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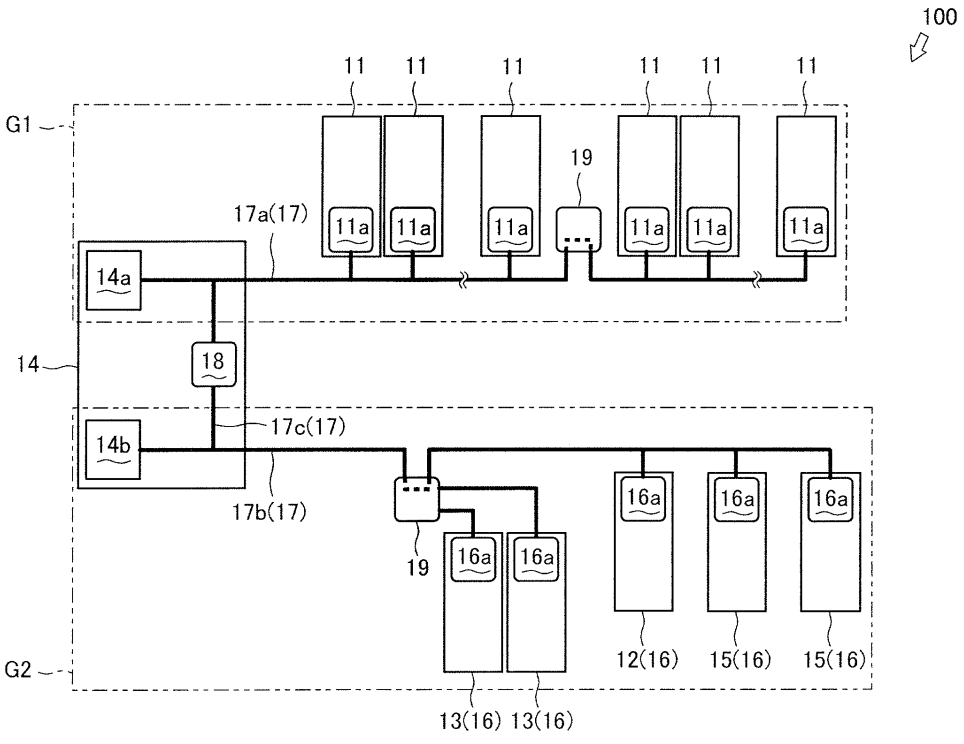
## (54) Yarn winding machine

(57) An object of the invention is to improve operation efficiency of a winding unit and an assisting unit of a yarn winding machine by reducing a delay in electronic signal processing. As means for solving such a problem, a yarn winding machine of the present invention includes a communication path (17) that connects a winding unit (11), an assisting unit (16), a first control section (14a), and a second control section (14b) so as to be communicable with each other, where an signal control device (18) is arranged on the communication path (17), and the signal control device (18) selects whether to transmit or shield an electronic signal in accordance with a transmitting destination of the electronic signal.

FIG. 2

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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present invention relates to a yarn winding machine.

#### 2. Description of Related Art

**[0002]** Conventionally, there is known a yarn winding machine including a plurality of winding units, a plurality of assisting units, and a control device that controls the operation of the winding unit and the assisting unit. In such a yarn winding machine, the winding unit winds a yarn by rotating a winding bobbin, and forms a package around the winding bobbin. The assisting unit assists an operation of forming the package by the winding unit.

**[0003]** An automatic winder which is a representative yarn winding machine includes a yarn supplying bobbin supplying device and a doffing device as the assisting unit (see e.g., Japanese Unexamined Patent Publication No. 2009-286608). The yarn supplying bobbin supplying device supplies a yarn supplying bobbin to each winding unit. The doffing device detaches the package and attaches the next winding bobbin. Furthermore, the automatic winder includes a control device that controls the operations of the winding unit, the yarn supplying bobbin supplying device, the doffing device, and the like. That is, the automatic winder is configured by a plurality of winding units that form a package, a plurality of assisting units including the yarn supplying bobbin supplying device and the doffing device, and the control device that controls the winding units and the assisting units.

**[0004]** A spinning machine which is a representative yarn winding machine includes, as the assisting unit, a yarn joining device that joins disconnected yarns and a doffing device that detaches the package and attach the next winding bobbin (see e.g., Japanese Unexamined Patent Publication No. 2008-95208). Furthermore, the spinning machine includes a control device that controls the operations of the winding unit, the yarn joining device, the doffing device, and the like. That is, the spinning machine is configured by a plurality of winding units that form a package, a plurality of assisting units including the yarn joining device and the doffing device, and the control device that controls the winding units and the assisting units.

**[0005]** Such yarn winding machines are configured to be communicable by connecting, through a bus, the plurality of winding units, the plurality of assisting units, and the control device that controls the winding units and the assisting units (see e.g., Japanese Unexamined Patent Publication No. 10-147472).

**[0006]** In recent years, such a yarn winding machine tends to have increased numbers of winding units and assisting units. Therefore, the numbers of winding units and assisting units controlled by one control device is also increasing. In addition, the method of control of the yarn winding machine is shifting from a mechanical control to an electrical control, and an amount of electronic signal transmitted and received among the winding unit, the assisting unit, and the control device is greatly increasing.

**[0007]** However, the yarn winding machine described in Japanese Unexamined Patent Publication No. 10-147472 has the winding unit, the assisting unit, and the control device connected through one bus. Thus, if the amount of electronic signal exceeding a tolerable amount is transmitted and received among the winding unit, the assisting unit, and the control device, an electronic signal waiting for information processing on the bus stagnates, and the winding unit and the assisting unit enter a standby state. Therefore, in the conventional yarn winding machine, there is still room for improvements in operation efficiency.

**[0008]** Therefore, there is considered a method of resolving the stagnation of the electronic signals by increasing the number of buses to a plurality of numbers. However, if a plurality of buses are arranged, wiring becomes complicated, maintenance becomes troublesome, and a cost increases.

### BRIEF SUMMARY OF THE INVENTION

**[0009]** An object of the present invention is to improve operation efficiency of a winding unit and an assisting unit of a yarn winding machine by reducing a delay in electronic signal processing.

**[0010]** The inventors of the present invention have made the following invention focusing on the fact that electronic signals transmitted and received among the winding unit, the assisting unit, and the control device can be divided into three: (1) the electronic signal that is required to be transmitted between the winding unit and the control device but is not required to be transmitted to the assisting unit; (2) the electronic signal that is required to be transmitted between the assisting unit and the control device but is not required to be transmitted to the winding unit; and (3) the electronic signal that is required to be transmitted between the winding unit and the assisting unit but is not required to be transmitted to the control device.

**[0011]** A first aspect of the invention relates to a yarn winding machine including a winding unit that winds a yarn to form a package; an assisting unit that assists the winding unit in forming the package; a first control section that receives an electronic signal from the winding unit and the assisting unit and transmits an electronic signal to the winding unit and the assisting unit; a second control section that receives an electronic signal from the winding unit and the assisting unit and transmits an electronic signal to the winding unit and the assisting unit; and a communication path that connects the winding unit, the assisting unit, the first control section, and the second

control section to be communicable with each other, wherein a signal control device is arranged on the communication path, and the signal control device selects whether to transmit or shield the electronic signal in accordance with a transmitting destination of the electronic signal.

**[0012]** According to a second aspect of the invention, in the yarn winding machine according to the first aspect, the communication path is sectionalized into a first communication path that connects the winding unit and the first control section to be communicable with each other, a second communication path that connects the assisting unit and the second control section to be communicable with each other, and a third communication path that connects a group connected with the first communication path and a group connected with the second communication path; and the signal control device is arranged on the third communication path.

**[0013]** According to a third aspect of the invention, in the yarn winding machine according to the second aspect, the signal control device transmits the electronic signal when transmitting the electronic signal from the group connected with the first communication path to the group connected with the second communication path, and shields the electronic signal when transmitting the electronic signal from the group connected with the first communication path only to the relevant group.

**[0014]** According to a fourth aspect of the invention, in the yarn winding machine according to the second or third aspect, the signal control device transmits the electronic signal when transmitting the electronic signal from the group connected with the second communication path to the group connected with the first communication path, and shields the electronic signal when transmitting the electronic signal from the group connected with the second communication path only to the relevant group.

**[0015]** According to a fifth aspect of the invention, in the yarn winding machine according to any one of the first to fourth aspects, the communication path connects the winding unit and the assisting unit to be communicable with each other without interposing the first control section and the second control section.

**[0016]** According to a sixth aspect of the invention, in the yarn winding machine according to any one of the first to fifth aspects, a signal restoring device that restores the electronic signal is arranged on the communication path.

**[0017]** According to a seventh aspect of the invention, in the yarn winding machine according to the sixth aspect, the signal control device and the signal restoring device are a router having functions of the signal control device and the signal restoring device.

**[0018]** The present invention has the following effects.

**[0019]** According to the first aspect, since the signal control device selects whether to transmit or shield the electronic signal in accordance with the transmitting destination of the electronic signal, the yarn winding machine can reduce the electronic signals from stagnating on the communication path. Accordingly, in the present yarn winding machine, since the winding unit, the assisting unit, the first control section, and the second control section can process the necessary electronic signal without receiving the unnecessary electronic signals, and the operation efficiency of the winding unit, the assisting unit and the like can be improved. Furthermore, in the present the yarn winding machine, since the winding unit, the assisting unit, the first control section, and the second control section are connected with one communication path and then the control of electronic signals is carried out, maintenance can be performed more easily and inexpensively compared to the case where they are connected with a plurality of communication paths.

**[0020]** According to the second aspect, since the signal control device selects whether to transmit or shield the electronic signal in accordance with the transmitting destination of the electronic signal between the group connected with the first communication path and the group connected with the second communication path, the stagnation of the electronic signals on the communication path can be more efficiently reduced.

Accordingly, the operation efficiency of the winding unit, the assisting unit, and the like can be improved. That is, the transmission and reception of electronic signals in the yarn winding machine are frequently carried out particularly between the winding unit and the control device. The number of times the electronic signals are transmitted and received is small between the assisting unit and the control device as compared to that between the winding unit and the control device. In the present yarn winding machine, therefore, the winding unit and the assisting unit are sectionalized as different groups, so that the assisting unit can be operated without having to wait for the electronic signal processing of the winding unit carried out a plurality of times.

**[0021]** According to the third aspect, since the signal control device transmits the electronic signal when transmitting the electronic signal from the group connected with the first communication path to the group connected with the second communication path, and shields the electronic signal when transmitting the electronic signal from the group connected with the first communication path only to the relevant group, the stagnation of the electronic signals on the communication path can be more efficiently reduced. Accordingly, the operation efficiency of the winding unit, the assisting unit, and the like can be improved.

**[0022]** According to the fourth aspect, since the signal control device transmits the electronic signal when transmitting the electronic signal from the group connected with the second communication path to the group connected with the first communication path, and shields the electronic signal when transmitting the electronic signal from the group connected with the second communication path only to the relevant group, the stagnation of the electronic signals on the communication path can be more efficiently reduced. Accordingly, the operation effi-

ciency of the winding unit, the assisting unit, and the like can be improved.

**[0023]** According to the fifth aspect, since the winding unit and the assisting unit can communicate with each other without interposing the first control section and the second control section, the transmission speed of the electronic signals is improved. Accordingly, the operation efficiency of the winding unit, the assisting unit, and the like can be improved.

**[0024]** According to the sixth aspect, since the signal restoring device that restores the electronic signals is arranged on the communication path, the electronic signals can be reliably transmitted. Accordingly, the operation efficiency of the winding unit, the assisting unit, and the like can be improved.

**[0025]** According to the seventh aspect, the function of the signal control device and the function of the signal restoring device can be realized with a common device. Accordingly, the number of devices can be reduced, and the present yarn winding machine can be more easily configured.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0026]**

FIG. 1 is a view illustrating an overall configuration of an automatic winder;
FIG. 2 is a view illustrating a communication path of the automatic winder;
FIG. 3 is a view illustrating an overall configuration of a spinning machine; and
FIG. 4 is a view illustrating a communication path of the spinning machine.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

**[0027]** First, an automatic winder 100, which is a yarn winding machine according to one embodiment of the present invention, will be described.

**[0028]** FIG. 1 is a view illustrating an overall configuration of the automatic winder 100. The automatic winder 100 is mainly configured by a plurality of winding units 11, a yarn supplying bobbin supplying device 12, a doffing device 13, a package conveyor (not illustrated), and a control device 14.

**[0029]** When a defected part is found in a yarn Y unwound from a yarn supplying bobbin B1, the winding unit 11 regulates the yarn quality by removing the defected part. The winding unit 11 winds the yarn Y by rotating a winding bobbin B2, and forms a package P on the winding bobbin B2. The winding unit 11 thus regulates the yarn quality of the yarn Y and forms the package P by winding the yarn Y.

**[0030]** Each winding unit 11 includes a winding unit control section 11a (see FIG. 2). The winding unit control section 11a includes a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and a communication port. The ROM stores a control program for controlling the operation of the winding unit 11. The CPU executes the control program stored in the ROM to enable the winding of the yarn Y to be appropriately carried out.

**[0031]** The communication port of the winding unit control section 11a is connected to the control device 14 and an assisting unit 16, thus enabling the transmission and reception of electronic signals (see FIG. 2). The control device 14 thus can collectively carry out the operation control and the information management of the plurality of winding units 11 arranged in the automatic winder 100.

**[0032]** The yarn supplying bobbin supplying device 12 includes a conveyor 12a extending in an arranging direction of the winding units 11, and a yarn supplying bobbin preparing device 15. The conveyor 12a is installed on a front side and a rear side of the winding unit 11. The yarn supplying bobbin preparing device 15 receives the yarn supplying bobbin B1 wound by the spinning machine, and places the yarn supplying bobbin B1 on a tray. The conveyor 12a installed on the rear side of the winding unit 11 transports the yarn supplying bobbin B1 to each winding unit 11 while being placed on the tray. The conveyor 12a installed on the front side of the winding unit 11 transports the yarn supplying bobbin B1 discharged from each winding unit 11 to a predetermined position. Thus, the yarn supplying bobbin supplying device 12 supplies the yarn supplying bobbin B1 to each winding unit 11, and also collects the yarn supplying bobbin B1 discharged from each winding unit 11.

**[0033]** The doffing device 13 moves along a rail 13a extending in the arranging direction of the winding units 11. The doffing device 13 detaches the fully-wound package P from the winding unit 11, and attaches the next winding bobbin B2. Thus, the doffing device 13 can collect the fully-wound package P, and also enable the winding unit 11 to continuously form the package P.

**[0034]** The package conveyor extends in an arranging direction of the winding units 11, and is intermittently operated so as to transport the fully-wound package P detached by the doffing device 13 to an end of the automatic winder 100 in a longitudinal direction.

**[0035]** The yarn supplying bobbin supplying device 12, the doffing device 13, and the package conveyor are devices that assist the winding unit 11 to form the package P. Therefore, in the present embodiment, the yarn supplying bobbin supplying device 12, the doffing device 13, and the package conveyor are defined as the assisting unit 16 of the winding unit 11. However, the assisting unit 16 merely needs to be a device adapted to directly or indirectly assist the winding unit 11 to form the package P (e.g., yarn supplying bobbin preparing device 15), and is not limited to the yarn supplying bobbin supplying device 12, the doffing device 13, and the package conveyor.

**[0036]** Each assisting unit 16 includes an assisting unit control section 16a (see FIG. 2). Similarly to the winding unit control section 11a, the assisting unit control section

16a includes a CPU, a ROM, a RAM, and a communication port. The ROM stores a control program for controlling each component of the assisting unit 16 (yarn supplying bobbin supplying device 12 or the like). The CPU executes the control program stored in the ROM to enable the bobbin supplying operation, the doffing operation, and the like to be appropriately carried out.

**[0037]** The communication port of the assisting unit control section 16a is connected to the control device 14 and the assisting unit 16, thus enabling the transmission and reception of the electronic signals (see FIG. 2). The control device 14 thus can collectively carry out the operation control and the information management of the plurality of assisting units 16 arranged in the automatic winder 100.

**[0038]** The control device 14 is configured by a first control section 14a and a second control section 14b (see FIG. 2). The first control section 14a and the second control section 14b are connected by the winding unit 11, the assisting unit 16, and a communication path 17 (see FIG. 2). Similarly to the winding unit control section 11a, the first control section 14a and the second control section 14b respectively includes a CPU, a ROM, a RAM, and a communication port.

**[0039]** The communication ports of the first control section 14a and the second control section 14b are connected to the communication port of the winding unit control section 11a and the communication port of the assisting unit control section 16a through the communication path 17 (see FIG. 2). According to such a configuration, the control device 14 can receive the electronic signal of the operation state and the like from the respective winding unit control section 11a and the respective assisting unit control section 16a, and can grasp the operation state of the winding unit 11 and the assisting unit 16. The control device 14 can also transmit the electronic signal of the operation condition and the like with respect to the respective winding unit control section 11a and the respective assisting unit control section 16a, and can set the operation state of the winding unit 11 and the assisting unit 16.

**[0040]** The first control section 14a has an information collecting function of receiving electronic signals from the winding unit 11 and the assisting unit 16 and grasping the operation state, and a setting function of transmitting electronic signals to the winding unit 11 and the assisting unit 16, and setting the operation state. The second control section 14b has a control function of receiving electronic signals from the winding unit 11 and the assisting unit 16 to carry out information processing, and transmitting electronic signals to the winding unit 11 and the assisting unit 16 to smoothly form the package P. However, the main functions of the first control section 14a and the second control section 14b are not limited thereto.

**[0041]** The electronic signal (operation condition or the like) transmitted to the winding unit 11 includes, for example, winding speed, yarn count, winding tension, package winding amount, package weight, and the like. The electronic signal (operation state or the like) transmitted from the winding unit 11 includes, for example, package diameter, winding speed, yarn cut occurrence situation, alarm information, and the like. The set value transmitted to the winding unit 11 may be transmitted while individually specifying each winding unit 11, or may be collectively transmitted to all the winding units 11.

**[0042]** FIG. 2 is a view illustrating the communication path 17 of the automatic winder 100. The communication path 17 is mainly sectionalized into a first communication path 17a, a second communication path 17b, and a third communication path 17c.

**[0043]** The first communication path 17a connects the winding unit 11 and the first control section 14a so as to be communicable with each other. Thus, the first communication path 17a can transmit an electronic signal transmitted from the winding unit 11 to the first control section 14a. The first communication path 17a can also transmit an electronic signal transmitted from the first control section 14a to the winding unit 11.

**[0044]** The second communication path 17b connects the assisting unit 16 and the second control section 14b so as to be communicable with each other. Thus, the second communication path 17b can transmit an electronic signal transmitted from the assisting unit 16 to the second control section 14b. The second communication path 17b can also transmit an electronic signal transmitted from the second control section 14b to the assisting unit 16.

**[0045]** The third communication path 17c connects a group connected by the first communication path G1 and a group connected by the second communication path G2 so as to be communicable with each other. Thus, the third communication path 17c can transmit an electronic signal transmitted from the winding unit 11 to the second control section 14b. The third communication path 17c can also transmit an electronic signal transmitted from the second control section 14b to the winding unit 11. Furthermore, the third communication path 17c can transmit an electronic signal transmitted from the assisting unit 16 to the first control section 14a. The third communication path 17c can also transmit an electronic signal transmitted from the first control section 14a to the assisting unit 16. That is, by connecting the group G1 configured by the winding unit 11 and the first control section 14a and the group G2 configured by the assisting unit 16 and the second control section 14b, the third communication path 17c enables the winding unit 11, the assisting unit 16, the first control section 14a, and the second control section 14b to be able to transmit electronic signals with each other.

**[0046]** The automatic winder 100 further includes a signal control device 18 on the third communication path 17c. That is, the signal control device 18 is arranged between the group connected by the first communication path G1 and the group connected by the second communication path G2.

**[0047]** The signal control device 18 is an information

communication device adapted to select whether to transmit or shield an electronic signal in accordance with a transmitting destination of the electronic signal. That is, the signal control device 18 switches between transmission and shielding of the electronic signal depending on whether the transmitting destination of the electronic signal to pass is the winding unit 11, the assisting unit 16, the first control section 14a, or the second control section 14b. Since the electronic signal that is not required to be transmitted is shielded by the signal control device 18, the number of electronic signals to be processed by the winding unit 11, the assisting unit 16, the first control section 14a, and the second control section 14b is reduced. As described above, since the signal control device 18 carries out a check on the transmitted electronic signal, the automatic winder 100 according to the present embodiment prevents unnecessary electronic signals from stagnating on the communication path, thus avoiding the winding unit 11, the assisting unit 16, and the like from entering the standby state.

**[0048]** According to such a configuration, in the automatic winder 100 according to one embodiment of the present invention, the delay in the electronic signal processing can be reduced since the signal control device 18 selects whether to transmit or shield an electronic signal in accordance with the transmitting destination of the electronic signal. Therefore, in the automatic winder 100, the operation efficiency of the winding unit 11, the assisting unit 16, and the like can be improved.

**[0049]** Furthermore, in the automatic winder 100, the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced since the signal control device 18 selects whether to transmit or shield an electronic signal in accordance with the transmitting destination of the electronic signal between the group connected with the first communication path G1 and the group connected with the second communication path G2. Accordingly, the operation efficiency of the winding unit 11, the assisting unit 16, and the like can be improved.

**[0050]** Here, a flow of an electronic signal processing in the automatic winder 100 will be specifically described assuming a case in which the package P is in a fully-wound state in one winding unit 11. Note that a control mode described below is merely an example, and the present invention is not limited thereto.

**[0051]** An electronic signal indicating that the package P is in a fully-wound state is transmitted from the winding unit 11 to the doffing device 13. The electronic signal transmitted from the winding unit 11 is transmitted to the doffing device 13 via the first communication path 17a and the third communication path 17c. Thus, when transmitting the electronic signal (doffing request signal) from the group connected with the first communication path G1 to the group connected with the second communication path G2, the signal control device 18 transmits the electronic signal.

**[0052]** During the operation of the package conveyor, the electronic signal indicating to prohibit the doffing operation is transmitted from the second control section 14b to the doffing device 13. The electronic signal indicating to prohibit the doffing operation controls the operation of the assisting unit 16 such as the doffing device 13 and the package conveyor. The assisting unit 16 such as the doffing device 13 and the package conveyor is data linked to each other, and hence the capacity of the electronic signal transmitted from the second control section 14b to the assisting unit 16 becomes large. Therefore, if the electronic signal transmitted from the second control section 14b to the assisting unit 16 is transmitted to the group G1 without being shielded by the signal control device 18, the transmission and reception of the electronic signals in the group G1 is greatly delayed. In this regard, in the automatic winder 100 according to the present embodiment, the delay of the electronic signal in the group G1 can be reduced since the signal control device 18 shields the transmission of the electronic signal to the group G1 when transmitting the electronic signal from the group G2 only to the relevant group G2.

**[0053]** Thus, when transmitting the electronic signal from the group connected with the second communication path G2 only to the relevant group G2, the signal control device 18 shields the electronic signal. That is, the signal control device 18 prevents the electronic signal from being transmitted into the group connected with the first communication path G1, so that reduction of the delay in the electronic signal processing is achieved. Meanwhile, in the group G1, the electronic signal of the current operation state or the like can be transmitted from the winding unit 11 to the first control section 14a, for example.

**[0054]** The electronic signal indicating that the collection of the package P and the attachment of the next winding bobbin B2 are completed is transmitted from the doffing device 13 to the winding unit 11. The electronic signal transmitted from the doffing device 13 is transmitted to the winding unit 11 via the second communication path 17b and the third communication path 17c. Thus, when transmitting the electronic signal from the group connected with the second communication path G2 to the group connected with the first communication path G1, the signal control device 18 transmits the electronic signal.

**[0055]** The electronic signal related to the winding condition of the winding unit 11 is transmitted from the first control section 14a to the winding unit 11. The electronic signal transmitted from the first control section 14a is transmitted to the winding unit 11 via the first communication path 17a. Thus, when transmitting the electronic signal from the group connected with the first communication path G1 only to the relevant group G1, the signal control device 18 shields the electronic signal. That is, the signal control device 18 prevents the electronic signal from being transmitted to the group connected with the second communication path G2, so that reduction of the delay in the electronic signal processing is achieved.

Meanwhile, in the group G2, the electronic signal indicating to prohibit the doffing device can be transmitted from the second control section 14b to the doffing device 13, for example. The electronic signal related to the winding condition of the winding unit 11 includes items related to winding speed, yarn count, winding tension, winding amount of winding package, and package weight.

**[0056]** The electronic signal transmitted from the group G1 only to the relevant group G1 includes information related to the winding state transmitted from the winding unit 11 to the first control section 14a. This information includes package diameter, winding speed, occurrence situation of yarn cut, detection situation of yarn defect, and the like. The information is sequentially transmitted from the winding unit 11 to the first control section 14a during the operation of the winding unit 11.

**[0057]** According to such a configuration, the signal control device 18 transmits the electronic signal when transmitting the electronic signal from the group connected with the first communication path G1 to the group connected with the second communication path G2, and shields the electronic signal when transmitting the electronic signal from the group connected with the first communication path G1 only to the relevant group G1. Thus, the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced. Accordingly, the operation efficiency of the winding unit 11, the assisting unit 16, and the like can be improved.

**[0058]** Moreover, the signal control device 18 transmits the electronic signal when transmitting the electronic signal from the group connected with the second communication path G2 to the group connected with the first communication path G1, and shields the electronic signal when transmitting the electronic signal from the group connected with the second communication path G2 only to the relevant group G2. Thus, the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced. Accordingly, the operation efficiency of the winding unit 11, the assisting unit 16, and the like can be improved.

**[0059]** A spinning machine 200, which is a yarn winding machine, according to one embodiment of the present invention will be described below.

**[0060]** FIG. 3 is a view illustrating an overall configuration of the spinning machine 200. The spinning machine 200 is mainly configured by a plurality of winding units 21, a yarn joining device 22, a doffing device 23, a package conveyor (not illustrated), and a control device 24.

**[0061]** The winding unit 21 drafts the supplied sliver and twists the drafted sliver to produce the yarn Y. The winding unit 21 winds the yarn Y by rotating a winding bobbin B3, and forms a package P on the winding bobbin B3. In this manner, the winding unit 21 produces the yarn Y from the sliver, and also forms the package P by winding the yarn Y.

**[0062]** Each winding unit 21 is connected to a winding unit control section 21a (see FIG. 4). The winding unit control section 21a includes a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and a communication port. The ROM stores a control program for controlling the operation of the winding unit 21. The CPU executes the control program stored in the ROM to enable the winding of the yarn Y to be appropriately carried out. In the spinning machine 200, the plurality of winding units 21 is connected to one winding unit control section 21a. The winding unit control section 21a is thus configured to be able to control the operation of the plurality of winding units 21.

**[0063]** The communication port provided in the winding unit control section 21a is connected to the control device 24 and an assisting unit 26 and is configured to be able to transmit and receive electronic signals (see FIG. 4). The control device 24 thus can collectively carry out the operation control and the information management of the plurality of winding units 21 arranged in the spinning machine 200.

**[0064]** The yarn joining device 22 moves along a rail 22a installed in the arranging direction of each winding unit 21. The yarn joining device 22 joins the yarn ends of the cut yarn Y of the winding unit 21. In this manner, the yarn joining device 22 joins the cut yarn Y so that the winding unit 21 can continuously form the package P.

**[0065]** The doffing device 23 moves along a rail 23a extended in the arranging direction of the winding units 21. The doffing device 23 detaches the fully-wound package P from the winding unit 21 and attaches the next winding bobbin B3. The doffing device 23 thus can collect the fully-wound package P and enable the winding unit 21 to continuously form the package P.

**[0066]** The package conveyor is arranged in the arranging direction of the winding units 21, and is intermittently operated so as to be able to transport the fully-wound package P detached by the doffing device 23 to the end in the longitudinal direction of the spinning machine 200.

**[0067]** The yarn joining device 22, the doffing device 23, and the package conveyor are devices that assist the winding unit 21 to form the package P. Therefore, in the present embodiment, the yarn joining device 22, the doffing device 23, and the package conveyor are defined as the assisting unit 26 of the winding unit 21. However, the assisting unit 26 merely needs to be a device for directly or indirectly assisting the winding unit 21 to form the package P, and is not limited to the yarn joining device 22, the doffing device 23, and the package conveyor.

**[0068]** Each assisting unit 26 includes an assisting unit control section 26a (see FIG. 4). Similarly to the winding unit control section 21a, the assisting unit control section 26a includes a CPU, a ROM, a RAM, and a communication port. The ROM stores a control program for controlling each component of the assisting unit 26 (yarn joining device 22 or the like). The CPU executes the control program stored in the ROM to enable the yarn joining operation, the doffing operation, and the like to be appropriately carried out.

**[0069]** The communication port of the assisting unit control section 26a is connected to the control device 24 and the assisting unit 26, thus enabling the transmission and reception of electronic signals (see FIG. 4) . The control device 24 thus can collectively carry out the operation control and the information management of the plurality of assisting units 26 arranged in the spinning machine 200.

**[0070]** The control device 24 is configured by a first control section 24a and a second control section 24b (see FIG. 4). The first control section 24a and the second control section 24b are connected to the winding unit 21 or the assisting unit 26 through a communication path 27 (see FIG. 4). Similarly to the winding unit control section 21a, the first control section 24a and the second control section 24b respectively includes a CPU, a ROM, a RAM, and a communication port.

**[0071]** The communication ports of the first control section 24a and the second control section 24b are connected to the communication port of the winding unit control section 21a and the communication port of the assisting unit control section 26a, respectively, through the communication path 27 (see FIG. 4). According to such a configuration, the control device 24 receives the electronic signals of the operation state and the like from the respective winding unit control section 21a and the respective assisting unit control section 26a, and thus can grasp the operation state of the winding unit 21 and the assisting unit 26. The control device 24 can transmit the electronic signals of the operation condition and the like to the respective winding unit control section 21a and the respective assisting unit control section 26a, and thus can set the operation state of the winding unit 21 and the assisting unit 26.

**[0072]** The first control section 24a has an information collecting function of receiving the electronic signals from the winding unit 21 and the assisting unit 26 to grasp the operation state, and a setting function of transmitting the electronic signal to the winding unit 21 and the assisting unit 26 to set the operation state. On the other hand, the second control section 24b, has a control function of receiving the electronic signal from the winding unit 21 and the assisting unit 26 to carry out the information processing, and to transmit the electronic signal to the winding unit 21 and the assisting unit 26 to smoothly form the package P. However, the main functions of the first control section 24a and the second control section 24b are not limited thereto.

**[0073]** The electronic signal (operation condition or the like) transmitted to the winding unit 21 includes, for example, winding speed, yarn count, winding tension, package winding amount, and package weight. The electronic signal (operation state or the like) transmitted from the winding unit 21 includes, for example, package diameter, winding speed, yarn cut occurrence situation, and alarm information. The set value transmitted to the winding unit 21 can be transmitted while individually specifying each winding unit 21, or may be collectively transmitted with respect to all the winding units 11.

**[0074]** FIG. 4 is a view illustrating the communication path 27 of the spinning machine 200. The communication path 27 is mainly sectionalized into a first communication path 27a, a second communication path 27b, and a third communication path 27c.

**[0075]** The first communication path 27a connects the winding unit 21 and the first control section 24a so as to be communicable with each other. Thus, the first communication path 27a can transmit an electronic signal transmitted from the winding unit 21 to the first control section 24a. The first communication path 27a can also transmit an electronic signal transmitted from the first control section 24a to the winding unit 21.

**[0076]** The second communication path 27b connects the assisting unit 26 and the second control section 24b so as to be communicable with each other. Thus, the second communication path 27b can transmit an electronic signal transmitted from the assisting unit 26 to the second control section 24b. The second communication path 27b can also transmit an electronic signal transmitted from the second control section 24b to the assisting unit 26.

**[0077]** The third communication path 27c connects a group connected by the first communication path G1 and a group connected by the second communication path G2 so as to be communicable with each other. Thus, the third communication path 27c can transmit an electronic signal transmitted from the winding unit 21 to the second control section 24b. The third communication path 27c can also transmit an electronic signal transmitted from the second control section 24b to the winding unit 21. Furthermore, the third communication path 27c can transmit an electronic signal transmitted from the assisting unit 26 to the first control section 24a. The third communication path 27c can also transmit an electronic signal transmitted from the first control section 24a to the assisting unit 26. That is, by connecting the group G1 configured by the winding unit 21 and the first control section 24a and the group G2 configured by the assisting unit 26 and the second control section 24b, the third communication path 27c enables the winding unit 21, the assisting unit 26, the first control section 24a, and the second control section 24b to be able to transmit electronic signals with each other.

**[0078]** The spinning machine 200 further includes a signal control device 28 on the third communication path 27c. That is, the signal control device 28 is arranged between the group connected by the first communication path G1 and the group connected by the second communication path G2.

**[0079]** The signal control device 28 is an information communication device adapted to select whether to transmit or shield an electronic signal in accordance with a transmitting destination of the electronic signal. That is, the signal control device 28 switches between transmission and shielding of the electronic signal depending on whether the transmitting destination of the electronic

signal to pass is the winding unit 21, the assisting unit 26, the first control section 24a, or the second control section 24b. Since the electronic signal that is not required to be transmitted is shielded by the signal control device 28, the number of electronic signals to be processed by the winding unit 21, the assisting unit 26, the first control section 24a, and the second control section 24b is reduced. Therefore, the spinning machine 200 according to the present embodiment prevents unnecessary electronic signals from stagnating on the communication path since the signal control device 28 carries out a check on the transmitted electronic signal, thus avoiding the winding unit 21, the assisting unit 26, and the like from entering the standby state.

**[0080]** According to such a configuration, in the spinning machine 200 according to one embodiment of the present invention, the delay in the electronic signal processing can be reduced since the signal control device 28 selects whether to transmit or shield an electronic signal in accordance with the transmitting destination of the electronic signal. Therefore, in the spinning machine 200, the operation efficiency of the winding unit 21, the assisting unit 26, and the like can be improved.

**[0081]** Furthermore, in the spinning machine 200, the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced since the signal control device 28 selects whether to transmit or shield an electronic signal in accordance with the transmitting destination of the electronic signal between the group connected with the first communication path G1 and the group connected with the second communication path G2. Accordingly, the operation efficiency of the winding unit 21, the assisting unit 26, and the like can be improved.

**[0082]** A flow of an electronic signal processing in the spinning machine 200 will be specifically described assuming a case in which the package P is in a fully-wound state in one winding unit 21. Note that a control mode described below is merely an example, and the present invention is not limited thereto.

**[0083]** An electronic signal indicating that the package P is in a fully-wound state is transmitted from the winding unit 21 to the doffing device 23. The electronic signal transmitted from the winding unit 21 is transmitted to the doffing device 23 via the first communication path 27a and the third communication path 27c. Thus, when transmitting the electronic signal (doffing request signal) from the group connected with the first communication path G1 to the group connected with the second communication path G2, the signal control device 28 transmits the electronic signal.

**[0084]** During the operation of the package conveyor, the electronic signal indicating to prohibit the doffing operation is transmitted from the second control section 24b to the doffing device 23. The electronic signal indicating to prohibit the doffing operation controls the operation of the assisting unit 26 such as the doffing device 23 and the package conveyor. The assisting unit 26 such as the doffing device 23 and the package conveyor is data linked to each other, and hence the capacity of the electronic signal transmitted from the second control section 24b to the assisting unit 26 becomes large. Therefore, if the electronic signal transmitted from the second control section 24b to the assisting unit 26 is transmitted to the group G1 without being shielded by the signal control device 28, the transmission and reception of the electronic signals in the group G1 is greatly delayed. In this regard, with the spinning machine 200 according to the present embodiment, the delay of the electronic signal in the group G1 can be reduced since the signal control device 28 shields the transmission of the electronic signal to the group G1 when transmitting the electronic signal from the group G2 only to the relevant group G2.

**[0085]** Thus, when transmitting the electronic signal from the group connected with the second communication path G2 only to the relevant group G2, the signal control device 28 shields the electronic signal. That is, the signal control device 28 prevents the electronic signal from being transmitted into the group connected with the first communication path G1, so that reduction of the delay in the electronic signal processing is achieved. Meanwhile, in the group G1, the electronic signal of the current operation state and the like can be transmitted from the winding unit 21 to the first control section 24a, for example.

**[0086]** The electronic signal indicating that the collection of the package P and the attachment of the next winding bobbin B3 are completed is transmitted from the doffing device 23 to the winding unit 21. The electronic signal transmitted from the doffing device 23 is transmitted to the winding unit 21 via the second communication path 27b and the third communication path 27c. Thus, when transmitting the electronic signal from the group connected with the second communication path G2 to the group connected with the first communication path G1, the signal control device 28 transmits the electronic signal.

**[0087]** The electronic signal related to the winding condition of the winding unit 21 is transmitted from the first control section 24a to the winding unit 21. The electronic signal transmitted from the first control section 24a is transmitted to the winding unit 21 via the first communication path 27a. Thus, when transmitting the electronic signal from the group connected with the first communication path G1 only to the relevant group G1, the signal control device 28 shields the electronic signal. That is, the signal control device 28 prevents the electronic signal from being transmitted to the group connected with the second communication path G2, so that reduction of the delay in the electronic signal processing is achieved. Meanwhile, in the group G2, the electronic signal indicating to prohibit the doffing device can be transmitted from the second control section 24b to the doffing device 23, for example. The electronic signal related to the winding condition of the winding unit 21 includes items related to winding speed, yarn count, winding tension, winding

amount of winding package, and package weight.

**[0088]** The electronic signal transmitted from the group G1 only to the group G1 includes information related to the winding state transmitted from the winding unit 21 to the first control section 24a. This information includes package diameter, winding speed, occurrence situation of yarn cut, detection situation of yarn defect, and the like. The information is sequentially transmitted from the winding unit 21 to the first control section 24a during the operation of the winding unit 21.

**[0089]** According to such a configuration, the signal control device 28 transmits the electronic signal when transmitting the electronic signal from the group connected with the first communication path G1 to the group connected with the second communication path G2, and shields the electronic signal when transmitting the electronic signal from the group connected with the first communication path G1 only to the relevant group G1, so that the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced. Accordingly, the operation efficiency of the winding unit 21, the assisting unit 26, and the like can be improved.

**[0090]** The signal control device 28 transmits the electronic signal when transmitting the electronic signal from the group connected with the second communication path G2 to the group connected with the first communication path G1, and shields the electronic signal when transmitting the electronic signal from the group connected with the second communication path G2 only to the relevant group G2, so that the delay in the electronic signal processing transmitted between the groups G1 and G2 can be reduced. The operation efficiency of the winding unit 21, the assisting unit 26, and the like thus can be improved.

**[0091]** Furthermore, in the automatic winder 100 and the spinning machine 200 according to the embodiments of the present invention, the winding unit 11, 21 and the assisting unit 16, 26 can be made communicable with each other without interposing the first control section 14a, 24a and the second control section 14b, 24b.

**[0092]** Specifically describing, if the first communication path 17a, 27a and the second communication path 17b, 27b are connected using the third communication path 17c, 27c, the winding unit 11, 21 and the assisting unit 16, 26 can directly communicate with each other without interposing the first control section 14a, 24a and the second control section 14b, 24b.

**[0093]** According to such a configuration, the winding unit 11, 21 and the assisting unit 16, 26 can communicate with each other without interposing the first control section 14a, 24a and the second control section 14b, 24b, and hence the transmission speed of the electronic signal improves. The operation efficiency of the winding unit 11, 21, the assisting unit 16, 26, and the like thus can be improved.

**[0094]** The automatic winder 100 and the spinning machine 200 according to the embodiments of the present invention include a signal restoring device 19, 29 for restoring the electronic signal on the communication path 17, 27.

**[0095]** The signal restoring device 19, 29 has a function of a so-called repeater for correcting distortion of the waveform of the electronic signal transmitted through the communication path 17, 27.

**[0096]** According to such a configuration, the signal restoring device 19, 29 for restoring the electronic signal is arranged on the communication path 17, 27, and thus the electronic signal can be reliably transmitted. Accordingly, the operation efficiency of the winding unit 11, 21, the assisting unit 16, 26, and the like can be improved.

**[0097]** The signal restoring device 19, 29 can also shield the transmission of the electronic signal by using a router having the functions of both the signal restoring device and the signal control device.

**[0098]** The automatic winder 100 and the spinning machine 200 described in the above embodiments have a configuration of including one doffing device 13, 23, but a plurality of assisting units 16, 26 such as the doffing devices 13, 23 may be arranged.

## Claims

1. A yarn winding machine (100) **characterized by** comprising:

   a winding unit (11) that is adapted to wind a yarn to form a package (P);
   an assisting unit (12, 13, 15) that is adapted to assist the winding unit (11) in forming the package (P);
   a first control section (14a) that is adapted to receive an electronic signal from the winding unit (11) and the assisting unit (12, 13, 15) and to transmit an electronic signal to the winding unit (11) and the assisting unit (12, 13, 15);
   a second control section (14b) that is adapted to receive an electronic signal from the winding unit (11) and the assisting unit (12, 13, 15) and to transmit an electronic signal to the winding unit (11) and the assisting unit (12, 13, 15); and
   a communication path (17) that is adapted to connect the winding unit (11), the assisting unit (12, 13, 15), the first control section (14a), and the second control section (14b) to be communicable with each other, wherein
   a signal control device (18) is arranged on the communication path (17), and
   the signal control device (18) is adapted to select whether to transmit or shield the electronic signal in accordance with a transmitting destination of the electronic signal.

2. The yarn winding machine (100) according to claim 1, **characterized in that**
   the communication path (17) is sectionalized into a

first communication path (17a) that is adapted to connect the winding unit (11) and the first control section (14a) to be communicable with each other, a second communication path (17b) that is adapted to connect the assisting unit (12, 13, 15) and the second control section (14b) to be communicable with each other, and a third communication path (17c) that is adapted to connect a group connected with the first communication path (G1) and a group connected with the second communication path (G2); and
the signal control device (18) is arranged on the third communication path (17c).

**3.** The yarn winding machine (100) according to claim 2, **characterized in that** the signal control device (18) is adapted to transmit the electronic signal when transmitting the electronic signal from the group connected with the first communication path (G1) to the group connected with the second communication path (G2), and to shield the electronic signal when transmitting the electronic signal from the group connected with the first communication path (G1) only to the relevant group (G1).

**4.** The yarn winding machine (100) according to claim 2 or 3, **characterized in that** the signal control device (18) is adapted to transmit the electronic signal when transmitting the electronic signal from the group connected with the second communication path (G2) to the group connected with the first communication path (G1), and to shield the electronic signal when transmitting the electronic signal from the group connected with the second communication path (G2) only to the relevant group (G2).

**5.** The yarn winding machine (100) according to any one of claims 1 to 4, **characterized in that** the communication path (17) is adapted to connect the winding unit (11) and the assisting unit (12, 13, 15) to be communicable with each other without interposing the first control section (14a) and the second control section (14b).

**6.** The yarn winding machine (100) according to any one of claims 1 to 5, **characterized in that** a signal restoring device (29) that is adapted to restore the electronic signal is arranged on the communication path (17).

**7.** The yarn winding machine (100) according to claim 6, **characterized in that** the signal control device (18) and the signal restoring device (29) are a router having functions of the signal control device (18) and the signal restoring device (29).

FIG. 1

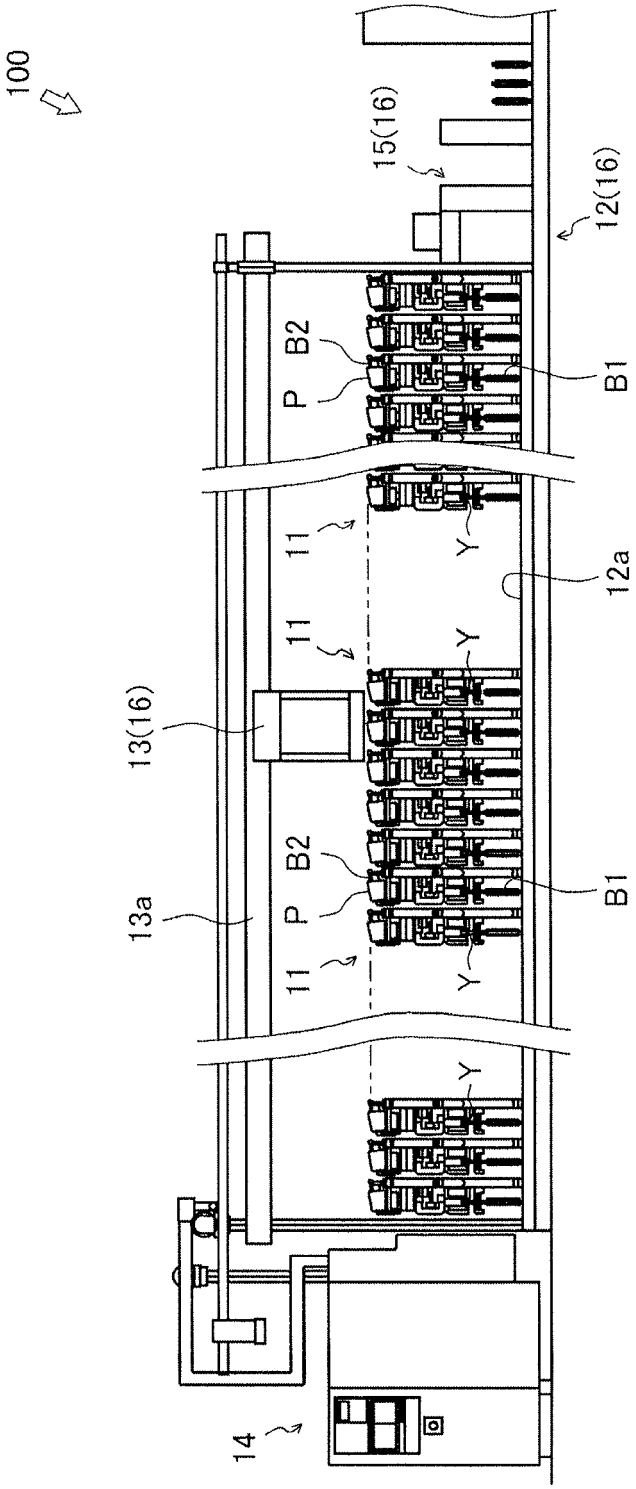


FIG. 2

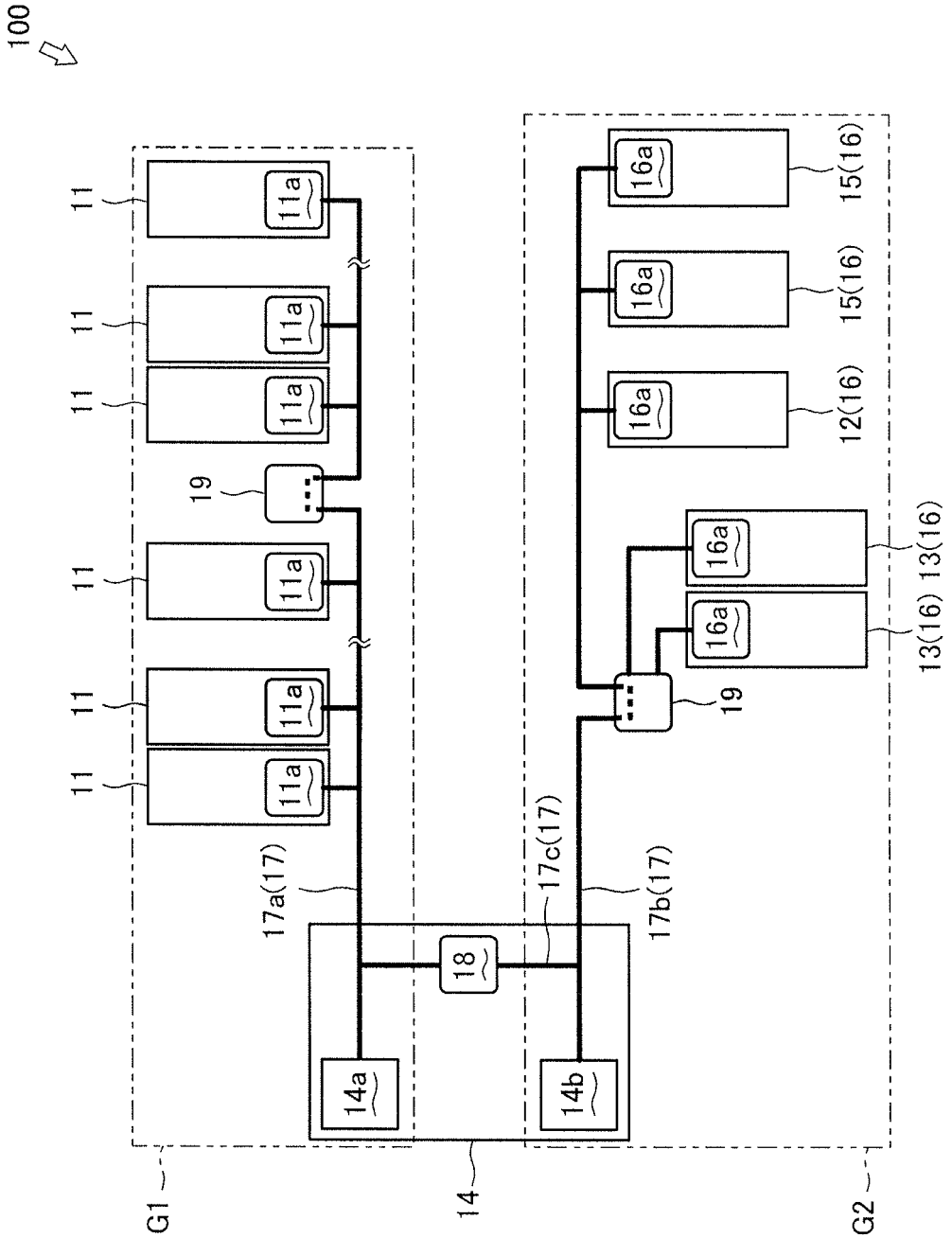

100
11
11a
19
17a(17)
17c(17)
17b(17)
18
14a
14b
14
G1
G2
16a
15(16)
12(16)
13(16)

FIG. 3

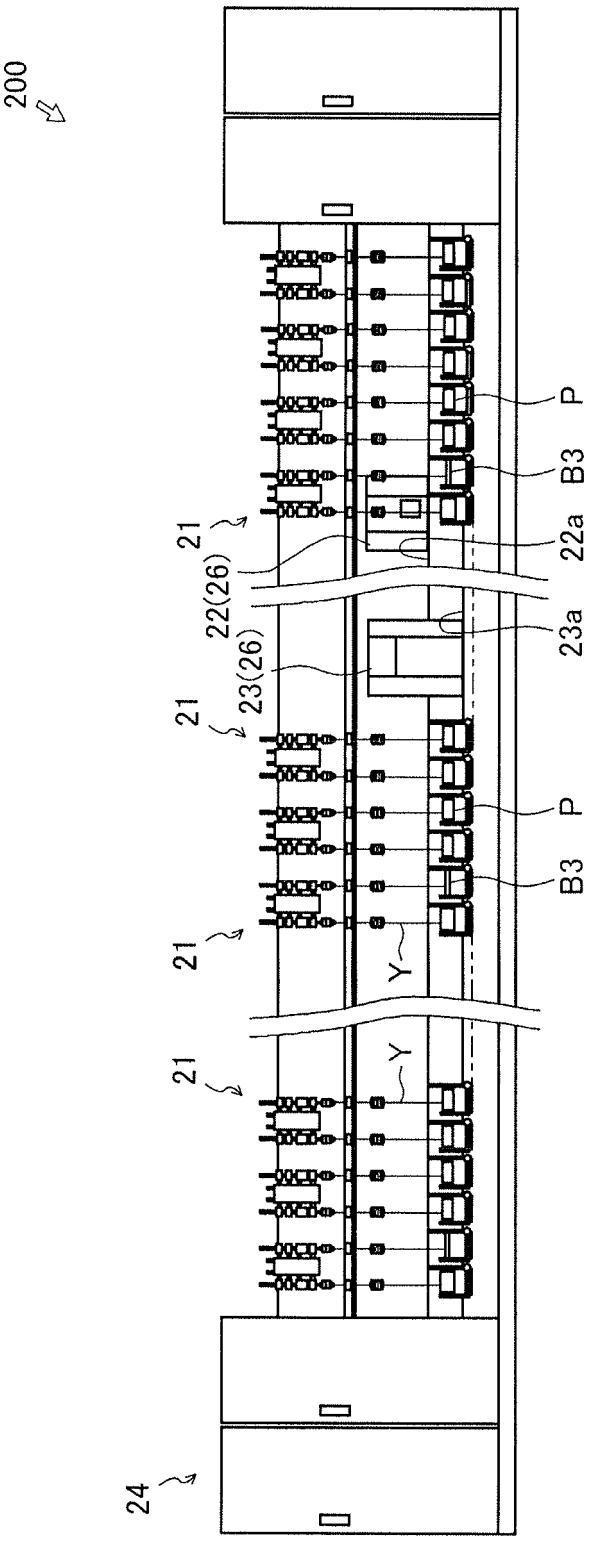
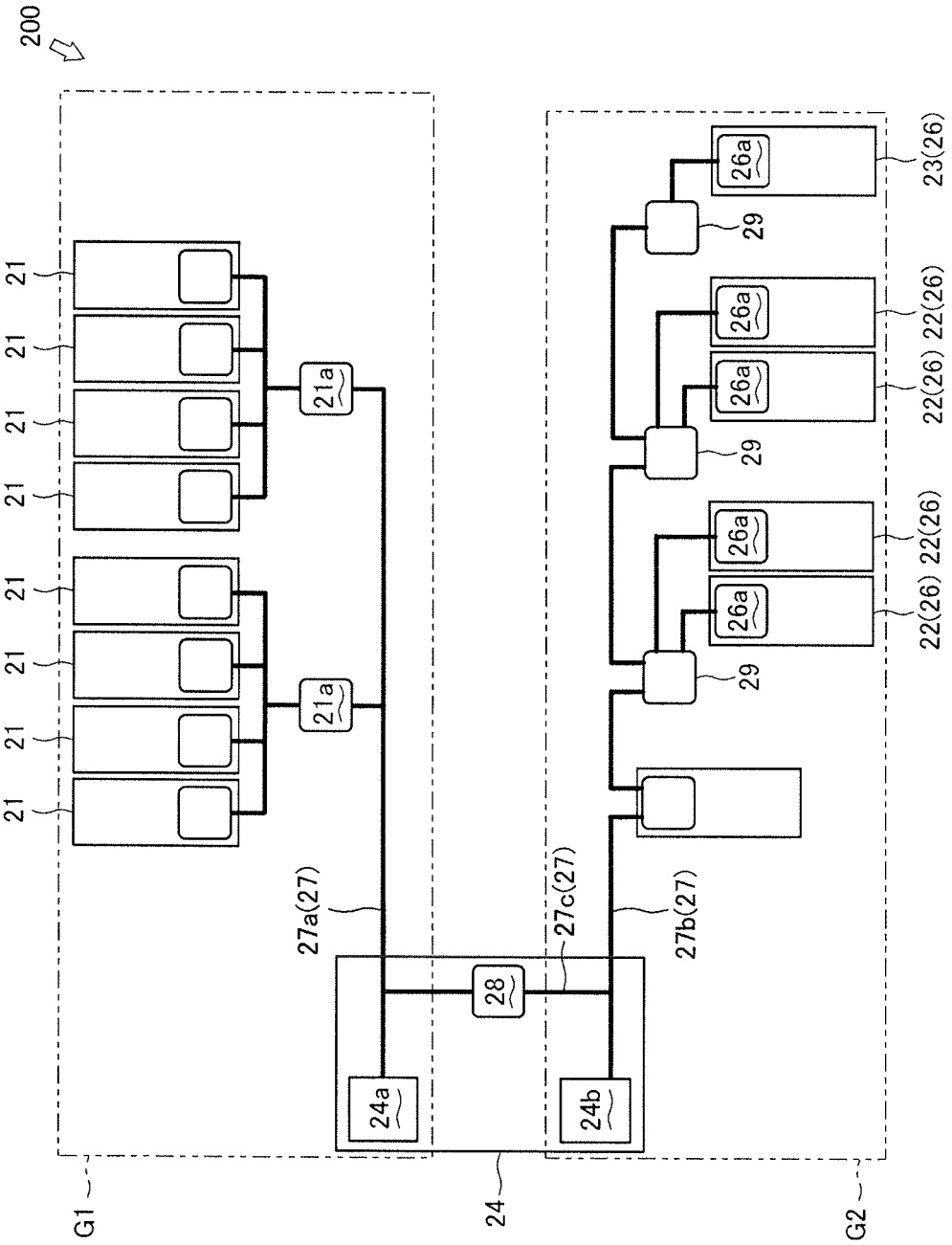


FIG. 4


200
21
21a
21a
27a(27)
27c(27)
27b(27)
28
24a
24b
24
G1
G2
29
26a
23(26)
22(26)

## REFERENCES CITED IN THE DESCRIPTION

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