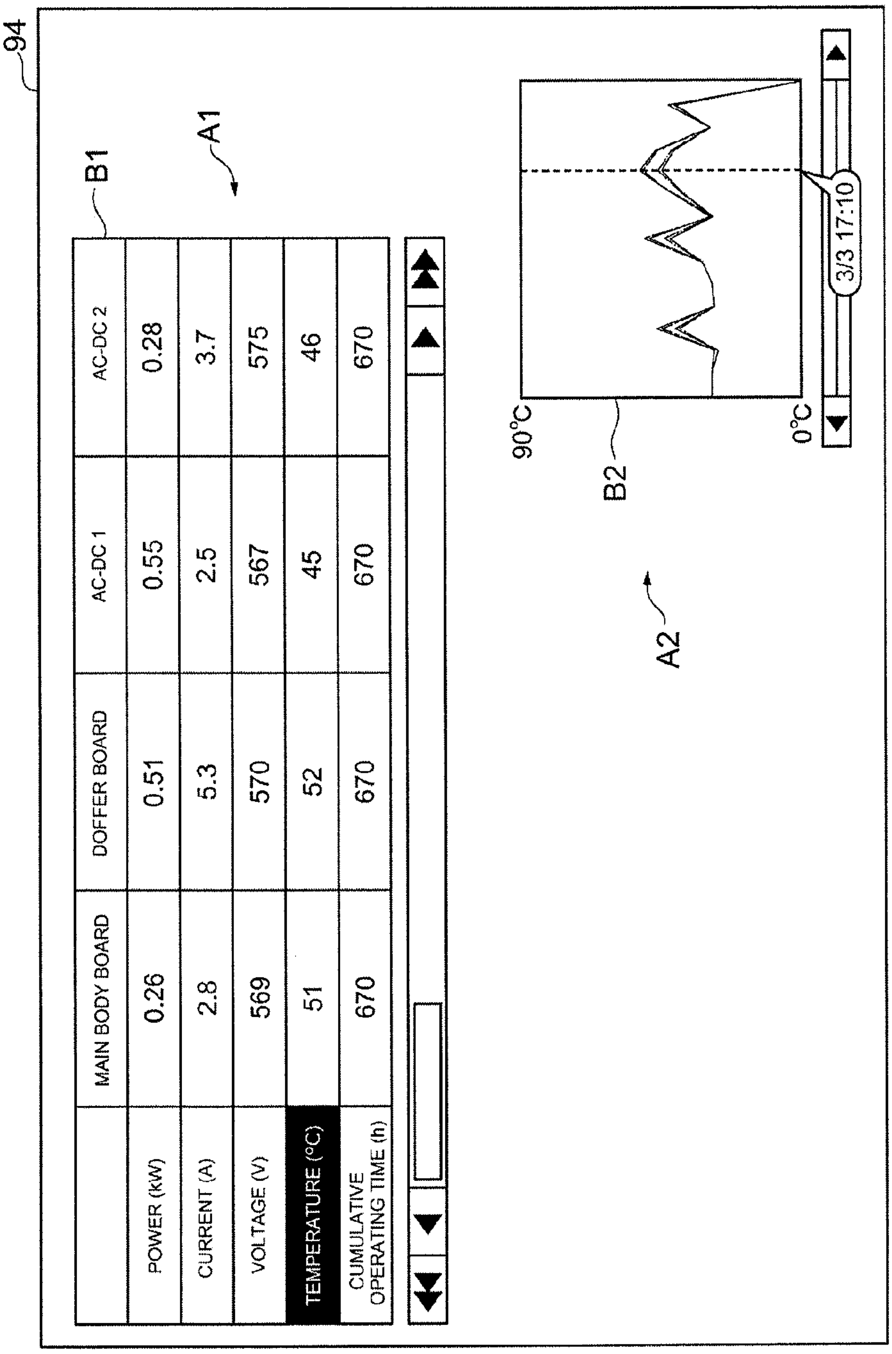

94
B1
A1
MAIN BODY BOARD
DOFFER BOARD
AC-DC 1
AC-DC 2
POWER (kW)
0.26
0.51
0.55
0.28
CURRENT (A)
2.8
5.3
2.5
3.7
VOLTAGE (V)
569
570
567
575
TEMPERATURE (°C)
51
52
45
46
CUMULATIVE OPERATING TIME (h)
670
670
670
670
90°C
0°C
B2
A2
3/3 17:10

FIG.5

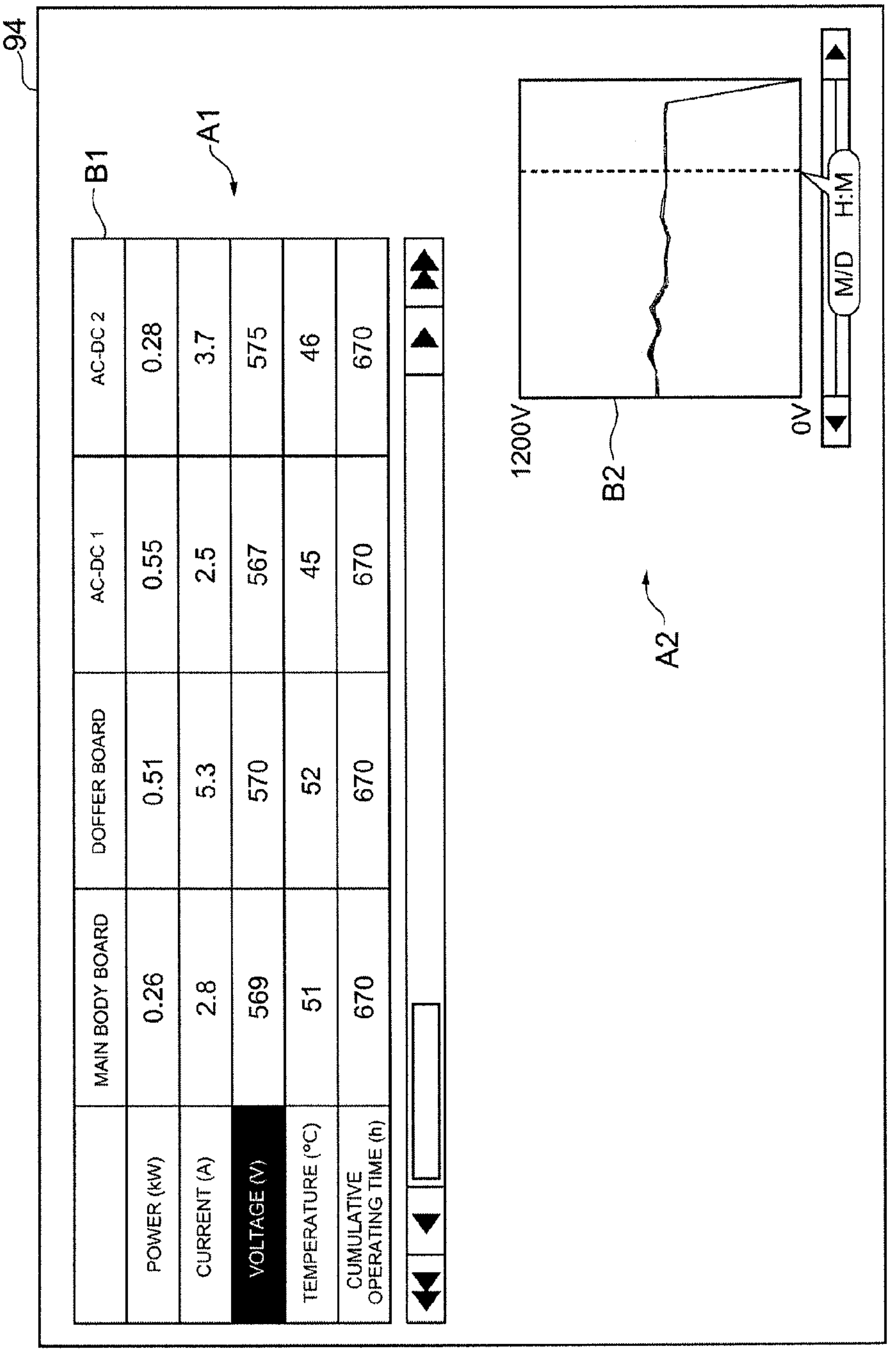

94
A1
B1
MAIN BODY BOARD
DOFFER BOARD
AC-DC 1
AC-DC 2
POWER (kW)
0.26
0.51
0.55
0.28
CURRENT (A)
2.8
5.3
2.5
3.7
VOLTAGE (V)
569
570
567
575
TEMPERATURE (°C)
51
52
45
46
CUMULATIVE OPERATING TIME (h)
670
670
670
670
1200V
0V
B2
M/D
H:M
A2

FIG.6

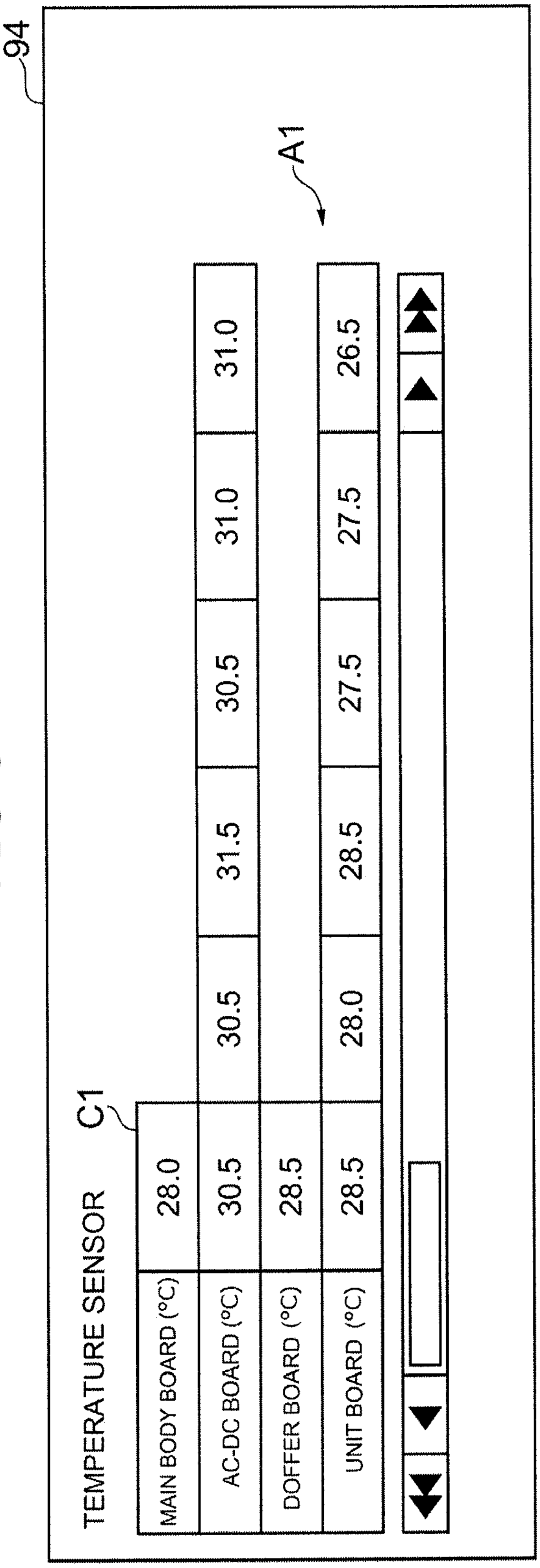

94
A1
C1
TEMPERATURE SENSOR
MAIN BODY BOARD (°C)
28.0
AC-DC BOARD (°C)
30.5
30.5
31.5
30.5
31.0
31.0
DOFFER BOARD (°C)
28.5
UNIT BOARD (°C)
28.5
28.0
28.5
27.5
27.5
26.5

FIG.7

94

DATE	TIME	BOARD	UNIT NUMBER	IMPORTANCE LEVEL	ALARM INFORMATION	CODE
3/3	17:13:07	MAIN BODY		1	ABC ERROR	12345
3/3	17:13:06	MAIN BODY		1	ABC ERROR	11245
3/3	17:13:06	MAIN BODY		1	ABC ERROR	12121
3/3	17:12:50	MAIN BODY		2	XYZ ALARM	11211
3/3	17:12:50	DOFFER		1	AAA ERROR	21141
3/3	17:12:50	WINDER UNIT	7	3	ABC ERROR	31412
3/3	17:12:50	DOFFER		3	ABC ERROR	47758
3/3	17:12:50	DOFFER		3	ABC ERROR	45268
3/3	17:12:50	DOFFER		3	XYZ ALARM	49685
3/3	17:12:50	SPLICER 4		3	AAA ERROR	54258
3/3	17:12:05	SPLICER 5		3	ABC ERROR	55236
3/3	17:12:05	SPLICER 6		3	ABC ERROR	56894
3/3	17:12:05	SPLICER 6		3	ABC ERROR	56428

FIG.8

94

DATE	TIME	BOARD	UNIT NUMBER	IMPORTANCE LEVEL	ALARM INFORMATION	CODE
3/3	17:12:50	WINDER UNIT	7	3	ABC ERROR	31412
3/3	17:11:07	WINDER UNIT	7	3	ABC ERROR	47758
3/3	17:11:07	WINDER UNIT	7	3	ABC ERROR	45268
3/3	17:09:31	WINDER UNIT	7	3	XYZ ALARM	49685
3/3	17:09:31	WINDER UNIT	7	3	AAA ERROR	54258
3/3	15:09:31	WINDER UNIT	7	3	ABC ERROR	55236
3/3	13:33:05	WINDER UNIT	7	3	ABC ERROR	56894
3/3	12:12:59	WINDER UNIT	7	3	ABC ERROR	56428

FIG.9

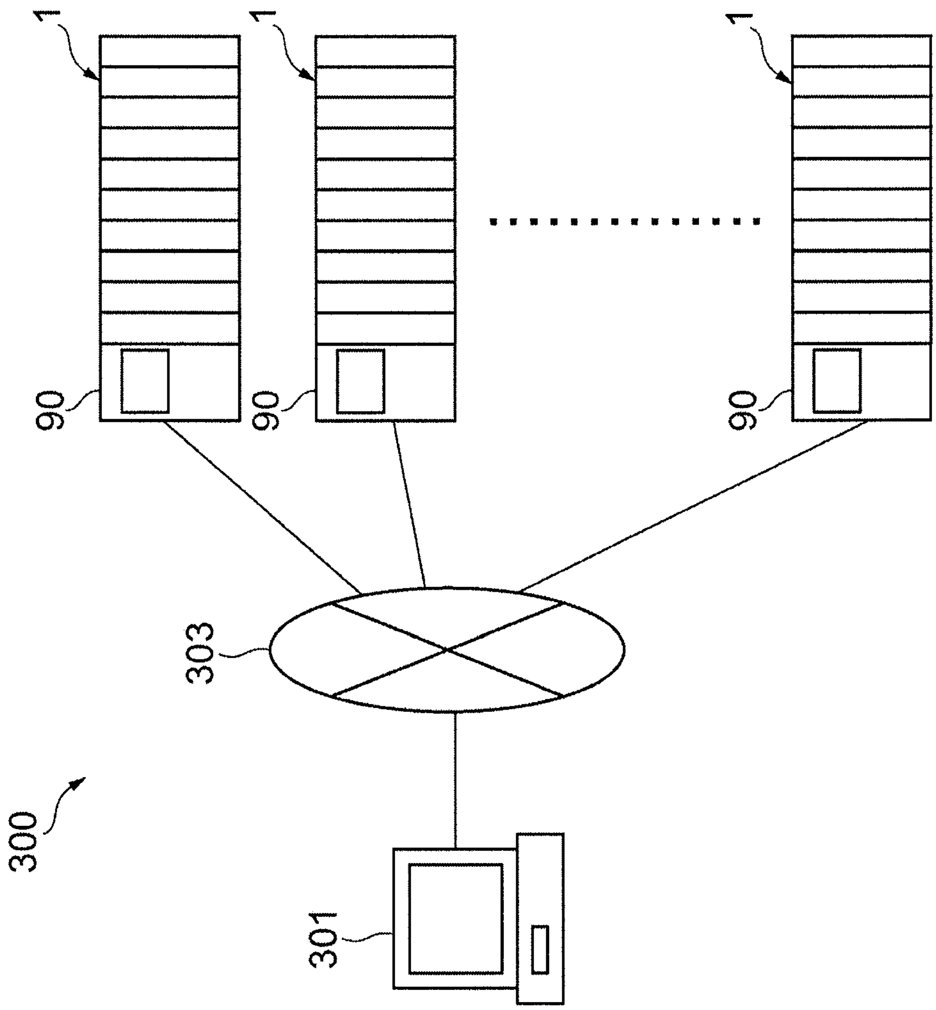


FIG.10

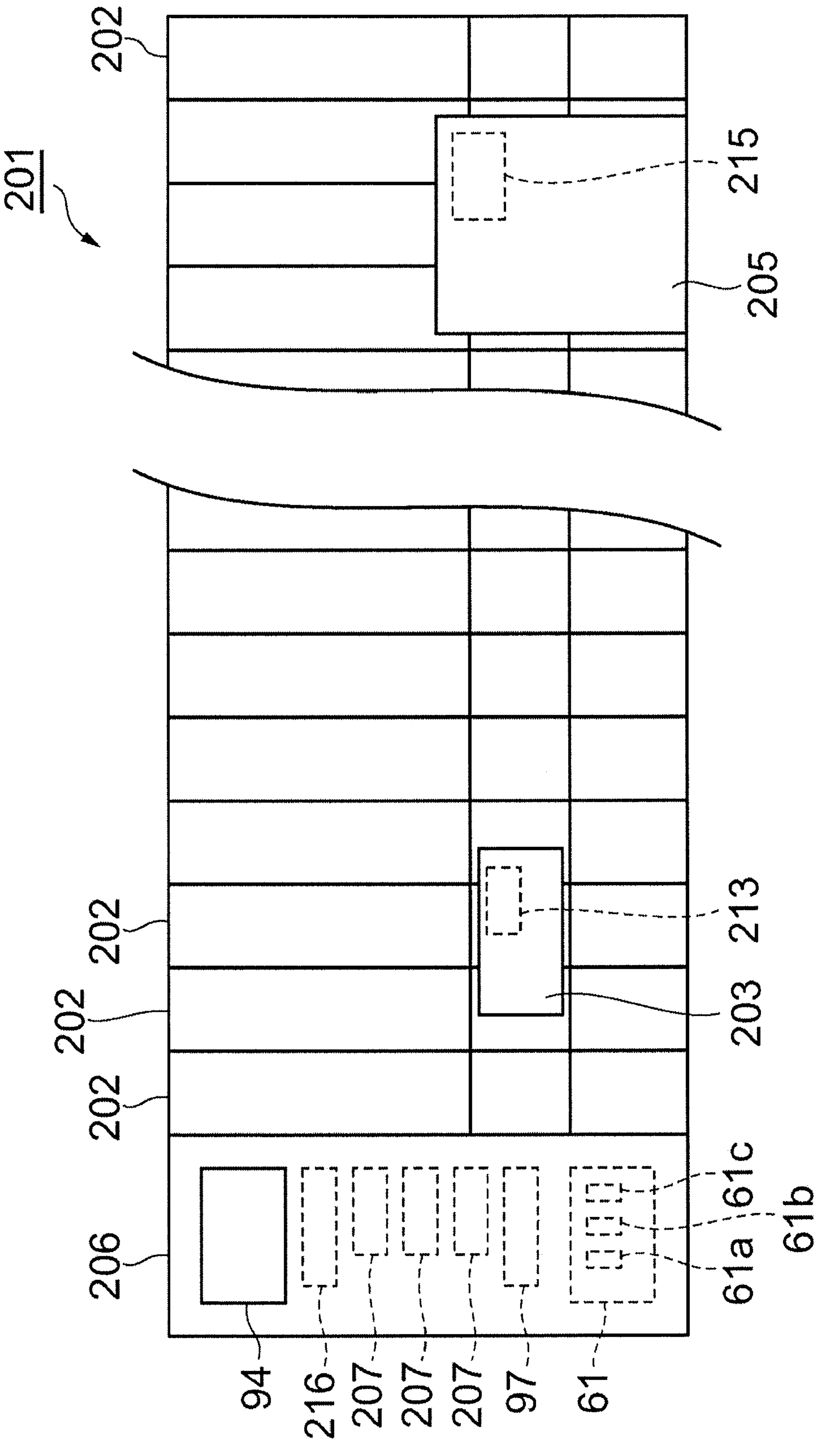
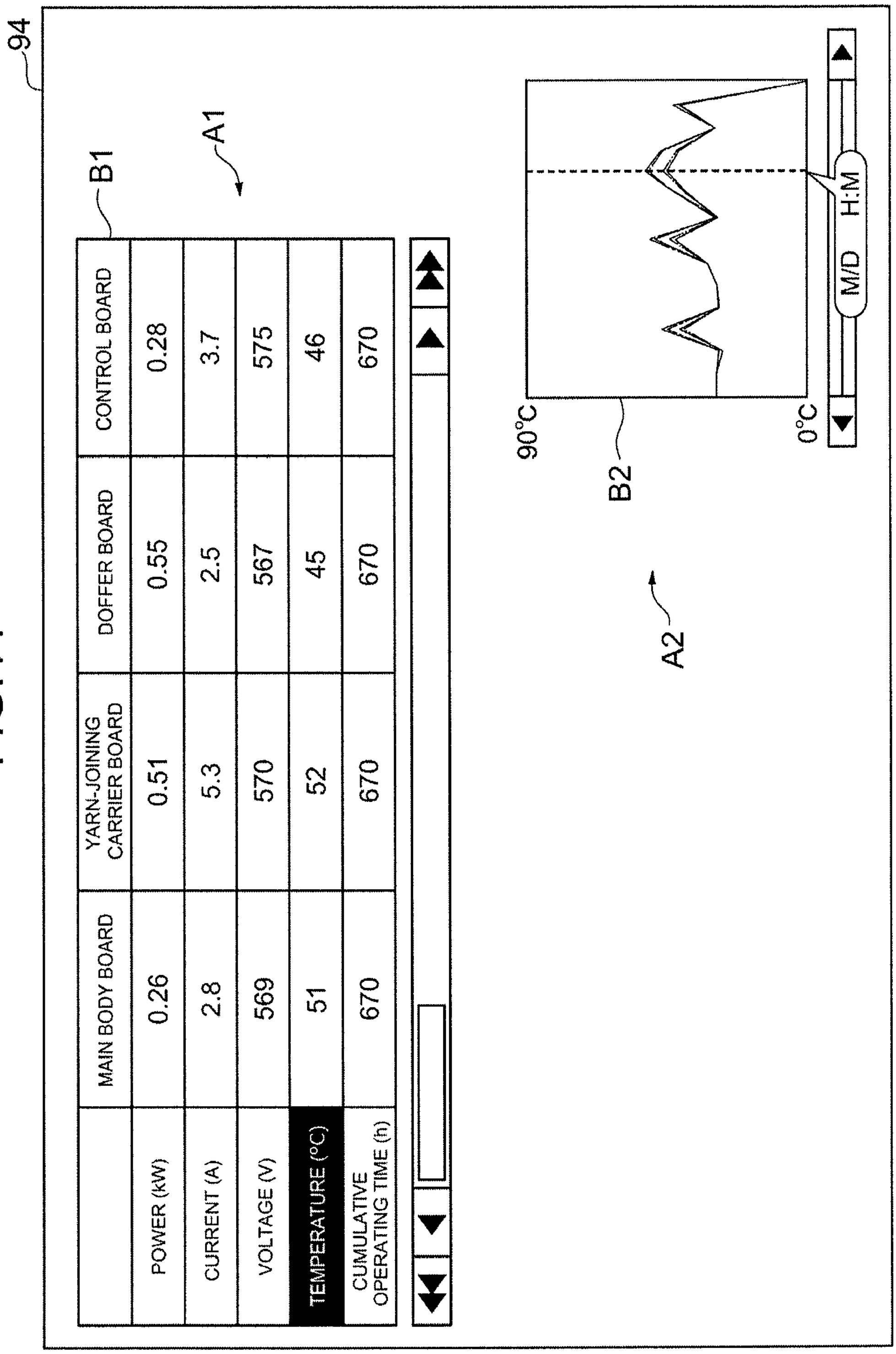
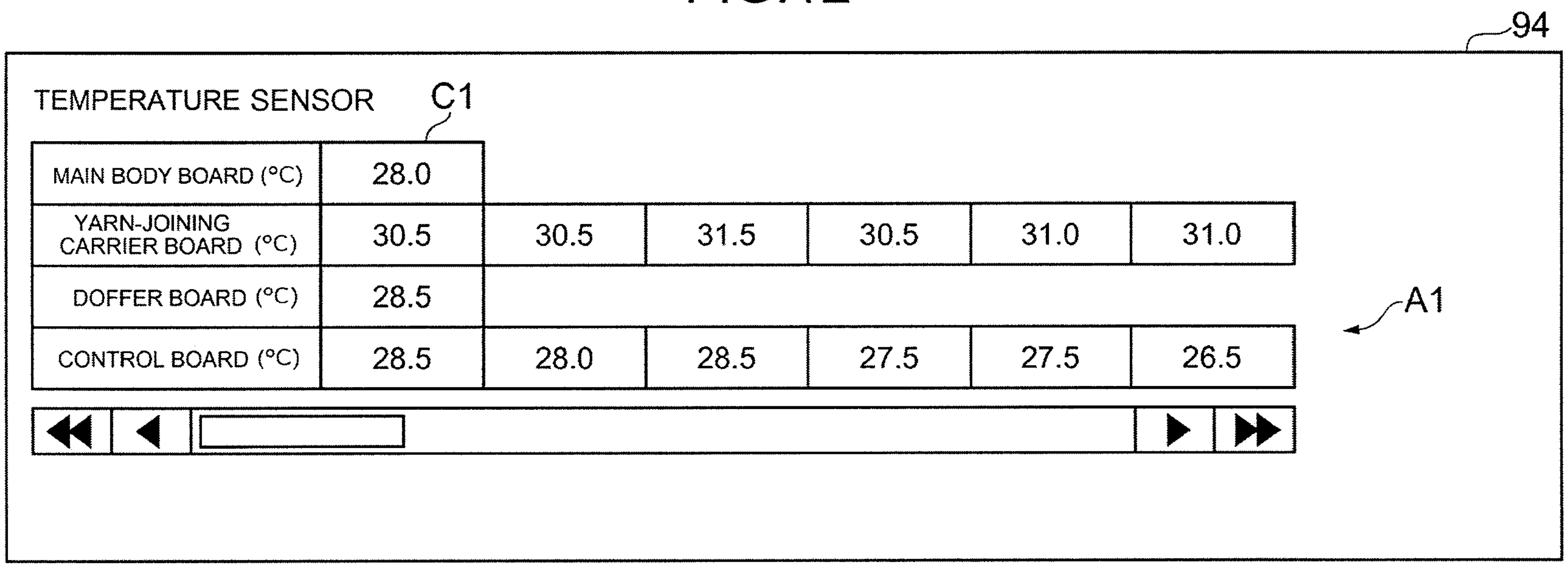

201
202
215
205
202
202
202
213
203
206
61c
61b
61a
94
216
207
207
207
97
61

FIG.11



	MAIN BODY BOARD	YARN-JOINING CARRIER BOARD	DOFFER BOARD	CONTROL BOARD
POWER (kW)	0.26	0.51	0.55	0.28
CURRENT (A)	2.8	5.3	2.5	3.7
VOLTAGE (V)	569	570	567	575
TEMPERATURE (°C)	51	52	45	46
CUMULATIVE OPERATING TIME (h)	670	670	670	670

FIG.12


94
TEMPERATURE SENSOR
C1
MAIN BODY BOARD (°C)
28.0
YARN-JOINING CARRIER BOARD (°C)
30.5
30.5
31.5
30.5
31.0
31.0
DOFFER BOARD (°C)
28.5
CONTROL BOARD (°C)
28.5
28.0
28.5
27.5
27.5
26.5
A1

REFERENCES CITED IN THE DESCRIPTION

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- JP 2011 A **[0083]**
- JP 016630 A **[0083]**
- JP H6127827 B **[0083]**