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(54) **TEXTILE MACHINE SYSTEM**

Textilmaschinensystem und Textilmaschine

Système de machine textile et machine textile

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(56) References cited:
WO-A1-2007/112873
DE-A1- 10 055 025
DE-A1- 10 055 026
DE-A1- 10 234 467
DE-A1-102005 050 058

EP 2 108 723 B2

Description

Field of the Invention

[0001] The present invention relates to a textile machine system that communicates information among a plurality of textile machines.

Background of the Invention

[0002] Textile machines are conventionally known each of which includes a plurality of fiber processing units and a control device that controls operation of the fiber processing units. An example of such a textile machine is a yarn winder including a plurality of yarn winding units. A control device for the yarn winder can monitor the current operating state of each winding unit and set various yarn processing conditions.

[0003] A plurality of yarn winders (frames) as described above are installed and operate in a textile factory. In this case, in order to operate the plurality of yarn winders under the same yarn processing conditions or to collectively change the yarn processing conditions, if an operator needs to go to each of the yarn winders to change set values for the yarn winder, operational efficiency is reduced. Such an operation imposes a heavy burden on the operator.

[0004] In this regard, the Unexamined Japanese Patent Application Publication (Tokkai) No. 2006-143338 discloses a yarn processing condition setting system for a textile machine which can transfer the set values via a local area network (LAN).

[0005] In the configuration in the Unexamined Japanese Patent Application Publication (Tokkai) No. 2006-143338, each of the frames is constructed to communicate with a host computer via LAN connections. Thus, when the yarn processing conditions set for one of the frames are to be transferred to another frame, the yarn processing conditions inevitably need to be transmitted via the host computer. The yarn processing conditions cannot be transferred from one frame directly to another, resulting in increased network traffic and the like. Furthermore, with the configuration in the Unexamined Japanese Patent Application Publication (Tokkai) No. 2006-143338, a defect in the host computer disables all communications among the frames, further affecting the system. Thus, the system still has room for improvement.

[0006] Moreover, when each of the frames is connected to the host computer via the wired LAN as described in the Unexamined Japanese Patent Application Publication (Tokkai) No. 2006-143338, rearrangement of the frames required in the textile factory is difficult. That is, it is difficult to move the frames to change the positions where the frames are provided in the textile factory. As a result, the rearrangement requires a long time, reducing the productivity of the factory as a whole.

[0007] On the other hand, the wired LAN in the Unexamined Japanese Patent Application Publication (Tokkai) No. 2006-143338 may be changed to a wireless LAN so that each of the frames can communicate wirelessly with the host computer. However, in this case, the other frames in the textile factory interfere with the communication. Thus, it is difficult to provide a layout design that allows all the frames to communicate properly with an access point for the wireless LAN. Consequently, communication disturbances may occur. Eventually, the same problems as those with the wired LAN may occur; the rearrangement of the frames requires a long time as is the case with the wired LAN.

[0008] WO 2007/112873 A1 describes a spinning machine having a plurality of internal sensors and actuators, wherein the actuators are connected to the sensors to, at least, receive the sensor signal to cause a predefined action in response to the sensor signal. For example, a sensor is provided for monitoring the yarn or a potential yarn break so that, in response to the detection of such a yarn break, by means of respective actuators, the necessary means inside the spinning machine can be actuated for splicing the yarn. The sensors and actuators internal in the spinning machine are connected with each other by a radio connection, for example, ZigBee, Bluetooth, WLAN or similar connections thereby avoiding a galvanic connection among the sensors and actuators.

[0009] DE 10 2005 050 058 A1 describes an approach for the exchange of information between textile machines using a transport medium which serves for the transport of data provided on the transport medium. The transport medium may be a memory inside a mobile telephone or a handheld computer, a disc drive, a magnetic drive, a compact disc, a DVD, a MO-disc or a mini disc.

Summary of the Invention

[0010] An object of the present invention is to provide a textile machine system in which the textile machines can communicate directly with one another without intervention of the host computer and can be easily rearranged.

[0011] This object is achieved by a textile machine system according to claim 1.

[0012] An aspect of the present invention provides a textile machine system including a plurality of textile machines configured as follows. That is, each of the textile machines includes at least one fiber processing unit, a control device, and a wireless communication section. The control device manages information on the fiber processing unit to control the fiber processing unit. The wireless communication section can carry out wireless communication according to a predetermined wireless communication standard (communication protocol). The wireless communication section can communicate directly via wireless communication with the wireless communication section provided in another textile machine. The control device of the textile machine transmits and receives the information to and from the control device

provided in another textile machine via wireless communication by the wireless communication sections.

[0013] With this configuration, in a facility in which a plurality of textile machines are installed, a textile machine communication system with the textile machines connected together like beads can be easily constructed. Thus, the control devices can communicate directly with each other without intervention of a host computer. This prevents the system as a whole from being affected by a fault in one host computer as in the case where communications involve the host computer. Furthermore, since the communication is wireless, the textile machines can be easily rearranged. That is, operators can easily move the textile machines to change the positions where the textile machines are provided in a textile factory. Moreover, since the textile machines can communicate with one another, the communication can be prevented from being disabled by blockage of radio waves by a particular frame as in the case in which the communication involves a predetermined access point. This allows the frames to be more freely arranged.

[0014] In the textile machine system, the fiber processing unit is a yarn winding unit that winds a yarn. The information is winding information of the yarn winding unit.

[0015] Thus, the winding information can be transmitted and received among the plurality of textile machines by wireless communication.

[0016] In the textile machine system, the wireless communication section is preferably removably provided in the textile machine.

[0017] Accordingly, by connecting the wireless communication section to a textile machine as required, direct wireless communication can be enabled between one textile machine and another textile machine. Alternatively, by removing the wireless communication section from a textile machine as required, such textile machine can be excluded from the textile machine communication system. Thus, the arrangement of the frames (textile machines) in the facility can be easily changed as in the case in which for example, the number of textile machines installed is increased from one to a plural number. As a result, the communication system can be more flexibly constructed, allowing inhibition of reduced productivity associated with the difficulty of rearrangement of the textile machines.

[0018] The textile machine system is configured as follows. That is, the plurality of textile machines are arranged adjacent to one another. The control device provided in one textile machine transmits, by wireless communication, information managed by the control device provided in the one textile machine to the control device provided in another textile machine located adjacent to the one textile machine. Upon receiving the information, the control device provided in the another textile machine can accumulatively transmit, together with the received information, information managed by the control device provided in the another textile machine to a control device provided in yet another textile machine located adjacent to the another textile machine.

[0019] Thus, when the textile machines transmit and receive information to and from one another, each of the textile machines can add the textile machine's own information to received information and then transmit both pieces of information. Consequently, the information can be efficiently collected in the textile machine system.

[0020] The textile machine system is preferably configured as follows. That is, such a textile machine system includes a textile machine with a first control device and a textile machine with a second control device, and both textile machines are respectively provided with a wireless communication section. In such a textile machine system, before transmitting information managed by the first control device to the second control device, a determination is made as to whether or not communication can be carried out between the textile machine with the first control device and the textile machine with the second control device. When the wireless communication section cannot communicate with the second control device, the wireless communication section communicates with a third control device. Further, the third control device is a control device provided in a textile machine different from that including the second control device.

[0021] Thus, even if the textile machine system includes a textile machine that fails to carry out communication, the textile machine system enables communication with another textile machine by skipping the textile machine that fails to carry out communication. As a result, for example, even if a radio wave condition is changed by rearrangement of the textile machines or the communication function of a particular textile machine is defective, a communication path can be automatically reconstructed. Thus, the textile machines can be more easily rearranged, and the communications throughout the textile machine system can be prevented from being shut down as a result of a defect in the communication function of a particular textile machine. This further improves the productivity.

[0022] In the above-described textile machine system, preferably, the predetermined wireless communication standard (communication protocol) is a short-distance wireless communication standard, and the plurality of textile machines can be connected together so as to be capable of consecutively communicating with one another via the wireless communication sections.

[0023] That is, by enabling the consecutive wireless communication, even the short-distance wireless communication can cover the plurality of textile machines. Thus, the textile machines can communicate with one another in a vast factory site. Therefore, the textile machine system is suitably configured as described above.

[0024] In the above-described textile machine system, the predetermined wireless communication standard is preferably ZigBee.

[0025] ZigBee is a wireless communication standard that enables terminals to communicate with each other.

ZigBee involves reduced power consumption and a transmission distance appropriate for use in a vast factory site. Thus, ZigBee is particularly suitably used for the textile machine.

[0026] Another aspect of the present invention provides a textile machine configured as described below. That is, the textile machine includes at least one fiber processing unit. Furthermore, the textile machine includes a communication terminal that can perform at least one of transmission and reception of information directly to and from another textile machine.

[0027] A plurality of textile machines configured as described above can be installed in a factory and communication can be carried out among such textile machines. Accordingly, communication can be carried out without intervention of a host computer. Thus, a communication network for the textile machines can be constructed in which textile machines can be easily rearranged.

[0028] In the above-described textile machine, the fiber processing unit is a yarn winding unit that winds a yarn. The information is winding information of the yarn winding unit.

[0029] Thus, a plurality of the textile machines each including the yarn winding unit can be installed, and winding information can be communicated among the textile machines.

[0030] In the above-described textile machine system, the predetermined wireless communication standard is preferably ZigBee.

[0031] ZigBee is a wireless communication standard that enables terminals to communicate with each other. ZigBee involves reduced power consumption and a transmission distance appropriate for use in a vast factory site. Thus, ZigBee is particularly suitably used for the communication network among the textile machines.

[0032] Other features, elements, processes, steps, characteristics and advantages of the present invention will become more apparent from the following detailed description of preferred embodiments of the present invention with reference to the attached drawings.

Brief Description of the Drawings

[0033]

Figure 1 is a schematic front view of an automatic winder according to an embodiment of the present invention.

Figure 2 is a conceptual drawing of a textile machine system according to an embodiment of the present invention.

Figure 3 is a flowchart of a parent-child relationship re-setting process according to an embodiment of the present invention.

Detailed Description of the Preferred Embodiments

[0034] Preferred embodiments of the present invention will be described with reference to the drawings.

[0035] As shown in Figure 1, an automatic winder 60 includes a frame control device (control device) 11, a plurality of yarn winding units (fiber processing units) 16 arranged side by side, a supplying device 52, and an automatic doffing device 51.

[0036] The supplying device 52 conveys a yarn supplying bobbin 21 along a supply path (not shown in the drawings) to supply the yarn supplying bobbin 21 to each yarn winding unit 16. When a package 30 becomes full at one of the winding units 16, the automatic doffing device 51 travels to the position of such yarn winding unit 16. Then, the automatic doffing device 51 collects the full package and provides an empty bobbin to the yarn winding unit 16. Operation of the supplying device 52 and the automatic doffing device 51 is controlled by the frame control device 11.

[0037] Each of the yarn winding units 16 unwinds a yarn 20 from the yarn supplying bobbin 21 and winds the unwound yarn 20 around a bobbin while traversing the yarn 20 by a traverse drum 41 to form a package 30. The yarn winding unit 16 includes a clearer (yarn quality measuring instrument) 42 that monitors the thickness of the traveling yarn 20 or the like. Upon detecting a defect in the yarn 20, the clearer 42 removes the detected defect in the yarn 20.

[0038] Each of the yarn winding units 16 includes a unit control section 50. The unit control section 50 includes a central processing unit (CPU), a read only memory (ROM), a random access memory (RAM), and an input and output (I/O) port (not illustrated in the drawings). The ROM stores control programs for controlling components (for example, the traverse drum 41) of the yarn winding unit 16. The CPU retrieves the control programs from the ROM to the RAM, and executes the control program to control the corresponding component. Thus, a yarn winding operation can be appropriately performed.

[0039] The I/O port of the unit control section 50 is connected to the frame control device 11 to enable transmission and reception of information. Thus, the plurality of yarn winding units 16 provided in the automatic winder 60 can be collectively managed by the frame control device 11.

[0040] The frame control device 11 includes a display 13, an input key 14, a universal serial bus (USB) port 15, and a ZigBee terminal 12 (radio communication section, wireless communication section, communication terminal) connected to the USB port 15. Like the unit control section 50, the frame control device 11 includes a CPU, a ROM, a RAM, and an I/O port. The display 13 and the input key 14 are connected to the I/O port. The USB port 15 is configured as a part of the I/O port.

[0041] The I/O port of the frame control device 11 is connected via an appropriate communication line to the I/O port of the unit control section 50 provided in each of the yarn winding units 16. The frame control device 11 can transmit various yarn winding conditions to the unit control section 50 of the yarn winding unit 16 to set the

yarn winding conditions. The frame control device 11 can receive information on the current yarn winding state (yarn winding state information) of the yarn winding unit 16 from the unit control section 50 of the yarn winding unit 16.

[0042] The yarn winding conditions include, for example, winding speed, yarn count, winding tension, the amount of yarn to be wound into a package, the weight of the package, and an item relating to a yarn defect. The yarn winding state information includes, for example, the current package diameter, the current winding speed, the occurrence state of yarn breakage, and the detecting state of a yarn defect.

[0043] Specifically, an operator can perform an appropriate operation to allow a yarn winding condition setting menu to be displayed on the display 13. The operator can then input numerical values via input keys 14 to set the yarn winding conditions. Set values for the yarn winding conditions can be transmitted collectively to all the yarn winding units 16. Alternatively, each yarn winding unit 16 can be designated individually, and the set values for the yarn winding conditions can be transmitted to the designated yarn winding unit 16.

[0044] The frame control device 11 can display the yarn winding state information, which changes constantly, on the display 13 in real-time. The frame control device 11 can store history of the past yarn winding state information. For example, the display 13 can display a graph in which the occurrence frequency of yarn defects is plotted along a time axis. The frame control device 11 can analyze the history of the yarn winding state information to calculate statistical information. For example, the frame control device 11 can calculate the winding efficiency of each of the yarn winding units 16, the number of yarn breakages that occurred within a given period in each of the yarn winding units 16, and display the calculation results on the display 13.

[0045] In the description below, the yarn winding conditions, the yarn winding state information, the history of the yarn winding state information, and the statistical information are sometimes collectively referred to as "winding information". As described above, the operator can use the frame control device 11 to set or view the winding information on the plurality of yarn winding units 16. Consequently, the operator can efficiently manage the automatic winder 60.

[0046] The ZigBee terminal 12 includes a well-known USB connector (not shown in the drawings). The USB connector is installed in the USB port 15 to connect the ZigBee terminal 12 to the frame control device 11. The ZigBee terminal 12 allows the frame control device 11 to transmit and receive the winding information to and from the frame control device 11 provided in another automatic winder 60. The ZigBee terminal 12 can be removed from the frame control device 11 by pulling out the USB connector from the USB port 15.

[0047] Next, an automatic winder system according to an embodiment of the present invention will be described. Figure 2 is a conceptual drawing of an automatic winder system (textile machine system) 70 including a plurality of the automatic winders 60, described above.

[0048] As shown by arrows in Figure 2, in the automatic winder system 70, the plurality of automatic winders 60 form a network in which the winding information can be transmitted and received. The winding information is transmitted and received via wireless communication by the ZigBee terminals 12 of the automatic winders 60. The plurality of automatic winders 60 shown in Figure 2 are denoted by reference numerals 61, 62, 63 so as to be distinguished from one another. In the description below, the automatic winders may be specified using the corresponding reference numeral.

[0049] The ZigBee terminals 12 carry out communication based on the ZigBee communication standard and can thus communicate with each other. This eliminates the need to install a particular host computer or access point, allowing a network capable of direct mutual communications (what is called an ad hoc network) to be constructed. Thus, the automatic winders 60 with the ZigBee terminals 12 can transmit and receive the winding information directly to and from one another by wireless communication.

[0050] In an actual textile factory, as shown in Figure 2, a plurality of the automatic winders 60 (frames) are typically arranged in parallel. Furthermore, in a factory large enough to include several tens of frames, when for example, the distance between the frames is about 2 m, the distance between the opposite ends of a frame installation space in a vertical direction of the sheet of Figure 2 may be longer than 100 m. Thus, for example, when carrying out wireless communication directly between the automatic winders 60 located at the respective opposite ends of the frame installation space, radio waves are difficult to reach the target automatic winder in the vast factory site. Furthermore, the frames located midway between the automatic winders 60 provided at the opposite ends may interfere with the radio waves. This radio wave condition makes the communication difficult.

[0051] In view of this, in the present embodiment, the ZigBee terminal 12 provided in each of the automatic winders 60 has an information relay function to enable information to be transmitted and received via the plurality of automatic winders 60. Specifically, the ZigBee terminal 12 provided in the automatic winder 60 functions as what is called a router (ZigBee router) that has a data relay function. In the description below, the automatic winder 60 including the ZigBee terminal 12 as a router may simply be referred to as a "router terminal".

[0052] Thus, even the automatic winders 60 (frames) incapable of direct communications because of the inappropriate radio wave condition can transmit and receive winding information via another automatic winder 60. Furthermore, by enabling mutual communications via a plurality of frames as described above, all the frames can be easily allowed to join the wireless communication network regardless of how or where the frames are ar-

ranged. Thus, the frames can be easily rearranged. Furthermore, since communications do not involve a host computer, a situation in which a defect in the host computer shuts down the whole network can be advantageously avoided.

[0053] Next, a description will be made on operations performed when starting the network for the automatic winder system 70.

[0054] In the ZigBee network, a terminal called a coordinator (ZigBee coordinator) starts up the network. One coordinator is present in the network. The coordinator is a terminal that controls the network. The coordinator also functions as a router. In the present embodiment, a specific automatic winder 60 (the ZigBee terminal 12 provided in the automatic winder 60) is preset to be a coordinator, and such an automatic winder 60 carries out a process of starting up the network.

[0055] The coordinator specifies an identification value called a personal area network (PAN) ID and starts the network. The PAN ID enables the network to be identified. Each of the router terminals can join the desired network by specifying the PAN ID and then connecting to the network.

[0056] When the automatic winder 60 serving as the coordinator cannot carry out communication, for example, when the power of the automatic winder 60 is not turned on or when the ZigBee terminal 12 is defective, the network for the automatic winder system 70 cannot be started up. In view of this, the automatic winder system 70 according to the present embodiment includes an alternative automatic winder 60 serving as the coordinator when the automatic winder 60 that should be serving as the coordinator cannot carry out communication.

[0057] This will be specifically described. For example, it is assumed that an automatic winder 61 is specified as the coordinator and an automatic winder 62 is specified as a backup coordinator. A first identification value is assigned to the automatic winder 61. A second identification value is assigned to the automatic winder 62. In all the automatic winders 60 included in the automatic winder system 70, the first identification value is pre-stored as the PAN ID with the first-order priority, and the second identification value is pre-stored as the PAN ID with the second-order priority, respectively.

[0058] In the above-described configuration, when each of the automatic winders 60 included in the automatic winder system 70 is powered on, the automatic winder 61 serving as the coordinator specifies the first identification value as the PAN ID to start up the ZigBee network. That is, the network with the first-order priority is started up.

[0059] The automatic winder 60 serving as the router monitors to check whether or not the network has been started. Upon detecting the network started based on the first identification value stored as the first-order priority and specified as the PAN ID, the automatic winder 60 joins the network.

[0060] Next, a description will be made of operations performed when the automatic winder 61 serving as the coordinator fails to start the network because of a defect or the like. The automatic winder 62 serving as the backup coordinator monitors to check whether or not any network with the first identification value specified as the PAN ID is present, for a predetermined period of time after the power is turned on. If the automatic winder 62 detects a network with the first identification value specified as the PAN ID within the predetermined period of time, the automatic winder 62 joins the network as a normal router.

[0061] If the automatic winder 62 fails to detect the network within the predetermined period of time, the automatic winder 62 serving as the backup coordinator starts up the network with the second identification value specified as the PAN ID. That is, the automatic winder 62 starts up the network with the second-order priority. Upon detecting only the network with the second-order priority and not the network with the first-order priority, the automatic winder 60 serving as the router joins the network with the second-order priority. Thus, since the automatic winder 62 is present as a backup for the automatic winder 61 that should serve as the coordinator, the network can be reliably started up.

[0062] Next, a description will be made of operations performed when the radio wave condition is changed by rearrangement of the frames, disconnection of some automatic winders from the network, or the like.

[0063] As described above, each of the router terminals can communicate via a plurality of other router terminals. Furthermore, the network is first started up by the coordinator. Thus, each router terminal first attempts to connect to the coordinator. However, due to the ratio wave conditions or the like, there are cases in which a router terminal cannot communicate directly with the coordinator. In such cases, the router terminal joins the network via a different router terminal that has already joined the network.

[0064] Thus, the network for the automatic winder system 70 according to the present embodiment is conceptually formed like a tree around the coordinator. In the description below, when focusing on a certain router terminal, among the other router terminals that the certain router terminal is directly carrying out communication, a "parent terminal" is defined as a router terminal which the certain router terminal communicates when carrying out communication with the coordinator. A "child terminal" is defined as a router terminal which carries out communication with the coordinator via the certain router terminal.

[0065] In the network configured as described above, if the parent terminal for a certain router terminal is disconnected from the network and cannot carry out communication, the certain router terminal and all the child terminals communicating via the certain router terminal fail to connect to the network. The reason for this situation is expected to be that for example, the automatic winder 60 as the parent terminal has been powered off or the

ZigBee terminal 12 in the automatic winder 60 as the parent terminal becomes defective. The above-described problem may also result from rearrangement of the frames or the like that may cause changes in the radio wave condition to prevent communication from being carried out with the parent terminal. In this case, if re-starting of the network and re-setting of the parent-child relationship are necessary every time when the communication becomes incapable, such operation would be cumbersome to the operator. This also reduces the productivity of the factory as a whole.

[0066] In view of this, the automatic winder system 70 according to the present embodiment is configured to automatically re-set the parent-child relationship. With reference to a flowchart shown in Figure 3, this parent-child relationship re-setting process will be described. Figure 3 shows the flow of a parent-child relationship re-setting process program executed when a router terminal belonging to the network for the automatic winder system 70 according to the present embodiment transmits winding information.

[0067] Before transmitting the winding information, the router terminal attempts to communicate with the parent terminal (step S101). The router terminal checks the presence or absence of a response from the parent terminal and the contents of the response to determine whether or not the communication is appropriate (step S102). If the router terminal can communicate appropriately with the parent terminal, the network can be maintained as it is. Thus, the flow is terminated with no particular process carried out. The winding information is transmitted to the parent terminal.

[0068] If the communication with the parent terminal is determined to be inappropriate in step S102 in Figure 3, the router terminal determines whether or not the router terminal has any child terminal (step S103). If a child terminal is present, the router terminal carries out a process of unlinking the child terminal from the router terminal (step S104).

[0069] When the above-described process is completed, the router terminal is unlinked from the parent terminal (step S105), and searches for a new parent terminal to link the router terminal to the parent terminal (step S106). Thereafter, the router terminal transmits the winding information to the new parent terminal.

[0070] If the router terminal can communicate with the child terminal, then the router terminal can omit the processing in step S104 and join and link to the new parent terminal together with the child terminal. However, a determination that the communication with the current parent terminal becomes incapable (step S102) means that the radio wave condition is likely to have been changed by rearrangement or the like. Thus, the router terminal allows each of the child terminals to unlink from the router terminal and to re-search for a parent terminal. Then, the network can be reconstructed with a more optimum path. The child terminal unlinked by the processing in step S104 searches for a parent terminal according to the flowchart shown in Figure 3 as described above.

[0071] Thus, the network for the automatic winder system 70 according to the present embodiment has a self-improvement function and a self-repair function. Consequently, the wireless communication network can always be maintained in a proper condition without requiring an operator to set the communication channel.

[0072] In the automatic winder system 70 according to the present embodiment, winding information can be accumulatively transmitted between the automatic winders 60. Specifically, when a certain automatic winder 60 receives winding information from another adjacent automatic winder 60 and then transmits the winding information to yet another adjacent automatic winder 60, the certain automatic winder 60 can add the winding information managed by the certain automatic winder 60 to the received winding information and transmit such winding information.

[0073] Consequently, every time information is transmitted and received between the automatic winders 60, the latest information is added to this information. As a result, the information is automatically collected and/or updated to allow the automatic winders 60 to share the latest information. This eliminates the need to provide a device such as a central server which is used to integrally manage the information. The automatic winders 60 included in the automatic winder system 70 can efficiently share the winding information. Meanwhile, at least one automatic winder 60 can be used as a central managing device so as to allow the information from the communicably connected automatic winders 60 to be intensively managed.

[0074] In the automatic winder system 70 according to the present embodiment, the wireless communication network is configured as described above so as to allow the automatic winders 60 to transmit and receive the winding information to and from one another. This facilitates management of the factory as a whole.

[0075] Specifically, for example, by transmitting the same yarn winding conditions to a plurality of the automatic winders 60, the yarn winding conditions can be set collectively. Furthermore, by the transmission and reception of the winding information as described above, the yarn winding state information and statistical information on all the frames can be appropriately monitored on the display 13 of any automatic winder 60. Thus, the operator can check, on the display 13 of the nearest automatic winder 60, information indicating that for example, the production rate of the X-th yarn winding unit 16 provided in the automatic winder 63 is inefficient, without moving to an area where such automatic winder 63 is installed.

[0076] As described above, the automatic winder system 70 according to the present embodiment includes the plurality of automatic winders 60. Each of the automatic winders 60 includes the plurality of yarn winding units 16, the frame control device 11, and the ZigBee terminal 12. The frame control device 11 manages the winding information on the yarn winding unit 16, and con-

trols the yarn winding unit 16. The ZigBee terminal 12 can communicate wirelessly according to ZigBee, which is a predetermined wireless communication standard. The ZigBee terminal 12 can communicate directly with the ZigBee terminal 12 provided in each of the other automatic winders 60. The frame control device 11 transmits and receives the winding information to and from the frame control device 11 provided in each of the other automatic winders 60 by carrying out wireless communication via the ZigBee terminals 12.

[0077] With this configuration, in the facility in which the automatic winders 60 are installed, the automatic winder communication system with the automatic winders connected together like beads can be easily constructed. Thus, the frame control devices 11 can communicate directly with each other without intervention of a host computer. This prevents the system as a whole from being affected by a fault in one host computer as in the case where communications involve the host computer. Furthermore, since the communication is wireless, the automatic winders 60 can be easily rearranged. That is, operators can easily move the automatic winders 60 to change the positions where the automatic winders 60 are provided in the facility. Moreover, since the automatic winders 60 can communicate with one another, the communication can be prevented from being disabled by blockage of radio waves by a particular frame as in the case in which the communication involves a predetermined access point. This allows the automatic winders 60 to be flexibly and freely rearranged.

[0078] In the automatic winder system 70 according to the present embodiment, the automatic winder 60 includes the plurality of yarn winding units 16. The frame control device 11 of the automatic winder 60 transmits and receives the winding information on the yarn winding unit 16 to and from the frame control device 11 of another automatic winder 60.

[0079] Thus, the winding information can be transmitted and received among the plurality of automatic winders 60 by wireless communication.

[0080] In the automatic winder system 70 according to the present embodiment, the ZigBee terminal 12 is removably provided in the automatic winder 60.

[0081] Accordingly, communication between one automatic winder 60 and another automatic winder 60 is enabled as required. Thus, the configuration of the frames in the facility can be easily changed as in the case in which for example, the number of automatic winders 60 is increased from one to a plural number. As a result, the system can be more flexibly constructed, while preventing reduction in productivity associated with the difficulty of rearrangement of the automatic winders 60.

[0082] In the automatic winder system 70 according to the present embodiment, the plurality of automatic winders 60 are arranged adjacent to and in parallel with one another. The automatic winders 60 can communicate as follows. That is, first, the frame control device 11 provided in one automatic winder 60 transmits, by wireless communication, the information managed by such a frame control device 11 to the frame control device 11 provided in another automatic winder 60 located adjacent to the above-described automatic winder 60. Upon receiving the information, the frame control device 11 provided in the another automatic winder 60 can accumulatively transmit, together with the received information, the information managed by the frame control device 11 to the frame control device 11 provided in yet another automatic winder 60 located adjacent to the another automatic winder 60.

[0083] Thus, when the automatic winders 60 transmit and receive information to and from one another, each of the automatic winders 60 can add information of each automatic winder 60 to the received information and then transmit both pieces of information. Consequently, the information can be efficiently collected on the automatic winder system 70.

[0084] The automatic winder system 70 according to the present embodiment is configured as follows. That is, for example, before the winding information managed by the frame control device 11 provided in the automatic winder 61 is transmitted to the frame control device 11 in the automatic winder 62, the ZigBee terminal 12 provided in the automatic winder 61 determines whether or not communication can be carried out with the frame control device 11 in the automatic winder 62 (step S102). When communication can be carried out with the frame control device 11 in the automatic winder 62, the ZigBee terminal 12 in the automatic winder 61 transmits the winding information managed by the frame control device 11 in the automatic winder 61 to the frame control device 11 in the automatic winder 62. When communication cannot be carried out with the frame control device 11 in the automatic winder 62, the ZigBee terminal 12 in the automatic winder 61 searches for and communicates with a frame control device provided in an automatic winder different from the automatic winder 62 (for example, the frame control device 11 provided in the automatic winder 63) (step S106).

[0085] Thus, even when the automatic winder system 70 includes an automatic winder 60 that cannot carry out communication (in the above-described example, the automatic winder 62), the automatic winder system 70 enables communication to be carried out with another automatic winder 60 by skipping the automatic winder 60 that cannot carry out communication. As a result, for example, even if the radio wave condition is changed by rearrangement of the frames or the communication function of a particular automatic winder 60 is defective, the communication path can be automatically reconstructed. Thus, the automatic winders 60 can be more easily rearranged, and the communications throughout the system can be prevented from being shut down as a result of the defect in the communication function of the particular automatic winder 60. This further improves the productivity.

[0086] In the automatic winder system 70 according to

the present embodiment, each of the automatic winders 60 includes the ZigBee terminal 12 using ZigBee as a wireless communication standard. ZigBee is a short-distance wireless communication standard. The plurality of automatic winders 60 can be connected together so as to be capable of communicating consecutively with one another via the ZigBee terminals 12.

[0087] The ZigBee terminals 12 can communicate with each other and consume a reduced amount of power. The transmission distance of the ZigBee terminals 12 is appropriate for use in a vast factory site. Furthermore, the ZigBee terminals 12 enable communication via a plurality of textile machines and can thus communicate with each other in a vast factory site. Thus, the ZigBee terminal 12 is particularly suitably used for the automatic winder system 70.

[0088] The automatic winder 60 according to the present embodiment includes the plurality of yarn winding units 16. Furthermore, the automatic winder 60 includes the ZigBee terminal 12 that can perform at least one of transmission and reception of information directly to and from another automatic winder 60.

[0089] A plurality of the automatic winders 60 configured as described above are installed so as to communicate with one another. Accordingly, the automatic winders 60 can communicate with one another without the intervention of a host computer. Thus, a communication network for the automatic winders 60 can be constructed in which the positions of the automatic winders 60 can be easily rearranged.

[0090] The preferred embodiment of the present invention has been described. The above-described configuration can be modified as described below.

[0091] The winding information described above is only an example. Another type of information may be communicated among the automatic winders. Furthermore, only a part of the winding information may be communicated, with the remaining part not communicated. For example, the configuration may be modified such that only the yarn winding conditions are communicated among the automatic winders 60.

[0092] The supply device 52 and the automatic doffing device 51 may be omitted or modified. For example, the configuration in which the yarn supplying bobbin 21 is supplied by the supply device 52 may be changed to a configuration in which a magazine type bobbin supply device is provided on a front side of each of the yarn winding units 16.

[0093] The wireless communication standard is not limited to ZigBee but may be changed to another wireless communication standard, for example, Bluetooth. However, with Bluetooth, slave terminals can communicate with a master terminal but the slave terminals cannot communicate with each other. Further, only one master terminal is provided in the network. With Bluetooth, only a small number of slave terminals, that is, only seven slave terminals can be connected to a single master terminal, and a communication distance is limited. Therefore, it may be difficult to adopt Bluetooth for communications among a large number of frames in a large space such as in a textile factory. Thus, to enable communication to be carried out among the frames in the textile factory, ZigBee can be particularly suitably used in terms of the flexibility of expansions and changes and fault resistance.

[0094] Instead of being connected to the USB port 15, the ZigBee terminal 12 may be connected to, for example, a wired LAN port.

[0095] Furthermore, the ZigBee terminal 12 may be irremovable from the automatic winder 60 rather than being removable from the automatic winder 60. However, in terms of expandability and flexibility, the ZigBee terminal 12 is preferably removable from the automatic winder 60.

[0096] The mounting position of the ZigBee terminal 12 is not limited to the positions shown in Figures 1 and 2. The ZigBee terminal 12 may be mounted on a top surface of the frame control device 11 or built in the frame control device 11.

[0097] The configuration in which the flow in Figure 3 is carried out to transmit information may be changed such that the flow is periodically carried out.

[0098] In the above description, two automatic winders 60 serve as the coordinators (one main coordinator and one backup coordinator). However, any number of backup coordinators may be provided. The area where the coordinators are installed is not particularly limited. Any of the automatic winders 60 may be set to be the coordinators.

[0099] Instead of previously designating the coordinators, for example, an automatic winder started first in the automatic winder system may be configured to function dynamically as the coordinator.

[0100] The textile machine is not limited to the automatic winder but may be a spinning machine including at least one spinning unit. In this case, spinning information on each spinning unit is transmitted to and received from another spinning machine.

[0101] The textile machine system is not limited to the communication between the frames of the same type but may be configured to include, for example, a plurality of automatic winders and a plurality of spinning machines. This configuration allows information to be consistently managed from yarn spinning to package production.

[0102] While the present invention has been described with respect to preferred embodiments thereof, it will be apparent to those skilled in the art that the disclosed invention may be modified in numerous ways and may assume many embodiments other than those specifically set out and described above. Accordingly, it is intended by the appended claims to cover all modifications of the present invention that fall within the scope of the invention.

Claims

1. A textile machine system comprising a plurality of textile machines (60), **characterized in that** each of the textile machines (60) includes:

   at least one fiber processing unit (16);
   a control device (11) that manages information on the fiber processing unit (16) and controls the fiber processing unit (16); and
   a wireless communication section (12) that can carry out wireless communication according to a predetermined wireless communication standard, and
   the wireless communication section (12) can carry out the wireless communication directly with a wireless communication section (12) provided in another textile machine (60), and
   the control device (11) of the textile machine (60) transmits and receives the information to and from a control device (11) provided in the another textile machine (60) via the wireless communication by the wireless communication section (12);
   wherein the plurality of the textile machines (60) are arranged adjacent to one another,
   the control device (11) provided in one textile machine (60) transmits, by wireless communication, information managed by the control device (11) provided in the one textile machine (60) to the control device (11) provided in the another textile machine (60) located adjacent to the one textile machine (60), and
   upon receiving the information, the control device (11) provided in the another textile machine (60) can accumulatively transmit, together with the received information, information managed by the control device (12) provided in the another textile machine (60) to a control device (12) provided in yet another textile machine (60) located adjacent to the another textile machine (60).

2. The textile machine system according to Claim 1, **characterized in that** the fiber processing unit (16) is a yarn winding unit that winds a yarn, and the information is winding information of the yarn winding unit.

3. The textile machine system according to Claim 1 or Claim 2, **characterized in that** the wireless communication section (12) is removably provided in the textile machine (60).

4. The textile machine system according to any one of Claims 1 to 3, **characterized in that** when the wireless communication section (12) transmits information managed by a first control device (11), which is the control device (11) of the textile machine (60) provided with such a wireless communication section (12), to a second control device (11), which is the control device (11) provided in a different textile machine (60), the wireless communication section (12) determines whether or not communication can be carried out between the first control device (11) and the second control device (11),
   when the wireless communication section (12) can communicate with the second control device (11), the wireless communication section (12) transmits the information managed by the first control device (11) to the second control device (11), and when the wireless communication section (12) cannot communicate with the second control device (11), the wireless communication section (12) communicates with a third control device (11) which is a control device (11) provided in a textile machine (60) that is different from the textile machine (60) including the second control device (11).

5. The textile machine system according to any one of Claims 1 to 4, **characterized in that** the predetermined wireless communication standard is a short-distance wireless communication standard, and the plurality of textile machines (60) can be consecutively connected together so as to be capable of communicating with one another via the wireless communication sections (12).

6. The textile machine system according to any one of Claims 1 to 5, **characterized in that** the predetermined wireless communication standard is ZigBee.

Patentansprüche

1. Ein Textilmaschinensystem, das eine Mehrzahl von Textilmaschinen (60) aufweist, **dadurch gekennzeichnet, dass** jede der Textilmaschinen (60) folgende Merkmale aufweist:

   zumindest eine Faserverarbeitungseinheit (16);
   eine Steuervorrichtung (11), die Informationen über die Faserverarbeitungseinheit (16) verwaltet und die Faserverarbeitungseinheit (16) steuert; und
   einen Drahtloskommunikationsabschnitt (12), der eine drahtlose Kommunikation gemäß einem vorbestimmten Standard für drahtlose Kommunikation ausführen kann, und
   wobei der Drahtloskommunikationsabschnitt (12) die drahtlose Kommunikation mit einem Drahtloskommunikationsabschnitt (12), der in einer weiteren Textilmaschine (60) vorgesehen ist, direkt ausführen kann und
   die Steuervorrichtung (11) der Textilmaschine (60) die Informationen zu und von einer Steuervorrichtung (11), die in der weiteren Textilma-

schine (60) vorgesehen ist, über die drahtlose Kommunikation durch den Drahtloskommunikationsabschnitt (12) sendet und empfängt;
wobei die Mehrzahl der Textilmaschinen (60) benachbart zueinander angeordnet ist,
die Steuervorrichtung (11), die in einer Textilmaschine (60) vorgesehen ist, durch drahtlose Kommunikation Informationen, die durch die Steuervorrichtung (11) verwaltet werden, die in der einen Textilmaschine (60) vorgesehen ist, an die Steuervorrichtung (11) sendet, die in der weiteren Textilmaschine (60) vorgesehen ist, die sich benachbart zu der einen Textilmaschine (60) befindet, und
nach Empfangen der Informationen die Steuervorrichtung (11), die in der weiteren Textilmaschine (60) vorgesehen ist, Informationen, die durch die Steuervorrichtung (12) verwaltet werden, die in der weiteren Textilmaschine (60) vorgesehen ist, zusammen mit den empfangenen Informationen akkumulativ an eine Steuervorrichtung (12) senden kann, die wiederum in einer weiteren Textilmaschine (60) vorgesehen ist, die sich benachbart zu der weiteren Textilmaschine (60) befindet.

2. Das Textilmaschinensystem gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Faserverarbeitungseinheit (16) eine Garnwickeleinheit ist, die ein Garn wickelt, und die Informationen Wickelinformationen der Garnwickeleinheit sind.

3. Das Textilmaschinensystem gemäß Anspruch 1 oder Anspruch 2, **dadurch gekennzeichnet, dass** der Drahtloskommunikationsabschnitt (12) in der Textilmaschine (60) abnehmbar vorgesehen ist.

4. Das Textilmaschinensystem gemäß einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass**
wenn der Drahtloskommunikationsabschnitt (12) Informationen, die durch eine erste Steuervorrichtung (11) verwaltet werden, die die Steuervorrichtung (11) der Textilmaschine (60) ist, die mit einem derartigen Drahtloskommunikationsabschnitt (12) versehen ist, an eine zweite Steuervorrichtung (11) sendet, die die Steuervorrichtung (11) ist, die in einer anderen Textilmaschine (60) vorgesehen ist, der Drahtloskommunikationsabschnitt (12) bestimmt, ob eine Kommunikation zwischen der ersten Steuervorrichtung (11) und der zweiten Steuervorrichtung (11) durchgeführt werden kann oder nicht,
wenn der Drahtloskommunikationsabschnitt (12) mit der zweiten Steuervorrichtung (11) kommunizieren kann, der Drahtloskommunikationsabschnitt (12) die Informationen, die durch die erste Steuervorrichtung (11) verwaltet werden, an die zweite Steuervorrichtung (11) sendet, und
wenn der Drahtloskommunikationsabschnitt (12) nicht mit der zweiten Steuervorrichtung (11) kommunizieren kann, der Drahtloskommunikationsabschnitt (12) mit einer dritten Steuervorrichtung (11) kommuniziert, die eine Steuervorrichtung (11) ist, die in einer Textilmaschine (60) vorgesehen ist, die eine andere als die Textilmaschine (60) ist, die die zweite Steuervorrichtung (11) umfasst.

5. Das Textilmaschinensystem gemäß einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der vorbestimmte Standard für drahtlose Kommunikation ein Standard für drahtlose Kommunikation im Nahbereich ist und die Mehrzahl von Textilmaschinen (60) fortlaufend miteinander verbunden sein kann, um über die Abschnitte für drahtlose Kommunikation (12) miteinander kommunizieren zu können.

6. Das Textilmaschinensystem gemäß einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** der vorbestimmte Standard für drahtlose Kommunikation ZigBee ist.

Revendications

1. Système de machines textiles comprenant une pluralité de machines textiles (60), **caractérisé par le fait que** chacune des machines textiles (60) comporte:

au moins une unité de traitement de fibres (16);
un dispositif de commande (11) qui gère les informations sur l'unité de traitement de fibres (16) et commande l'unité de traitement de fibres (16); et
un segment de communication sans fil (12) qui peut effectuer une communication sans fil selon une norme de communication sans fil prédéterminée, et
le segment de communication sans fil (12) peut effectuer la communication sans fil directement avec un segment de communication sans fil (12) prévu dans une autre machine textile (60), et
le dispositif de commande (11) de la machine textile (60) transmet et reçoit les informations à et d'un dispositif de commande (11) prévu dans l'autre machine textile (60) via la communication sans fil par le segment de communication sans fil (12) ;
dans lequel la pluralité de machines textiles (60) sont disposées adjacentes l'une à l'autre,
le dispositif de commande (11) prévu dans une machine textile (60) transmet, par une communication sans fil, les informations gérées par le dispositif de commande (11) prévu dans l'une machine textile (60) au dispositif de commande (11) prévu dans l'autre machine textile (60) située adjacente à l'une machine textile (60), et

à la réception des informations, le dispositif de commande (11) prévu dans l'autre machine textile (60) peut transmettre de manière cumulative, ensemble avec les informations reçues, les informations gérées par le dispositif de commande (12) prévu dans l'autre machine textile (60) à une dispositif de commande (12) prévu dans encore une autre machine textile (60) située adjacente à l'autre machine textile (60).

2. Système de machines textiles selon la revendication 1, **caractérisé par le fait que** l'unité de traitement de fibres (16) est une unité de bobinage de fil qui bobine un fil, et les informations sont des informations de bobinage de l'unité de bobinage de fil.

3. Système de machines textiles selon la revendication 1 ou la revendication 2, **caractérisé par le fait que** le segment de communication sans fil (12) est prévu de manière amovible dans la machine textile (60).

4. Système de machines textiles selon l'une quelconque des revendications 1 à 3, **caractérisé par le fait que**, lorsque le segment de communication sans fil (12) transmet les informations gérées par un premier dispositif de commande (11), qui est le dispositif de commande (11) de la machine textile (60) pourvue d'un tel segment de communication sans fil (12), à un deuxième dispositif de commande (11), qui est le dispositif de commande (11) prévu dans une machine textile différente (60), le segment de communication sans fil (12) détermine si la communication peut être effectuée ou non entre le premier dispositif de commande (11) et le deuxième dispositif de commande (11),
lorsque le segment de communication sans fil (12) peut communiquer avec le deuxième dispositif de commande (11), le segment de communication sans fil (12) transmet les informations gérées par le premier dispositif de commande (11) au deuxième dispositif de commande (11), et
lorsque le segment de communication sans fil (12) ne peut pas communiquer avec le deuxième dispositif de commande (11), le segment de communication sans fil (12) communique avec un troisième dispositif de commande (11), qui est un dispositif de commande (11) prévu dans une machine textile (60) qui est différente de la machine textile (60) comportant le deuxième dispositif de commande (11).

5. Système de machines textiles selon l'une quelconque des revendications 1 à 4, **caractérisé par le fait que** la norme de communication sans fil prédéterminée est une norme de communication sans fil à courte distance, et la pluralité de machines textiles (60) peuvent être connectées successivement entre elles, de sorte qu'elles soient à même de communiquer entre elles via les segments de communication sans fil (12).

6. Système de machines textiles selon l'une quelconque des revendications 1 à 5, **caractérisé par le fait que** la norme de communication sans fil prédéterminé est ZigBee.

FIGURE 1

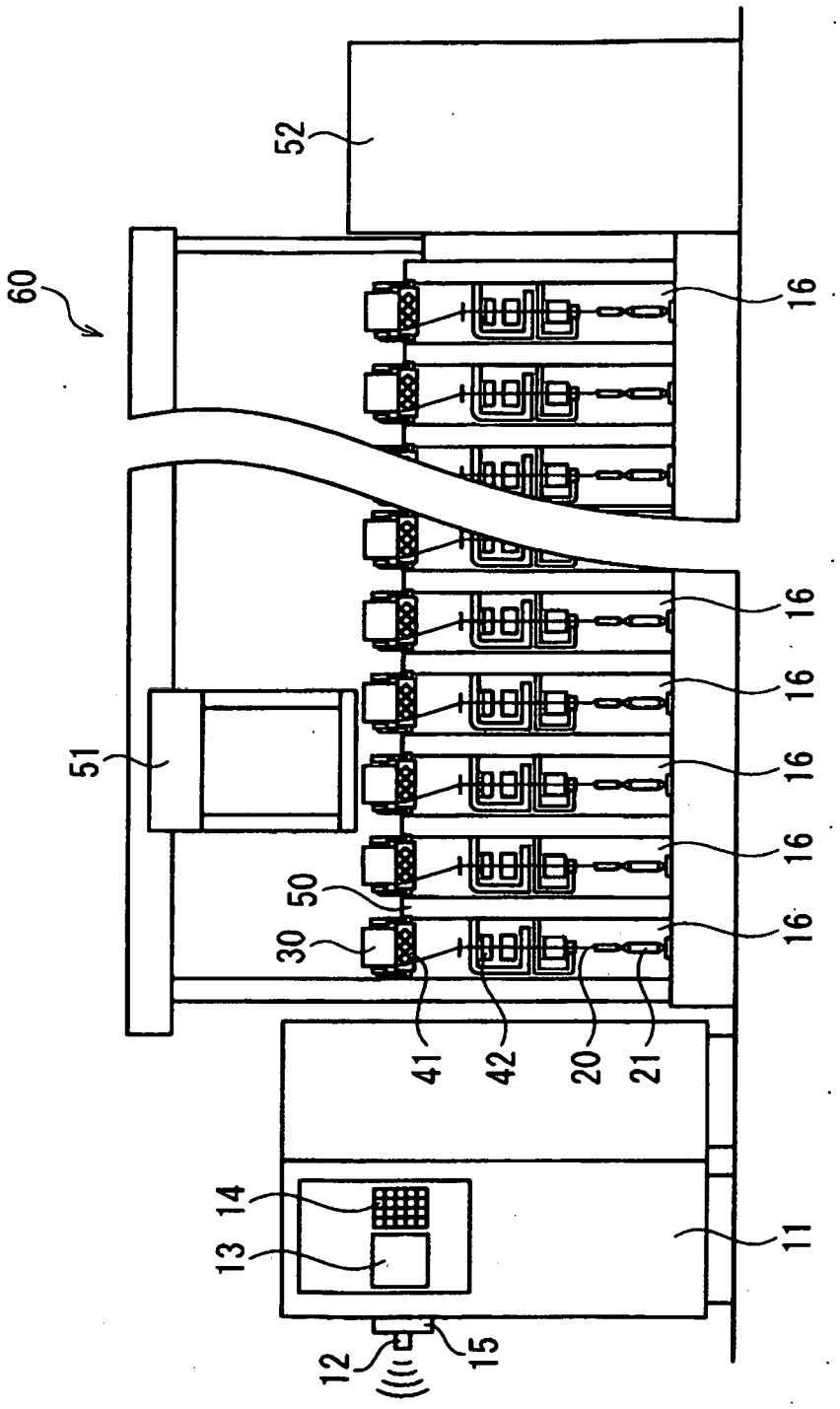


FIGURE 2

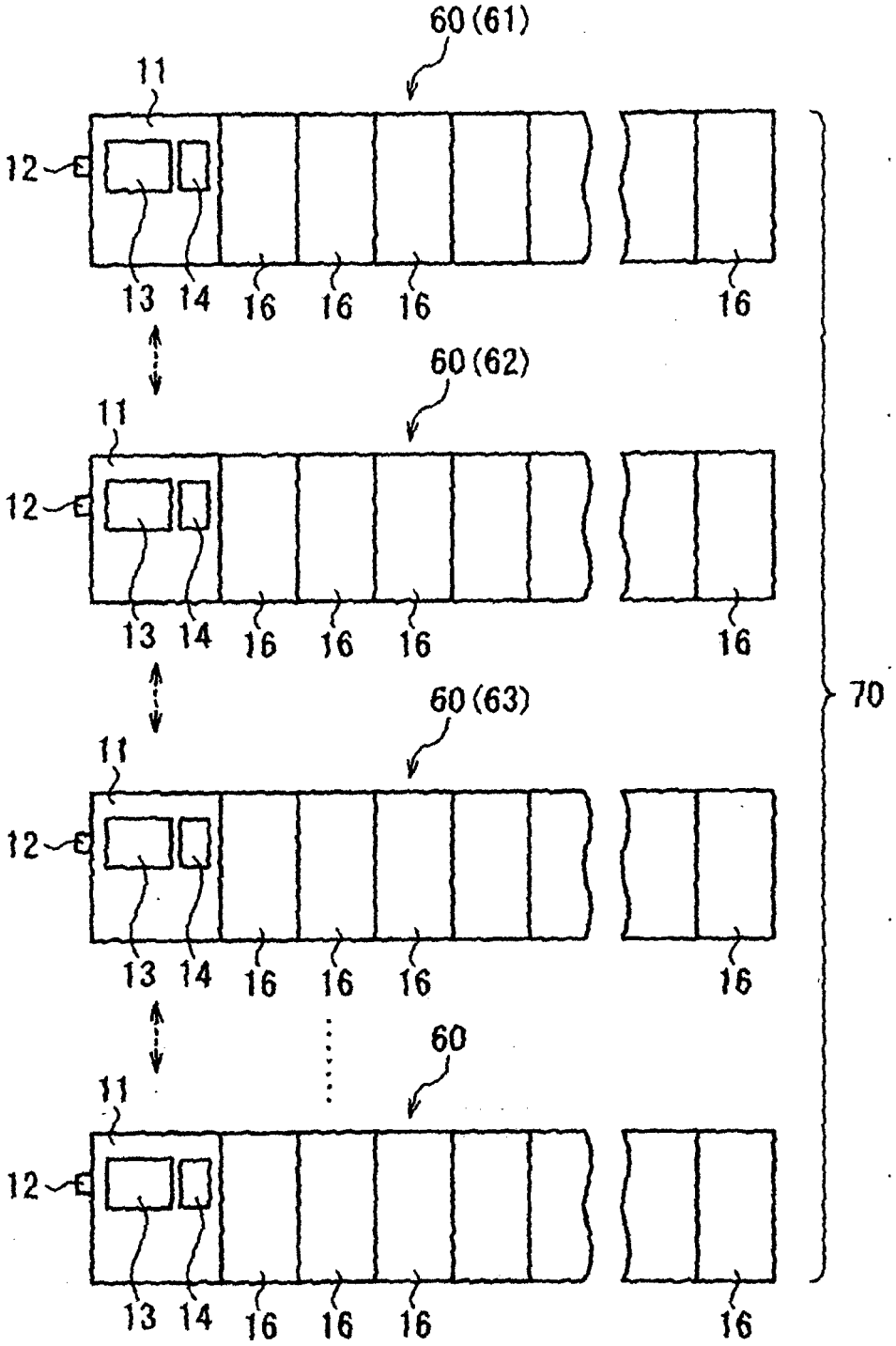
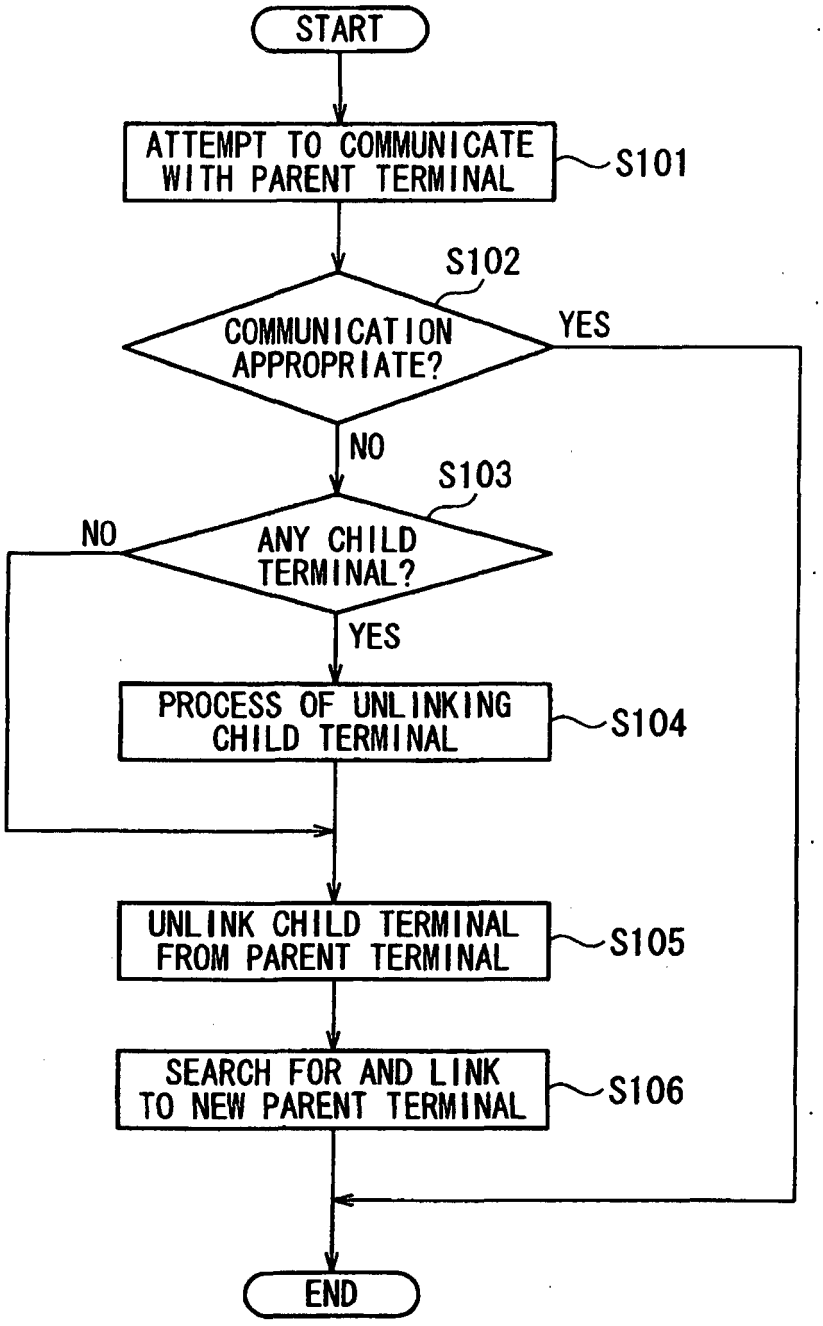

60 (61)
11
12
13
14
16
16
16
16
60 (62)
11
12
13
14
16
16
16
16
60 (63)
11
12
13
14
16
16
16
16
60
11
12
13
14
16
16
16
16
70

FIGURE 3


START
ATTEMPT TO COMMUNICATE WITH PARENT TERMINAL
S101
S102
COMMUNICATION APPROPRIATE?
YES
NO
S103
NO
ANY CHILD TERMINAL?
YES
PROCESS OF UNLINKING CHILD TERMINAL
S104
UNLINK CHILD TERMINAL FROM PARENT TERMINAL
S105
SEARCH FOR AND LINK TO NEW PARENT TERMINAL
S106
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006143338 A **[0004] [0005] [0006] [0007]**
- WO 2007112873 A1 **[0008]**
- DE 102005050058 A1 **[0009]**